7. Groundwater

The purpose of **Chapter 7, Groundwater**, is to characterize the existing environment, Project-environment interactions and potential residual Project and cumulative effects of the Project on the groundwater VECs. The Project has the potential to cause adverse effects on these components of the aquatic and biophysical environment through the open pit mine dewatering and associated discharge, changes to the local or regional water supplies or local supply wells, reduced baseflow to aquatic ecosystems, water quality degradation of groundwater water resources through groundwater transport of mining-related contaminants, water supply well damage due to blasting, and acid rock drainage from exposed sulfide minerals. Changes in the groundwater environment can also influence aquatic and terrestrial ecosystems, and the people that use the natural resources or ecosystem services (e.g., surface water, fish, plants, and wildlife). Therefore, the groundwater assessment consequently provides information that is used to support the assessments of other biophysical and socioeconomic VECs, where applicable.

7.1 Approach to the Effects Assessment

The methods and assessment presented in this chapter were developed in consideration of the requirements under the provincial *Environmental Protection Act* (Government of Newfoundland and Labrador 2002), with specific consideration of the requirements set out in the provincial EIS Guidelines for the Project issued by the Minister of Environment and Climate Change (Government of Newfoundland and Labrador 2024). A table of concordance to the EIS Guidelines is provided in the Executive Summary. The assessment of groundwater followed the overall effects assessment approach and methods (**Chapter 4, Effects Assessment Methodology**).

Where possible, comparison to the outcomes of the assessment of groundwater completed within the previous EIS have been made to highlight where effects on groundwater have been reduced through consideration of environmental design features and mitigation or where new adverse effects may be introduced and require additional consideration in Project planning.

7.2 Integrating Engagement from Indigenous Groups and Local Stakeholders

Champion Kami Partner Inc. (Champion) has been engaging with potentially effected Indigenous groups and local community stakeholders since the acquisition of the Project in 2021. The overall approach and methods for the incorporation of engagement feedback into the EIS is discussed in detail in **Chapter 22, Engagement**.

Issues and concerns related to groundwater and/or the VECs raised by Indigenous groups and local stakeholders and how these issues and concerns were addressed through the assessment are summarized in Table 7-1, including cross-references to where comments were considered or addressed in the chapter. Previous assessments and engagements have treated groundwater and surface water resources as a combined VEC, as such the issues and concerns identified by Indigenous groups and local stakeholders that are considered related to groundwater are within the context of their effect on surface water resources.

Table 7-1: Summary of Issues and Concerns Related to Groundwater by Indigenous Groups and Local Stakeholders

Comment Theme	How it is Addressed in the Assessment	Where it was Addressed in the Assessment	Indigenous Group or Local Stakeholder	Raised in Alderon EIS (Yes/No)
Lac Daviault and surrounding lakes water level being impacted by the mining of Rose Pit.	The potential for cumulative effects on water resources surrounding the Project area is addressed through identification of water resources, the numerical groundwater flow model developed to simulate the effects of dewatering on surrounding surface water and groundwater, along with the water management approach implemented for the Project.	Identification of water resource users is provided in Section 7.4.7, Existing Groundwater Users. The results of the numerical groundwater model in the context of cumulative effects is discussed in Section 7.5, Effects Assessment. Water management infrastructure is described in Chapter 2. The modelling report is available in TSD V.	Members of the public (Fermont), CRE	Yes

Comment Theme	How it is Addressed in the Assessment	Where it was Addressed in the Assessment	Indigenous Group or Local Stakeholder	Raised in Alderon EIS (Yes/No)
Lac Daviault and surrounding lakes water quality being impacted by the mining of Rose Pit.	Potential effects on surface water quality as it relates to the groundwater VEC is addressed through identification of water resources, the numerical groundwater flow model developed to simulate the effects of dewatering on surrounding surface water and groundwater, along with the water management approach implemented for the Project.	Identification of water resource users is provided in Section 7.4.7. The results of the numerical groundwater model in the context of cumulative effects is discussed in Section 7.5. Water management infrastructure is described in Chapter 2. The modelling report is available in TSD V.	Cabin owners, Innu Nation, surrounding municipalities (Fermont, Labrador City, Wabush), and members of the public	Yes

EIS = Environmental Impact Statement; CRE = Community Real Estate; VEC = valued environmental component.

7.3 Assessment Scoping

This section identifies key issues for groundwater, defines and provides a rationale for the selection of VECs for groundwater identifies the measurable parameters selected for the assessment, and defines assessment boundaries for groundwater.

7.3.1 Key Issues

Key issues often relate to the potential environmental, social, economic, and health effects of a proposed project. Key issues identified for the Project reflect the primary concerns raised by regulatory authorities, Indigenous groups, and local stakeholders, including local residents, cabin owners, business owners and other interested parties.

To identify key issues related to groundwater, the following sources were reviewed:

- Section 4.1 of the EIS Guidelines, which summarized key issues from regulatory agencies and feedback received on the Project Registration and draft EIS Guidelines
- the record of engagement (Chapter 22), which captures engagement input received through meetings, phone calls, letters, and interviews
- past experience with mining projects in Labrador
- the key issues identified in the previous Kami EIS

Key issues related to groundwater include the following:

- open pit mine dewatering and associated discharge of effluents
- local to regional water table lowering and effects on adjacent water supply wells
- interception of base flow to sensitive aquatic environments
- water quality degradation of groundwater and surface water resources (through groundwater transport) from contaminated seepages from tailings, mine dewatering, mine rock, chemical storage, and waste management sources
- water well damage from blasting and major site vibration sources
- acidic rock drainage from exposed sulfide mineralization

7.3.2 Valued Environmental Components and Measurable Parameters

Groundwater is water below the ground surface saturated in the surficial overburden sediments or in the pores and fractures of bedrock deposits. Groundwater originates from the percolation of precipitation or surface water into the ground, flowing from areas of high elevation (recharge areas) to areas of low elevation (discharge areas), where it exits the sub-surface as springs, streams, lakes, and/or wetlands. The upper surface of the water saturated zone in the sub-surface is called the water table. An aquifer is a saturated formation or group of formations which store or yield groundwater to production wells or springs. Natural groundwater quality is directly influenced by the geochemical composition of the geological materials through which it passes, and the time the water resides within the materials.

Groundwater is considered a resource for human use and consumption. Groundwater can also provide baseflow to surface waters and can become a critical component for the maintenance of streamflow and ecological functioning of freshwater aquatic ecosystems. Groundwater can also be impacted by climate change. Groundwater availability for ecological and human uses and its susceptibility to chemical degradation or depletion by human activities is determined by hydrogeological and geochemical properties of the surficial and bedrock geology in which it is hosted.

Groundwater is selected as a VEC as there is potential for disruption or contamination of the groundwater drinking supply for nearby users and potable water supply requirements for the various phases of the Project and therefore requires assessment. Furthermore, groundwater is an integral component of the hydrologic cycle that can interact with and indirectly affect surface water resources and freshwater ecosystems at points of discharge.

Groundwater can be a critical water transport pathway between the various Project components and adjacent surface water resources. Conversely, groundwater can transmit water from surface water sources and permeable aquifers towards Project components such as open pits and excavations. The physical quantity and chemical quality of the groundwater will vary as groundwater flow components interact with Project-related infrastructure and operations, soil and rock, ecological receptors, surface water, and people, throughout all phases of the Project. The EIS Guidelines require an evaluation of the effects of the Project on groundwater quality and quantity, including how to avoid or minimize the potential effects to groundwater.

Measurable parameters are used to characterize changes to attributes of the environment from the Project, other human developments, and natural factors. The changes in measurable parameters are used to assess change and predict overall effects on VECs. Two measurable parameters were identified and used for the groundwater VEC assessment:

- changes in groundwater quantity
- changes in groundwater quality

Table 7-2 summarizes the groundwater VECs, the rationale for selection, and measurable parameters.

Table 7-2: Valued Environmental Components, Rationale for Selection, and Measurable Parameters

Valued Environmental Component	Rationale for Selection	Measurable Parameters	Linkages to other VECs
Groundwater (Quantity and Quality)	– Groundwater VEC includes assessments of groundwater water resources, which is considered a resource for humans and can provide baseflow for surface waters, an important component in fresh water aquatic ecosystems. – Project-related activities and components are expected to include temporary and possibly permanent changes to existing groundwater conditions due to dewatering of pits, construction of surface water management facilities, and stockpiling of materials on surface.	– Groundwater quantity: – groundwater flow – artesian flow (springs) – groundwater levels – groundwater withdrawal/dewatering – groundwater discharge and surface water interactions – Groundwater quality: – water quality (general chemistry, metals, COPCs)	– Fresh water fish, fish habitat and fisheries – Surface water – Wetlands

VEC = valued environmental component; COPC = constituent of potential concern.

7.3.3 Assessment Boundaries

Assessment boundaries define the spatial and temporal extents of the assessment for each VEC. The spatial boundaries for the groundwater assessment are defined in Table 7-3 and shown in Figure 7-1, and consist of the site study area (SSA), a local study area (LSA), and a larger regional study area (RSA).

The SSA includes the proposed infrastructure for the Project (i.e., the Project footprint) with an additional buffer to reflect existing uncertainty in the final design of the Project and so that adverse effects on VECs are not underestimated (i.e., the SSA area is twice as large as the anticipated Project footprint). The SSA is constrained to avoid certain features, including major lakes, the

Québec–Labrador provincial border and sensitive features, like the Wahnahnish Lake Protected Public Water Supply Area. The SSA represents the smallest scale of assessment and an area where the potential direct effects of the anticipated Project can be assessed accurately and precisely.

The LSA for groundwater includes the area within which Project-related effects can be predicted or measured with a reasonable degree of accuracy and confidence. As the most significant effects on groundwater will be due to dewatering of Rose Pit, and data inputs for the numerical groundwater model are concentrated in this area, the LSA focusses on the area surrounding Rose Pit where effects can be reasonably predicted and measured. The LSA for groundwater includes the approximately 9,205 ha area surrounding Rose Pit and the tailings management facility (TMF), and includes the overburden stockpile area, the mine rock stockpile area, and several surface water bodies including Daviault Lake, Gleeson Lake, Duley Lake, Mills Lake, Molar Lake, and Pike Lake.

Compared to the previous EIS, this LSA differs in that the groundwater and surface water resources were previously combined, and as such the assessment boundaries included effects on surface waters. The previous LSA included an area of approximately 8,000 ha.

The RSA for groundwater covers an area of approximately 20,000 ha included in the numerical groundwater flow model that has been developed for the Project. This provides broader context for the assessment of Project effects on groundwater and provides an appropriate scale to assess cumulative effects from the Project combined with existing conditions and other RFDs.

Compared to the previous EIS, this RSA differs in that groundwater and surface water resources were previously combined, and as such the assessment boundaries included effects on surface waters. The RSA in this EIS is bound by physical boundaries where modelled boundary conditions were applied, such as no-flow or constant head conditions.

Table 7-3: Spatial Boundaries for Assessment of Groundwater Valued Environmental Components

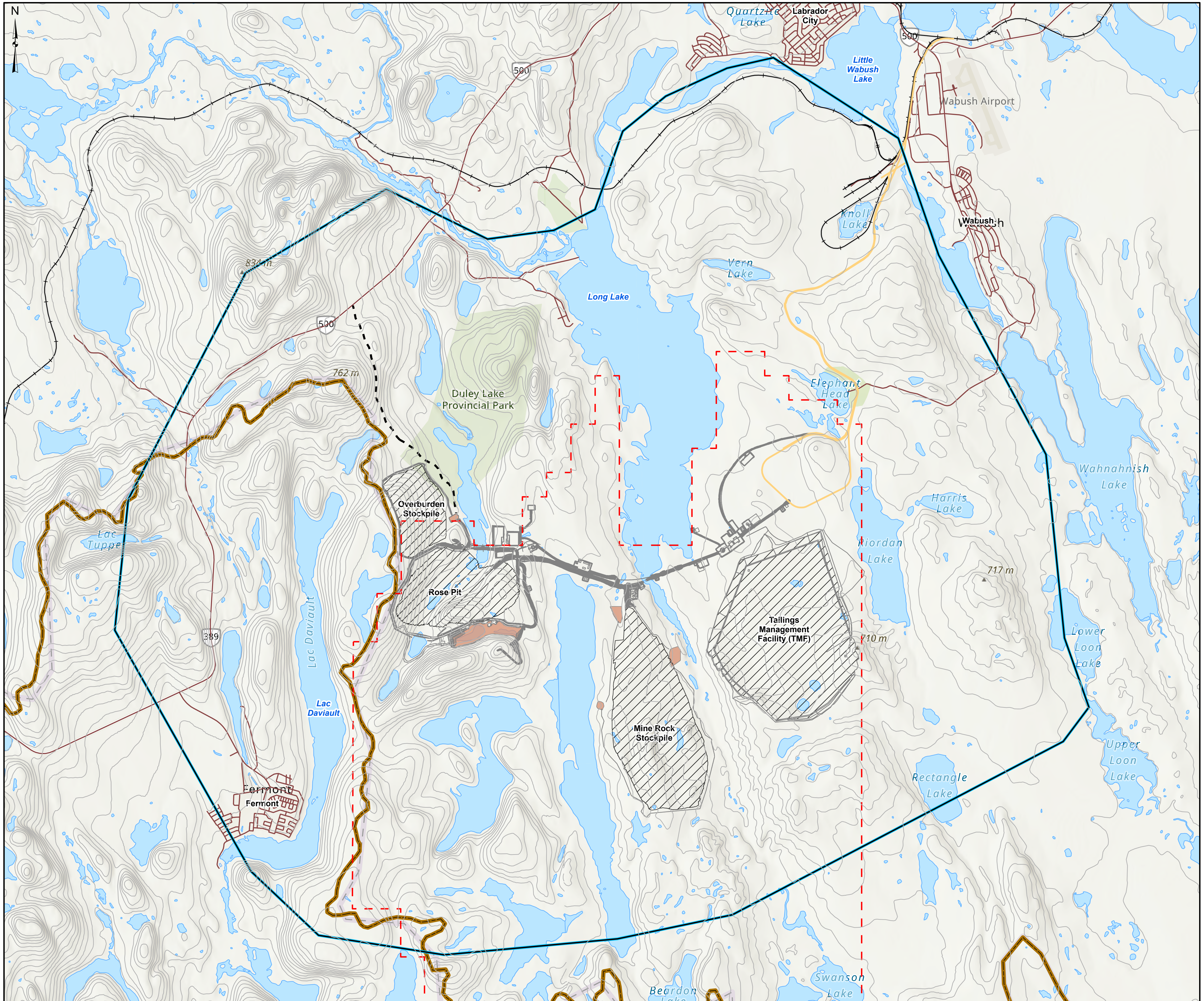
Study Area	Area (ha)	Description/Rationale
SSA	4,323	Includes the Project footprint plus additional buffered areas to incorporate a level of uncertainty into the Project design so that effects are not underestimated. The SSA was defined using bounding points around the outermost components of the Project footprint.
LSA	9,205	Includes area where effects on groundwater levels due to Project activities are anticipated and can be reasonably predicted by the numerical model. Includes Rose Pit, TMF, overburden stockpile area, the mine rock stockpile area, Daviault Lake, Gleeson Lake, Duley Lake, Mills Lake, Molar Lake, and Pike Lake.
RSA	20,000	Includes SSA, LSA and extends to limits of numerical groundwater flow model (mesh boundary). Provides broader context for the assessment of Project effects on groundwater and provides an appropriate scale to assess cumulative effects from the Project combined with existing conditions.

SSA = site study area; LSA = local study area; RSA = regional study area; TMF = tailings management facility.

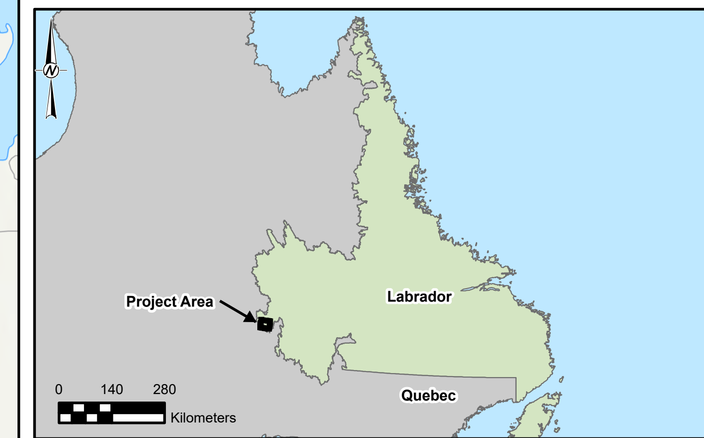
The temporal scope of the assessment focuses on the 40-year period from initial construction to the end of decommissioning and rehabilitation (i.e., Closure) as defined by the following Project phases:

- **Construction phase (referred to as Construction)–**includes site preparation, mine, process plant and site infrastructure development, and commissioning the structures, systems, and components. The duration of Construction is expected to be four years.
- **Operations and Maintenance phase (referred to as Operations)**–includes the mining and milling of iron ore, production and shipment of iron ore concentrate, tailings management, management of mine rock, waste management, water management, release of treated effluent, site maintenance and transportation of staff and materials to and from the site. Operations initiates with one year of pre-development mining (i.e., ramp-up) and concludes when processing is complete and is expected to be 26 years.
- **Decommissioning and Rehabilitation phase (referred to as Closure)**–includes accelerated flooding of the Rose Pit, re-establishment of passive surface water drainage following the pit-flooding period, and recontouring and revegetating disturbed areas. Physical infrastructure that is not required during post-closure monitoring and for other activities required to achieve the Project's decommissioning criteria and to return the Project site to a safe and stable condition will be removed. Closure is expected to be 10 years.

During the Construction and Operations phases, Project-related effects are considered to be temporary, while effects that persist after decommissioning and reclamation are considered to be permanent. Effects assessments have been conducted based on the anticipated effects at the Year 26 snapshot in time when the Rose Pit will reach its final depth, and maximum effects on the groundwater VEC are anticipated.



KEY MAP



SCALE 1:20,000,000

LEGEND

LEGEND

- Existing Railway
- Existing Road
- Proposed Access Road and Railway Corridor
- Potential Access Road
- Proposed Sedimentation Pond
- Proposed Infrastructure
- Labrador/Quebec Boundary
- Contour
- Waterbody
- Project Infrastructure
- Kami Surface Lease Area
- Fellow Model Limit

0 2 4

1:80,000 KILOMETRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS: WORLD TOPOGRAPHIC MAP: SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY WORLD HILLSHADE: ESRI, NASA, NGA, USGS
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE

GROUNDWATER SPATIAL BOUNDARY

CONSULTANT

Kami

YYYY-MM-DD	2025-06-26
DESIGNED	----
PREPARED	RRD
REVIEWED	CB
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0020	0	7-1

7.4 Existing Environment

The existing environment for groundwater generally formed the basis against which the residual Project and cumulative effects were assessed. The existing environment also represents the outcome of historical and current environmental and socioeconomic pressures that have shaped the observed condition of groundwater. Environmental and socioeconomic pressures or factors were either natural (e.g., weather, wildfire, predation, disease, climate change) or human related (e.g., industrial development, forestry, changing business models, fishing, hunting).

Hydrogeological investigations included a Water Resources Baseline study and associated information from geotechnical investigations conducted in 2011-2012 (Stantec 2012b). The Water Resources Baseline study included an assessment of groundwater and surface water resources to support the EA. The report discusses the existing environmental conditions for freshwater quality and quantity and is structured to allow for distinction between groundwater and surface water components. Various additional geotechnical and hydrogeological investigations have been completed in 2023, 2024, and more are planned for 2025 to fill any remaining data gaps related to groundwater within the existing baseline study, to support further refinement of the numerical hydrogeological model and address the Conditions of Release (Government of Newfoundland and Labrador 2014).

7.4.1 Methods

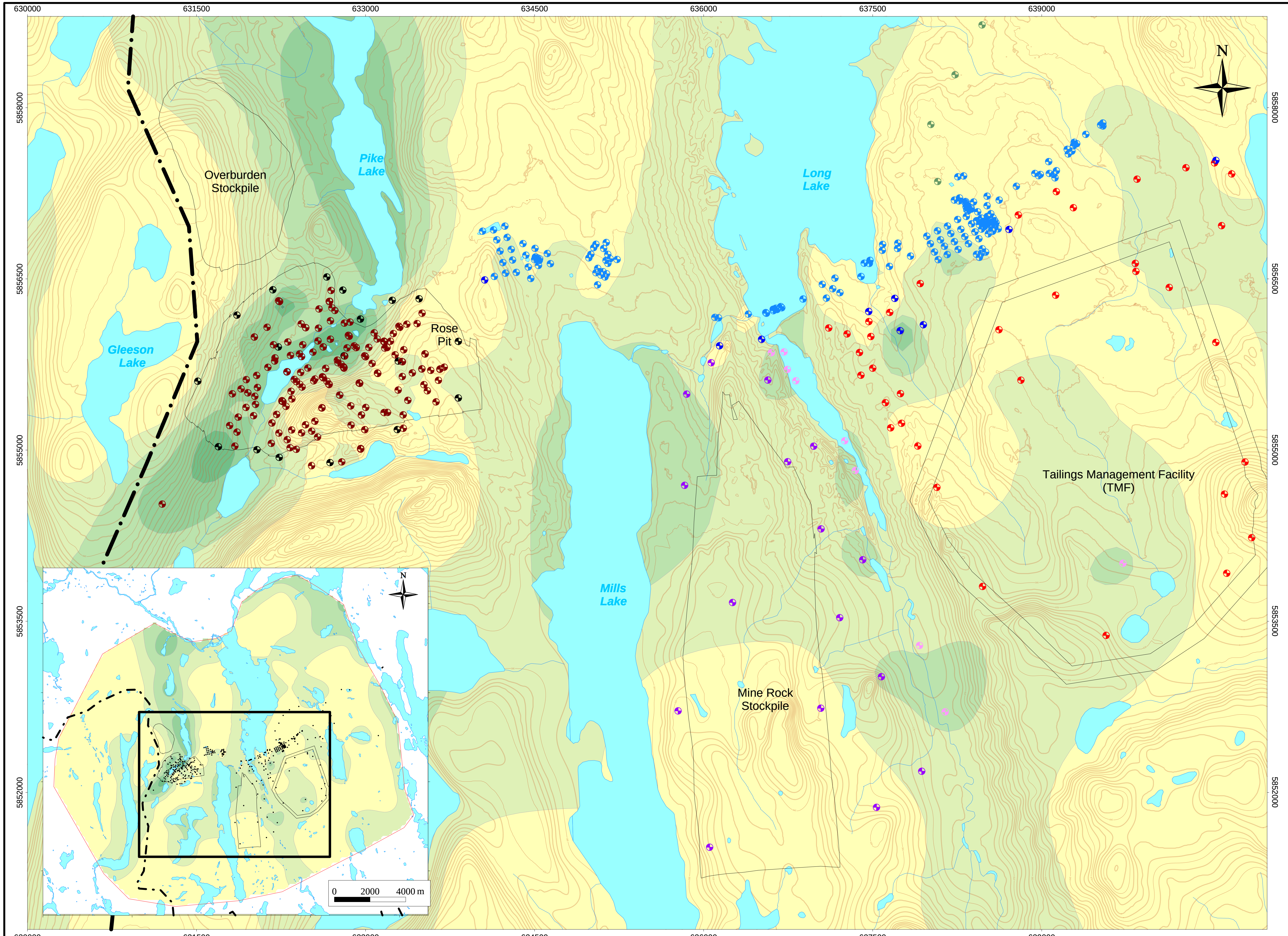
The following sections summarize the methods employed to characterize the existing environment as it relates to the groundwater VEC.

7.4.2 Physiographic Setting

The physiographic setting is described by existing climate conditions discussed in **Chapter 5, Air Quality and Climate**, along with the surficial geology, bedrock geology, and regional hydrogeology which are discussed below.

7.4.2.1 Surficial Geology

Overburden at the Project site was determined through borehole drilling programs and generally consists of veneers of organic soils overlying sequences of undifferentiated glacial till, and occasional glacio-fluvial and fluvial deposits. Overburden thickness is varied across the LSA; within the vicinity of Rose Pit area glacial till thicknesses range from 0.9 to 62.2 m, outside of the pit area south of Duley Lake till thicknesses range from 0.2 to 48.4 m. In general, overburden thickness within the RSA is greatest at topographic lows within valleys and is smallest at topographic highs. Till thickness across the RSA was interpolated using available data coverage: estimated thickness ranges between 1 and 5 m for topographic highs and approximately 20 m in valleys. Estimated overburden thickness across the Project site is provided in Figure 7-2, which is reproduced from AtkinsRéalis (2024).



NOTES

In the pit and tailings area, interpolation is based on data from exploration and geotechnical drilling. Outside this area, on the periphery of the study zone, control points were added to compensate for the lack of information. Till thickness was estimated based on topography (between 1 and 5 m on the topographic highs and 20 m in the valleys)

LEGEND

Boreholes and wells used for the overburden interpolation:

- ROB-11-series
- K-series
- BH-12-series
- BH-AS-series
- BH-EPL-series
- BH-GE-series
- BH-RS / RSD-series
- BH-TF / TMF-series
- QUÉBEC -LABRADOR BOUNDARY
- HYDROGEOLOGICAL MODEL LIMIT
- PROPOSED INFRASTRUCTURES
- TOPOGRAPHIC CONTOUR (5 m INTERVAL)
- 50 / 0 TILL THICKNESS (10 m INTERVAL)

Kami | Kamistiatusset Mining Project

Pre-Feasibility Study of the Kamistiatusset (Kami) Iron Ore Property Hydrogeology and Water Management

Estimated Overburden Thickness

Source :

Project 692696 Kami Mine Conceptual Hydrogeological and Water Blance Study
Topographic Data of Canada - CanVec Series, Governement of Canada, 2019
Projection NAD83 UTM Zone 19N

0 2000 4000 m

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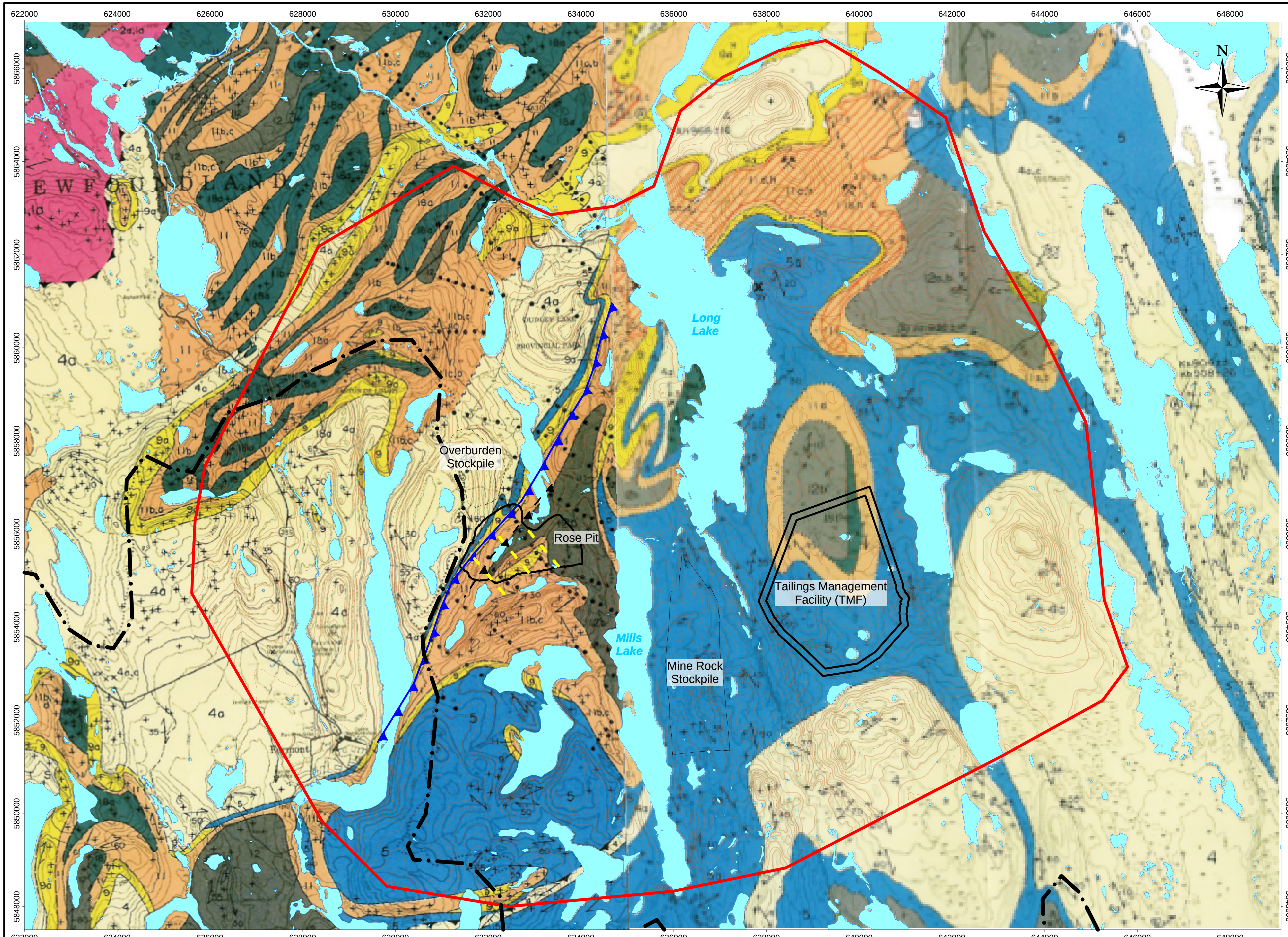
7.4.2.2 Bedrock Geology

Bedrock geology at the site was determined through borehole drilling programs conducted over the various hydrogeological and geotechnical investigations associated with the Project. The bedrock at the Project site consists of the highly metamorphosed and deformed metasedimentary sequence in the Grenville Province of the Labrador Trough (Stantec 2012a). Middle Proterozoic aged Archean granite gneiss is overlain by the metamorphosed sequences of the Ferriman Group, which includes: Denault (Duley) Formation dolomitic and calcitic marble, Wishart (Carol) Formation quartzite, schist and quartz pebble conglomerate, Sokoman (Wabush) Formation, and the Menihek Formation. The Sokoman Formation includes iron oxide, carbonate, and silicate facies and hosts iron oxide deposits, while the Menihek Formation consists of marine sediment deposits with dykes and sills of biotite-garnet-amphibole commonly found throughout all formations, but particularly within the Menihek Formation.

Two significant fault-zones have been identified within the LSA throughout the drilling programs: The Katsao-Wishart Fault and the Central Fault. In some boreholes, the entire Wishart formation was observed to be weathered to poorly consolidated material. This intense fracturing of the Wishart is linked to a major, regional scale fault zone formed by the contact between the Katsao and Wishart formations. Within the central pit area, recent geotechnical investigations (AtkinsRéalis 2024) revealed highly fractured and altered zones of varying thickness (20 to 50 m) primarily within the Sokoman formation at different depths (from 150 to 350 m). The fractured zones do not appear to be related to lithological contacts and are hypothesized to be due to the development of iron deposits in vuggy bedrock.

Regional geology and the position of regional faults from AtkinsRéalis 2024 are provided in Figure 7-3.



NOTES

Fault locations are approximative and fault continuity is uncertain outside Rose pit area.

A major thrust fault, parallel to the strike of the deposit, has been interpreted at the Wishart and Katsao Formation contact in the northwest portion of the North Rose deposit (Katsao-Wishart fault).

A second fault (or fractured zone) have been interpreted in the Sokoman Formation, in the center of the pit (Central fault).

Three interpreted sub-vertical dip-slip faults bisect the deposits, trending roughly northwest-southeast. However, it is understood that more structures may be present based on review of aerial imagery. As a result of directional bias of the exploration boreholes, these structures are rarely intersected and are at present interpreted only through 3D geological interpolation.

Stantec's Pit Slope Design report (2012a) mentions the presence of a potential fault in the Menihek unit (syncline axis), however the existence or location of this fault was not confirmed during this study.

BEDROCK GEOLOGY

- SHABOGAMO FORMATION
  Gabbro, metagabbro and amphibolite
- MENIHEK FORMATION
  Mica Schist
- SOKOMAN FORMATION
  Silicate-carbonate and oxide iron formation
- WISHART
  Quartzite sandstone
- DENAULT
  Dolomite and calcitic marble
- KATSAO
  Archean gneiss
- GRANITOID INTRUSIONS

LEGEND

- SUB-VERTICAL DIP-SLIP FAULT
- KATSAO-WISHART FAULT
- CENTRAL FAULT
- HYDROGEOLOGICAL MODEL LIMIT
- PROPOSED INFRASTRUCTURES
- TOPOGRAPHIC CONTOUR (5 m INTERVAL)

Kami Kamistiatusset Mining Project

Pre-Feasibility Study of the Kamistiatusset (Kami) Iron Ore Property Hydrogeology and Water Management

Regional Geology

Source :
Project 692696 Kami Mine Conceptual Hydrogeological and Water Blance Study
Rivers, T. 1985: Geology of the Lac Virot area, Labrador/Quebec. Map 85-025. Scale 1:100,000. Government of Newfoundland and Labrador, Department of Mines and Energy, Mineral Development Division, GS#LAB/0696
Projection NAD83 UTM Zone 19N

0 1000 2000m

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7.4.2.3 Regional Hydrogeology

Regional hydrogeologic information was obtained from The Hydrogeology of Labrador (AECOM 2013). The Project area is characterized by rugged bedrock dominated uplands that have been carved by glacial erosion to form valleys, as a result, both surficial (till) and bedrock aquifers are present throughout the region.

The deposits at the Project site are located within or below both surficial and bedrock aquifers which have been classified regionally as distinct hydrostratigraphic units that have been mapped across the province. Locally, the deposits are located within or below two surficial aquifer hydrostratigraphic units named Unit B – Till and Ribbed (Rogen) Moraine Deposits and Unit E – Glaciofluvial Deposits. Unit B is characterized by blanket till and Rogen moraine deposits and are considered to have a low to moderate aquifer potential. Unit E is characterized by glaciofluvial deposits (e.g., Eskers) that are composed of well sorted, coarse sediment and are considered to have high aquifer potential. For bedrock aquifers, the deposits are located within the bedrock hydrostratigraphic group labelled Unit 4 – Sedimentary and Volcanic Rocks of the Labrador Trough and Seal Lake Group (and metamorphosed equivalents). Unit 4 is characterized as having a moderate to high yield aquifer potential, with well yields ranging from 9 to 600 with a geometric mean of 44.7 litres per minute (LPM).

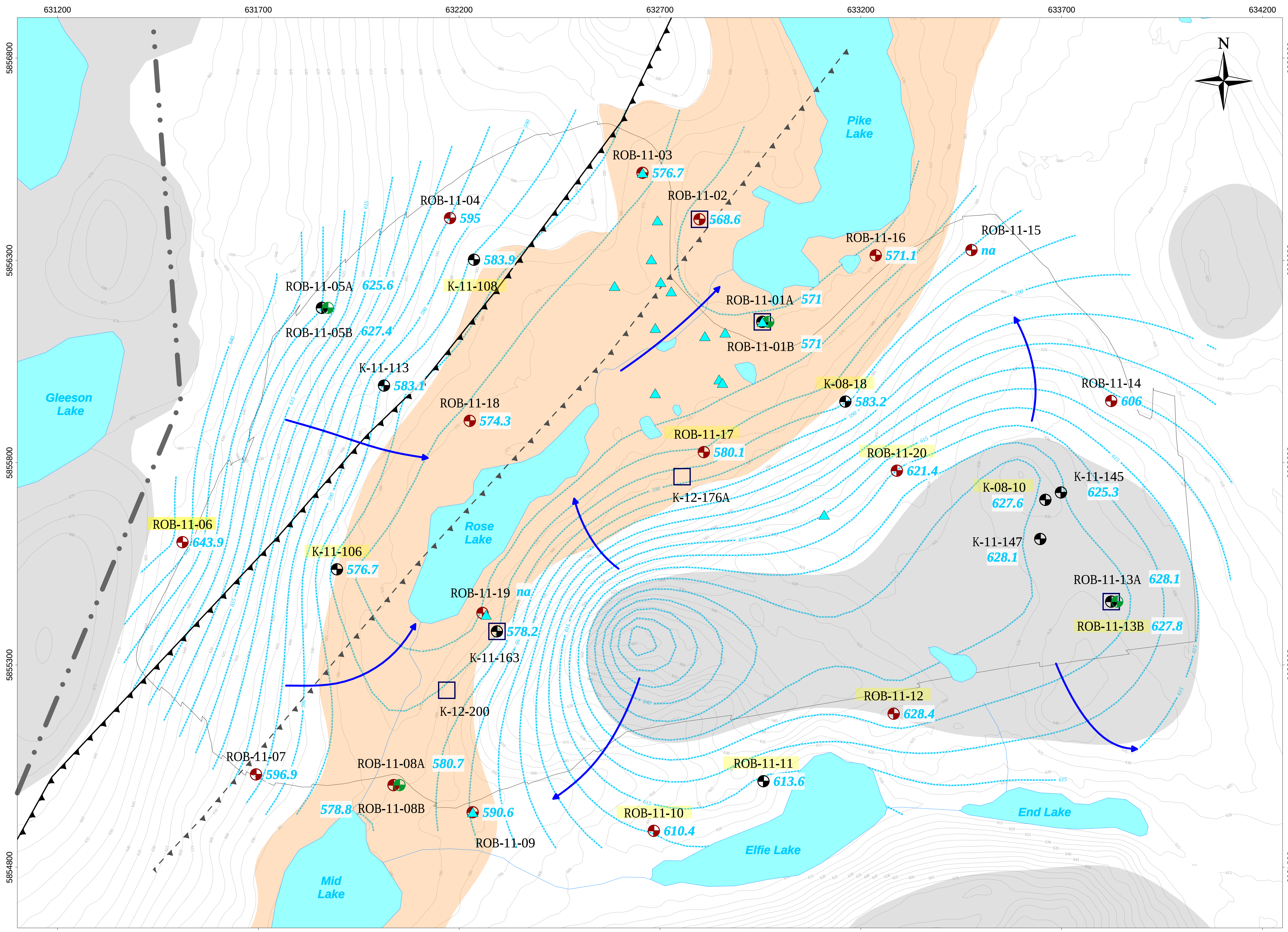
It is expected that the surficial aquifers in the area will be largely controlled by topography, surface run-off and local recharge/discharge conditions, while the bedrock aquifers may be influenced by recharge at higher elevations. Groundwater flow in metamorphic and igneous rocks generally occurs through secondary porosity (e.g., fractures, joints and faults) which will become tighter and less frequent with increasing depth. The underlying bedrock aquifer is likely to be under semi-confining conditions due to widespread presence of blanket till. Groundwater flow directions generally follow topography and the surface water flow patters from southwest to northeast along the Churchill River watershed. Locally, groundwater moves from higher topography areas towards lakes, streams and wetlands distributed across the site.

7.4.3 Water Levels

Groundwater depths vary across the site and generally reflect the topographic relief of the area. Manual groundwater levels in the pit area were measured in 32 monitoring wells during the baseline water resources study (Stantec 2012b) and have been monitored with automated dataloggers in 8 monitoring wells from 2013 to 2021, some of the dataloggers are still installed and collected data at present. Further baseline data collection for water levels in the other Project component areas such as the overburden and mine rock stockpiles, and the TMF area is planned for 2025.

Groundwater levels varied from artesian conditions (max >2 m above ground) in low-lying and wetland areas to 13.55 mbgs at higher elevations. Topographic highs to the west (near Gleeson Lake) and southeast of the pit (near Elfie Lake) act as preferential recharge areas, whereas the centre of the valley represents a local discharge area in alignment with Mid, Rose and Pike Lake. Groundwater elevations range from approximately 537 masl near the Waldorf River crossing to 646 masl at the watershed divide near Gleeson Lake, a difference of approximately 109 m. Water level contours and groundwater flow directions in the Pit area are provided in Figure 7-4.

Continuous water level monitoring by dataloggers from 2013-2023 show that groundwater fluctuates seasonally, with decreasing water level during low recharge season (fall and winter), and spiking during the spring melt period where water levels remain relatively consistent throughout the summer months.



NOTES

Strong gradients are seen on slopes, in the bedrock, between K-08-10 and K-08-18 (0.08 m/m) and ROB-11-05A and K-11-113 (0.17 m/m). More gentle gradients were estimated in the center of the valley, at the till/bedrock interface, between ROB-11-07 and ROB-11-02 (0.02 m/m) and between ROB-11-04 and ROB-11-02 (0.03 m/m).

A vertical downwards gradient of 0.06 m/m was estimated at ROB-11-06A/B, in the western part of the pit, on a topographic high; vertical upwards gradients were estimated at ROB-11-08A/B (0.17 m/m) in the local discharge area in the valley center; and vertical upwards gradients were also estimated at ROB-11-13A/B (0.04 m/m) located on a topographic high in the eastern part of the pit.

During the May and September 2023 field investigations by SNCL, some exploration boreholes and wells showed artesian conditions. The presentation of artesian wells on the map is not exhaustive, as only certain areas were checked.

LEGEND

- LOCAL RECHARGE AREA
- LOCAL DISCHARGE AREA
- QUÉBEC - LABRADOR BOUNDARY
- KATSAO-WISHART FAULT
- CENTRAL FAULT
- ARTESIAN WELL (May & Sep. 2023)
- PRESSURE TRANSDUCER INSTALLED (May 2023)
- Location ID — PRESSURE TRANSDUCER INSTALLED (2011-2012)
- Location ID / Measured water level — OBSERVATION WELL (Till)
- Location ID / Measured water level — OBSERVATION WELL (Till/Bedrock)
- Location ID / Measured water level — OBSERVATION WELL (Bedrock)
- 536 — INTERPOLATED PIEZOMETRIC ELEVATION (5m INTERVAL)
- GROUNDWATER FLOW DIRECTION

Kami Kamistiatusset Mining Project

Pre-Feasibility Study of the Kamistiatusset (Kami) Iron Ore Property Hydrogeology and Water Management

2011-2012 Measured Groundwater Elevation in the Pit Area

Source :

Project 692696 Kami Mine Conceptual Hydrogeological and Water Blance Study
Topographic Data of Canada - CanVec Series, Governement of Canada, 2019
Projection UTM Zone 19N

0 100 200m

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7.4.4 Groundwater Flow Direction

Groundwater flow directions at the site were characterized by water level monitoring to determine the general direction of groundwater flow, as well as hydraulic gradient estimations to determine the magnitude of groundwater flow in a given direction. Groundwater flow directions generally follow topography from upland territory to valleys. Groundwater flow direction is provided in Figure 7-4.

Horizontal groundwater gradients were estimated between different pairs of wells within the same hydrostratigraphic unit. Strong gradients (0.17 m/m) were observed on valley slopes, while more gentle gradients (0.02 to 0.08 m/m) were observed in the centre of the valley and at the till/bedrock interface.

Vertical groundwater gradients were estimated in paired/multi-level monitoring wells screened within overburden and bedrock units. Both upward and downward vertical gradient directions were observed. A gentle downward gradient (0.06 m/m) was estimated in the western part of the pit, on the slope at a topographic high. A strong upward gradient (0.17 m/m) was measured in the local discharge area in the centre of the pit area.

7.4.5 Groundwater Chemistry

Groundwater quality in the Rose Pit area was characterized from 26 wells and boreholes sampled during baseline (Stantec 2012b) and subsequent monitoring events (2023-2025). Sampling was conducted for general chemistry and metal parameters. Further groundwater quality sampling to characterize other areas within the LSA are planned for 2025. The major ion concentrations of all sampled wells were similar, and generally described as clear to slightly coloured, moderately soft, neutral to slightly acidic, calcium-bicarbonate type water with low total dissolved solids. A Piper diagram of the 2012 water chemistry data is presented in Figure 7-5.

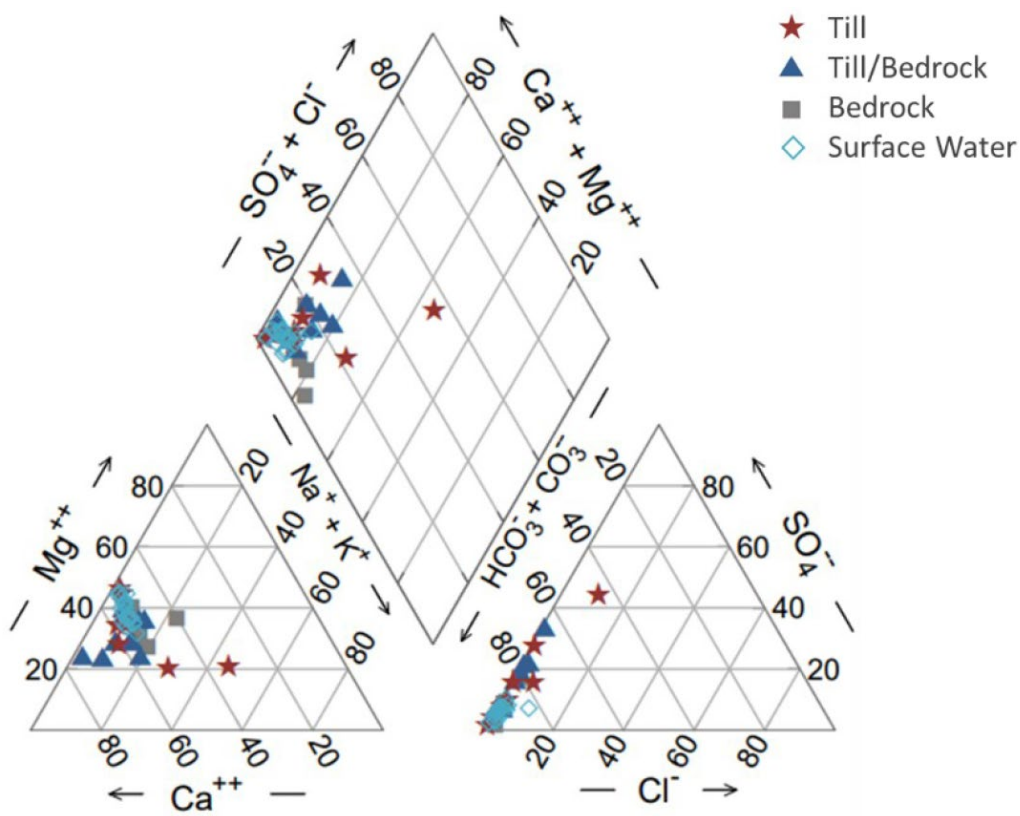


Figure 7-5: Piper Diagram for Baseline Groundwater Samples (AtkinsRéalis 2024)

Groundwater quality was analyzed for the till, till/bedrock, and bedrock screened wells and compared to Guidelines for Canadian Drinking Water Quality (GCDWQ; Health Canada 2025):

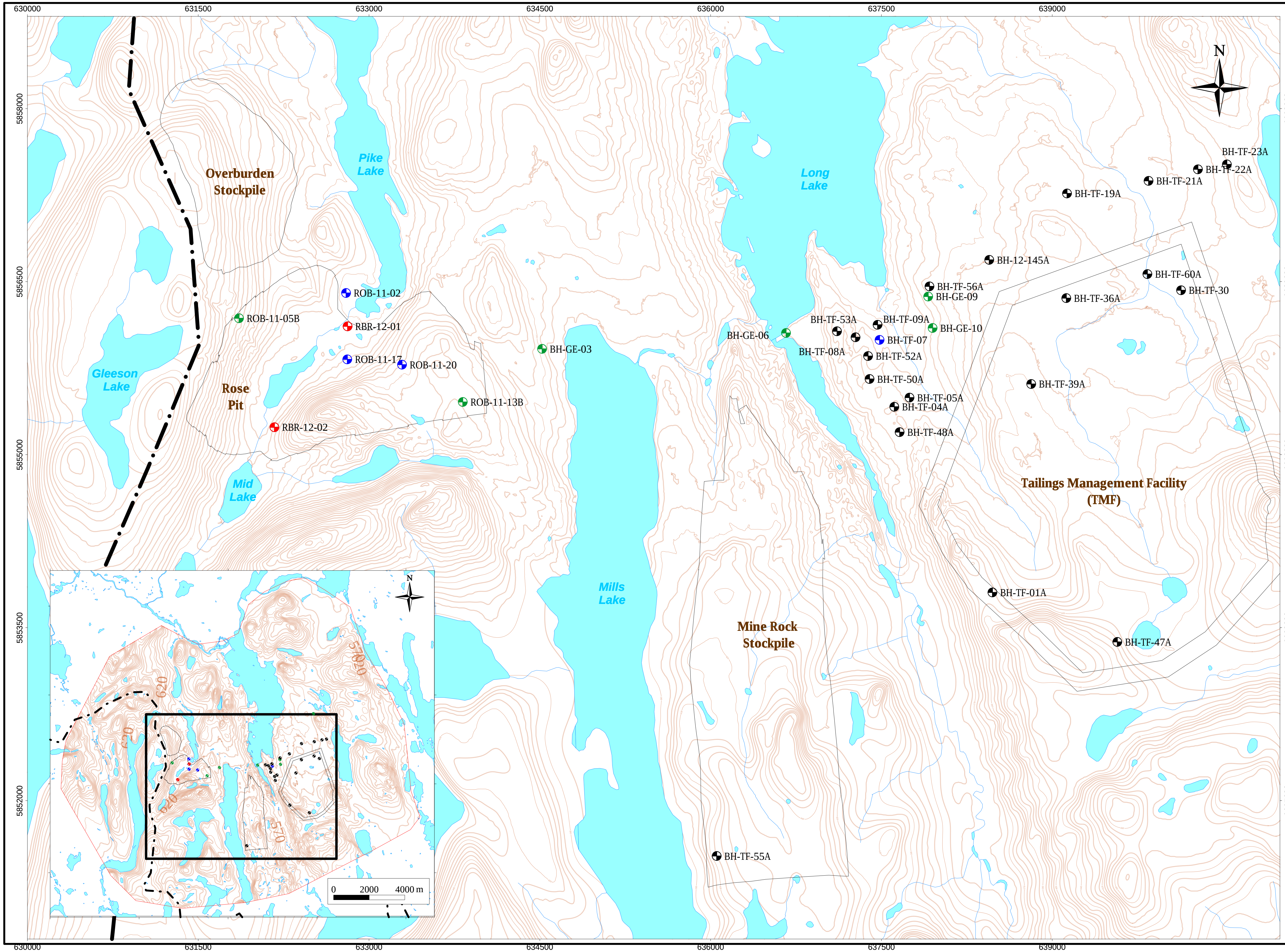
- **In till**—All parameters except manganese (average concentration of 0.297 mg/L) meet GCDWQ. Compared to other lithologic units the overburden chemistry appears slightly higher in sodium, chloride, and total dissolved solids, and lower in alkalinity, organic carbon, and trace metals.
- **In till/bedrock**—All parameters except iron (average concentration of 0.517 mg/L) and manganese (average concentration of 0.442 mg/L) meet GCDWQ. The till/bedrock well chemistry typically has a higher total organic concentration than other lithologic units.
- **In bedrock**—Iron (average concentration of 1.469 mg/L) and manganese (0.286 mg/L) typically exceed GCDWQ and all other parameters meet GCDWQ. In comparison to overburden lithologic units, the bedrock typically has higher alkalinity, pH and higher concentrations of copper, iron and zinc.

7.4.6 Hydraulic Properties

Hydraulic conductivity (K) of overburden till has been measured through in situ hydraulic conductivity tests (slug tests) in six wells. K values range from 2.4×10^{-7} to 2.6×10^{-5} with an average of 1.2×10^{-6} m/s for till at the Project site. Additionally, K was estimated in four wells screened at the till/shallow bedrock contact, K values ranged from 3.2×10^{-8} to 1.2×10^{-6} with an average of 1.8×10^{-7} m/s.

K of bedrock has been measured through slug tests in 24 wells, mostly located south of Duley Lake and conducted in shallow bedrock, and through packer injection tests of two deep boreholes. K values range from 1.0×10^{-8} to 2.8×10^{-6} with an average of 1.2×10^{-7} m/s measured for shallow bedrock. Two deeper boreholes were drilled within the centre of the Pit area had measured K values range from 8.6×10^{-8} to $>1.0 \times 10^{-5}$ with an average of 2.4×10^{-6} m/s. The packer tests revealed zones of elevated hydraulic conductivity which exceeded the range of the packer test method ($>1 \times 10^{-5}$ m/s) which are attributed to the Central Fault.

The location and spatial coverage of hydraulic conductivity tests are provided in Figure 7-6.



LEGEND

Hydraulic conductivity (K) data available (slug tests) from Stantec, 2012a

- TILL
- TILL/BEDROCK
- BEDROCK
- RBR-12-01 & RBR-12-02 (Packer tests)
- QUÉBEC -LABRADOR BOUNDARY
- HYDROGEOLOGICAL MODEL LIMIT
- PROPOSED INFRASTRUCTURE
- TOPOGRAPHIC CONTOUR (5 m INTERVAL)

Kami

Pre-Feasibility Study of the Kamistiatusset (Kami) Iron Ore Property Hydrogeology and Water Management

Available Hydraulic Conductivity Data

Source :

Project 692696 Kami Mine Conceptual Hydrogeological and Water Blance Study
Topographic Data of Canada - CanVec Series, Governement of Canada, 2019
Projection NAD83 UTM Zone 19N

0 2000 4000 m

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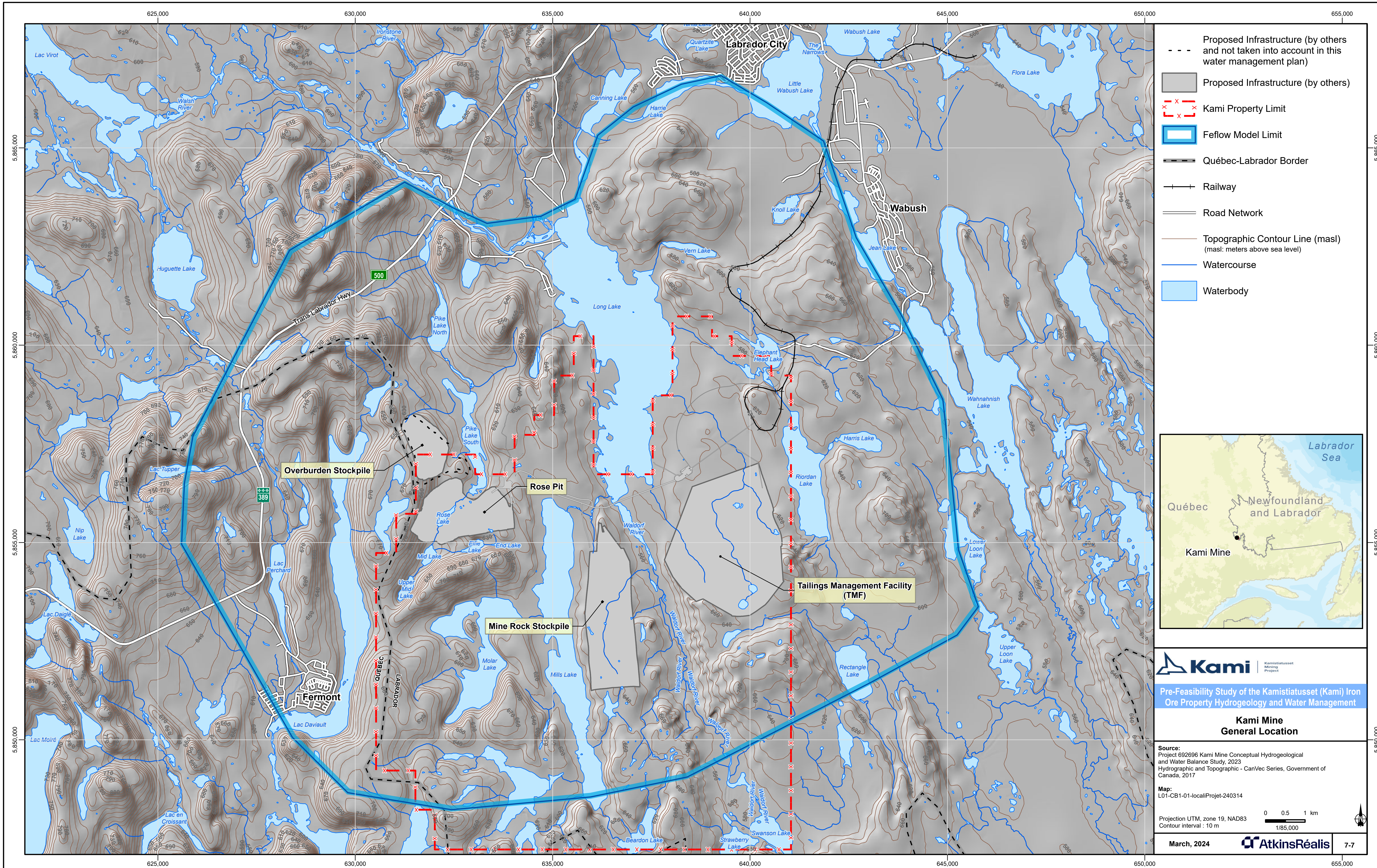
7.4.7 Existing Groundwater Users

Determination of groundwater users within the assessment boundaries was done by reviewing available water supply information from the Newfoundland and Labrador Department of Environment and Climate Change (NLDECC) Water Resources Management Division and from the Québec Department of Environment, Climate Change, Wildlife and Parks. No municipal groundwater supplies are found within the assessment boundaries; the municipalities of Fermont, Labrador City, and Wabush in the RSA use surface water resources as their drinking water supply. An inventory of drilled wells within the RSA was provided by NLDECC and obtained through the Québec Department of Environment, Climate Change, Wildlife and Parks Hydrogeological Information System.

No groundwater wells were found within the Québec portion of RSA when querying the Québec Department of Environment, Climate Change, Wildlife and Parks Hydrogeological Information System database – five drilled wells were found in the municipality of Fermont, but outside the RSA. Information provided by the NLDECC indicates that 15 drilled wells are present within the assessment boundaries (RSA); however, only one well is located within the LSA where effects to groundwater are measurable and anticipated. The location of groundwater users near the Project site are provided in Figure 7-7.

Groundwater users within the RSA are all for domestic use to supply their cabin/property, the Tamarack Golf Club has a supply well that is located just north of the RSA boundary. The majority of the groundwater users within the RSA are located along the northwest shore of Duley Lake. One well is located within the LSA on the southwest shore of Duley Lake, it is possible that more users are located in these areas which have not been captured in the NLDECC drilled well database.



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7.5 Effects Assessment

7.5.1 Methods

7.5.1.1 Effect Pathway Screening

Interactions between Project components or activities, and the corresponding potential changes to the environment that could result in a potential effect to the groundwater VEC were identified by an effect pathway screening. The effect pathway screening was used to inform the residual Project and cumulative effects analyses for the groundwater VEC. Potential pathways from Project activities to groundwater VECs were identified using the following:

- review of the Project Description (**Chapter 2, Project Description**) and scoping of potential effects by the EIS team for the Project
- input from Engagement (Chapter 22)
- scientific knowledge
- review of EISs for similar mining projects, including the previous Kami EIS (Alderon 2012b) and Conditions of Release (Government of Newfoundland and Labrador 2014)
- previous experience with mining projects
- consideration of key issues (Section 7.3.1)

Potential adverse effects of the Project were then identified and practicable mitigation was applied to avoid, minimize and/or rehabilitate effects on groundwater VECs. Avoidance and minimization are widely recognized as the most important for biodiversity conservation (BBOP 2015). Avoidance designs and actions integrated into the Project were developed iteratively by the Project's EIS team. The effectiveness of mitigation measures proposed for each effect pathway was assessed to determine whether the mitigation would address the potential Project effect such that the pathway was eliminated, would result in a negligible adverse effect on a particular VEC or if residual adverse effects on groundwater from the Project remained.

This effect pathway screening was a preliminary assessment that was intended to focus the effects analysis on effect pathways that required a more quantitative or comprehensive assessment of effects on VECs. Using scientific knowledge, feedback from consultation, logic, experience with similar developments, and an understanding of the effectiveness of mitigation (i.e., level of certainty that the proposed mitigation would work), each effect pathway was categorized as one of the following:

- **No effect pathway**—The effect pathway could be removed (i.e., the effect would be avoided) by avoidance measures and/or additional mitigation so that the Project would result in no measurable environmental change relative to existing conditions or guideline values (e.g., air, soil, or water quality guidelines) and would therefore have no residual effect on groundwater or an associated VEC.
- **Negligible effect pathway—**With the application of mitigation, the effect pathway could result in a measurable but minor environmental change relative to existing conditions or guideline values, but the change is sufficiently small that it would have a negligible residual effect on groundwater (e.g., a decrease in groundwater levels that will not affect any groundwater users, or an increase in a water quality parameter that is negligible compared to the range of existing values and is well within the applicable groundwater quality standards for drinking water and aquatic environment for that parameter). Therefore, further detailed assessment of the residual effect is not warranted as the effect pathway would not be expected to result in a significant residual Project or cumulative effect on groundwater.
- **Residual effect pathway—**Even with the application of mitigation, the effects pathway is still likely to result in a measurable environmental change relative to existing conditions or guideline values that could cause a greater-than-negligible adverse or positive effect on groundwater or an associated VEC and warrants additional assessment.

Project interactions determined as no effect pathway or negligible effect pathways were not carried forward for further assessment (Section 7.5.3). Residual effect pathways that could result in changes to the environment with one or more associated measurable parameter and have the potential to cause a greater than negligible effect on groundwater VECs were carried forward to the residual Project effects analysis (Section 7.5.3) and residual cumulative effects analysis (Section 7.5.4, Residual Cumulative Effects Analysis).

7.5.1.2 Residual Project Effect Analysis

The residual effects analysis measures and describes the effects of the Project on groundwater quality and quantity relative to existing conditions. The residual effects analysis was conducted using the temporal snapshot identified for the assessment (Section 7.3.3, Assessment Boundaries). Residual effects are described for each of the measurement indicators for the residual effect pathways identified.

The residual effect analysis used a numerical 3-dimensional geological and groundwater flow model, as described in TSD V, to simulate the response of local groundwater flow systems due to Rose Pit excavation and dewatering activities. A seepage analysis to quantify seepage losses from the TMF was performed using the SEEP/W module of GeoStudio (GEO-SLOPE 2022), as described in Technical Supporting Document I (Tailings Management Facility Pre-Feasibility Design). SEEP/W is a steady-state, two-dimensional finite element model. Simulated groundwater levels and groundwater inflow rates/outflow rates are used to conduct the effects analysis. Furthermore, groundwater quantities and flow paths as described above were incorporated into the site-wide water balance and water quality model (TSD VI), which was used to assess the Project and inform the surface water effects assessment (Section 8.5, Effects Assessment, **Chapter 8, Surface Water**).

The residual effects analysis used a reasoned narrative to describe anticipated changes to each measurable parameter caused by the Project. This narrative description of anticipated effects is the foundation for the residual effects classification. Residual effects are summarized or classified in tabular form using effects criteria, which is intended to provide structure and comparability across VECs assessed for the Project. The residual effects classification uses nature, magnitude, geographic extent, duration, timing, frequency, reversibility, and probability of occurrence as criteria. The approach to classify each residual effect criterion is provided in Table 7-4. Following classification of residual Project effects, the analysis also evaluates the significance of residual Project effects using threshold criteria or standards beyond which a residual effect is considered significant. The definition of a significant effect for groundwater is provided in Section 7.5.1.4, Significance Determination.

Table 7-4: Definitions Applied to Effects Criteria Classifications for the Assessment of Groundwater Valued Environmental Component

Criterion	Rating	Definition
Nature	Positive	Change in measurable parameter results in net improvement or benefit to the groundwater regime
	Neutral	Change in measurable parameter results in no change to the groundwater regime
	Adverse	Change in measurable parameter results in net degradation or loss to the groundwater regime
Magnitude	Qualitative narrative or numeric quantification	Change in measurable parameter is described by effect size (i.e., the delta in groundwater level, quantity, or quality/concentration of a certain groundwater quality parameter as a result of one or more of the Project phases) Low: effect occurs and is detectable but is within the normal variability of the baseline conditions Moderate: effect occurs that would cause and increase with regard to baseline but is within regulatory limits and objectives High: effect occurs that would singly or as a substantial contribution in combination with other sources cause exceedances or objectives or standards within the Project RSA
Geographic extent	SSA	Change in measurable parameter is confined to the SSA
	Local	Change in measurable parameter extends outside the SSA but within the LSA
	Regional	Change in measurable parameter extends beyond the LSA but is confined to the RSA
	Beyond regional	Change in measurable parameter extends beyond the RSA
Duration	Qualitative narrative or numeric quantification	Short term: effect occurs for less than two years Medium term: effect occurs for between three and 20 years Long term: effect persists beyond 20 years Permanent: will not change back to original condition
Timing	Qualitative narrative or numeric quantification	Change in measurable parameter is described with a focus on seasonality (i.e., changes to the hydroperiod of the groundwater regime, or not applicable, where seasonal aspects are unlikely to affect groundwater)
Frequency	Occasional	Change in measurable parameter is expected to occur rarely (i.e., once or a few times)
	Periodic	Change in measurable parameter is expected to occur consistently at regular intervals or associated with temporal events (i.e., during hot, dry climatic conditions)
	Continuous	Change in measurable parameter is expected to occur all the time

Criterion	Rating	Definition
Reversibility	Reversible	Change in measurable parameter is reversible within a clearly defined time period
	Irreversible	Change in measurable parameter is predicted to influence the component indefinitely
Probability of occurrence	Unlikely	Change in measurable parameter is not expected to occur, but not impossible
	Possible	Change in measurable parameter may occur, but is not likely
	Probable	Change in measurable parameter is likely to occur, but is uncertain
	Certain	Change in measurable parameter will occur
Ecological and Socioeconomic Context	Qualitative narrative or numeric quantification	Change in measurable parameter is described by the perception of an effect that considers sensitivity and resilience of groundwater (ecological context), and the cultural and social significance placed on groundwater and the unique values, customs or aspirations of local communities or Indigenous groups

RSA = regional study area; SSA = site study area; LSA = local study area.

7.5.1.3 Residual Cumulative Effect Analysis

The cumulative effects assessment builds on the results of the residual Projects effects assessment and considers the incremental changes that were predicted to have a likely residual adverse effect on groundwater. This would include the effects of past and current projects or past climate-related changes (i.e., forest fires), which contribute to existing conditions upon which residual Project effects are assessed. For the EIS, the description of the existing environment characterizes the environment already affected by past and current projects and activities; therefore, the cumulative effects assessment focused on analyzing the effects of other RFDs in combination with the Project. Although positive residual effects are characterized in the residual Project effects analysis, they are not carried forward to the cumulative effects analysis, as the Project benefits from other past, present and RFDs or activities are unlikely to be known or publicly disclosed (e.g., Benefit Agreements with Indigenous groups or local community stakeholders).

The cumulative effects assessment followed a three-step process:

- Identify RFDs and potential cumulative effects that overlap in time and space with residual effects.
- Identify and describe any additional mitigation measures, if applicable.
- Characterize residual cumulative effects, using the same criteria defined for the residual Project effects analysis (Section 7.5.1.2, Residual Project Effect Analysis).

Chapter 4 provides a list of known RFDs and physical activities with potential residual effects that could overlap spatially and temporally with the Project's residual environmental effects. This list was considered in the identification of RFDs for the assessment of cumulative effects on groundwater. Following the identification of applicable RFDs, residual Project effects on groundwater were evaluated for temporal and spatial overlap with the effects of RFDs to identify potential cumulative effects. The evaluation was completed qualitatively based on publicly available information (e.g., Project Registrations or EIS reports) describing the environmental effects of RFDs. If effects from these RFDs overlapped spatially or temporally with the residual Project effects on groundwater, then potential cumulative effects were identified. If no spatial or temporal overlap existed for the residual Project effects and RFDs identified in Chapter 4, then a cumulative effects assessment was not required.

Based on the assessment of potential cumulative effects, an assessment was made regarding whether additional mitigation measures, beyond those proposed for the Project, were required to address potential cumulative effects. Where applicable, additional mitigation measures were identified.

Residual cumulative effects were characterized using the same criteria assessed for residual Project effects (Section 7.5.1.2), and employed a qualitative approach to assess cumulative effects on groundwater.

Following classification of residual cumulative effects, the analysis also evaluated the significance of residual Project effects using threshold criteria or standards beyond which a residual environmental effect was considered significant. The definition of a significant effect for groundwater is provided in Section 7.5.1.4.

7.5.1.4 Significance Determination

A significant adverse residual effect on groundwater is defined as one that:

- results in changes in groundwater quantity, such that the yield from an otherwise adequate water supply well decrease to the point where it is inadequate for intended use
- or results in changes in groundwater quality, such that the water quality from an otherwise adequate water supply well which meets GCDWQ deteriorates to the point where it cannot meet GCDWQ

The following sections present the results of each of the assessment steps described in Section 7.4.1.

7.5.2 Effect Pathway Screening

The effect pathway screening predicts potential effects pathways that are then evaluated considering proposed mitigation to predict whether the effect pathway had the potential to cause residual adverse or positive effects. The effectiveness of mitigation measures proposed for each effect pathway was assessed to determine whether the mitigation would address the potential Project effect such that the effect pathway was eliminated or would result in a negligible adverse effect on a VEC. As described in Section 7.5.1.1, Effect Pathway Screening, each effect pathway was categorized as one of the following:

- **no effect pathway** (i.e., avoidance measures and/or mitigation results in no residual effect on groundwater)
- **negligible effect pathway** (i.e., mitigation results in negligible effect of groundwater)
- **residual effect pathway** (i.e., effect that is greater than negligible and carried forward for further assessment)

The effects pathway screening is summarized in Table 7-5. The subsections following the table provide the rationale used to assign potential effects to the no effect pathway and negligible effect pathway categories and list residual effect pathways. Each Project component/activity identified as a residual effect pathway was carried forward for detailed assessment in Section 7.5.3.

Table 7-5: Potential Effects Pathways for Groundwater

VEC	Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening
Groundwater Quantity: Project components or activities that may affect groundwater quantity due to altering the existing groundwater flow regime, changing recharge or discharge rates during Construction, Operations, and Closure	**Construction:** — Site preparation, including: – vegetation clearing, soil grubbing and grading – handling and storage of overburden – road construction — Quarry development and excavation of aggregate, including: – blasting and excavating aggregate – handling and storage of excavated materials — Water management, including: – dewatering activities – handling, storage and discharge of non-contact water – handling, storage, treatment and discharge of contact water – water intake for fresh water and process water – sewage collection, treatment and surface discharge — Construction of TMF starter dam including Pike, Mid, and Elfie dams	**Groundwater quantity:** — **Construction dewatering** – Dewatering activities will lower groundwater levels in the local area surrounding the dewatering point/excavation. Removal of or stockpiling of material on surface changes the permeability of the surface which can affect groundwater recharge. — **Construction of water management infrastructure** – Water management infrastructure can influence the local groundwater flow regime by changing the existing hydraulic gradients and directions.	**Construction:** — **Dewatering** – Beneficial re-use of treated water (i.e., to remove suspended solids) should be completed where possible to mitigate the anticipated temporary local recharge deficits. – Dewatering infrastructure (i.e., sump pumps or wells) will be installed in accordance with applicable regulations. – Water withdraw will be completed in accordance with provincial and federal standards and licence/permit conditions and industry best standards – Wells will be equipped suitably (i.e., with variable-frequency drive pumps) to allow effective control of dewatering rates within permitted rates. – Perform routine inspection and maintenance of water containment and conveyance structures (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment. – Implement the Environmental Effects Monitoring Program (Annex 5E) that includes a site specific groundwater monitoring plan to monitor groundwater levels in the LSA. – Implement mitigation measures presented in the Erosion and Sediment Control Plan (Annex 5F) to mitigate effects of construction activities. – Develop and implement a Project-specific Waste Management Plan and site contact water management procedures under the Environmental Protection Plan — **Construction of water management Project components** – Implement the Environmental Effects Monitoring Program that includes a site-specific Groundwater Monitoring Plan to monitor groundwater levels in the LSA. – Develop and implement a Project-specific Waste Management Plan and site contact water management procedures under the Environmental Protection Plan.	**Negligible Effect Pathway**

VEC	Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening
	Operations and Maintenance: — Open pit mining, including: – blasting and crushing ore and mine rock – handling and storage of overburden, mine rock and ore — Pit dewatering and site water management, including: – operation and management of the TMF – handling, storage and discharge of non-contact water – handling, storage, treatment and discharge of contact water — Sewage collection, treatment and surface discharge	**Groundwater quantity:** — **Dewatering from the pit** – Dewatering of open pits during Operations will result in localized lowering of the water table, potentially reducing availability of groundwater for existing well users (if any are present) and reducing flow (and therefore habitat) in fish-bearing streams. — **Water management or materials management facilities** – Water management and materials management Project components, such as the TMF, collection ponds, overburden and mine rock stockpiles, and other infrastructure can influence the local groundwater flow regime by changing the existing hydraulic gradients and directions. — **Water supply well** – Groundwater takings from the aquifer can alter the local groundwater flow regime.	**Operations and Maintenance:** — **Dewatering from the pit** – Implement water transfers from Duley Lake to Pike Lake as a key water management tool as described in Chapter 2 of this EIS. – Beneficial re-use of treated water (i.e., to remove suspended solids) should be completed where possible to mitigate the anticipated temporary local recharge deficits. – Dewatering infrastructure (i.e., sump pumps or wells) will be installed in accordance with applicable regulations. – Wells or sumps will be equipped suitably (i.e., with variable-frequency drive pumps or the like) to allow effective control of dewatering rates within permitted rates. – Provide adequate contact water storage capacity to manage run-off, seepage and inflows from the pit, Project infrastructure and disturbed areas – Implement water transfers from Duley Lake to Pike Lake as a key water management tool. – Instrumentation of dewatering wells and monitoring wells will be completed to allow for threshold values for groundwater level to be established, potentially leading to creation of a Trigger-Action-Response Plan (TARP) to be adhered to during Operations and Maintenance. — **Water management or materials management facilities** – Recommendations from water balance studies for the Project should be implemented to maintain the hydrologic and hydrogeological regimes in the areas immediately surrounding these facilities. – Transfer surface water from Duley Lake to Pike Lake with the intent to offset groundwater withdrawals and meet surface flow demands for fish-bearing streams down-gradient of the dewatered pit. – Develop and implement a Project-specific Waste Management Plan and site contact water management procedures under the Environmental Protection Plan — **Water supply well** – Information provided by the NLDECC indicates that 15 drilled wells are present within the assessment boundaries (RSA); however, only one well is located within the LSA where effects to groundwater are measurable and anticipated. For this well, verification of its use and status should be completed prior to Operations (prior to Construction as well, if possible). Options to reduce risk to the user would be to provide an alternative water supply of the same quantity and quality or to provide a make-good agreement.	**Residual Effect Pathway**
	Closure: — Accelerated pit flooding — Removal of infrastructure, restoration and revegetation of Project components	**Groundwater quantity:** — **Accelerated pit flooding** – Ending the dewatering/water management program will affect the local groundwater flow regime, returning it to near original conditions. — **Removal of infrastructure, restoration and revegetation of Project components** – Removal or reclamation of water and waste management facilities such as the TMF, bridges, dams, dikes (i.e., Pike Dike) and collection ponds will change the groundwater flow regime.	**Closure:** — **Flooding of pit** – Maintain water management systems associated with pit flooding until hydrological equilibrium is achieved. – Implement water transfers from Duley Lake to Pike Lake as a key water management tool. – Implement the Environmental Effects Monitoring Program that includes a site-specific Groundwater Monitoring Plan to monitor groundwater levels in the LSA, to confirm the anticipated groundwater levels are observed. – Develop and implement a Rehabilitation and Closure Plan for the Project to return the landscape, as close as possible, to it is undisturbed condition — **Removal of water management infrastructure and reclamation of Project components** – Develop and implement a Rehabilitation and Closure Plan for the Project to return the landscape, as close as possible, to it is undisturbed condition.	**Negligible Effect Pathway**

VEC	Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening
Groundwater Quality: Project components or activities that may affect groundwater quality due to altering the existing groundwater chemistry during Construction, Operations, and Closure	**Construction:** — Site preparation, including: – vegetation clearing, soil grubbing and grading – handling and storage of overburden – road construction — Quarry development and excavation of aggregate, including: – blasting and excavating aggregate – handling and storage of excavated materials — Water management, including: – dewatering activities – handling, storage and discharge of non-contact water – handling, storage, treatment and discharge of contact water – water intake for fresh water and process water – sewage collection, treatment and surface discharge — Construction of TMF starter dam including Pike, Mid, and Elfie dams	**Groundwater quality:** — **Dewatering** – Dewatering activities will lower groundwater levels in the local area surrounding the dewatering point/excavation which can mobilize contaminants from farther afield if any are present. Removal of or stockpiling of material on surface changes the permeability of the surface which can affect groundwater recharge, encouraging infiltration of potentially contaminated water from run-off. — **Construction of water management Project components** – Water management infrastructure can influence the local groundwater quality regime by changing the existing hydraulic gradients and directions. — **General deterioration of groundwater quality due to operational processes** – Changes to surface and subsurface infrastructure can affect groundwater recharge, encouraging infiltration of potentially contaminated water from run-off. – Backfilled utility corridors can act as preferential pathways for groundwater flow and thus contaminants. — **Accidental spill** – Hydrocarbons or other commonly used chemicals can be accidentally spilled on the site, causing groundwater contamination if not cleaned up at the time of release.	**Construction:** — **Dewatering** – Beneficial re-use of treated water (i.e., to remove suspended solids) should be completed where possible to mitigate the anticipated temporary changes in water quality. – Dewatering infrastructure (i.e., sump pumps or wells) will be installed in accordance with applicable regulations. – Perform routine inspection and maintenance of water containment and conveyance structures (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment. – Implement the Environmental Effects Monitoring Program that includes a site-specific Groundwater Monitoring Plan to monitor groundwater quality in the LSA. — **Construction of water management Project components** – Implement the Environmental Effects Monitoring Program that includes a site-specific Groundwater Monitoring Plan to monitor groundwater quality in the LSA. — **General alteration of groundwater quality due to operational processes** – Avoid placing soil stockpiles near waterbodies (i.e., maintaining 150 m buffer from waterbodies and watercourses), and near natural drainage features, unless required for temporary storage – Provide adequate contact water storage capacity to manage run-off, seepage and inflows from the pit, Project infrastructure and disturbed areas – Characterize, identify, and manage potentially acid generating mine rock to prevent localized acid mine drainage and minimize metal leaching. – Construct run-off and seepage collection ditches around the overburden stockpile, mine rock stockpile, TMF and other Project facilities and divert seepage to collection ponds and WTP, as required, to meet site-specific water quality objectives and regulatory requirements (Chapter 2 and TSD II for details about water management infrastructure) – Implement the Environmental Effects Monitoring Program that includes a site-specific Groundwater Monitoring Plan to monitor groundwater quality in the LSA. — **Accidental spill** – Implement a standard practice for guarding against spills. – Implement a robust Spill Response Plan.	**Negligible Effect Pathway**

VEC	Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening
	Operations and Maintenance: — Open pit mining, including: – blasting and crushing ore and mine rock – handling and storage of overburden, mine rock and ore — Pit dewatering and site water management, including: – operation and management of the TMF – handling, storage and discharge of non-contact water – handling, storage, treatment and discharge of contact water — Sewage collection, treatment and surface discharge	— **Groundwater quality:** — **Dewatering from the pit** – Dewatering activities will lower groundwater levels in the local area surrounding the dewatering point/excavation which can mobilize contaminants from farther afield if any are present. Removal of or stockpiling of material on surface changes the permeability of the surface which can affect groundwater recharge, encouraging infiltration of potentially contaminated water from run-off. — **Water management or materials management facilities** – Water management and materials management Project components, such as the TMF, collection ponds, overburden and mine rock stockpiles, and other infrastructure can influence the local groundwater flow regime by changing the existing hydraulic gradients and directions, which can mobilize contaminants from farther afield if any are present. — **Water supply well** – Groundwater takings from the aquifer can alter the local groundwater flow and thus quality regime. — **General deterioration of groundwater quality due to operational processes** – Changes to surface and subsurface infrastructure can affect groundwater recharge, encouraging infiltration of potentially contaminated water from run-off. – Backfilled utility corridors can act as preferential pathways for groundwater flow and thus contaminants. — **Accidental spill** – Hydrocarbons or other commonly used chemicals can be accidentally spilled on the site, causing groundwater contamination, if not cleaned up at time of release.	**Operations and maintenance:** — **Dewatering from the pit** – Beneficial re-use of treated water (i.e., to remove suspended solids) should be completed where possible to mitigate the anticipated temporary changes in water quality. – Dewatering infrastructure (i.e., sump pumps or wells) will be installed in accordance with applicable regulations. – Dewatering for the Construction phase of the Project is anticipated to be temporary and transient (i.e., it is treated separately than the proactive dewatering required to allow for mining during the Operations phase). – Perform routine inspection and maintenance of water containment and conveyance structures (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment. – Implement the Environmental Effects Monitoring Program that includes a site-specific Groundwater Monitoring Plan to monitor groundwater quality in the LSA. — **Water management or materials management facilities** – Recommendations from water balance studies for the Project should be implemented to maintain the hydrologic and hydrogeological regimes in the areas immediately surrounding these facilities. – Maintain seepage collection and mine water management systems associated with mine waste facilities as required to collect, convey and manage site contact water for discharge to Duley Lake through Operations. — **Water supply well** – Information provided by the NLDECC indicates that 15 drilled wells are present within the assessment boundaries (RSA); however, only one well is located within the LSA where effects to groundwater are measurable and anticipated. For this well, verification of its use and status should be completed prior to Operations (prior to Construction as well, if possible). Options to reduce risk to the user would be to provide an alternative water supply of the same quantity and quality or to provide a make-good agreement. — **General deterioration of groundwater quality due to operational processes** – Implement the Environmental Effects Monitoring Program that includes a site-specific Groundwater Monitoring Plan to monitor groundwater quality in the LSA. — **Accidental spill** – Implement a standard practice for guarding against spills. – Implement a robust Spill Response Plan, as provided in the Emergency Response/Contingency Plan (Annex 5C), as amended.	**Negligible Effect Pathway**

VEC	Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening
	Closure: — Accelerated pit flooding — Removal of infrastructure, restoration and revegetation of Project components	**Groundwater quality:** — **Accelerated pit flooding** – Ending the dewatering/water management program will affect the local groundwater flow regime, returning groundwater quality it to near original conditions as flooding progresses. — **Removal of infrastructure, restoration and revegetation of Project components** – Removal or reclamation of water and waste management facilities such as the TMF and collection ponds will change the groundwater flow and thus quality regime. — **Accidental spill** – Hydrocarbons or other commonly used chemicals can be accidentally spilled on the site, causing groundwater contamination, if not cleaned up at time of release.	**Closure:** — **Flooding of pit** – Collect run-off and seepage water in drainage ditches around the mine rock stockpile and overburden stockpile and direct to the collection ponds, and pump to Rose Pit to facilitate flooding during Closure. – Implement water transfers from Duley Lake to Pike Lake as a key water management tool. – Implement the Environmental Effects Monitoring Program that includes a site-specific Groundwater Monitoring Plan to monitor groundwater quality in the LSA, to confirm the anticipated groundwater levels are observed in addition to applying and validating the predictive tool measures associated with the EEMP. – Develop and implement a Rehabilitation and Closure Plan for the Project to return the landscape, as close as possible, to it is undisturbed condition. — **Removal of water management infrastructure and reclamation of Project components** – Update and implement recommendations from water balance and water quality model (TSD VI) to account for unanticipated changes that may have occurred during Operations and Maintenance. – Install engineered cover system on mine rock stockpile, and the TMF during Closure to promote positive passive drainage, limit ponding, and support revegetation. – Collect seepage water in drainage ditches around the mine rock stockpile following reclamation and pump to the bottom of the Rose Pit during Post-closure. – Routinely test surface and seepage water during Closure. – Maintain seepage collection and mine water management systems associated with the mine rock stockpile as required to collect, convey and manage contact water for discharge to the bottom of the flooded pit through Closure and Post-closure. – Develop and implement a Rehabilitation and Closure Plan for the Project to return the landscape, as close as possible, to it is undisturbed condition. — **Accidental spill** – Implement a standard practice for guarding against spills. – Implement a robust Spill Response Plan, as provided in the Emergency Response/Contingency Plan , as amended.	**Negligible Effect Pathway**

RSA = regional study area; LSA = local study area; VEC = valued environmental component; TMF = tailings management facility; NLDECC = Newfoundland and Labrador Department of Environment and Climate Change; TARP = Trigger-Action Response Plan.

7.5.2.1 No Effect Pathways

There are no Project interactions that are predicted to result in no effect pathway to groundwater.

7.5.2.2 Negligible Effect Pathways

7.5.2.2.1 Groundwater Quantity

The following effect pathways are predicted to result in negligible effect pathways to groundwater quantity and are not carried forward in the assessment:

- effects to groundwater quantity during the Construction phase
- effects to groundwater quantity during the Closure phase

Effects to Groundwater Quantity During the Construction Phase

The following Project activities during the Construction phase have the potential to impact the groundwater quantity VEC:

- site preparation
  - vegetation clearing, soil grubbing and grading
  - handling and storage of overburden
  - road construction
- quarry development and excavation of aggregate
  - blasting and excavating aggregate
  - handling and storage of excavated materials
- water management
  - dewatering activities
  - handling, storage and discharge of non-contact water
  - handling, storage, treatment and discharge of contact water
  - water intake for fresh water and process water
  - sewage collection, treatment and surface discharge
- construction of TMF starter dam and water management infrastructure, including the Rose Pit collection pond and Elfie, End Lake and Mid Lake dams

Site preparation activities have a potential pathway to affect local groundwater flow through ground disturbance, which has the potential to alter hydrogeologic properties of the surface and alter recharge and discharge dynamics of groundwater flow.

The Rose Pit quarry will be advanced throughout the Construction phase and cover the extent of the surface footprint of the Rose Pit. A total of 7.4 Mm^3 of mine rock and 1.3 Mm^3 of structural fill and aggregate will be required for construction. These materials will be used for concrete production and to construct site laydowns, access roads, on-site roads, the railway and the TMF starter dam. Quarry development activities which have the potential to affect the groundwater quantity VEC include blasting and excavation of aggregate, and handling and storage of excavated materials. These activities have the potential to affect local groundwater flow through ground disturbance which has the potential to alter hydrogeologic properties of the surface which can affect recharge and discharge dynamics of groundwater flow.

Water management, including in-water works during construction includes dewatering activities and the isolation of work areas to facilitate in-water construction of water crossing infrastructure and water management infrastructure such as bridges, dams, dikes and collection ponds. Water management activities that have the potential to affect the groundwater quantity VEC include dewatering and construction of water management infrastructure including the construction of the Mid Lake dam and Rose Pit collection pond, which consists of the Elfie, End Lake dams. Groundwater discharge into the excavation may lower groundwater levels in the local area around the developed quarry, but changes to groundwater levels will not occur over a large enough distance to affect any groundwater users. The construction of water management ponds (Rose Pit collection pond), dikes (Pike Dike) and dams (Mid Lake, End Lake and Elfie Lake dams) will alter the hydrological flow regime by increasing hydraulic head over the area of the ponds or upstream of dams and providing a constant head boundary from that point forward until decommissioning. This will also have a local effect on the groundwater flow regime.

The construction of the TMF will consist of a starter dam representing Stage 1 for the facility (Chapter 2, Section 2.8.5). The TMF starter dam will comprise the northwest, west and east embankments. The south dam will be constructed as part of Stage 4 (approximately Year 10 of Operations) as the embankments are raised to accommodate tailings storage and water management, to avoid contact water from entering the Wahnahnish Lake Public Water Supply Area located to the south of the facility. In addition to the TMF facility, collection ponds will also be constructed to handle and store contact water from seepage and run-off from the TMF during Operations. Construction of the TMF and its water management infrastructure will require clearing of all trees and dewatering of existing wetlands and ponds from the embankment footprints and from the extents of basin area. Foundation preparation activities will consist of stripping and grubbing, removal of unsuitable material and proof rolling. The construction of the TMF is expected to result in effects to the groundwater VEC by changing the groundwater flow regime through site clearing and dewatering activities.

The following mitigation measures will be implemented to mitigate effects to the groundwater quantity during the Construction phase:

- Water withdraw will be completed in accordance with provincial and federal standards and licence/permit conditions and industry best standards.
- Beneficial re-use of treated water (i.e., to remove suspended solids) should be completed where possible to mitigate the anticipated temporary local recharge deficits.
- Dewatering infrastructure (i.e., sump pumps or wells) will be installed in accordance with applicable regulations.
- Wells will be equipped suitably (i.e., with variable-frequency drive pumps) to allow effective control of dewatering rates within permitted rates.
- In-water works will be completed sequentially and will be managed using a combination of mitigation measures to reduce the duration of in-water works, minimize effects on the local aquatic environment and maintain conservation of lakes and rivers within the local watersheds. Mitigation measures for in-water works will include erosion and sedimentation measures including temporary settling ponds, which will be used to collect water and allow for suspended particles to settle prior to the discharge of water to the natural environment. Other measures such as sedimentation barriers, geotubes and/or silt fences will also be implemented.
- Perform routine inspection and maintenance of water containment and conveyance structures (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment.
- A Sediment And Erosion Control Plan (Annex 5F) will be implemented to mitigate effects of construction activities.
- The construction Environmental Protection Plan (Annex 5D, Environmental Protection Plan Annotated Table of Contents) will include water management strategies that are developed to meet all regulatory requirements. These water management strategies will aim to minimize the effect of site preparation and construction works on the surrounding aquatic environment. The next engineering stages, including updates to the water management approach will better define the specific water management measures for each infrastructure. The Environmental Protection Plan will be prepared prior to Construction, in consultation with ECC.
- Site-specific groundwater monitoring will be implemented through the Groundwater Monitoring Plan to monitor groundwater levels during Construction.

Site preparation and construction activities have the potential to affect local groundwater flow through ground disturbance which has the potential to alter hydrogeologic properties of the surface which can affect recharge and discharge dynamics of groundwater flow. Dewatering activities have the potential to alter the hydrological flow regime by altering groundwater levels, hydraulic gradients, and potentially groundwater flow direction.

While the potential to affect the groundwater quantity VEC is present, following the implementation of mitigation measures, the overall predicted effected is anticipated to be minimal to non-existent. Additionally, the effects would not be expected to extend to any potential groundwater users due to the distance from the Project components and the presence of intervening surface water bodies between the site and potential users which would buffer against any potential changes to the groundwater quantity conditions.

The resulting change in groundwater flow patterns and recharge rates may affect groundwater discharge to surface water features and wetlands. Potential effects on surface water features and wetlands from the lowering of groundwater levels and changes to baseflow are further assessed in **Chapter 8, Surface Water** and **Chapter 10, Vegetation, Wetlands and Protected Areas**.

Effects to Groundwater Quantity During the Closure Phase

Project activities during the Closure phase which have the potential to effects the groundwater quantity VEC include:

- accelerated pit flooding
- removal of infrastructure, restoration and revegetation of Project components.

At the beginning of the Closure phase, dewatering of the Rose Pit will cease and accelerated pit flooding will commence. The surface water bodies within the LSA (Pike Lake, Mills Lake, Daviault Lake, and Molar Lake) are expected to contribute to flooding the Rose Pit through groundwater flow paths. While accelerated flooding occurs, surface flow rates in surrounding water bodies will be maintained (i.e., water transfers from Duley Lake to Pike Lake will continue as required). Water will also be pumped from Duley Lake to facilitate accelerated flooding. Contact waters from the overburden stockpile, mine rock stockpile, and TMF will be pumped to the Rose Pit. It is currently assumed that pit flooding and equilibrium will take 10 years to complete from the initiation of the Closure phase. Project infrastructure will be removed and disturbed areas no longer requiring use will be revegetated. The water treatment plant will be decommissioned and removed when the process plant building is removed, or until Rose Pit flooding is complete. The pumping system and pipeline transferring water from the south side of the Pike Lake dike to Pike Lake will be maintained until the Rose Pit is flooded (i.e., pre-Project hydraulic gradients have been achieved). The Pike Lake dike will be removed to achieve hydrological equilibrium, once Rose Pit is flooded.

The following mitigation measures will be implemented to mitigate effects to the groundwater quantity during the Closure phase:

- Maintain water management systems associated with pit flooding until hydrological equilibrium is achieved.
- Implement the Environmental Effects Monitoring Program that includes a site-specific Groundwater Monitoring Plan to monitor groundwater levels in the LSA, to confirm the anticipated groundwater levels are observed.
- Develop and implement a Rehabilitation and Closure Plan for the Project to return the landscape, as close as possible, to it is undisturbed condition

During the Closure phase, the effect pathways have the potential to affect the local groundwater flow regime by altering groundwater levels, hydraulic gradients, and potentially groundwater flow direction. The effects are anticipated to be temporary and transient, resulting in a negligible effect on groundwater quantity during the Closure phase, since the ultimate effect will be that of a return to pre-Project groundwater quantity conditions.

7.5.2.2.2 Groundwater Quality

The following effect pathways are predicted to result in negligible effect pathways to groundwater quantity and are not carried forward in the assessment:

- effects to groundwater quality during the Construction, Operations, and Closure phases

Construction Phase

Groundwater quality effects during the Construction phase can include changes in groundwater chemistry from infiltrating water in exposed areas of overburden and aggregate removal within the quarry. The short duration of the construction period is not anticipated to result in acid rock drainage/metal leaching issues; therefore, groundwater quality effects are not anticipated during Construction, with eventual changes to water quality, if any, observed during Operations. Additionally, on-site mitigation measures (Table 7-5) in the form of water management facilities to capture and treat contact water reduce the possibility for changes in groundwater quality. The construction Environmental Protection Plan (Annex 5D) will include water management strategies that are developed to meet all regulatory requirements. These water management strategies will aim to minimize the effect of site preparation and construction works on the surrounding aquatic environment. The Environmental Protection Plan will be prepared prior to Construction, in consultation with ECC. In addition, a site-specific groundwater monitoring will be implemented through the Groundwater Monitoring Plan to monitor groundwater quality during Construction.

Operations Phase

Project activities during the Operations phase which have the potential to impact the groundwater quality VEC but are predicted to result in negligible effect pathway include:

- open pit mining, including:
  - blasting and crushing ore and mine rock
  - handling and storage or overburden, mine rock and ore
- pit dewatering and site water management, including:
  - operation and management of the TMF
  - handling, storage and discharge of non-contact water
  - handling, storage, treatment and discharge of contact water
- accidental spills

The following mitigation measures will be implemented to mitigate effects to the groundwater quality during the Operations phase:

- Beneficial re-use of treated water (i.e., to remove suspended solids) should be completed where possible to mitigate the anticipated temporary changes in water quality.
- Dewatering infrastructure (i.e., sump pumps or wells) will be installed in accordance with applicable regulations.
- Perform routine inspection and maintenance of water containment and conveyance structures (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment.
- Implement the Environmental Effects Monitoring Program that includes a site-specific Groundwater Monitoring Plan to monitor groundwater quality in the LSA.
- Maintain seepage collection and mine water management systems associated with mine waste facilities as required to collect, convey and manage site contact water for discharge to Duley Lake through Operations.
- Implement a standard practice for guarding against spills.
- Implement a robust Spill Response Plan, as provided in the Emergency Response Plan (Annex 5C).

As part of open pit mining, permitting requirements for water withdraw will need to be satisfied. This will include stipulations on water quality discharge and locations. In addition, implementation of the Environmental Effects Monitoring Program (that includes a site-specific Groundwater Monitoring Plan to monitor groundwater quality in the LSA will be implemented. Monitoring stations will provide early detection of changes to groundwater quality, if any occur. Assuming permitting and monitoring are completed effectively; open pit mining is anticipated to have a negligible effect on groundwater quality.

A pumping system located at the bottom of Rose Pit will be used for pit dewatering and management of site run-off and pit infiltration. The pumping system nominal capacity will be 4,680 m^3/h. Two permanent sumps are planned to manage the water. Temporary pumping using diesel or electric pumps at the complete bottom of the pit and following mining sequence will also be necessary. Maximum pumping will occur during spring freshet. Pumping infrastructures will be geared to run 12 months a year to be able to manage the infiltration flow into the pit. Due to this infiltration rate, constant pumping activities should be required, with a peak occurring at spring and during rain events. All contact water, including pit in-flows run-off and seepage from the overburden stockpile, mine rock stockpile, TMF and surface facilities will be directed to collection ponds and basins. Contract water will either be reused in the process plant of treated in the water treatment plant, prior to discharge to Duley Lake.

The water treatment plant will be in operation for the duration of the Operations phase. Discharge permitting will be required for successful and responsible operation of the water treatment plant. Assuming correct construction and operation of water management infrastructure and the water treatment plant, effects on groundwater quality during the Operations phase are predicted to be negligible.

The TMF is expected to affect the groundwater VEC with the potential to change groundwater chemistry through seepage of tailings porewater through tailings dams into overburden, or through the bottom of the TMF into deeper bedrock. The main potential water quality issues identified in an effluent characterization study (Lorax 2025) include red water (suspended iron), nitrogen from incomplete combustion of explosives, trace metal leaching, and acidity loading. The primary receptors from tailings seepage would be nearby groundwater users and the discharge to surface waters. The water quality effects from the groundwater seepage plume could change surface water chemistry depending on the rate and concentration of the contaminants. The effect on groundwater users is expected to be negligible due to the distance to the nearest identified groundwater user, and the presence of several surface water boundaries between the source and receptor. Potential surface water effects are discussed in Chapter 8.

Information provided by the NLDECC indicates that 15 drilled wells are present within the assessment boundaries (RSA); however, only one well is located within the LSA where effects to groundwater are measurable and anticipated. For this well, verification of its use and status should be completed prior to Operations. Options to reduce risk to the user would be to provide an alternative water supply of the same quantity and quality or to provide a make-good agreement.

With respect to accidental spill occurrence, spill prevention and response plans should be implemented during all Project phases to act as mitigation measures. Spill response measures are outlined in the Emergency Response Plan (Annex 5C).

Closure Phase

With respect to the Closure phase, the Project activities that also act as the effects pathways to groundwater quality, include the following:

- accelerated pit flooding
- removal of infrastructure, restoration and revegetation of facilities and infrastructure
- accidental spill

The following mitigation measures will be implemented to mitigate effects to the groundwater quality during the Closure phase:

- Collect run-off and seepage water in drainage ditches around the mine rock stockpile and overburden stockpile and direct to the collection ponds, and pump to Rose Pit to facilitate flooding during Closure.
- Implement the Environmental Effects Monitoring Program that includes a site-specific Groundwater Monitoring Plan to monitor groundwater quality in the LSA, to confirm the anticipated groundwater levels are observed in addition to applying and validating the predictive tool measures associated with the EEMP.
- Develop and implement a Rehabilitation and Closure Plan for the Project to return the landscape, as close as possible, to it is undisturbed condition.
- Install engineered cover system on mine rock stockpile, and the TMF during Closure to promote positive passive drainage, limit ponding, and support revegetation.
- Routinely test surface and seepage water during Closure.
- Maintain seepage collection and mine water management systems associated with the mine rock stockpile as required to collect, convey and manage contact water for discharge to the bottom of the flooded pit through Closure and Post-closure.
- Implement a standard practice for guarding against spills.
- Implement a robust Spill Response Plan, as provided in the Emergency Response Plan, as amended.

The water treatment plant will be decommissioned and removed once the process plant building is removed and the seepage meets the water quality criteria, or until Rose Pit flooding is complete. The pumping system and pipeline transferring water from the south side of the Pike Lake dike to Pike Lake will be maintained until the Rose Pit is flooded and water quality in the Rose Pit has reached acceptable discharge quality.

With respect to pit flooding and removal of water management infrastructure and reclamation of Project components, in both cases, the effect pathways have the potential to affect the local groundwater quality regime by removing the need for process water treatment and by changing the local hydraulic gradient as it tends back to pre-Project conditions. Since the ultimate effect will be that of a return to pre-Project groundwater quality conditions, the effects of closure on groundwater quality will be net positive, if any unanticipated degradation to water quality does occur during Operations and Maintenance.

With respect to accidental spill occurrence, spill prevention and response plans should be implemented during all Project phases to act as mitigation measures. Spill response measures are outlined in the Emergency Response Plan (Annex 5C).

7.5.2.3 Residual Effect Pathways

The following Project interactions were predicted to be residual effect pathways to groundwater quantity and were advanced for further assessment of residual effects (Section 7.5.3):

- Effects to Groundwater Quantity During Operations

Effects to Groundwater Quantity During Operations

During the Operations and Maintenance phase, dewatering from the pit will has the potential to cause a lowering of groundwater levels in the overburden and bedrock aquifers both within the local and surrounding areas. According to studies (AtkinsRéalis 2024), it is expected that the lowering of the water table will have an effect of the groundwater supply for existing users in the area (if present) and local habitat; therefore, residual effects are anticipated.

The previous EIS (Alderon 2012a) stated the effects on residential groundwater supplies during Operations in the vicinity of Wabush, labrador City or Fermont are likely to be negligible, as a result of water supply wells existing within the close proximity to the Project components, distance between the Project and potential well users, and the intervening lakes and watershed divides that would act as hydraulic barriers.

Preliminary assessment suggests that the effect of the mine dewatering will be limited to the watershed hosting the open pit. Drawdown effects are not expected to extend more than about 1,000 m from the open pit mine or into Québec. The previous EIS stated the presence of Gleeson Lake, located westwards of the open pit mine, and a large topographic elevation between the open pit mine and Lac Daviault mitigates this concern. Nearby lakes (Mills, Duley and Pike Lakes) that are located within 1 km east and north of the open pit mine are expected to act as hydraulic boundaries for open pit mine dewatering effects.

Change to drainage patterns and watercourses can also be influenced by water management and materials management facilities, such as TMF, collection ponds, overburden and mine rock stockpiles and other infrastructure. Existing hydraulic gradients and directions can be altered with the onset of new materials and infrastructure. The effects of these facilities are typically localized in nature and likely to be negligible.

Additionally, water quantity effects (consumptive and non-consumptive) may result during the Operations phase, and can include process water uses, sanitary water uses and dust suppression water uses. Sanitary and dust suppression water uses are considered non-consumptive. Sanitary water uses are typically cycled back into the environment post-treatment and dust suppression water use peaks during the warmer snow-free season and the consumption portion is lost to evaporation. Processed water usages is the largest water demand of the Project and proportionally related to annual ore production. The majority of processed water is mixed with tailing to produce a pumpable slurry that will freely drain from the TMF back to the tailings pond and polishing pond. A proportion of the tailings slurry water is expected to be retained in the pore space of the tailings matrix and for the purposes of the Project water balance is considered to be a loss. Concrete moisture is an additional process water loss.

To minimize the potential effects on the groundwater water resulting from Project activities pertaining to operations and maintenance, mitigation and enhancement measures will include:

- Recommendations stemming from the Project's water balance study (TSD VI) should be implemented to maintain the hydrologic and hydrogeological regimes in the area immediately surrounding the water management and materials management facilities.
- Champion will implement a Groundwater Monitoring Plan, as part of the Environmental Effects Monitoring Program that includes the installation of groundwater wells in accordance with applicable regulation. Instrument the dewatering and monitoring wells with continuous dataloggers, to allow for the establishment of threshold values which can be used to create a Trigger-Action-Response Plan and later be adhered to during the Operations phase.
- Sump pumps are to be operated at optimized rates to allow for the effective control of dewatering within the operational needs.
- Dewatering well(s) (if required) should be equipped with variable-frequency drive pumps to allow for the effective control of dewatering within the operational needs.
- Implement water transfers from Duley Lake to Pike Lake as a key water management tool as described in Chapter 2 of this EIS.
- Treat (i.e., remove suspended solids) and re-use processed water to minimize and mitigate the anticipated water quantity deficits on the local recharge system.
- Appropriate remediation (water treatment or well replacement) should be applied if/once an effect is detected.

- Site reconnaissance indicates one well is to be drilled within the LSA where impacts to groundwater are measurable and anticipated. It is recommended that the well's status and usage be verified prior to Construction. Options to reduce risk to the user would be to provide an alternative water supply of the same quantity and quality or to provide a make-good agreement. In the event that any supply wells are identified within proximity to the Project component, appropriate steps will be taken to inspect and monitor. Information provided by the NLDECC indicates that 15 drilled wells are present within the assessment boundaries (RSA); however, only one well is located within the LSA where effects to groundwater are measurable and anticipated. For this well, verification of its use and status should be completed prior to Operations.

7.5.3 Residual Project Effect Analysis

This section provides results of the residual Project effects analysis for groundwater for the residual effects pathways identified in Section 7.5.2.3, Residual Effect Pathways.

Methods for completing the residual Project effects analysis for groundwater is presented in Section 7.5.1.2.

7.5.3.1 Residual Project Effects Characterization

This sub-section assesses the predicted changed to the receiving environment groundwater quantity from the residual effect pathways identified in Section 7.5.1.2.

7.5.3.1.1 Open Pit Dewatering Levels

The anticipated changes to the groundwater levels and hydraulic inflow gradients in the vicinity of the Project site have been discussed and presented by Alderon (2012b), and in the hydrogeological modelling report (TSD V) and Site-Wide Water Balance and Water Quality Modelling Report (TSD VI).

Changes in groundwater level (and/or quality) is a measurable parameter whereby changes in water levels (and/or quality) in monitoring wells adjacent to a major source during the Operations phase, such as the open mine pit, TMF, collection ponds, overburden and mine rock stockpiles and/or other Project infrastructure. The rationale for this parameter selection is that variability in key indicator parameters relative to the established baseline condition could indicate an effect on the groundwater levels. It is anticipated that changes may occur in the vicinity of the open pit mine and near various Project facilities. Additionally, changes in water levels in remote monitoring wells that are established between the Project components and potential receptor wells can provide an indication on effect changes in domestic well yield (and/or quality) during the Construction and Operations phases. It is anticipated that changes in water levels at distance may occur as a result of long-term mine dewatering. An assessment completed in the previous EIS to determine the potential for the open pit mine to affect residential wells located southwest of the open pit mine (Alderon 2012b) determined that no residential wells (other than the proposed site wells) would be affected by the mine. Since that time, information provided by the NLDECC indicates that 15 drilled wells are present within the assessment boundaries (RSA); however, only one well is located within the LSA where effects to groundwater are measurable and anticipated.

Previous groundwater investigations collected data where monitoring wells were installed in the majority of boreholes at the Rose Pit and elsewhere throughout the Project (Alderon 2012b). The groundwater component baseline data were derived from borehole exploration drilling programs, site-specific hydrogeological testing, automated and manual groundwater level monitoring, and water quality sampling throughout the Project area over the time period of October 2011 and June 2012. Appendix G in the Alderon EIS (2012b) contains information used to develop a conceptual understanding of the groundwater flow conditions and baseline groundwater chemistry throughout the vicinity of the Project. Details pertaining to the aquifer description, measured water levels, groundwater quality, hydraulic properties, groundwater flow directions and velocity can be found in the report.

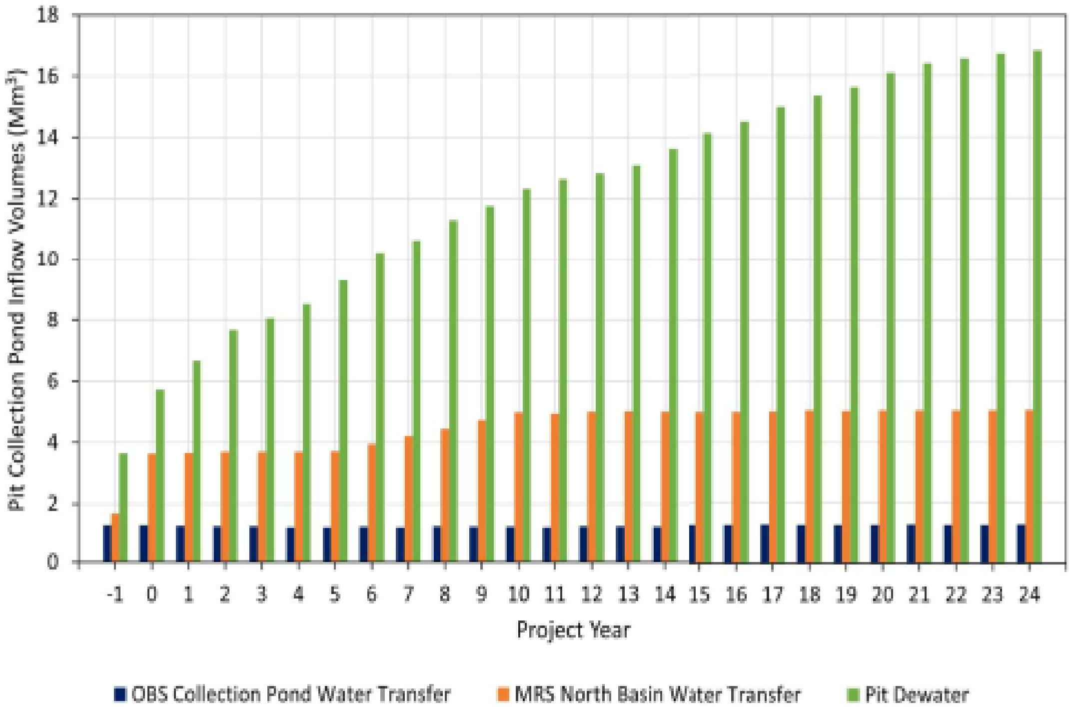
In the Water Balance and Water Quality Modelling Report (TSD VI) it was determined that as the open mine pit is developed and operated, it is estimated that it will receive groundwater seepage from nearby lakes, with the majority of seepage originating from Pike Lake. Mid Lake is diverted to Pike Lake to facilitate the redirection of clean, non-contact water around the pit. Nearby lake levels will be maintained as additional water is transferred from Duley Lake to Pike Lake to mitigate the impact of groundwater seepage from Pike Lake.

Preliminary inflow estimation on the LSA (Rose Pit), were performed by Alderon (2012b), where open pit mine inflows from groundwater used hydraulic conductivities of the surficial overburden and bedrock in the open pit area (see report Table 16.27 [Alderon 2012b]). With the assumptions that the mine pit had a perimeter of 8,627 m, an average seepage face height of 10 m during operations and a conservative hydraulic gradient of 0.5 m/m towards the pit wall, the estimated inflow to the pit through silty sand glacial till overburden material ranged from 1,886 to 7,156 m^3/day, with an average of 5,262 m^3/day. The study also applied the Hydraulic Conductivity (K) data from two packer test and three wells that intersected the till-bedrock interface. Using similar pit morphology assumptions, the estimated inflow into the pit through the bedrock could range from 118 to 9,615 m^3/day with an average of 3,764 m^3/day. The report assumptions were that the overburden inflows would be controlled by perimeter dykes and sumps and that the bedrock inflows will be controlled by a sump located within the open pit as it advances in depth. Subsequently, using the Darcian approach (Q=TiL) a second estimation of potential mine flows was generated where Q = inflow in m^3/day, T = transmissivity in m^2/day (hydraulic conductivity/aquifer thickness or the mine depth), I = average regional hydraulic gradient in m/m, and L = effective width of pit in metres perpendicular to the dominant direction of regional groundwater flow. This calculation estimated preliminary inflow to be about 3,838 m^3/day, which is approximately the same order of magnitude as the initial preliminary seepage estimates. The 2012 Alderon Report noted that the estimates should be considered as very preliminary, pending on future hydraulic testing of the bedrock (packer and pumping test).

In the Hydrogeology Modelling Report (TSD V), a preliminary estimate of groundwater open pit mine inflow was completed using numerical models of the area. The hydrogeological model dome covered an area of approximately 200 km^2, with physical boundary conditions that extended to the topographic highs west of Daviault Lakes, where a no flow condition was applied, and to Wahnahnish Lake in the east, where fixed head conditions were applied to represent the natural flow from Wahnahnish Lake to Labrador City. The results showed that dewatering rates during the years of Operations (5 to 26 years) range between 16,261 and 40,849 m^3/day.

Information from TSD VI produced a time series of predicted annual flows to the pit during Construction and Operations based on the mean annual precipitation scenario (Figure 7-8 and Table 2.10; TSD VI). The model included groundwater flow into the open pit to be derived from direct precipitation, surrounding undiverted natural catchment run-off, pit wall run-off, and groundwater inflow. As the pit develops, pit natural catchment (non-contact) run-off decreases, while the pit wall run-off increases until year 10, when the pit wall reaches its maximum area. The predicted groundwater inflow to the pit shows a consistent upward trend through Operations, reaching 14.8 Mm^3 at the end of Operations for the mean annual precipitation scenario. The pit sump is dewatered into the Pit collection pond.

Based on the above preliminary groundwater inflow estimates reported by Alderon (2012b), AtkinsRéalis (TSD V) and Lorax (TSD VI), it can be seen that groundwater seepage will be a significant portion of the total expected mine sump inflow.



Notes: Mm^3 = million cubic metres; OSP = overburden stockpile; MRS = mine rock stockpile.

Figure 7-8: Time Series of Predicted Major Annual Mine Flows to Pit Collection Pond during Construction and Operations Based on the Mean Annual Precipitation Scenario (Lorax 2025)

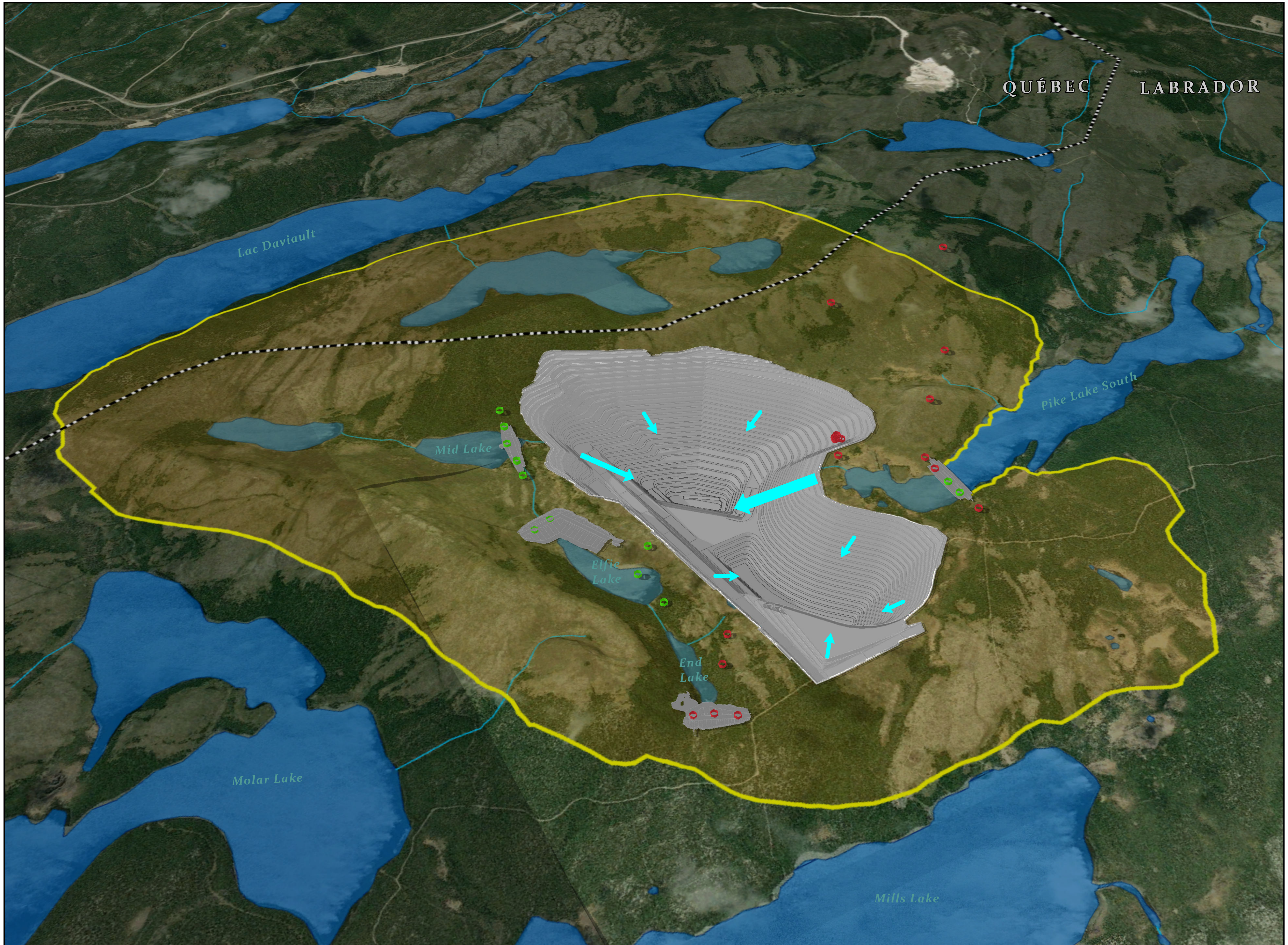
3-Dimensional Numerical Groundwater Flow Model

The main uncertainty related to water management in the Project is the quantity of groundwater infiltration associated with the development of Rose Pit. The Comprehensive Study Report (CEAA 2018) from the previous EIS conditions of release recommended the following:

- As part of ongoing Project design, continue field work and analyses to update and refine the current model of the existing hydrogeological environment around the proposed open pit, and the potential effects of the open pit development. Present the results of the advanced hydrogeological work for review by regulators.
- Refine and update hydraulic conductivity estimates when additional investigation of soil and bedrock hydraulic properties is carried out during the detailed engineering and design phase of the Project.
- Undertake long-term pumping tests when site access is approved to assess the role and impact of geological features such as faults and fractures.
- Update the 3D numerical groundwater flow model for the Project to include data from pumping tests that focuses on dewatering of the open pit prior to and during operation.

Champion completed additional field investigations and developed an updated conceptual hydrogeological model (TSD V), which led to the conclusion that much of the dewatering and subsequent lowering of water levels was related to dewatering through fault zones in the Rose Pit area, and that these faults may be hydraulically linked to surface water bodies such as Pike Lake, which would provide a consistent hydraulic gradient to drive groundwater into the pit. Due to the local geology of the area, including the presence of fault zones in the footprint of the pit, a large amount of infiltration is expected to occur (Figure 7-9). This, in turn, has enabled the need to assess and design infrastructure with incremental storage capacity and effluent volume.

Further refinement of the model suggests that this connection may not be as strong as previously thought due to the presence thick overburden deposits below Pike Lake (TSD VI). Data collection including the completion of a pumping test and refinement of the 3-dimensional model is ongoing and will continue as further hydrogeologic data are collected to fill data gaps and improve the accuracy of the model prior to Project construction.



LEGEND

- 2024 - 2025 Planned Drilling
- 2023 - 2024 Completed Drilling
- Pit Dewatering Area of Influence
- Rose Pit and Dam
- Provincial Boundary
- Natural Watercourse
- Natural Waterbody

Inflow to the Pit

- High
- Midium
- Low

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Environmental Impact Study of the Kamistiatusset (Kami) Iron Ore Property Hydrogeology and Water Management

Kami Mine Water Management Plan
Groundwater Management

Source:
Environmental Impact Study of the Kamistiatusset (Kami) Iron Ore Property Hydrogeology and Water Management, 2024
World Imagery, Esri, Maxar, Earthstar Geographics, and the GIS User Community, 2024.

Map:
L01-CB1-02-forageField-publicConsultation-241002

Projection UTM, zone 19, NAD83
Contour interval : 10 m

October, 2024 AtkinsRéalis **7-9**

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Subsurface Hydraulic Interconnectivity with Surface Water

In the previous EIS, the previous proponent performed an assessment to investigate the possibility of a hydraulic interaction between the open pit mine and adjacent surface water bodies, include Pike, Rose, Mills, Duley (formerly known as Long), Gleeson and Daviault Lakes. There was also the potential for the water table lowering west of the Québec–Labrador border. The conceptual cross-section displayed two aquifer dewatering effects. In the surficial overburden (silty sand glacial till) the water table drawdown will likely describe an asymptotic curve that extends several tens to hundreds of metres from the pit wall as the excavation progresses. It is anticipated that seepage from the proximal overburden will be collected in interception ditching to be diverted from the open pit mine to collection ponds for storage and eventual reuse in the process plant or into the receiving water environment. The bedrock water table is anticipated to be much steeper than in the overburden, as a result of the lower hydraulic conductivity of the rock mass and could extend 1 to 2 km east and west of the open pit mine. Alderon's preliminary assessment, anticipated that Mills Lake on the east, Pike Lake on the north and Gleeson Lake on the west will act as hydraulic barriers to further development of the water table drawdown.

The residual Project effects on groundwater resources are summarized in Table 7-6. The residual environmental effect for the operation of the Project are characterized by the following criterion: nature, magnitude; geographic extent, duration, timing, reversibility, frequency, likelihood, and environmental or socioeconomic context.

In summary, the data analysis pertaining to the residual environmental effects on the lowering of the groundwater levels determines the nature of the change during Operations and Maintenance to be adverse, meaning that the water levels have declined in comparison to baseline conditions and trends. The magnitude of the groundwater level change is considered low to moderate, in that the effect of the lowering of the water take is detectable, but it causes an increase of baseline groundwater levels but is, however, within regulatory limits. The geographic extent of the lowering of the water table is local, with the effect restricted to the LSA. The duration and timing of the lowering of the water table is considered medium to long term, with the effect occurring between 3 to greater than 20 years and will occur during Construction, Operations, and Closure. The reversibility of the lowering of the water table is considered reversible, with the effect of the lowered groundwater levels ceasing when the Project operations are completed. The frequency of the lowering of the water table is considered occasional, as the effect occurs on a regular basis and at regular intervals but ceasing when the Project operations are completed. The likelihood or probability of occurrence of the residual effect is considered certain, as based on scientific evidence and information, and statistical analysis this effect will occur. The environmental or socioeconomic context of the lowering of the water table is considered to be both undisturbed and low development, in that the majority of the lowering of the water levels and gradient changes effect takes place within an area that is relatively or not adversely affected by human activity; however, there are areas where groundwater users are reported to exist (i.e., local residential cabins).

Table 7-6: Characterization of Residual Effects on Groundwater Measurable Parameters

Residual Effect	Criterion	Rating/Effect Size
Change in groundwater quantity	Nature	Adverse. Will lower groundwater levels near pit, may not affect users due to surface water buffering. Need more modelling to confirm
	Magnitude	Low to moderate. Groundwater levels will fall below the maximum pit depth of 450 m below existing grade and extend beyond the pit footprint of 2.8 km^2
	Geographic extent	Local
	Duration	Medium/long term: effect occurs between 3 to >20 years
	Timing	Year-round
	Reversibility	Reversible
	Frequency	Occasional
	Probability of occurrence	Possible
	Ecological and socioeconomic context	Undisturbed/low development

km^2 = square kilometre.

7.5.3.2 Significance Determination

The significance determination of a residual environmental effect on the groundwater resources is defined as a Project-related environmental effect that results in changes to the groundwater quantity, quality and/or aquifer. Changes to the groundwater quality include the yield from an otherwise adequate water supply well that decreases to the point where it is inadequate for intended use. Changes in groundwater quality (if applicable) are defined where the quality of groundwater from an otherwise adequate water supply well that meets criteria guidelines, alters to the point where it becomes non-potable or cannot meet the criteria established in the Guidelines for Canada Drinking Water Quality (Health Canada 2025). The physical or chemical alteration to an aquifer by which interactions with local surface water results in adverse changes to streamflow or surface water that affect aquatic life or down-stream water supply.

Several potential residual effects related to groundwater quantity were assessed, specifically the primary effects of mine operations that involve the dewatering of the open pit mine and groundwater inflow from nearby aquifers and surrounding surface water bodies. During the Construction phase, water levels will decline as the overburden is removed and the effects are expected to be limited to the LSA and considered to be negligible. During the Operations and Maintenance phase, the open pit mine will lower the water levels in the surrounding overburden and bedrock extending approximately ~1 km from the mine. Water levels are expected to lessen with magnitude the farther away from the pit. There is one known groundwater user located within LSA (located on the southwest shore of Duley Lake); therefore, verification of its use and status should be completed prior to Operations. Options to reduce risk to the user would be to provide an alternative water supply of the same quantity and quality or to provide a make-good agreement. As a result of the theoretic water level lowering, small base flow reductions in nearby streams should be balanced by the open pit mine discharge back into the hydrogeologic system. Following mine closure and reclamation, the mine pit will be allowed to flood to equilibrium, resulting in pre-mine water table conditions, reversing the effect from Operations.

During Construction and Operations, changes in groundwater levels are expected to be local in scale, and non-existent following Closure. Following mine closure no residual effects are anticipated on groundwater resources. The residual effect on groundwater quantity due to pit dewatering during operations is expected to **not be significant**, once monitoring and mitigation and measures are implemented effectively.

7.5.4 Residual Cumulative Effects Analysis

7.5.4.1 Reasonably Foreseeable Developments and Potential Cumulative Effects

Chapter 4 provides a list of known reasonably foreseeable developments (RFDs) and physical activities that could overlap spatially and temporally with the Project's residual environmental effects. Chapter 4, Figure 4-4 presents the location of identified RFDs. Reasonably foreseeable developments which may have a potential cumulative effect on the regional groundwater VEC are listed in Table 7-7.

Potential cumulative effects on groundwater resources relate to changes in groundwater quality and quantity, as a result of Project activities in combination with those of other past, present and future projects and activities in the RSA. The RSA is an area where cumulative effects and the significance of those effects on groundwater resources typically have the potential to occur, as this area encompasses several sub-watersheds and hosts numerous mining operations which cumulatively could affect the regional groundwater.

In association with the residual effects characterization discussed above, an assessment of the potential cumulative effects was conducted for other projects and activities that have the potential to interact with the Project. The potential for overlap between Project activities and cumulative effects of other projects and activities currently being conducting in the RSA are identified in Table 7-7. The identified projects were anticipated to not have the potential for cumulative effects with those of the Project as they are either located in a different watershed or outside the RSA beyond which the residual effects are not measurable for groundwater resources.

Table 7-7: Other Projects and Activities Considered in the Cumulative Effects Assessment

Project Name or Physical Activity	Description of Project Effects	Approximate Direct Distance to the Project Site	Status/Timing	Interaction with Residual Effects on Groundwater from the Project
Bloom Lake Iron Mine - Increasing tailings and waste rock storage capacity	Increasing tailings and waste rock storage capacity will result in local changes to the groundwater flow regime. This could result in possible contamination of groundwater affecting groundwater quality.	17 km	2024 to 2040	No, change in groundwater flow regime are not anticipated for such a large distance, and would not act cumulatively with the residual effect to groundwater quantity from the Project.
Scully Mine Tailings Impoundment Area Expansion Project	Increasing tailings impound area will result in local changes to the groundwater flow regime. This could result in possible contamination of groundwater affecting groundwater quality.	13 km	Anticipated start in 2025 and expand operations by 22 years	No, change in groundwater flow regime are not anticipated for such a large distance, and would not act cumulatively with the residual effect to groundwater quantity from the Project.
Rio Tinto IOC Smallwood North Extension Project	Expanding the boundaries of the existing Smallwood Pit and the associated pit dewatering, surface water management, and waste rock stockpiling will result in local changes to the groundwater flow regime.	25 km	Construction started in summer 2024 into 2030	No, change in groundwater flow regime are not anticipated for such a large distance, and would not act cumulatively with the residual effect to groundwater quantity from the Project.
Rio Tinto Labrador City Humphrey South Iron Ore Extension	Adding an extension to the Humphrey South Pit and the associated pit dewatering, surface water management, and waste rock stockpiling will result in local changes to the groundwater flow regime.	20 km	Construction started in 2024 and operations anticipated by 2026	No, change in groundwater flow regime are not anticipated for such a large distance, and would not act cumulatively with the residual effect to groundwater quantity from the Project.

IOC = Iron Ore Company of Canada.

7.6 Prediction Confidence and Uncertainty

A key element of a comprehensive EA is the prediction of future conditions of the environment as a result of the Project from previous and existing projects and activities and RFDs. Given that environments change naturally and continually through time and across space, assessments of effects and predictions about future conditions embody some degree of uncertainty (CEA Agency 2018a).

The purpose of the Prediction Confidence and Uncertainty section is to identify the key sources of uncertainty and qualitatively describe how uncertainty was addressed for groundwater to increase the level of confidence that effects would not be larger than predicted, including the potential need for monitoring and adaptive management that can reduce uncertainty over time.

Confidence in effects analyses can be related to many elements for groundwater, including the following:

- adequacy of the baseline data for providing an understanding of the existing conditions
- the nature, magnitude, and spatial extent of future fluctuations in ecological, cultural, and socioeconomic variables, independent of effects from the Project and other developments (e.g., climate change, fire, flood)
- assumptions, conditions, and constraints of quantitative model inputs
- understanding of Project-related effects on complex social-ecological systems that contain interactions across different scales of time and space (e.g., how and why the Project would influence wildlife and Indigenous Land and Resource Use)
- knowledge and experience with the type of effect in the system

- knowledge of the effectiveness of proposed Project environmental design features or mitigation for avoiding or minimizing effects
- uncertainties associated with the exact location, physical footprint, activity level, and the timing and rate of future developments

As described in Section 7.5.3.1.1, Champion further reduced uncertainty of the existing hydrogeological environment by progressing with an updated hydrogeological model and hydraulic conductivity estimates to inform predicted groundwater inflow rates to the pit and water management and storage requirements to mitigate hydrological effects to adjacent waterbodies during Project operations. The assessment of baseline conditions and the conceptual model representing groundwater processes are based on industry standards and practices for quality assurance and control, which were applied to both field and laboratory procedures. The predicted effects on groundwater levels and baseflow from the Project are based on a steady-state groundwater flow model. Prediction confidence is high because the groundwater flow model was calibrated within an acceptable range of error for groundwater levels and groundwater discharge to surface water features. Further data collection to collect updated site water levels for an updated baseline is planned and further refinement of the groundwater flow model will be completed.

As discussed in the modelling report (TSD V), predictions made using the model are based on several conservative assumptions to reduce the influence of uncertainty in the predictions, including the assumption of saturated waste rock piles, no attenuation of water quality along the flow paths, and that all mass of leached parameters from the piles will arrive simultaneously at the receptor. These assumptions result in a conservative prediction of the mass loading in the early phases of the Project (i.e., Operations) and provide a better (while still conservative) representation of long-term water quality through Closure.

7.7 Monitoring, Follow-Up, and Adaptative Management

This section presents a summary of the identified monitoring and follow-up required to confirm effects predictions and address uncertainty identified in Section 7.6, Prediction Confidence and Uncertainty.

Specifically, follow-up and monitoring programs will be used:

- to evaluate the effectiveness of reclamation and other mitigation actions, and modify or enhance as necessary through monitoring and developing updated mitigation measures (if needed)
- to identify unanticipated negative effects, including possible accidents and malfunctions
- to contribute to the overall continual improvement of the Project

A Groundwater Monitoring Plan will be developed by Champion in collaboration with the province, which will include drilling of an appropriate number of monitoring and production wells. The objective of the plan will be to verify the performance of water management infrastructure and inform adaptive management measures. A framework for this plan is included in Annex 5E (Environmental Effects Monitoring Program). Groundwater monitoring well locations will be selected following the completion of the EIS, based on site-specific hydrogeological conditions, potential impact zones, and regulatory guidance. Once the well locations and associated monitoring details are finalized, this information will be incorporated into a revised version of the EEMP to guide ongoing groundwater monitoring activities.

Where relevant, adaptive management measures to address the uncertainties associated with the effects predictions and mitigation, may be proposed. The process for determining when, how, and where adaptive management would be used will be described in an Environmental Protection Plan. A table of contents for the Environmental Protection Plan that will be prepared for the Construction phase is included in Annex 5D of this EIS. As new information verifies environmental effects and the efficacy of mitigation measures, monitoring programs will also be improved accordingly through updates to the Environmental Effects Monitoring Program. Monitoring will be compared to anticipated effects and permit requirements.

7.8 Predicted Future Conditions Should the Project Not Proceed

The Project is in an area with a long history of mining and mineral exploration, and it is possible that other mining projects would occur in this area if this Project were not to proceed. Future projects are anticipated to have similar effects on groundwater resources. Should mineral reserves associated with the Project remain undeveloped, the predicted future condition of groundwater resources would be relatively unchanged from what is discussed in the existing environment portion of this assessment, although groundwater resources could change over time as a result of climate change.

7.9 Key Findings and Conclusions

Upon completion of the groundwater effect assessment scoping, characterization of the existing environment, effect pathway screening, residual Project effect analysis, it was determined that of the two measurable parameters identified and used for the groundwater VEC assessment (i.e., changes in groundwater quantity and quality), the only residual effect will be that of changes to groundwater quantity during the Operations phase of the Project.

In reference to the previous EIS, the proposed Project construction, operations and maintenance, and decommissioning activities were expected to result in localized changes to groundwater quality and quantity. In the previous EIS it was stated that all residual effects associated with groundwater quantity and quality were predicted to be low in magnitude and not likely to be significant. Cumulative residual effects on groundwater quantity and quality from the Project were determined to be not significant. The groundwater removal from the pit dewatering is returned to the Churchill River watershed through mine water management facilities, and upon decommissioning the pit will be flooded and groundwater pumping would cease. Additionally, the previous EIS found that groundwater pathways are anticipated to be short between the mine components and surface water regime, groundwater seepages are collected within the mine water management system and then treated with as surface water.

To meet conditions of the release of the previous EIS, Champion completed an updated hydrogeological model (TSD V) and site-wide water balance and water quality model (TSD VI) to enhance understanding of the hydrogeological and hydrological conditions and potential effects from the Project. This modelling resulted in additional environmental design features to mitigate effects to groundwater and surface water resources, including the design and implementation of additional water management infrastructure. Details on the water management infrastructure is provided in Chapter 2 and TSD II.

Effects to groundwater quantity during Construction and Closure and groundwater quality during all Project phases were predicted to be negligible, following the implementation of mitigation measures. Residual effects to groundwater quantity during Operations were predicted, as the open pit mine will lower the water levels in the surrounding overburden and bedrock extending approximately ~1 km from the mine. There is one known groundwater user located within LSA (located on the southwest shore of Duley Lake); therefore, verification of its use and status should be completed prior to Operations. Options to reduce risk to the user would be to provide an alternative water supply of the same quantity and quality or to provide a make-good agreement. As a result of the theoretic water level lowering, small base flow reductions in nearby streams should be balanced by the open pit mine discharge back into the hydrogeologic system. Following mine closure and reclamation, the mine pit will be allowed to flood to equilibrium, resulting in pre-mine water table conditions, reversing the effect from Operations.

Champion will implement an Environmental Protection Plan that will include water management strategies that are developed to meet all regulatory requirements. These water management strategies will aim to minimize the effect of site preparation and construction works on the surrounding aquatic environment. The Environmental Protection Plan will be prepared prior to Construction, in consultation with ECC. In addition, a site-specific groundwater monitoring will be implemented through the Groundwater Monitoring Plan to monitor groundwater quality during Construction. Champion will implement an adaptive management approach to assess changes required to monitoring program(s) and mitigation measures implemented during all Project phases, in the interest of protecting groundwater as a VEC in the region.

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8. Surface Water

The purpose of Chapter 8, Surface Water, is to characterize the existing environment, Project-environment interactions and potential residual Project and cumulative effects of the Project on surface water quantity and quality. The Project has the potential to cause adverse effects on these components of the aquatic environment through the drainage and discharge of water that has come into contact with areas where mine rock and ore would be mined, processed, and stored. Changes in the aquatic environment can also influence aquatic and terrestrial ecosystems, and the people that use natural resources or ecosystem services (e.g., surface water, fish, plants, and wildlife). Therefore, the surface water quantity and quality assessment consequently provide information that is used to support the assessments of other biophysical and socio-economic VECs, where applicable.

8.1 Approach to the Effects Assessment

The methods and assessment presented in this chapter were developed in consideration of the requirements under the provincial *Environmental Protection Act* (NL EPA), with specific consideration of the requirements set out in the provincial Environmental Impact Statement Guidelines (EIS Guidelines) for the Project issued by the Minister of Environment and Climate Change (Government of NL 2024a). A table of concordance to the EIS Guidelines is provided in the Executive Summary. The assessment of surface water quantity and quality followed the overall effects assessment approach and methods (Chapter 4, Effects Assessment Methodology).

Where possible, comparison to the outcomes of the assessment of surface water completed within the previous EIS have been made to highlight where effects on surface water quantity and quality have been reduced through consideration of environmental design features and mitigation or where new adverse effects may be introduced and require additional consideration in Project planning.

8.2 Integrating Engagement from Indigenous Groups and Local Stakeholders

Champion has been engaging with potentially effected Indigenous groups and local community stakeholders since the acquisition of the Project in 2021. The overall approach and methods for the incorporation of engagement feedback into the EIS is discussed in detail in Chapter 22, Engagement.

Issues and concerns related to surface water raised by Indigenous groups and local stakeholders and how these issues and concerns were addressed through the assessment are summarized in Table 8-1, including cross-references to where comments were considered or addressed in the chapter.

Table 8-1: Summary of Issues and Concerns Related to Surface Water by Indigenous Groups and Local Stakeholders

Comment Theme	How It Is Addressed in the Assessment	Where It Was Addressed in the Assessment	Indigenous Group or Local Stakeholder	Raised During Alderon EIS (Yes/No)
Concern regarding environmental protection	– Potential Projects effects on environment (surface water) are assessed – Mitigation measures will be implemented to mitigate predicted effects – Environmental monitoring, follow-up and adaptive management will be implemented	Section 8.5.2, Effect Pathway Screening Section 8.5.3, Residual Project Effects Analysis Section 8.7, Monitoring, Follow-Up, and Adaptive Management	Innu Nation	Yes
Concern regarding rivers and stream on the Project property and interest in environment evaluation report	– Potential Project effects on water quantity and quality in waterbodies (including river/streams) are assessed – Mitigation measures will be implemented to mitigate predicted effects – Environmental monitoring, follow-up and adaptive management will be implemented – Environment evaluation report will be shared publicly	Section 8.5.2 Section 8.5.3 Section 8.7	Innu Takuaikan Uashat mak Mani-Utenam	No

Comment Theme	How It Is Addressed in the Assessment	Where It Was Addressed in the Assessment	Indigenous Group or Local Stakeholder	Raised During Alderon EIS (Yes/No)
Concern regarding water quality in relation to rail option and possible diesel contamination	– Potential Project effects on water quality (including rail option) are assessed – Potential effects due to air emissions from transportation are assessed – Mitigation measures will be implemented to mitigate predicted effects on water quality – Environmental monitoring, follow-up and adaptive management will be implemented	Section 8.5.2 Section 8.5.3 Section 8.7	Wabush	Yes
Concern regarding water quality of Daviault Lake	– Potential Project effects on water quality of Daviault Lake are not anticipated because Project is not expected to effect Daviault Lake watershed	Section 8.5.3	Fermont	Yes
Concern regarding water quality due to discharges in Duley Lake	– Potential Project effects on water quality in Duley Lake due to effluent discharges are assessed – Mitigation measures will be implemented to mitigate predicted effects – Environmental monitoring, follow-up and adaptive management will be implemented	Section 8.5.2 Section 8.5.3 Section 8.7	Duley Lake Cabin Owners Association	No

EIS = Environmental Impact Statement.

8.3 Assessment Scoping

This section identifies key issues for surface water, defines and provides a rationale for the selection of VECs for surface water, identifies the measurable parameters selected for the assessment, and defines assessment boundaries for surface water.

8.3.1 Key Issues

Key issues often relate to the potential environmental, social, economic, and health effects of a proposed project. Key issues identified for the Project reflect the primary concerns raised by regulatory authorities, Indigenous groups, and local stakeholders, including local residents, cabin owners, business owners and other interested parties.

To identify key issues related to surface water, the following sources were reviewed:

- Section 4.1 of the EIS Guidelines, which summarized key issues from regulatory agencies and feedback received on the Project Registration and draft EIS Guidelines
- past experience with mining projects in Labrador
- the key issues identified in the previous EIS

Key issues related to surface water include the following:

- changes to surface water quantity (flows and water levels) of receiving waterbodies
- changes to drainage patterns and watercourse alteration
- changes to surface water quality of receiving waterbodies
- changes to sediment quality of receiving waterbodies
- overall water management
- cumulative effects of changes on surface water (quantity and quality)

8.3.2 Valued Environmental Components and Measurable Parameters

Surface water is a vital component of both the biosphere and human environment, and it is protected under federal and provincial legislations. Project activities can directly (e.g., controlled discharge of mining-affected water to receiving waterbodies [lakes and watercourse]) and indirectly (e.g., non-controlled discharge of mining-affected groundwater from open pit development) affect the quantity and quality of surface water that could potentially affect other VECs.

To assess Project effects on surface water, surface water quantity (hydrology), surface water and sediment quality were selected as VECs based on their connection to aquatic and terrestrial ecosystem (Table 8-2) and human health. VECs, such as surface water quantity, and surface water and sediment quality, are crucial to the EIS assessment because understanding changes to them is necessary for evaluating various effect pathways. For instance, changes in surface water quality by a certain magnitude over a specific duration cannot be fully evaluated without understanding their implications for fish and fish habitats, birds and wildlife, human health and quality of life, vegetation and wetlands, and land use. Therefore, changes in surface water quantity and quality are considered in assessments of fish and fish habitats, groundwater, vegetation and wetlands, birds and wildlife, human health and quality of life, and land use.

The rational for selection of surface water VECs is as follows:

- **Surface water is highly valued by Indigenous groups and local residents**
  - Surface water quantity and quality is highly valued by Indigenous groups and local stakeholders. Issues and concerns related to surface water due to Project activities were raised by Indigenous groups and local stakeholders during engagement activities. Issues and concerns are summarized in Section 8.2, Integrating Engagement from Indigenous Groups and Local Stakeholders
  - The surface water surrounding the Project in Labrador serves as the fresh water habitat for fish, aquatic organisms, vegetation and wetlands. It is essential for the life function of these biota, providing a crucial habitat component of the aquatic ecosystem.
  - Locally, surface water is used as the public water supply for the Towns of Labrador City, Wabush, and Fermont, as well as cabin owners. The Project's effects and interactions with local surface water features, used as human drinking water sources, have the potential to effect water quantity and quality. Therefore, these interactions must be assessed for the sustainability of the water supply and the preservation of water quality. The sustainability of the water supply and preservation of water quantity and quality are vital and are protected in Québec and NL public water regulations.
  - Surface water holds recreational value for activities such as fishing, boating, snowmobiling, bathing and other recreational uses. It is aesthetically important to society for its visual presence within the natural environment.
  - Changes to surface water drainage patterns, quantity, quality and sediment quality due to Project development phases, as well as the release of effluent during upset conditions, can affect the form and function of the aquatic environment. This, in turn, directly effects the quality, nature and sustainability of aquatic ecosystems. Project effluents are specifically regulated through the provisions of the NL *Water Resources Act* and federal *Fisheries Act*.
- **Surface water VECs affect other VECs**
  - Changes to surface water quantity and quality can directly affect the quality and quantity of water that is available for groundwater recharge, fish and fish habitat, birds and wildlife, and vegetation and wetlands. Hydrological changes can also affect physiography, geology, terrain and soils by altering physical processes such as erosion, leaching of minerals and nutrients, and organic matter decomposition. Changes in flow, fluvial geomorphic processes, freeze-thaw patterns, and water quality can affect the availability and quality of water and ice, which are essential for wildlife, fish and fish habitats, and vegetation.
  - Changes to surface water quantity and quality can indirectly affect human valued components. Effects on Aboriginal and Treaty Rights and Interests may occur when changes affect surface water of cultural spiritual significance, as well as the availability and quality of Traditional foods and medicine. Surface water changes can also affect the quantity and quality of water for land and resource use including recreation and tourism. Human health and community safety can be affected by changes to quality and quantity of drinking water sources and food (i.e., fish and game). Additionally, changes to ice conditions potentially caused by Project-related activities can also pose safety issues for winter travel and recreation on water bodies.
- **Surface water VECs are affected by other VECs**
  - Surface water may be indirectly affected by changes to other environmental disciplines. The atmospheric environment can affect water quality through aerial deposition of pollutants from Project activities, either directly to surface water bodies or on to the terrestrial environment where pollutants can be transported to water bodies via run-off. Changes to physiography, geology, terrain and soils as well as vegetation can alter flow patterns and the interaction of water with soils and vegetation thereby affecting hydrology (water quantity) and water quality. Changes to groundwater that effects its quality or quantity can also affect surface water in areas with significant groundwater-surface water interactions

(e.g., groundwater-dominated baseflow periods at permanent watercourses). Land and resource use that may be affected by the Project, such as expansion of industry like forestry, extraction, recreation, and tourism, can affect surface water due to water consumptive use and potential for pollution associated with these industries.

Changes in surface water quantity and quality are considered in the following VEC-specific assessments:

- Chapter 7, Groundwater
- Chapter 9, Fish and Fish Habitat
- Chapter 10, Vegetation, Wetlands, and Protected Areas
- Chapter 11, Wildlife
- Chapter 14, Other Land and Resource Use
- Chapter 17, Community Health and Well-Being

Surface water information is also addressed within the Human Health Risk Assessment (TSD XI).

Measurable parameters are used to characterize changes to attributes of the environment from the Project, other human developments, and natural factors. The changes in measurable parameters are used to assess change and predict overall effects on VECs. Three measurable parameters were identified and used for the surface water VEC.

- Surface water quantity
  - Changes in flows and water levels in watercourse and lakes, and/or changes in water balance components (surplus, run-off and infiltration) of lake and stream (watercourse) watersheds are compared to baseline/background conditions to identify potential changes to the aquatic environment due to Project development.
- Surface water quality
  - Water quality constituent (physical and chemical) concentrations: Includes physical, nutrient, major ion, and trace metal concentrations in watercourses and lakes, which are compared to water quality thresholds (e.g., *Metal and Diamond Mining Effluent Regulations* [MDMER], Canadian Council of Ministers of the Environment [CCME] and Site-Specific Water Quality Objectives [SSWQOs]) that apply to protection of aquatic and terrestrial life.
- Sediment quality
  - Sediment quality constituent (physical and chemical) concentrations: Includes trace metal concentrations in watercourses and lakes, which are qualitatively assessed in relation to changes to water quality constituent.
  - Sedimentation and erosion potential and TSS loadings to receiving environment are assessed to identify changes to the aquatic environment due to Project development.

The measurement indicators of surface water quantity (flows and water levels) were compared with the background/baseline conditions. The measurement indicators of surface water quality (constituent concentrations) were compared to guidelines/thresholds that have been developed for the Project, which are presented in Section 8.5.1.2.3, Development of Water Quality Criteria/Threshold. For the Project, specific water quality constituents were selected from a broad range of water quality parameters. This group of constituents, referred to as COPCs, represent a focused list of conventional water quality parameters, nutrients, major ions, and metals that have the potential to pose a risk to aquatic and terrestrial life and/or human health should they increase because of the Project.

For each COPC, a Project-specific criteria/threshold was determined, as necessary. The Project-specific criteria/thresholds were concentration limits intended to delineate an upper bound concentration limit where, if COPC concentrations remain below these thresholds, aquatic and terrestrial life, human health, and Indigenous Land and Resource Use would be protected. The screening and selection process is described in Section 8.5.1.2.2, Constituents of Potential Concern. The selection of measurement indicators, and their specific COPCs, for surface water quality aligned with Indigenous and Local Knowledge and community concerns regarding the potential effects of degrading water quality on ecosystems, the ability to consume fish and wildlife, and the importance of high-quality drinking water for human consumption. Table 8-2 summarizes the surface water VECs, the rationale for selection, and measurable parameters.

Table 8-2: Valued Environmental Components, Rationale for Selection, and Measurable Parameters

Valued Environmental Component	Rationale for Selection	Measurable Parameters	Linkages to Other VECs
Surface water quantity	– Valued by Indigenous groups/local residents and the Government – Important for the protection of aquatic habitat, and potable water supplies – Directly link to surface water and sediment quality, groundwater quality and quantity, and affects to groundwater–surface water interactions	– Changes in drainage patterns – Changes in flow – Changes in water levels – Changes in water balance components	– Air quality and climate – Groundwater – Fish and fish habitat – Vegetation, wetlands, and protected areas – Wildlife – Land and resource use
Surface water quality	– Valued by Indigenous groups/local residents and the Government – Important for the protection of aquatic habitat, and potable water supplies – Directly link to sediment quality and groundwater quality	– Change in physical and chemical parameters of water	– Air quality and climate – Groundwater – Fish and fish habitat – Vegetation, wetlands, and protected areas – Wildlife – Land and resource use
Sediment quality	– Important for the protection of aquatic habitat, and potable water supplies – Directly link to water quality and groundwater quality	– Change in physical and chemical characteristics of sediment – Sedimentation and erosion potential – TSS loading	– Air quality and climate – Groundwater – Fish and fish habitat – Vegetation, wetlands and protected areas – Wildlife – Land and resource use

VEC = valued environmental component.

8.3.3 Assessment Boundaries

Assessment boundaries define the spatial and temporal extents of the assessment for each VEC. The spatial boundaries for surface water are defined in Table 8-3 and shown in Figure 8-1, and consist of the site study area (SSA), a local study area (LSA), and a larger regional study area (RSA).

The SSA includes the proposed infrastructure for the Project (i.e., the Project footprint) with an additional buffer to reflect existing uncertainty in the final design of the Project and so that adverse effects on VECs are not underestimated (i.e., the SSA area is twice as large as the anticipated Project footprint). The SSA is constrained to avoid certain features, including major lakes, the Québec-Labrador provincial border and sensitive features, like the Wahnahnish Lake Protected Public Water Supply Area. The SSA represents the smallest scale of assessment and an area where the potential direct effects of the anticipated Project can be assessed accurately and precisely.

The LSA includes several waterbodies and watercourses or local watershed and sub-watersheds around the Project, including Pike Lake, Daviault Lake, Molar Lake, Mills Lake, Duley Lake, Waldorf River, Rectangle Lake, and Riordan Lake that overlap with the Project and represents the scale to which most or all effects from the Project are anticipated. The LSA represent a surface area of 31,326 ha and is composed of Daviault Lake on the West, Mills Lake, Waldorf River watershed, and Rectangle Lake on the south, Riordan Lake on the east, and Duley Lake and Duley Lake Provincial Park on the north (Figure 8-1).

Compared to the previous EIS, the current LSA of the Project is larger and generally includes all the LSA of the previous EIS. Daviault Lake, Molar Lake, Rectangle Lake on the west and south of the Project are included in the current LSA due to anticipated effects from the Rose Pit and tailings management facility. However, on the east side, small waterbodies over which the rail line and access road would cross are excluded because the Project effects are anticipated to be negligible.

The RSA includes the LSA plus the Walsh River, Wabush Lake, and several brooks and lakes. It extends from the highlands along the Québec–Labrador border, northeastward through Wabush and Labrador City along the chain of lakes, including Wabush Lake and the southwestern end of Shabogamo Lake, and includes the Walsh River watershed in the northeast. The RSA provides broader context for the assessment of Project effects on surface water and provides an appropriate scale to assess cumulative effects from the Project combined with existing conditions and other reasonably foreseeable developments (RFDs). The assessment boundaries for the Project RSA are larger than the RSA in the previous EIS; the Project RSA includes the Walsh River watershed in addition to the RSA in the previous EIS.

Table 8-3: Spatial Boundaries for Assessment of Surface Water Valued Environmental Components

Study Area	Area (ha)	Description/Rationale
SSA	4,323	Includes the Project footprint plus additional buffered areas to incorporate a level of uncertainty into the Project design so that effects are not underestimated. The site assessment area was defined using bounding points around the outermost components of the Project footprint.
LSA	31,326	Includes several waterbodies and water courses or local watershed and sub-watersheds around the Project that overlap with the Project and represents the scale to which most or all effects on surface water from the Project are anticipated.
RSA	152,906	Includes the area of the LSA plus the furthest extent to which cumulative effects from the Project activities could occur and significance of those effects could be predicted.

SSA = site study area; LSA = local study area; RSA = regional study area.

The temporal scope of the assessment focuses on the 40-year period from initial construction to the end of Decommissioning and Rehabilitation (i.e., Closure) as defined by the following Project phases:

- **Construction phase (referred to as Construction)**—Includes site preparation, mine, process plant and site infrastructure development, and commissioning the structures, systems, and components. The duration of Construction is expected to be four years.
- **Operations and Maintenance phase (referred to as Operations)**—Includes the mining and milling of iron ore, production and shipment of iron ore concentrate, tailings management, management of mine rock, waste management, water management, release of treated effluent, site maintenance and transportation of staff and materials to and from the site. Operations initiates with one year of pre-development mining (i.e., ramp-up) and concludes when processing is complete and is expected to be 25 years.
- **Decommissioning and Rehabilitation phase (referred to as Closure)**—Includes accelerated flooding of the Rose Pit, re-establishment of passive surface water drainage following the pit-flooding period, and recontouring and revegetating disturbed areas. Physical infrastructure that is not required during Post-closure monitoring and for other activities required to achieve the Project's decommissioning criteria and to return the Project site to a safe and stable condition will be removed. Closure is expected to be 10 years.

The temporal boundaries applied to cumulative effects assessments include the duration of residual effects from previous and existing developments that overlap with residual effects from the Project, and the period during which the residual effects from RFDs overlap with the Project.

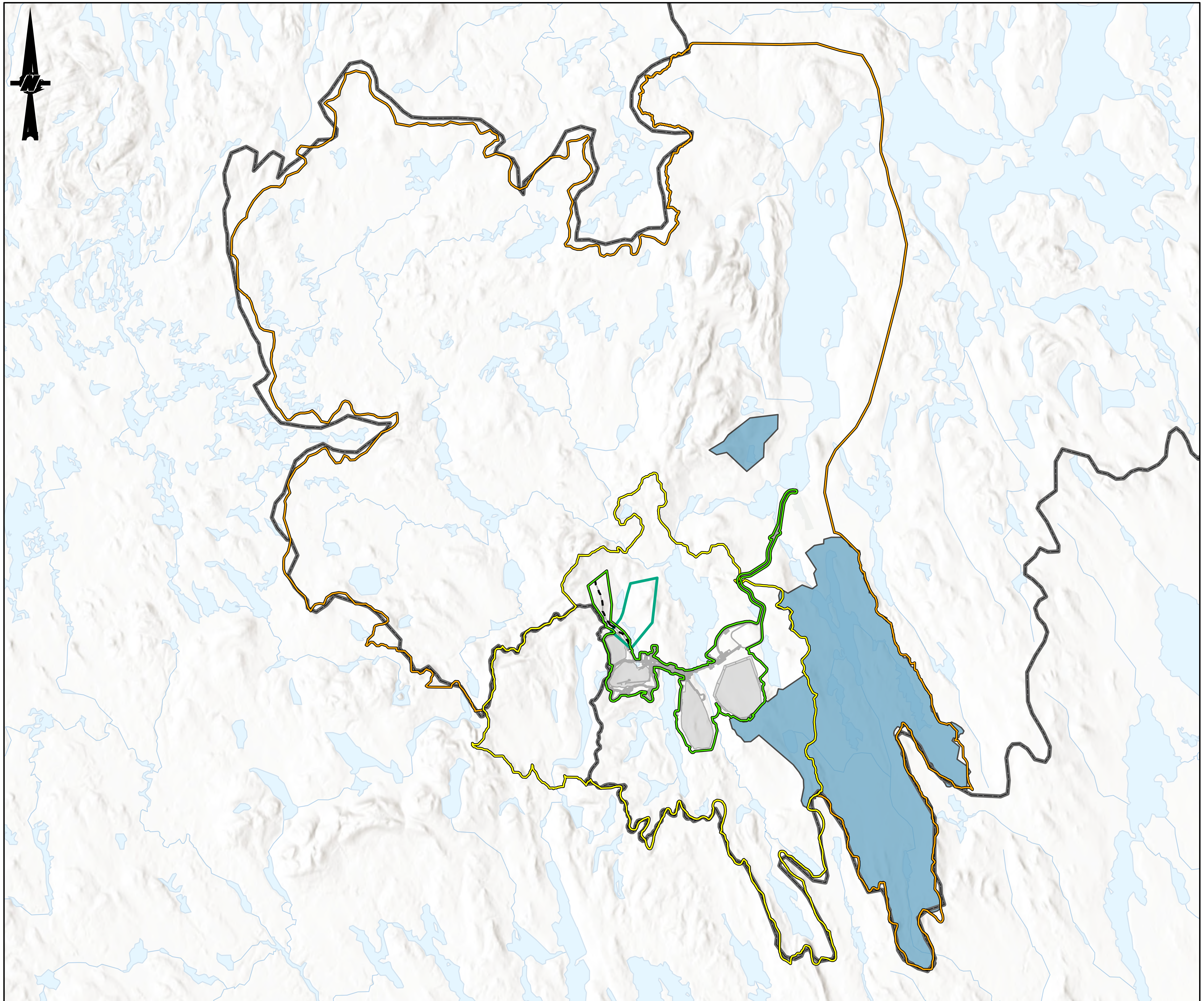
The temporal scope of the surface water quality assessment also considered water quality effects that may occur from the Project following Closure (i.e., in the far future). Far-future effects were included in the water quality assessment because, for surface water quality, the duration of effects from the Project could occur well beyond Closure. The assessment of surface water quality effects for the far future was based on surface water quality modelling that spanned 74 years, including the 35-year Project timeline (Construction, Operations and Closure) and 38 years after Closure.

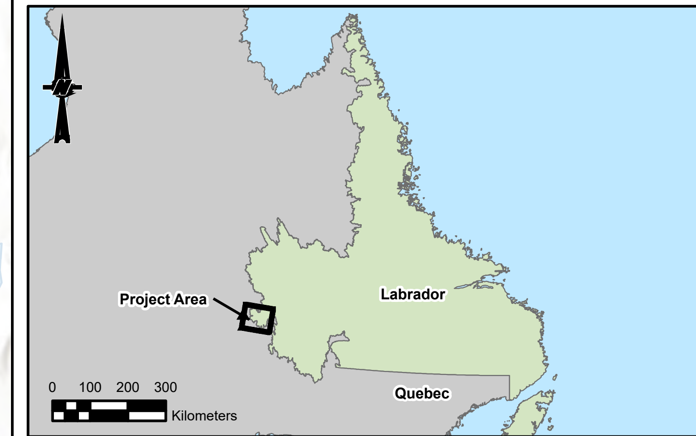
The concept of assessment cases was applied to the surface water quantity and quality assessment using site-wide water balance and water quality model (WBWQM) to estimate the incremental and cumulative effects from the Project. Pre-mine condition (i.e., pre-development, natural case) and base case (i.e., with Project) were simulated.

- **Pre-mine (pre-development) case**—The pre-mine module of WBWQM considered no mine area footprints and/or water-related management activities.
- **Base case**—Base case module of WBWQM had mine plan and water management activities with the Project fully encoded. Under mine case the surface water assessments considered surface water quantity and quality effects that may occur from Project during:
  - Construction and Operations (25 years: Construction [Year -1] and Operations [years 0 through 24])
  - Closure (12-year pit flooding period; years 25 through 36)
  - Post-closure (years 37 through 73)

This approach allows for a direct comparison to be made between the current and undisturbed flow regime and the predicted mine affected flow regime, for any location and/or time period of interest, over the entire model domain and the full Project lifespan (Construction through Post-closure). See TSD VI, Site-Wide Water Balance and Water Quality Modelling Report for details on assessment cases.

For certain potential Project effects, snapshots (i.e., fixed in time or steady-state) were used to simulate processes rather than simulating Project effects over continuous time frames. Snapshots are used when the modelling platform does not have the ability to represent changing conditions over time (e.g., gradual changes in lake water quality). For example, various assessment snapshots of Project effects were considered in the near-field (i.e., within 100 metres [m] of the treated effluent diffuser) water quality modelling completed to assess dilution and mixing characteristics of the treated effluent and treated sewage discharge location in Duley Lake.





SCALE 1:240,000

Legend

PROJECT DATA

- Proposed Project Infrastructure
- Regional Study Area (RSA)
- Local Study Area (LSA)
- Site Study Area (SSA)
- Potential Access Road
- Duley Lake Park
- Labrador/Quebec Boundary
- Public Water Supply

0 3,000 6,000 12,000

1:240,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. IMAGERY CREDITS: WORLD TERRAIN BASE: SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY WORLD HILLSHADE: ESRI, NASA, NGA, USGS
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE

SURFACE WATER SPATIAL BOUNDARIES

CONSULTANT

Kami

YYYY-MM-DD	2025-06-27
DESIGNED	----
PREPARED	GM
REVIEWED	MS
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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8.4 Existing Environment

The existing environment for surface water generally formed the basis against which the residual Project and cumulative effects were assessed. The existing environment also represents the outcome of historical and current environmental and socio-economic pressures that have shaped the observed condition of surface water. Environmental and socioeconomic pressures or factors were either natural (e.g., weather, wildfire, predation, disease, climate change) or human related (e.g., industrial development, forestry, changing business models, fishing, hunting).

Surface water baseline studies were conducted to support the characterization of the surface water existing environment. The overarching objective of the 2024 surface water baseline study was to establish baseline conditions for surface water quantity and surface water and sediment quality prior to mine development that will serve as a benchmark for the prediction of potential surface water effects arising from the proposed mining development and operations.

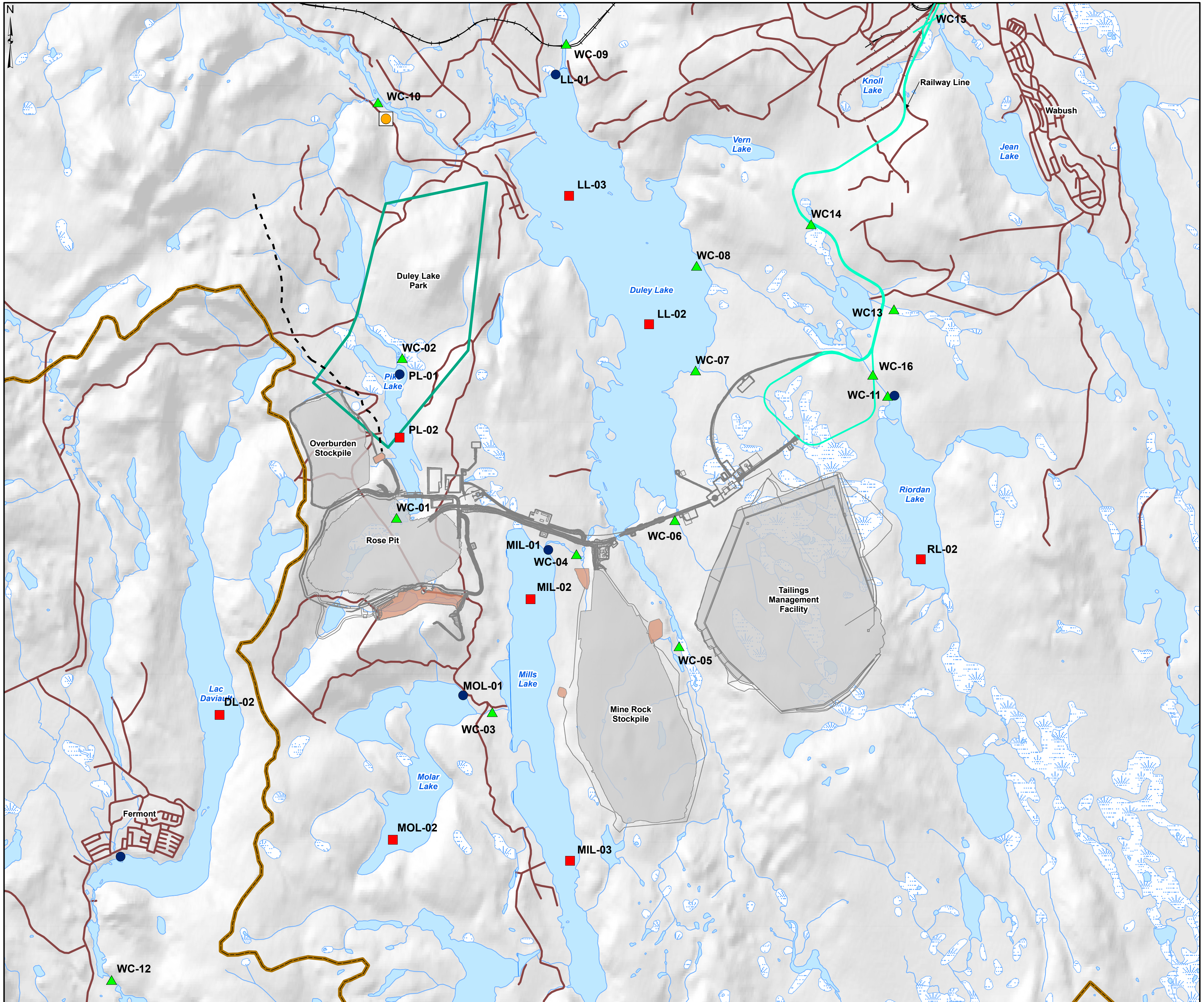
From a quantitative perspective, data and information collected during the baselines study at the local scale offer detailed and precise measurements of existing conditions. This allows for the prediction of Project-related changes to the measurement indicators for surface water VECs with respect to baseline/existing conditions. A summary of data derived from the existing conditions characterization was used to develop the surface water quantity and quality conditions for the pre-mine case in the assessment, which served as the environmental setting in the local and regional surface water quality modelling (TSD VI).

A copy of the 2024 surface water baseline report is provided in Annex 2A, Surface Water Baseline Report.

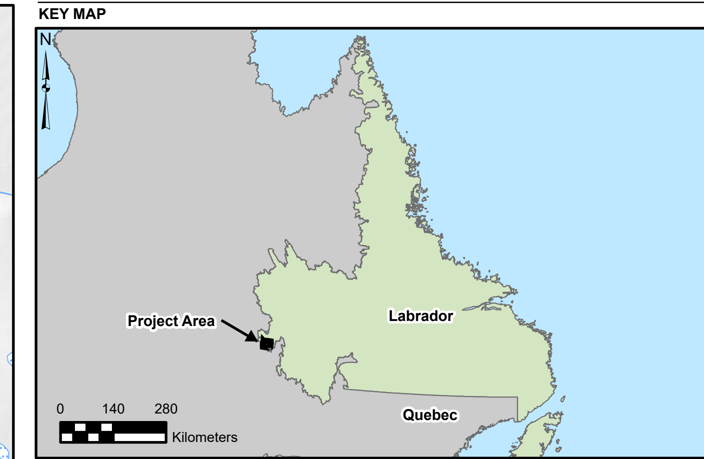
8.4.1 Methods

To characterize the baseline conditions of the surface water quantity, as well as surface water and sediment quality within the LSA, both the desktop methods and field monitoring programs were used.

The study area for the 2023-2024 surface water baseline program sampling locations encompasses the waterbodies and watercourses immediately adjacent and downstream of the proposed Kami Mining Project (the Project). Surface water monitoring stations were established, and field surveys were conducted to gather data on water levels, flows, and samples of water and sediment, along with other relevant Project information. WSP Canada Inc. carried out a total of six field surveys between June 2023 and August 2024. Sampling locations were selected to be similar to the locations previously sampled by Stantec (Stantec 2012) in support of the previous EIS to support a comparison of existing conditions. Additional sampling stations were added in 2023 to develop a more comprehensive understanding of local and regional hydrological and water quality conditions. Figure 8-2 illustrates the locations of 2023–2024 surface water monitoring stations. Details of the methods used to acquire information on existing conditions relative to the surface water VECs are presented in the following sub-sections.



KEY MAP



Scale: 1:20,000,000

Legend

- Watercourse Station
- Lake Level Station
- Lake Basin Station
- Rain Gauge Station
- Existing Railway
- Existing Road
- Proposed Project Infrastructure (Linear)
- Potential Access Road
- Proposed Access Road and Railway Corridor
- River/Stream
- Labrador/Quebec Boundary
- Proposed Project Infrastructure
- Proposed Sedimentation Pond
- Bog/Wetland
- Waterbody

0 500 1,000 2,000

1:64,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT
CHAMPION IRON MINES LTD.

PROJECT
KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE
2023-2024 SURFACE WATER MONITORING STATIONS

CONSULTANT

Kami

YYYY-MM-DD	2025-06-27
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REVIEWED	MS
APPROVED	CD

PROJECT NO.	CONTROL	REV.	FIGURE
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8.4.1.1 Meteorology

To evaluate the meteorological conditions, climate data of temperature and precipitation in the vicinity of the Project were gathered from an Environment and Climate Change Canada weather station at Wabush Airport (Station ID: 8504177) and analyzed for monthly and seasonal trends in temperature and precipitation.

In addition to the above climate dataset, climate data from the nearby climate stations and regional and global climate datasets, computed by various monitoring and modelling agencies, were also collected, compiled and analyzed for input to water balance and water quality model (TSD VI; Lorax 2024). Lists of climate stations and regional and global datasets analyzed by TSD VI and Lorax (2024) are provided below:

Climate stations

- Wabush Lake A (Station ID: 8504175)
- Wabush A (1) (Station ID: 8504176)
- Wabush A (2) (Station ID: 8504177)

Regional and global datasets

- Adjusted and Homogenized Canadian Climate Data (AHCCD)
- Natural Resources Canada dataset (NRCANmet)
- Canadian Precipitation Analysis (CaPA)
- Fifth generation of the European Centre for Medium-Range Weather Forecasts atmospheric reanalysis of the global climate (ERA5)-Land

8.4.1.2 Surface Water Quantity

To characterize the natural drainage of the waterbodies in the LSA, baseline information was collected using a desktop study and field-based assessments.

Watersheds of key waterbodies (e.g., lakes and/or streams) within the LSA and the flow direction maps were generated using ArcGIS software (version 10.8.2). Provincially available data layers for watercourses, waterbodies, roads, and topography were used in conjunction with the Project footprint and other geographic data acquired for the Project. During the field campaigns, defined surface water features (i.e., channels and/or areas of diffuse flows), culvert crossings and local topography were also located and documented using a hand-held GPS, field sketches and photographs.

To characterize the physical configuration of the lake system, bathymetric surveys were carried out at Duley Lake, Mills Lake, Pike Lake, and Riordan Lake, while lake depth surveys were conducted at Daviault Lake and Molar Lake. Generally, the bathymetric surveys were conducted with a 3 m zodiac boat that was fitted with a Lowrance sounder and Garmin GPS bulb. Lake depth surveys were conducted by collecting a series of depth measurements for the sole purpose of locating lake basins and did not map the entire lake, as the bathymetry did. Bathymetry data were interpolated and presented as bathymetry maps using ArcGIS software (version 10.8.2). Bathymetric data had previously been collected in 2012 (Stantec 2012) at Duley Lake only during March and April 2012 by drilling through ice cover and measuring depth with a weighted tape. The historical results were reviewed and, where applicable, compared with 2023-2024 bathymetry measurements.

To evaluate seasonal streamflow and lake level regimes for key surface water stations within the LSA, water level monitoring was conducted at six lake stations (located on Daviault Lake, Duley Lake, Mills Lake, Molar Lake, Pike Lake, and Riordan Lake), water level and flow monitoring was undertaken at 12 watercourse (stream) stations and manual flow monitoring was undertaken at 16 stations (Figure 8-2). Note that water level monitoring had previously been undertaken in 2011 through 2012 (Stantec 2012) at two lake stations (Mills Lake and Duley Lake) only, continuous water level and flow monitoring at five stream stations (located at selected streams) and two lake stations (Mills Lake and Duley Lake) and manual flows at five stream stations (located at selected streams) only. Water levels in 2023-2024 were recorded using Van Essan DIVER water level dataloggers (i.e., non-vented pressure transducer loggers). The water level records were compensated for atmospheric pressure (via a DIVER Barologger). During field campaigns, manual flows were also measured using the velocity-area method. Continuous water level records and stage-discharge rating curves, developed using the manual flow measurements, were used to generate flow hydrographs. Additionally, for some stations an extra stage-discharge rating curve, to be used in spring 2024, was also developed. Historical stage-discharge rating curves (Stantec 2012) were developed using Manning's equation (i.e., theoretical approach) instead of measured flow data and presented as figures only; no stage-discharge relationship was provided. Water quantity results (including water levels, flows and seasonal variability patterns) at lake and watercourse (stream) stations were compared to historical water quantity results from Stantec (2012).

List of water level monitoring lake stations, manual flow measurement stations and water level and flow monitoring watercourse (stream) stations are provided in Table 8-4 and Table 8-6, respectively, and typical field monitoring station set-ups are shown in Figure 8-3 and Figure 8-4.

Table 8-4: Water Level Monitoring Stations

Station ID	UTM Coordinates[a] Northing/Easting	Description	Period of Record
DL-01	5850710/628351	Daviault Lake – downstream portion near the outlet	June 2023 to August 2024
LL-01[b]	5863619/635536	Duley Lake – downstream portion near the outlet	June 2023 to August 2024
MIL-01[b]	5855772/635414	Mills Lake – downstream portion near the outlet	June 2023 to August 2024
MOL-01	5853371/634007	Molar Lake – downstream portion near the outlet	August 2023 to August 2024
PL-01	5858813/632936	Pike Lake – downstream portion near the outlet	June 2023 to August 2024
RL-01	5858318/641130	Riordan Lake – downstream portion near the outlet	August 2023 to August 2024

(a) UTM coordinates based on NAD83 Zone 19.

(b) Lake water levels were also measured from October 2011 to May 2012. Note that the locations of 2011–2012 and 2023–2024 lake water level monitoring stations were not the same. Location coordinates of 2011–2012 monitoring stations are provided in Surface water baseline report (Annex 2A).

UTM = Universal Transverse Mercator.

Table 8-5: Manual Flow Measurement Stations Water Level and/or Continuous Flow Monitoring Stations

Station ID	UTM Coordinates[a] Northing/Easting	Description	Flow Measurement Event
WC-01[b]	5856192/632810	Unnamed stream – reporting to Pike Lake from the southwest	June 2023, August 2023, October 2023, March 2024, June 2024, and August 2024
WC-02[b]	5858897/632920	Unnamed stream – immediately downstream of Pike Lake outlet	June 2023, August 2023, October 2023, March 2024, June 2024, and August 2024
WC-03[b]	5853179/634709	Unnamed stream – reporting to Mills Lake from the west	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-04	5855857/635378	Unnamed stream – reporting to Duley Lake from the southwest	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-05	5854636/637507	Waldorf River – reporting to Duley Lake from the south	August 2023, June 2024, and August 2024
WC-06[b]	5856351/637511	Unnamed stream – reporting to Duley Lake from the southeast	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-07	5858758/637921	Unnamed stream – reporting to Duley Lake from the southeast	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-08	5860478/637962	Unnamed stream – reporting to Duley Lake from the east	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-09	5863790/635635	Unnamed stream – immediately downstream of Duley Lake outlet	June 2023, August 2023, and August 2024
WC-10	5863449/632468	Walsh River — reporting to Duley Lake from the northwest	June 2023 and August 2024
WC-11	5858315/641017	Unnamed stream – immediately downstream of Riordan Lake	October 2023, June 2024, and August 2024
WC-12	5848673/628202	Unnamed stream – immediately downstream of Daviault Lake	October 2023, June 2024, and August 2024

Station ID	UTM Coordinates[a] Northing/Easting	Description	Flow Measurement Event
WC-13	5859809/640950	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake from the east[c]	August 2024
WC-14	5860604/640077	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake northwest[c]	August 2024
WC-15	5865198/641766	Proposed railway crossing – unnamed stream reporting Little Wabush Lake from the southeast[c]	August 2024
WC-16	5858663/640772	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake from the southeast[c]	August 2024

(a) UTM coordinates based on NAD83 Zone 19.

(b) Manual flows were also measured in October 2011 at a nearby historical station (Stantec 2012). Note that the locations of 2011–2012 and 2023–2024 manual flow stations were not the same. Location coordinates of 2011–2012 monitoring stations are provided in surface water baseline report (Annex 2A).

(c) Sampling was completed at this location based on an earlier design iteration of the proposed railway; therefore, the sampling location does not align with the proposed railway alignment presented in Figure 8-2.

UTM = Universal Transverse Mercator.

Table 8-6: Water Level and/or Continuous Flow Monitoring Stations

Station ID	UTM Coordinates[a] Northing/Easting	Description	Period of Record
WC-01[b]	5856192/632810	Unnamed stream – reporting to Pike Lake from the southwest	June 2023 to August 2024
WC-02[b]	5858897/632920	Unnamed stream – immediately downstream of Pike Lake outlet	June 2023 to August 2024
WC-03[b]	5853179/634709	Unnamed stream – reporting to Mills Lake from the west	June 2023 to August 2024
WC-04	5855857/635378	Unnamed stream – reporting to Duley Lake from the southwest	June 2023 to August 2024
WC-05[c]	5854636/637507	Waldorf River – reporting to Duley Lake from the south	June 2023 to August 2024
WC-06[b]	5856351/637511	Unnamed stream – reporting to Duley Lake from the southeast	June 2023 to August 2024
WC-07	5858758/637921	Unnamed stream – reporting to Duley Lake from the southeast	June 2023 to August 2024
WC-08	5860478/637962	Unnamed stream – reporting to Duley Lake from the east	June 2023 to August 2024
WC-09	5863790/635635	Unnamed stream – immediately downstream of Duley Lake outlet	June 2023 to June 2024
WC-10	5863449/632468	Walsh River – reporting to Duley Lake from the northwest	June 2023 to August 2024
WC-11[d]	5858315/641017	Unnamed stream – immediately downstream of Riordan Lake	August 2023 to August 2024
WC-12[e]	5848673/628202	Unnamed stream – immediately downstream of Daviault Lake	June 2023 to August 2024

(a) UTM coordinates based on NAD83 Zone 19.

(b) Continuous water levels and flows were also measured from October 2011 to May 2012 at a nearby historical station (Stantec 2012). Note that the locations of 2011–2012 and 2023–2024 continuous water level and flow stations were not the same. Location coordinates of 2011–2012 monitoring stations are provided in surface water baseline report (Annex 2A).

(c) GPS survey could not be completed due to lack of signal reception. The water levels at this station are tied to local benchmark.

(d) Continuous water levels were not recorded. Water level records from a nearby station RL-01 were used to develop flow hydrographs for WC-11.

(e) Continuous water levels were not recorded. Water level records from a nearby station DL-01 were used to develop flow hydrographs WC-12.

UTM = Universal Transverse Mercator.

Figure 8-3: A Typical Installation of a Flow Monitoring Station at a Watercourse

Figure 8-4: A Typical Cross-Section Set-Up for Manual Flow Measurement at a Watercourse

8.4.1.3 Surface Water and Sediment Quality

To characterize existing water chemistry of the surface waters and sediment characteristics within the LSA, field measurements and water and sediment samples were collected from a total of 25 watercourse (stream) and lake sampling stations (Figure 8-2) over the monitoring period (2023–2024). Historical water and sediment quality samples (Stantec 2012) were generally collected from 7 stations in the vicinity of the Project from October 2011 to May 2012, noting in April 2012 an additional 10 water quality samples were also collected. Note that 2023–2024 water and sediment quality sampling events and number of samples were greater than the historical water and sediment quality sampling data (Stantec 2012).

Field measurements included physio-chemical (i.e., physical- and chemistry-related parameters) water column profiles of temperature, dissolved oxygen (DO), acidity (pH), and specific conductivity in waterbodies or spot measurements of temperature, DO, pH, electrical conductivity (EC), and turbidity in watercourses (streams). Field-measured data were obtained using hand-held meters and probes (i.e., water quality sensors, such as Horiba Water Quality meter and YSI Multiparameter Water Quality Sonde) that were lowered into the water at each sampling location.

Seasonal patterns in water column profiles at Daviault Lake (Reference Lake), Duley Lake, Mills Lake, Molar Lake, Pike Lake, and Riordan Lake were characterized to evaluate the potential for lake stratification and/or turnover. No water column profiles were measured during the previous assessment (Stantec 2012). Lake column profiling station at each lake were located at the deepest areas within the lake basins and/or sub-basins. For each station, field measurements of temperature, EC, pH, and DO were collected at 1 m intervals throughout the water column. Table 8-7 provides details about lake water column profile stations and the field measurement events.

Table 8-7: Lake Column Profile Stations

Lake Basin	Station ID	UTM Coordinates[(a)] Northing/Easting	Description	Approx. Water Depth (m)	Water Column Profile Measurement Events
Reference Lake	DL-02	5853048/629986	Daviault Lake – deepest location near the centre	22	August 2023, October 2023, June 2024, and August 2024
Duley Lake	LL-02	5859719/637173	Duley Lake – deepest location near the centre	28	June 2023, August 2023, October 2023, March 2024, June 2024, and August 2024
	LL-03	5861616/635757	Duley Lake – second deepest location in the north	15	August 2023, October 2023, March 2024, June 2024, and August 2024
Mills Lake	MIL-02	5854958/635121	Mills Lake – deepest location near the north side	20	June 2023, August 2023, October 2023, June 2024, and August 2024
	MIL-03	5850640/635773	Mills Lake – second deepest location near the centre	25	August 2023, October 2023, June 2024, and August 2024
Molar Lake	MOL-02	5850987/632847	Molar Lake – near deepest location in the southwest	27	August 2023, October 2023, June 2024, and August 2024
Pike Lake	PL-02	5857541/632953	Pike Lake – deepest location near the centre	9	June 2023, August 2023, October 2023, March 2024, June 2024, and August 2024
Riordan Lake	RL-02	5855616/641565	Riordan Lake – deepest location in the south	15	August 2023, October 2023, June 2024, and August 2024

(a) UTM coordinates based on NAD83 Zone 19.

UTM = Universal Transverse Mercator.

Water and sediment samples were collected from lake and watercourse (stream) stations during field visit in 2023 and 2024. Table 8-8 and Table 8-9 provides lists of water and sediment sampling stations along with sampling events. Sediment quality sampling had been previously undertaken at watercourses and lake stations in 2011 through to 2012 in support of the previous EA process for the Project. These historical results were reviewed and, where applicable, used for comparison purposes.

Samples were sent under chain of custody documentation to Bureau Veritas and analyzed for a wide variety of parameters (Table 8-10). At lake stations, water quality samples were collected at approximately 1 m below the water surface and, where possible, approximately 1 m above the bed. For water quality analysis, parameters included general parameters, anions and nutrients, metals, radionuclides, surrogate recovery parameters and PAHs, whereas for sediment quality analysis, parameters included general parameters, anion and nutrients, and metals.

Table 8-8: Water Quality Sampling Stations

Station ID	Description	Water Sampling Event
WC-01	Unnamed stream – reporting to Pike Lake from the southwest	June 2023, August 2023, October 2023, March 2024, June 2024 and August 2024
WC-02	Unnamed stream – immediately downstream of Pike Lake outlet	June 2023, August 2023, October 2023, March 2024, June 2024 and August 2024
WC-03	Unnamed stream – reporting to Mills Lake from the west	June 2023, August 2023 (2), October 2023, June 2024, and August 2024
WC-04	Unnamed stream – reporting to Duley Lake from the southwest	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-05	Waldorf River – reporting to Duley Lake from the south	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-06	Unnamed stream – reporting to Duley Lake from the southeast	June 2023, August 2023 (2), October 2023, June 2024, and August 2024
WC-07	Unnamed stream – reporting to Duley Lake from the southeast	June 2023, August 2023 (2), October 2023, June 2024, and August 2024
WC-08	Unnamed stream – reporting to Duley Lake from the east	June 2023, August 2023 (2), October 2023, June 2024, and August 2024
WC-09	Duley Lake outlet	June 2023, August 2023, October 2023, March 2024, June 2024, and August 2024
WC-10	Walsh River — reporting to Duley Lake from the northwest	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-11	Unnamed stream – immediately downstream of Riordan Lake	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-12	Unnamed stream – immediately downstream of Daviault Lake	June 2023, August 2023, October 2023, June 2024, and August 2024
WC-13	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake from the east[a]	October 2023 and August 2024
WC-14	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake northwest[a]	October 2023 and August 2024
WC-15	Proposed railway crossing – unnamed stream reporting Little Wabush Lake from the southeast[a]	October 2023 and August 2024
WC-16	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake from the southeast[a]	October 2023 and August 2024
DL-01	Daviault Lake – at staff gauge location	June 2024 and August 2024
DL-02	Daviault Lake – deepest location near the centre	August 2023, October 2023, June 2024, and August 2024
LL-02	Duley Lake – deepest location near the centre	June 2023, August 2023 (2), October 2023, March 2024, June 2024, and August 2024
LL-03	Duley Lake – second deepest location in the north	August 2023, October 2023, March 2024, June 2024, and August 2024
MIL-02	Mills Lake – deepest location near the north side	June 2023, August 2023 (2), October 2023, June 2024, and August 2024
MIL-03	Mills Lake – second deepest location near the centre	August 2023, October 2023, June 2024, and August 2024
MOL-02	Molar Lake – near deepest location in the southwest	August 2023, October 2023, June 2024, and August 2024

Station ID	Description	Water Sampling Event
PL-02	Pike Lake – deepest location near the centre	June 2023, August 2023, October 2023, March 2024, June 2024, and August 2024
RL-02	Riordan Lake – deepest location in the south	August 2023, October 2023, June 2024, and August 2024

(a) Sampling was completed at this location based on an earlier design iteration of the proposed railway; therefore, the sampling location does not align with the proposed railway alignment presented in Figure 8-2.

Table 8-9: Sediment Quality Sampling Stations

Station ID	Description	Sediment Sampling Event
WC-01	Unnamed stream – reporting to Pike Lake from the southwest	June 2023, August 2023, and October 2023
WC-02	Unnamed stream – immediately downstream of Pike Lake outlet	June 2023, August 2023, and October 2023
WC-03	Unnamed stream – reporting to Mills Lake from the west	June 2023, August 2023, and October 2023
WC-04	Unnamed stream – reporting to Duley Lake from the southwest	June 2023, August 2023, and October 2023
WC-05	Waldorf River – reporting to Duley Lake from the south	June 2023, August 2023, and October 2023
WC-06	Unnamed stream – reporting to Duley Lake from the southeast	June 2023, August 2023, and October 2023
WC-07	Unnamed stream – reporting to Duley Lake from the southeast	June 2023, August 2023, and October 2023
WC-08	Unnamed stream – reporting to Duley Lake from the east	June 2023, August 2023, and October 2023
WC-09	Duley Lake outlet	June 2023, August 2023, and October 2023
WC-10	Walsh River – reporting to Duley Lake from the northwest	June 2023, August 2023, and October 2023
WC-11	Unnamed stream – immediately downstream of Riordan Lake	October 2023
WC-12	Unnamed stream – immediately downstream of Daviault Lake	August 2023 and October2023
WC-13	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake from the east[(a)]	October 2023
WC-14	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake northwest[(a)]	October 2023
WC-15	Proposed railway crossing – unnamed stream reporting Little Wabush Lake from the southeast[(a)]	October 2023
DL-02	Daviault Lake – deepest location	August 2023 and October 2023
LL-02	Duley Lake – deepest location	June 2023, August 2023, and October 2023
LL-03	Duley Lake – second deepest location	August 2023 and October2023
MIL-02	Mills Lake – deepest location	June 2023, August 2023, and October 2023
MIL-03	Mills Lake – second deepest location	August 2023 and October 2023
MOL-02	Molar Lake – near deepest location	August 2023 and October 2023
PL-02	Pike Lake – deepest location	June 2023, August 2023, and October 2023
RL-02	Riordan Lake – deepest location	August 2023 and October 2023

(a) Sampling was completed at this location based on an earlier design iteration of the proposed railway; therefore, the sampling location does not align with the proposed railway alignment presented in Figure 8-2.

Table 8-10: Laboratory Analyzed Surface Water and Sediment Quality Parameters Included in Surface Water Baseline Report

Sample Type	Parameter Group	Parameters
Surface water	General parameters	pH, acidity, alkalinity, colour, electrical conductivity, hardness, dissolved organic carbon, total organic carbon, total dissolved solids, and total suspended solids
	Anion and nutrients	ammonia, bromide, chloride, fluoride, nitrite, nitrate, nitrate plus nitrite, orthophosphate, phosphorus, reactive silica and sulphate
	Metals	aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, caesium, calcium, cerium, chromium, cobalt, copper, dysprosium, erbium, europium, gadolinium, gold, holmium, iridium, iron, lanthanum, lead, lithium, lutetium, magnesium, manganese, mercury, molybdenum, neodymium, nickel, palladium, phosphorus, platinum, potassium, praseodymium, rubidium, ruthenium, samarium, scandium, selenium, silicon, silver, sodium, strontium, sulfur, tellurium, terbium, thallium, thorium, thulium, tin, titanium , tungsten, uranium, vanadium, ytterbium, yttrium, zinc, and zirconium
	Radionuclides[(a)]	lead-210, polonium-210, radium-226, and thorium-230
	Surrogate recover parameters[(a)]	D10-Anthracene, D-14-Terphenyl, D8-Acenaphthylene, and D8-Naphthalene
	PAHs[(a)]	acenaphthene, acenaphthylene, acridine, anthracene, benzo(a)anthracene, benzo(b/j)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, benzo(c)phenanthrene, benzo(a)pyrene, benzo(e)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene, phenanthrene, perylene, pyrene, and quinoline
Sediment	General parameters	moisture, texture (i.e., clay, sand, and silt);
	Anion and nutrients	nitrite, nitrate, nitrate plus nitrite, nitrogen, total Kjeldahl nitrogen, and total organic carbon
	Metals	aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, phosphorous, potassium, selenium, silver, sodium, strontium, tin, titanium, uranium, vanadium, and zinc.

(a) Sampled at selected locations in August 2023.

PAHs = polycyclic aromatic hydrocarbons.

The results of water quality testing were compared to the Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life – Freshwater (CCME 1999a), whereas the sediment quality results were compared to the Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines for the Protection of Aquatic Life Freshwater and Marine ISQG/PEL (CCME 1999b).

8.4.2 Existing Conditions

This subsection provides a summary of information relevant to the surface water VECs existing conditions in the LSA. This section provides an overview of meteorology, surface water quantity, surface water quality and sediment quality within the LSA.

8.4.2.1 Meteorology

Table 8-11 summarizes mean monthly temperatures and total precipitation from 2014 to 2023 at a nearest Environment and Climate Change Canada meteorological station at Wabush Airport. Data showed that the climatic conditions in the LSA are sub-arctic, characterized by long winters and short mild summers. Freezing temperatures and snowfall persisted from January 2023 to mid-April 2023 at the start of the year and from the end of October 2023 through December 2023. Total precipitation in 2023 was 556.1 mm which is 13% below the 638 mm average of the preceding five years. During the monitoring period (i.e., June 2023 to August 2024), the monthly precipitation varied between 65.4 and 114.1 mm, with August 2023 having the most precipitation and July 2023 having the least. Average temperatures in 2023 were 1-2°C warmer than the 10-year mean. The mean annual temperature in 2023 reflected this trend with a value of -1.5 °C compared to the 10-year mean of -3.0°C. A comparison of the 5-year mean annual precipitation with the 10-year mean annual precipitation showed an 8% increase in precipitation in the recent five years, indicating an increasing trend in annual precipitation.

Table 8-11: Monthly Temperature and Precipitation Means at Environment and Climate Change Canada Wabush A (2014 to 2023)

Wabush A	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean Annual
2023 temperature (°C)	-21.7	-24.2	-10.2	-2.9	4.6	11.7	17.0	12.7	10.3	4.5	-8.8	-11.3	-1.5
10-yr temperature (°C)[(a)]	-21.7	-21.6	-14.1	-5.7	3.4	10.0	14.5	13.3	7.4	2.0	-8.4	-14.8	-3.0
5-yr precipitation (mm)	13.3	15.5	25.2	36.6	58.1	89.1	92.8	107.1	66.3	57.5	34.2	42.2	638
10-yr precipitation (mm)[(a)]	13.1	13.9	16.8	32.7	55.9	77.4	89.7	109.2	58.7	57.4	37.2	31.3	590

(a) Mean 10-year temperature and precipitation excluding 2014 data due to record gap for January to September and mean annual.

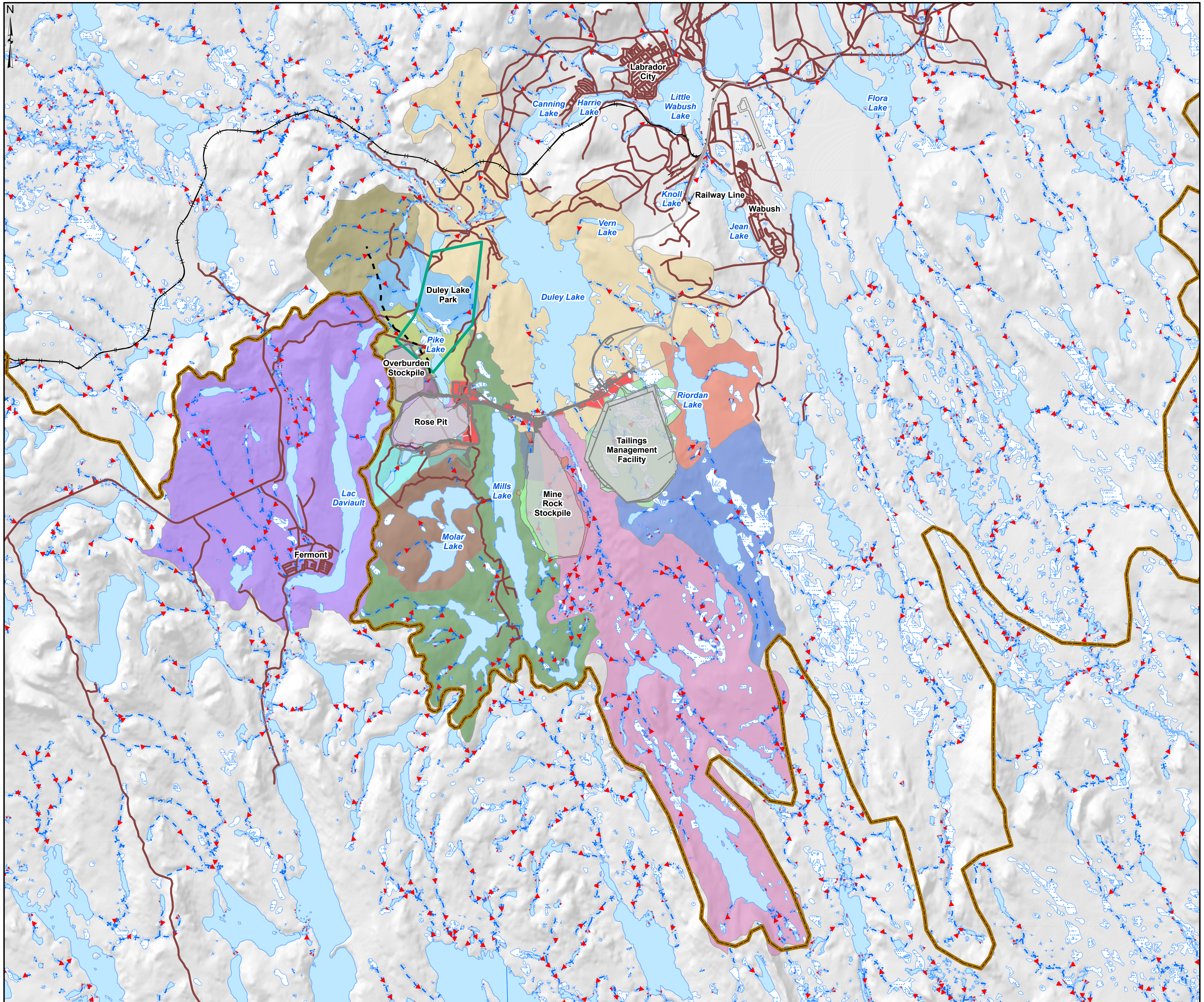
As discussed in Section 8.4.1.1, Meteorology, analysis of climate data was conducted and compared to datasets. Summary of results from TSD VI and Lorax (2024) is as follows:

- Wabush A (1) and A (2) precipitation data have data gaps. Differences between mean annual precipitation during 1961 to 2022 and 2013 to 2022 were noted and attributed to gauge undercatch.
- Monthly average precipitation data from the Wabush Lake A station were compared against the precipitation datasets for overlapping records (2002-2012). The AHCCD precipitation dataset consistently showed higher values than the station data, with greater discrepancies observed during winter months. The NRCANmet precipitation dataset was consistently biased low relative to the station data by 17% annually. The CaPA and ERA5-Land precipitation datasets showed comparable values, providing a better estimate of variability and magnitude of monthly station data than the AHCCD and NRCANmet precipitation datasets. The Wabush Lake A station mean annual precipitation was biased high by less than 10% by ERA5-Land and CaPA datasets over the 2002-2012 period.
- CaPA precipitation data were recommended for use in driving the water balance model (WBM) as CaPA data were superior to other gridded products for watershed model applications in eastern Canada where the Project is located (Gbambie et al. 2017).
- Mean annual precipitation estimated by CaPA ranges from 850 to 1,190 mm between 2002 and 2022, with an average of 1,000 mm.
- Snow water equivalent (SWE) records were extracted from the Canadian historical SWE dataset. Annual maximum SWE measured at Churchill-Wabush station varies from 184 to 470 mm over the period of record, with an average of 322 mm.
- Daily average, minimum and maximum air temperatures for the Project were derived using the hourly data recorded at the Wabush Lake A, Wabush A (1) and Wabush A (2) climate stations. Monthly average temperatures ranged from -20.1°C in January to 14.6°C in July.

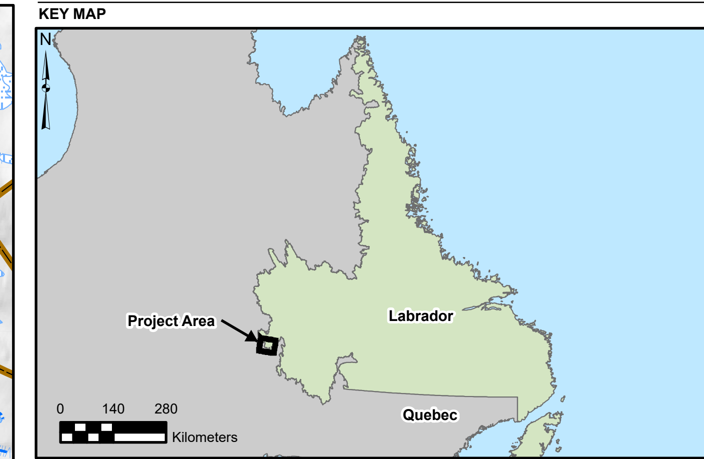
8.4.2.2 Surface Water Quantity

8.4.2.2.1 Watershed Delineation and Drainage

Local watershed of waterbodies and the flow direction maps were generated using ArcGIS software (version 10.8.2). Delineated local watershed and flow directions are shown in Figure 8-5. The LSA was found to generally drains to the northeast through a series of wetlands, lakes and streams which are all part of the Churchill River Watershed, except the sub-watershed of Daviault Lake that drains to south and is a part of St. Lawrence drainage area. Table 8-12 provides details about areas of local watersheds within the LSA.



KEY MAP



Scale: 1:20,000,000

Legend

- Flow Direction
- Watercourse
- Existing Railway
- Existing Road
- Potential Access Road
- Duley Lake Park
- Labrador/Quebec Boundary
- Proposed Project Infrastructure
- Proposed Sedimentation Pond
- Bog/Wetland
- Waterbody

Watersheds

- Basins
- Duley Lake
- Lac Daviault
- MRS East Basin
- MRS North Basin
- MRS West Basin
- Mid and Upper Mid Lakes
- Mills Lake
- Molar Lake
- Overburden Stockpile Collection Pond
- Pike Lake Dike
- Pike Lake North
- Pike Lake South
- Rectangle Lake
- Riordan Lake
- Rose Pit
- Rose Pit Collection Pond
- Tailings Management Facility
- Unnamed Lake North of Pike Lake North
- Waldorf River

0 1,250 2,500 5,000

1:130,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT
CHAMPION IRON MINES LTD.

PROJECT
KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE
LOCAL WATERSHEDS & FLOW DIRECTION

CONSULTANT

Kami

YYYY-MM-DD	2025-06-27
DESIGNED	----
PREPARED	MS
REVIEWED	MS
APPROVED	CD

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0013	0	8-5

Table 8-12: Local Natural (pre-construction) Watersheds within Local Study Area

Local watershed	Area (ha)	Ultimate receiver
Duley Lake[(a)]	7,274	Churchill River watershed
Pike Lake South	917	Churchill River watershed
Rose Lake	165	Churchill River watershed
Mid and Upper Mid Lakes	285	Churchill River watershed
Elfie and End Lakes	80	Churchill River watershed
Pike Lake North	656	Churchill River watershed
Unnamed lake (north of Pike Lake North)	885	Churchill River watershed
Riordan Lake	980	Churchill River watershed
Rectangle Lake	1,807	Churchill River watershed
Waldorf river	7,054	Churchill River watershed
Molar Lake	1,180	Churchill River watershed
Mills Lake	3,629	Churchill River watershed
Daviault Lake	6,414	St. Lawrence drainage area

a) Duley Lake watershed presented in this table represents local natural watershed draining directly into Duley Lake. Note that Duley Lake receives water from LSA sub-watersheds listed in this table, excluding Daviault Lake and Rectangle Lake; however, it also includes the Walsh River watershed. The total watershed area of Duley Lake, including all sub-watersheds, is approximately 90,388 ha (i.e., watershed area of WC-09 [Duley Lake outlet] in Table 8-29).

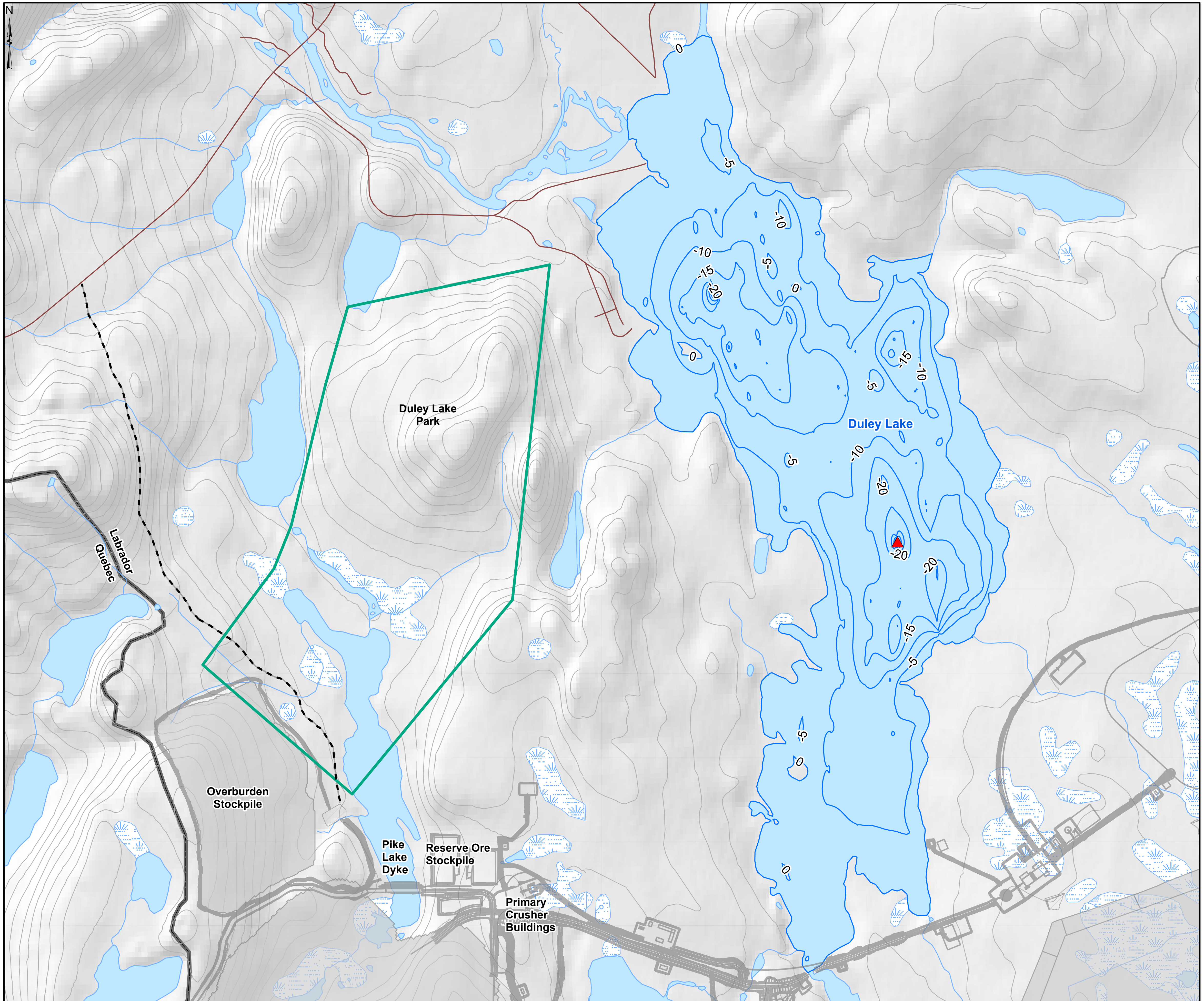
LSA = local study area.

8.4.2.2.2 Lake Bathymetry

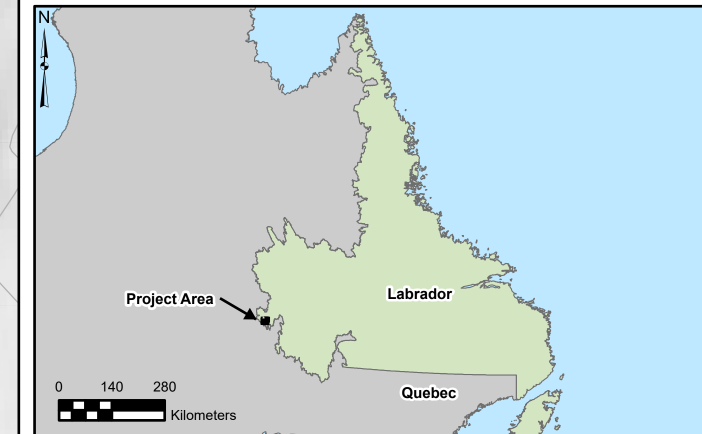
Bathymetric surveys were carried out at Duley Lake, Mills Lake, Pike Lake, and Riordan Lake, whereas lake depth surveys were conducted at Daviault Lake and Molar Lake. The results of bathymetry and Lake depth survey showed that:

- Duley Lake is characterized by several basins with approximate depths between 20 m to 55 m. According to historical bathymetry results (Stantec 2012), the southern end of Duley Lake is relatively shallow ranging in depth from <1 m to about 3.5 m and the lake deepens toward the north. Similar to historical results (Stantec 2012), 2023-2024 bathymetric survey results showed shallower depth (range approximately from <1 to 5 m) at southern end of the Duley Lake and deeper depth towards the north.
- Mills Lake consists of three distinct deep basins on the respective north, central and south sides of the lake. The bathymetry results of the northern and southern portions of the lake are relatively shallower, with depths from 9 to 19 m, while the central portion of the lake includes several basins with an approximate maximum depth of 24 m.
- Pike Lake is composed of three basins on the respective north and central sides of the lake. The bathymetry of the northern portion consists of shallow depths from 1 to 4 m, with changes in depth following relatively gradual transition from the surrounding shoreline areas to the basin. The bathymetry in the central portion of the lake includes a relatively deep basin with an approximate maximum depth of 10 m.
- Riordan Lake is characterized by four relatively small basins with approximate maximum depths between 6 m and 14 m. The two basins to the south are comparatively deeper and located in the upstream portion of the lake, approximately 2.8 km from the outlet area.
- The deepest point in Daviault Lake is located at the north side of the lake, with an approximate maximum depth of 23 m; whereas in Molar Lake deepest point is located at the south portion of the lake, with an approximate maximum depth of 28 m. Note that lake depth surveys were completed at Daviault Lake and Molar Lake in place of bathymetry surveys.

Figure 8-6 and Figure 8-7 shows the results of bathymetry and depth surveys of Duley Lake and Daviault Lake, respectively.



KEY MAP



SCALE 1:20,000,000

LEGEND

PROJECT DATA

- Deepest Point in Lake
- Bathymetry (m)

PROJECT INFRASTRUCTURE

- Proposed Project Infrastructure
- Potential Access Road

BASEMAP INFORMATION

- Road
- Railway
- Watercourse
- Contour
- Bog/Wetland
- Waterbody
- Labrador/Quebec Boundary
- Duley Lake Park

0 500 1,000 2,000

1:32,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE PROJECT
WABUSH, NL

TITLE

2023 DULEY LAKE BATHYMETRY

CONSULTANT

Kami

YYYY-MM-DD	2025-06-27
DESIGNED	----
PREPARED	MS
REVIEWED	MS
APPROVED	CD

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0013	0	8-6

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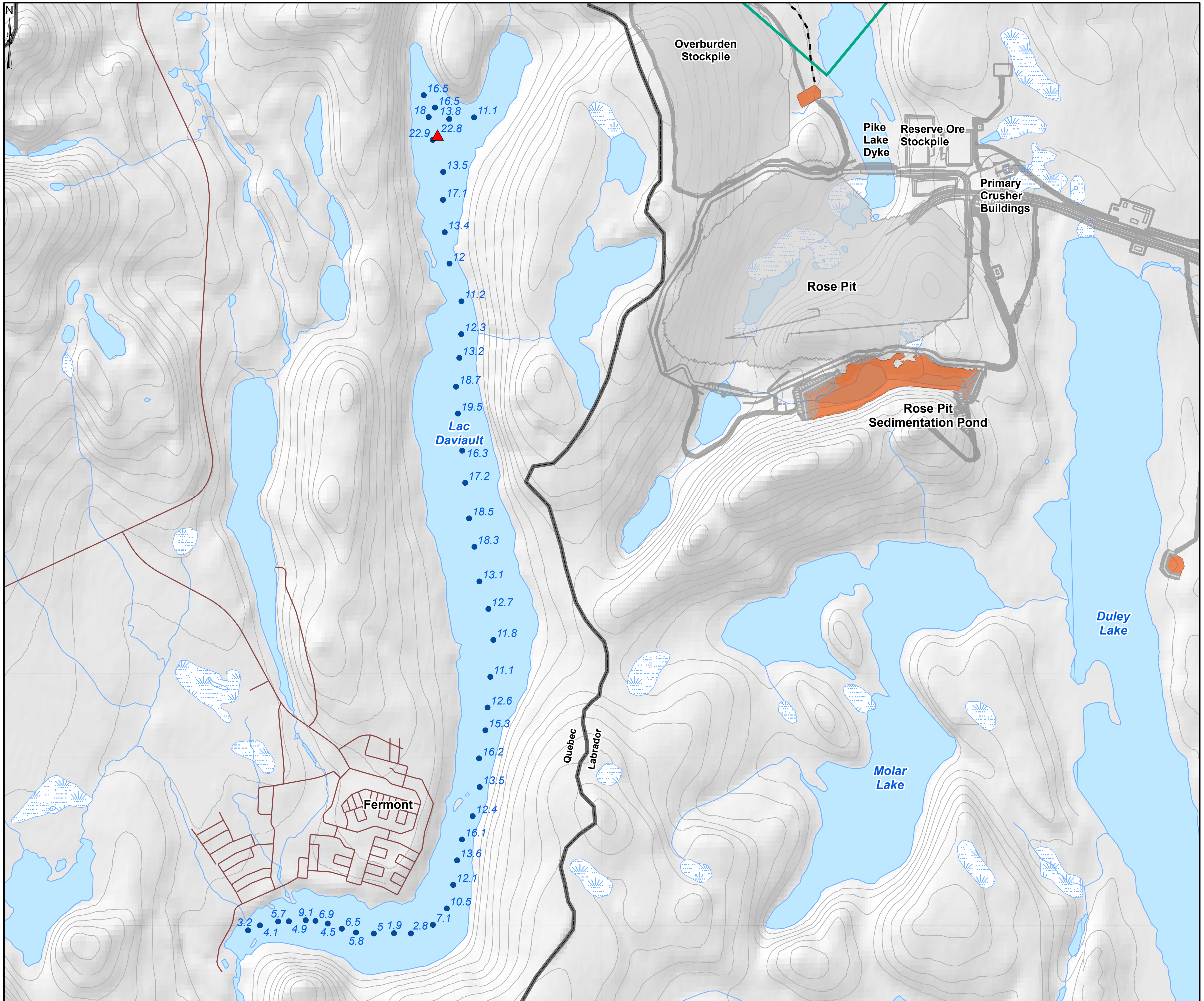
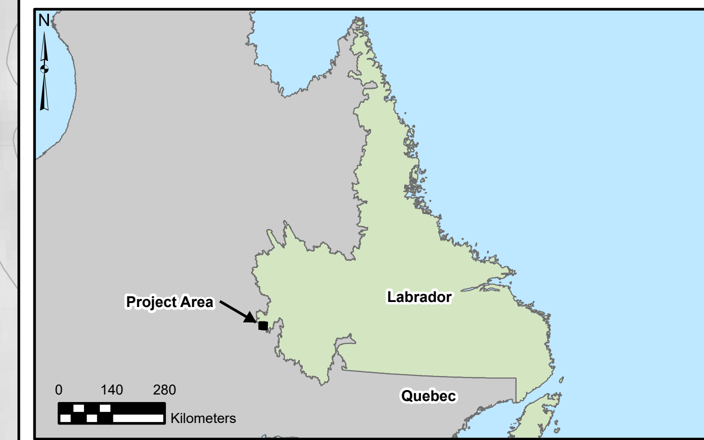


KEY MAP



SCALE 1:20,000,000

LEGEND

PROJECT DATA

- Deepest Point in Lake
- Depth Location

PROPOSED PROJECT INFRASTRUCTURE

- Proposed Infrastructure
- Proposed Sediment Pond
- Potential Access Road

BASEMAP INFORMATION

- Road
- Contour
- Railway
- Watercourse
- Waterbody
- Bog/Wetland

0 337.5 675 1,350

1:32,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE PROJECT
WABUSH, NL

TITLE

2023 LAKE DAVIAULT DEPTH SURVEY

CONSULTANT

Kami

YYYY-MM-DD	2025-06-27
DESIGNED	----
PREPARED	MS
REVIEWED	MS
APPROVED	CD

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0013	0	8-7

8.4.2.2.3 Lake Water Levels

As discussed in Section 8.4.1.2, Surface Water Quantity, water level monitoring was conducted at six (6) lake stations (located on Daviault Lake, Duley Lake, Mills Lake, Molar Lake, Pike Lake and Riordan Lake). Summary of results of water level monitoring at Lakes is as follows:

- Changes in water levels at lake stations were generally in correlation with rain events.
- Water levels were observed to gradually decrease from June 2023 to August 2023 (spring to summer), gradually increase from August 2023 to October 2023 (summer to fall) correlating with rain events, and then gradually decrease in winter months. Elevated water levels in May 2024 were indicative of spring freshet and/or beaver activity.
- The water levels at two lakes (Duley Lake and Mills Lake), reported a marked response to rain events.
- At Molar Lake, water level records showed unusual sudden fluctuations, which are comparable to a pumped system with rapid withdrawal and release responses. At Pike Lake, water levels showed an unusual steady increase in the lake level after mid-August 2023, likely caused by beaver dams located at the outlet of Pike Lake , which were observed during the October 2023 and August 2024 visits.

Comparison of 2011–2012 historical water levels (Stantec 2012) at Mills and Duley Lakes with the 2023–2024 water levels, at stations located in proximity to historical stations, showed a similarity in range and/or season water level trends, noting that some deviation due to meteorological factors are generally expected in comparisons with historical results. Like 2023–2024 water levels, historical water levels also indicated an increase in water levels at lake stations due to spring freshet from mid-April to May. A station-wide comparison of water levels and flows is presented in the surface water baseline report (Annex 2A).

Figure 8-8 shows a record of water level fluctuations at Duley Lake station LL-01.

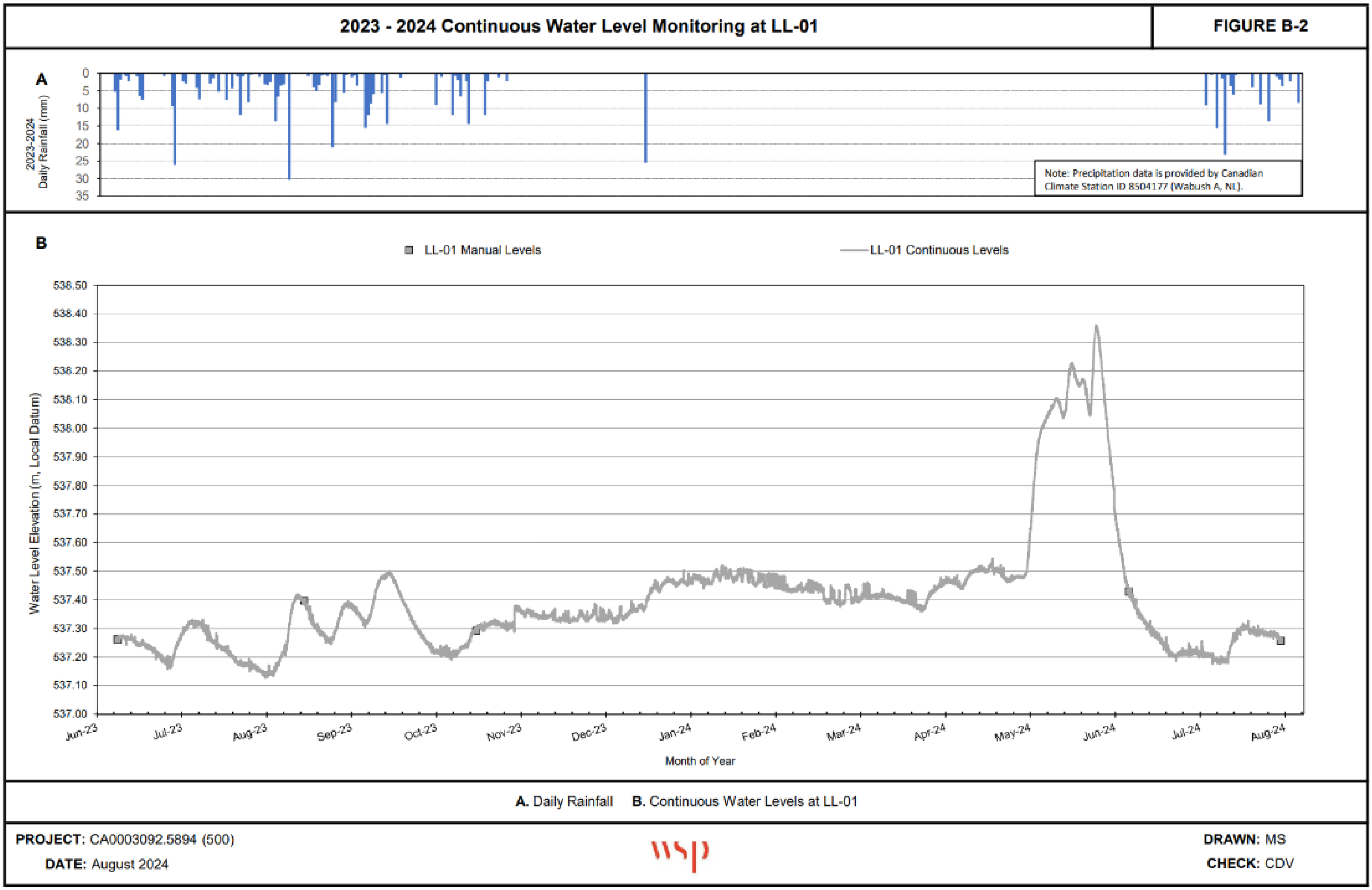


Figure 8-8: 2023–2024 Water Level Monitoring at Duley Lake Station LL-01

8.4.2.2.4 Manual Flows, Stage-Discharge Rating Curves, Continuous Water Levels and Hydrographs

As discussed in Section 8.4.1.2, manual flow, continuous water level and flow monitoring were undertaken watercourse (steam) stations (and Table 8-6) during the monitoring period in 2023 and 2024. Note that the manual flows at additional four (4) stations (WC-13 to WC-16) were also measured during August 2024 only. The results of manual flow measurements at watercourse (stream) stations are presented in Table 8-13.

Table 8-13: Summary of Manual Flow Measurements (litres per second)

Station ID	2023			2024		
	June (spring)	August (summer)	October (fall)	March (spring)	June (spring)	August (summer)
WC-01	57	150	110	44	93	44
WC-02	135	532	237	79	206	40
WC-03	110	209	164	–	391	163
WC-04	629	1,013	947	–	1,610	593
WC-05	(a)	189	(d)	–	570	138
WC-06	41	299	71	–	39	14
WC-07	244	780	302	–	101	31
WC-08	313	621	540	–	835	146
WC-09	13,802 (b)	19,551 (b)	(a)	–	(a)	7,076
WC-10	13,430 (b)	(a)	(a)	–	(a)	6,068
WC-11	(c)	(c)	230	–	532	170
WC-12	(c)	(c)	1,191	–	4,415	653
WC-13	–	–	–	–	–	8.6
WC-14	–	–	–	–	–	0.84
WC-15	–	–	–	–	–	1,953
WC-16	–	–	–	–	–	37

(a) Data not available due to unsafe stream conditions.

(b) Flow measurements estimated with fewer than normal velocity readings.

(c) Data not available due to limited access during the monitoring event.

(d) Stagnant conditions.

– = data not available

Summary of the results of manual flow measurements is as follows:

- The manual flows in 2023 were observed to be higher in August following an event response, whereas in 2024 manual flows were observed to be higher in June 2024 following the spring freshet.
- The 2023 measured flows ranged from 41 L/s (recorded in June at a stream discharging to Duley Lake from southeast [i.e., WC-06]) to 19,551 L/s (recorded in August downstream of the Duley Lake outlet [i.e., WC-09]).
- The 2024 measured flows ranged from 14 L/s (recorded in August at an unnamed tributary discharging to Duley Lake from southeast [i.e., WC-06]) to 7,076 L/s (recorded in August downstream of the Duley Lake outlet [i.e., WC-09]), noting that the June flow at WC-09 that could not be measured was expected to be even higher.
- A comparison of 2011–2012 historical flows (Stantec 2012) with the 2023–2024 flows, at stations located in proximity to historical stations, showed that the historical flows were generally close to and/or within that range observed in 2023 and 2024, noting that some deviation due to meteorological factors are generally expected in comparisons with historical results. A station-wide comparison of flows is presented in the 2024 surface water baseline report (WSP 2024; Annex 2A).

Manual flow measurements at watercourse (stream) stations WC-01 through WC-10 were used to develop stage-discharge rating curves. The stage-discharge rating curves generally matched well with the measured manual flows and associated water levels. During spring (June) 2024, lake water levels were found elevated at some stations without expected increase in the associated flows, thus affecting the stage-discharge relationships at these stations. The overall increase in water levels was attributed to spring freshet and/or beaver activity and to account for such unexpected increase in water levels, a second stage-discharge rating curve, to be used in spring 2024, was developed for each effected station. Table 8-14 provides summary of stage-discharge rating curve relationships and Figure 8-9 shows stage-discharge rating curves for a watercourse (stream) station.

Historical stage-discharge rating curves (Stantec 2012) were presented as figures only; no stage-discharge relationship was provided. Historical curves were developed using Manning's equation (i.e., theoretical approach) instead of measured flow data; therefore, no comparison of historical stage-discharge rating curves and 2023–2024 stage-discharge rating curve was made.

Table 8-14: 2023 to 2024 Stage-Discharge Rating Curve Equations

Station ID	Stage-Discharge Rating Curve Equation	Rating Curve Offset Y_o (masl)
WC-01	$Q = 2.50y^3$	569.410
WC-01 (for 2024 Spring)	$Q = 2.5y^3$	569.482
WC-02	$Q = 26.72y^{2.7}$	567.290
WC-02 (for 2024 Spring)	$Q = 26.72y^{2.7}$	567.340
WC-03	$Q = 3.20y^{3.25}$	578.210
WC-04	$Q = 66.84y^{2.5}$	578.410
WC-05[(a)]	$Q = 0.49y^{1.5}$	100.000
WC-06	$Q = 1.79y^3$	537.025
WC-06 (for 2024 Spring)	$Q = 1.79y^3$	537.565
WC-07	$Q = 4.33y^{2.32}$	537.227
WC-07 (for 2024 Spring)	$Q = 4.33y^{2.32}$	537.657
WC-08	$Q = 11.02y^{2.34}$	537.168
WC-08 (for 2024 Spring)	$Q = 11.02y^{2.34}$	537.533
WC-09[(b)]	$Q = 41.45y^{1.5}$	536.418
WC-10[(b)]	$Q = 30.7y^{1.69}$	545.600
WC-11	$Q = 7.0y^{3.8}$	587.661
WC-12	$Q = 5.58y^{2.0}$	585.393

(a) Actual ground elevations with respect to sea level were not available.

(b) During field campaigns flows could not be measured completely due to unsafe conditions. Flows were estimated from the partial flow measurements; therefore, these rating curves are presented with lower confidence.

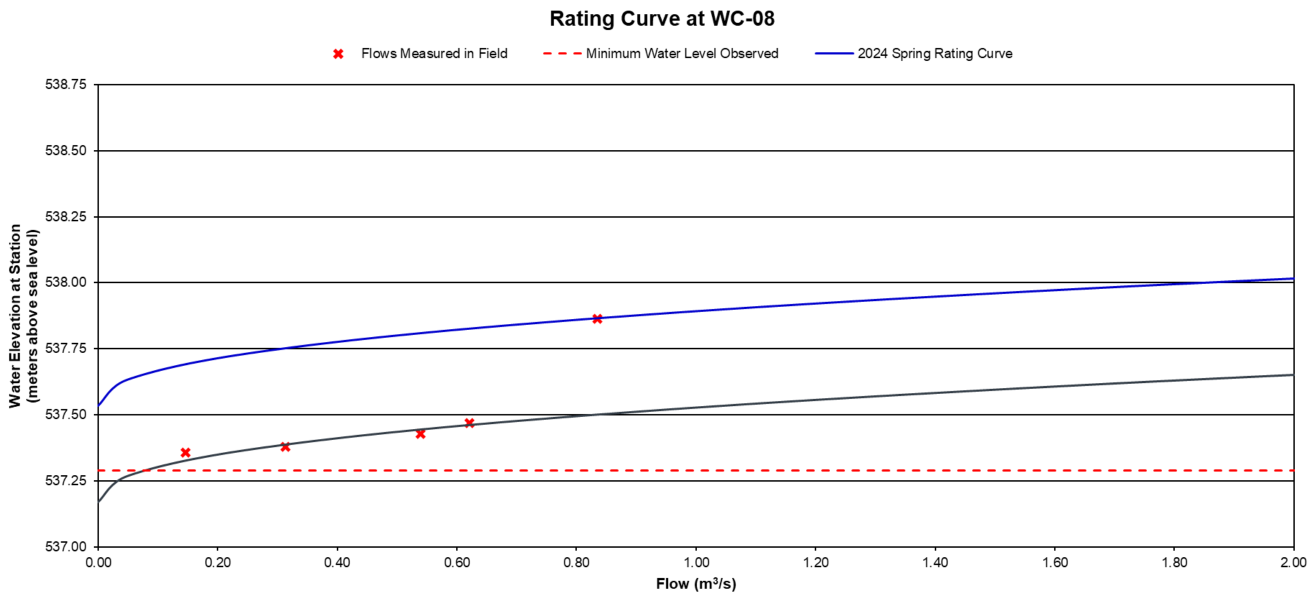


Figure 8-9: Stage-Discharge Rating Curves for WC-08

Summary of results of continuous water level monitoring undertaken at watercourse (stream) stations is as follows:

- Water levels correlated well with rain events and were observed to gradually decrease from June 2023 to August 2023, and then gradually increase from August 2023 to October 2023, followed by gradual decreases in the winter months of 2023 and 2024. Major water level changes, observed in May 2024, were indicative of spring freshet and/or beaver activity.
- Most stream station water levels exhibited a noticeable, but gradual, response to major rain events. Only three watercourse (stream) stations WC-01 (stream discharging to Pike Lake from the southwest), and WC-06 and WC-07 (both located on streams discharging to Duley Lake from the southeast) exhibited rapid and flashy hydrologic response to rainfall events characterized by higher peaks with steep rising and falling limbs.
- Water levels as high as 588.18 m and as low as 536.5 m were recorded at WC-11 (immediately downstream of Riordan Lake) and WC-09 (immediately downstream of the Duley Lake outlet), respectively.

Flow hydrographs were generated using stage-discharge rating curves. Hydrographs showed that the peak flows could range from 556 L/s (estimated at unnamed stream discharging to Pike Lake from the southwest [WC-01]) to 87,870 L/s (estimated at unnamed stream located immediately downstream of the Duley Lake outlet [WC-09]), noting that the peak flows were influenced by spring freshet.

Continuous water level record showing water level fluctuations and flow hydrographs based on the stage-discharge rating curves, at station WC-06 (located at unnamed stream discharging to Duley Lake from the southeast) are presented in Figure **8-10**.

A comparison of 2011–2012 historical water levels and flows (Stantec 2012) with the 2023–2024 water levels and flows, at stream stations located in proximity to historical stations, showed a similarity in range and/or season water level trends, noting that some deviation due to meteorological factors are generally expected in comparisons with historical results. Like 2023–2024 water levels, historical water levels also indicated an increase in water levels at stream stations due to spring freshet from mid-April to May. A station-wide comparison of water levels and flows is presented in the surface water baseline report (Annex 2A).

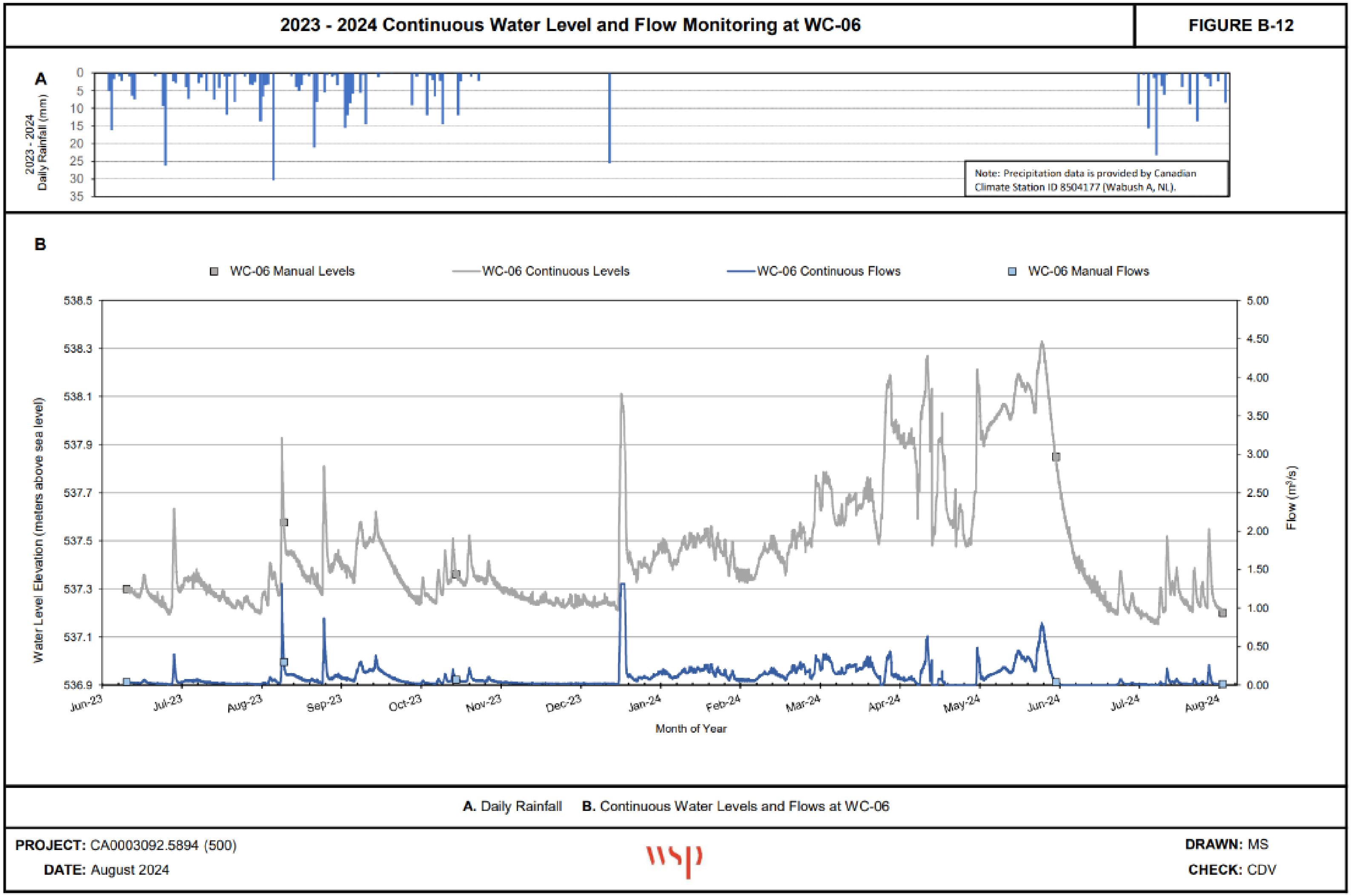


Figure 8-10: Continuous Water Level and Flow Monitoring at WC-06

8.4.2.3 Surface Water Quality

8.4.2.3.1 Lake Water Column Profiles

Water column profiles at Daviault Lake (Reference Lake), Duley Lake, Mills Lake, Molar Lake, Pike Lake, and Riordan Lake were measured during 20203-2024. Noting that the lake water column profiles were not measured during the previous assessment (Stantec 2012), the data represent significant improvement compared to the previous assessment. Based on the results of measurements, seasonal variation in water temperatures at all lake stations was observed, noting higher temperatures in the spring of 2023 and lower in the fall 2023. Temperature profiles showed that the reference and study lakes generally begin to thermally stratify in mid-June with the upper thermal layer increasing in temperature, become well stratified with a marked thermocline through the intermediate layers in August, and turnaround completely in October with well mixing (i.e., no thermally stratified conditions). Water column profiles at each of the lake basin stations also showed relatively stable electrical conductivity and dissolved oxygen with depth. The pH conditions at all lake basin stations were generally near neutral throughout the water column and demonstrated minor variations over depth and season, except for three lakes (Molar Lake, Daviault Lake and Mills Lake) where relatively higher and lower than neutral pH was observed in August 2024. Figure 8-11 shows lake column profiles measured in 2023 at Duley Lake station LL-02.

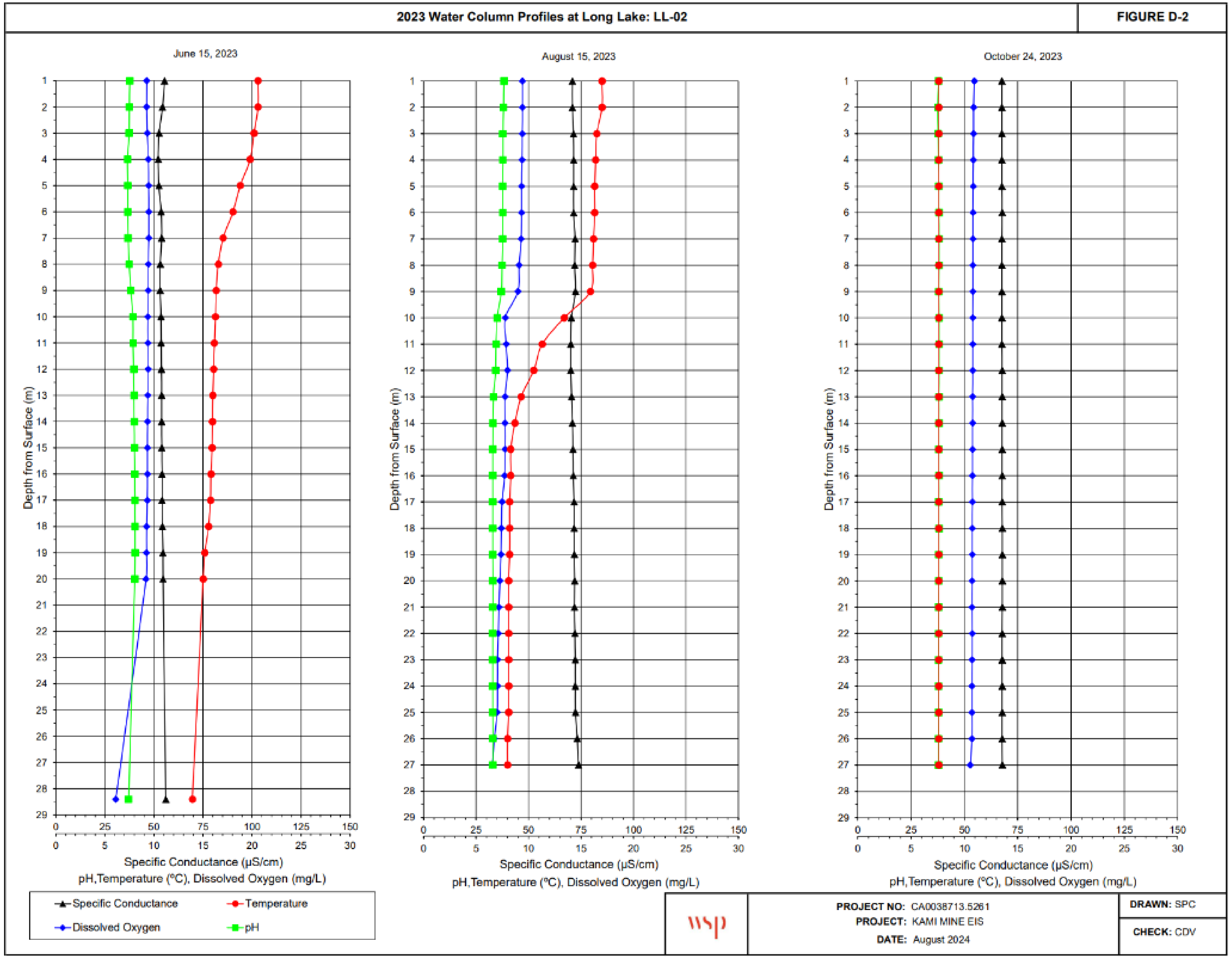


Figure 8-11: 2023 Water Column Profiles at Duley Lake Station LL-02

8.4.2.3.2 Water Quality in the Local Study Area

As discussed above in Section 8.4.1.3, Surface Water and Sediment Quality, water quality samples were collected and analyzed in laboratory to characterize background/baselines conditions. Table 8-15 presents summary statistics of general parameters, anion and nutrients (presented in Table 8-10) for all sampling stations. The lab results indicated that:

- pH values ranged from 6.52 to 8.03 with an average of 7.55, demonstrating slightly alkaline conditions and indicating no strong difference between stream and lake pH values. All lab pH values were within CCME guidelines. Note that the field pH values in some lake water samples were recorded below the CCME threshold of 6.5
- total alkalinity ranged from 9.9 to 99 mg/L with an average of 37.4 mg/L. The alkalinity values in this range are considering low to moderate. Some water samples were also tested for carbonate and bicarbonate alkalinity. While the carbonate alkalinity was measured below the detection limit (<1 mg/L), bicarbonate alkalinity ranged from 30 to 90 mg/L with an average of 52.25 mg/L
- total hardness ($CaCO_3$) ranged from 11 to 97 mg/L with an average of 37.2 mg/L. Parameters such as copper, cadmium, lead and nickel are hardness-adjusted in CCME guidelines. The range of hardness values result in lower CCME thresholds for lower hardness concentrations to higher thresholds for higher concentrations
- acidity concentrations ranged from <2.5 to 12 mg/L, noting that most values were measured below the reporting detection limit (RDL)
- electrical conductivity ranged from 26.1 to 191 µS/cm with average value of 78.2 µS/cm. The range of conductivity corresponds to values typically observed in lakes and streams
- the turbidity values ranged from 0 to 6.56 Nephelometric Turbidity Units with an average value of 0.42 Nephelometric Turbidity Units
- salinity was observed at <2 mg/L
- the TDS values ranged from <10 to 115 mg/L and the TSS ranged from <1 to 24 mg/L
- the mean colour value was 13.48, which is below the Canadian Drinking Water Quality Aesthetic guidelines of 15 true colour units for colour (Health Canada 2024)
- the DOC values ranged from 2.2 to 9.4 mg/L with an average of 3.78 mg/L and TOC ranged from 4.1 to 6.0 mg/L with an average of 4.6 mg/L
- anion sum ranged from 0.65 to 1.86 with an average of 1.08 and cation sum ranged from 0.64 to 1.98 with an average of 1.13
- Langelier saturation index values were measured negative and indicative of pH under-saturation with calcium carbonate ($CaCO_3$). Langelier Index @ 20C ranged from -1.55 to -0.08 with an average of -0.9 and Langelier Index @ 4C ranged from -1.8 to -0.33 with an average of -1.15. The negative Langelier saturation index values indicate that the local surface water will tend to dissolve solid $CaCO_3$ and will not be scale forming. Saturation @ 20C ranged from 8.05 to 8.99 with an average value of 8.6 and saturation @ 4C ranged from 8.3 to 9.24 with an average value of 8.85
- while the fluoride and dissolved bromide were observed below their detection limits (0.1 and 1.0 mg/L, respectively), dissolved chloride ranged from <1 to 2.7 mg/L, noting that most values of dissolved chloride were below the RDL of 1 mg/L
- dissolved sulphate ranged from 1.2 to 5.0 mg/L with an average value of 3.04 mg/L
- total ammonia ranged from below detection limit (<0.05 mg/L) to 0.43 mg/L and total un-ionized ammonia ranged from <0.00051 to 0.0098 mg/L, noting that most values were measured below the detection limit
- nitrate ranged from <0.1 to 27 mg/L and nitrite ranged from < 0.01 to 0.015 mg/L, noting that most values were measured below the detection limits. Samples were also tested for dissolved nitrate and nitrite. Both were measured below the detection limits of 0.044 and 0.033 mg/L, respectively
- total phosphorous ranged from the detection limit of 0.004 to 0.033 mg/L
- orthophosphate was measured below the detection limit of 0.01 mg/L
- reactive silica ranged from 2.5 to 4.3 mg/L with an average value of 3.48 mg/L

Table 8-15 presents summary statistics of total and dissolved metals (presented in Table 8-10) for all stations. With some exception, the concentrations of metals were below the CCME guidelines. Only ten samples reported slight exceedance of the CCME guidelines for small group of metals (i.e., aluminum, iron, manganese, lead, and copper), noting that the total phosphorous was observed to exceed ultra-oligotrophic (<4 µg/L) conditions and the observed concentrations ranged from ultra-oligotrophic (<4 µg/L) to meso-eutrophic conditions (20 to 35 µg/L). In addition to above parameters, samples collected at selected stations in August 2023 were also tested for radionuclides, surrogate recovery parameters and PAHs. The values of most parameters were observed below the

RDL except at an unnamed stream located immediately downstream of the Pike Lake outlet (WC-02), where benzo(a)pyrene, benzo(b/j)fluoranthene, benzo(g,h,i)perylene, and pyrene were observed above the RDL.

Water quality parameters at lake and watercourse (stream) stations were compared to the historical water quality results reported in 2011–2012 (Stantec 2012). The parameters were generally found to be in similar range and/or demonstrated a similar behaviour, noting some minor deviations for some parameters were observed. Historical water quality results (Stantec 2012) also showed exceedances of CCME guidelines for total cadmium (at Pike Lake, Waldorf River, and Duley [Long] Lake), total copper [at Mills Lake] and total iron [at Pike Lake], in addition to pH value of 5.67 [below CCME threshold] in one composite sample on Molar Lake). For details, refer to Surface Water Baseline Report (Annex 2A).

Table 8-15: Summary Statistics of Concentrations of General Parameters, Anions, and Nutrients in the Local Study Area

Parameter	Unit	CCME Guideline[a]		Detection Limit	All Stations							
General Parameters	-	Short Term	Long Term	-	# of Samples	# of Samples Above DL	Minimum	25th Percentile	Average	75th Percentile	95th Percentile	Maximum
Field pH		–	6.5 to 9	–	146	–	5.52	7.20	7.41	7.73	8.095	8.38
Field temperature	°C	–	Narrative[b]	–	146	–	-0.3	7.43	12.63	17.50	21	25.07
Lab pH		–	6.5 to 9	–	144	–	6.52	7.40	7.55	7.72	7.90	8.03
Bicarb. alkalinity	mg/L as $CaCO_3$	–	–	1	8	8	30.0	34.8	51.3	66.8	89.0	90.0
Carb. alkalinity	mg/L as $CaCO_3$	–	–	1	8	0	**0.5**	0.5	0.5	0.5	0.5	**0.5**
Total alkalinity	mg/L as $CaCO_3$	–	–	1	144	144	9.9	30.0	37.5	43.3	63.7	99.0
Acidity	mg/L as $CaCO_3$	–	–	5	132	5	**2.5**	2.5	2.7	2.5	2.5	12.0
Conductivity	µS/cm	–	–	1	144	144	26.1	63.0	78.2	87.3	129.9	191.0
Salinity		–	–	2	8	0	**1.00**	1.00	1.00	1.00	1.00	**1.00**
Turbidity	NTU	–	Narrative[c]	0.1	153	153	0	0.00	0.42	0.32	2.048	6.56
Calculated TDS	mg/L	–	–	1	8	8	35.0	40.0	56.5	71.8	94.0	95.0
TDS	mg/L	–	–	10	133	130	**5.0**	40.0	54.9	70.0	100.0	115.0
TSS	mg/L	–	–	1-10	144	12	**0.5**	5.0	4.6	5.0	5.0	24.0
Dissolved hardness	mg/L as $CaCO_3$	–	–	0.5	50	50	13.00	29.35	36.49	41.73	64.99	96.20
Total hardness	mg/L as $CaCO_3$	–	–	0.5-1	132	132	11.00	29.75	37.22	42.00	63.45	97.00
DOC	mg/L	–	–	0.4	132	132	2.20	3.10	3.78	4.30	5.69	9.40
TOC	mg/L	–	–	0.4	8	8	4.10	4.28	4.60	4.55	5.76	6.00
Colour	TCU	–	Narrative[d]	2	25	25	6.00	10.00	13.48	16.00	22.80	29.00
Anions and Nutrients												
Anion sum	me/L	–	–	–	8	–	0.65	0.75	1.08	1.40	1.84	1.86
Cation sum	me/L	–	–	–	8	–	0.64	0.76	1.13	1.48	1.97	1.98
Ion balance (% Difference)	%	–	–	–	0	–	–	–	–	–	–	–
Langelier index (@ 20C)		–	–	–	8	–	-1.55	-1.30	-0.90	-0.47	-0.12	-0.08
Langelier index (@ 4C)		–	–	–	8	–	-1.80	-1.55	-1.15	-0.72	-0.37	-0.33
Saturation pH (@ 20C)		–	–	–	8	–	8.05	8.32	8.60	8.84	8.94	8.99
Saturation pH (@ 4C)		–	–	–	8	–	8.30	8.57	8.85	9.10	9.191	9.24
Fluoride	mg/L	–	0.012	0.1	133	0	**0.05**	0.05	0.05	0.05	0.05	**0.05**
Dissolved chloride	mg/L	640	120	1	133	13	**0.50**	0.50	0.65	0.50	2.10	2.70
Dissolved bromide	mg/L	–	–	1	133	0	**0.50**	0.50	0.50	0.50	0.50	**0.50**
Dissolved sulphate	mg/L	–	–	1	133	133	1.20	2.50	3.04	3.60	4.44	5.00
Total ammonia	mg/L as NH_3	–	0.021 – 231[e]	0.061	115	7	**0.031**	0.031	0.039	0.031	0.080	0.525
Total ammonia-N	mg/L	–	0.017 – 190	0.05	133	7	**0.025**	0.025	0.031	0.025	0.039	0.430
Dissolved nitrate	mg/L as N	–	–	0.01-0.05	11	6	**0.005**	0.005	0.018	0.023	0.046	0.053
Dissolved nitrate	mg/L	–	–	0.044	11	6	**0.022**	0.022	0.071	0.075	0.205	0.240
Dissolved nitrite	mg/L	–	–	0.033	11	0	**0.017**	0.017	0.017	0.017	0.017	**0.017**
Dissolved nitrite	mg/L as N	–	–	0.01	11	0	**0.005**	0.005	0.005	0.005	0.005	**0.005**
Nitrite	mg/L as N	–	0.06	0.01-0.1	122	1	**0.005**	0.005	0.006	0.005	0.005	**0.050**
Nitrate	mg/L as N	3	124	0.01-0.1	122	8	**0.005**	0.050	0.057	0.050	0.110	0.270
Total phosphorus	mg/L	–	Guidance framework[f]	0.004-0.02	143	9	**0.002**	0.010	0.010	0.010	0.010	0.033
Nitrate + nitrite	mg/L as N	–	–	0.1	122	8	**0.05**	0.05	0.06	0.05	0.11	0.27
Dissolved nitrate + nitrite	mg/L as N	–	–	0.01-0.05	11	6	**0.005**	0.01	0.02	0.02	0.0455	0.053
Total Un-ionized ammonia	mg/L	–	0.019	0.00051-0.002	87	1	**0.00025**	0.00031	0.00066	0.00058	0.00150	0.00980
Orthophosphate	mg/L	–	–	0.01	52	0	**0.005**	0.005	0.005	0.005	0.005	**0.005**
Reactive silica	mg/L	–	–	0.5	8	8	2.5	3.28	3.48	3.80	4.125	4.3

Notes:

Bold numbers are values under detection limits and are adjusted to half values of detection limit for analytical purposes.

(a) CCME [Canadian Council of Ministers of the Environment] Water Quality Guidelines for the Protection of Aquatic Life (CCME 1999a).

(b) https://ccme.ca/en/chemical/209.

(c) https://ccme.ca/en/chemical/219.

(d) https://ccme.ca/en/chemical/69.

(e) https://ccme.ca/en/chemical/5.

(f) https://ccme.ca/en/chemical/167.

$CaCO_3$ = total hardness; DOC = dissolved organic carbon; DL = detection limit; N = nitrogen; NH_3 = ammonia; NTU = Nephelometric Turbidity Units; TCU = true colour unit; TDS = total dissolved solids; TOC = total organic carbon; TSS = total suspended solids; – = not applicable.

Table 8-16: Summary Statistics of Concentrations of Total and Dissolved Metals in the Local Study Area

Parameter		Unit	CCME Guideline [(a)]		Detection Limit (DL)	All Stations							
Metals	Type	-	Short Term	Long Term	-	# of Samples	# of Samples Above DL	Minimum	25th Percentile	Average	75th Percentile	95th Percentile	Maximum
Ag	Total	µg/L	–	0.25	0.005-0.09	144	1	**0.0025**	0.010	0.024	0.045	0.045	**0.045**
	Dissolved	µg/L			0.005-0.09	144	0	**0.0025**	0.010	0.024	0.045	0.045	**0.045**
Al	Total	µg/L	–	5, 100[(b)]	0.5-4.9	144	137	**1.5**	8.1	19.5	20.0	53.2	313.0
	Dissolved	µg/L			0.5-4.9	144	112	**1.5**	3.2	12.0	11.6	38.4	170.0
As	Total	µg/L	–	5	0.02-1	144	31	0.043	0.050	0.258	0.500	0.500	**0.500**
	Dissolved	µg/L			0.02-1	144	30	**0.050**	0.050	0.256	0.500	0.500	**0.500**
Au	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			2	9	0	**1.000**	1.000	1.000	1.000	1.000	**1.000**
B	Total	µg/L	29000	1500	10-50	144	1	**5.0**	5.0	12.0	25.0	25.0	**25.0**
	Dissolved	µg/L			10-50	144	0	**5.0**	5.0	11.9	25.0	25.0	**25.0**
Ba	Total	µg/L	–	–	0.02-2	144	144	6.0	8.9	11.7	13.0	19.0	44.5
	Dissolved	µg/L			0.02-2	144	144	6.1	8.8	11.4	13.0	19.9	28.9
Be	Total	µg/L	–	–	0.01-0.4	144	1	**0.005**	0.050	0.109	0.200	0.200	**0.200**
	Dissolved	µg/L			0.01-0.4	144	1	**0.005**	0.050	0.109	0.200	0.200	**0.200**
Bi	Total	µg/L	–	–	0.005-1	144	2	**0.0025**	0.500	0.400	0.500	0.500	**0.500**
	Dissolved	µg/L			0.005-1	144	0	**0.0025**	0.500	0.400	0.500	0.500	**0.500**
Ca	Total	µg/L	–	–	50-200	144	144	2850	6853	8579	9503	14000	21000
	Dissolved	µg/L			50-200	144	144	2820	6900	8748	9733	15000	21400
Cd	Total	µg/L	0.11, variable, 7.7[(c)]	0.04, variable, 0.37[(c)]	0.005-0.09	144	3	**0.0025**	0.0050	0.0229	0.0450	0.0450	**0.0450**
	Dissolved	µg/L			0.005-0.09	144	1	**0.0025**	0.0050	0.0226	0.0450	0.0450	**0.0450**
Ce	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			0.3	9	0	**0.150**	0.150	0.150	0.150	0.150	**0.150**
Co	Total	µg/L	–	–	0.005-0.5	144	30	0.0058	0.10	0.15	0.25	0.25	0.33
	Dissolved	µg/L			0.005-0.5	144	27	**0.0025**	0.100	0.150	0.250	0.250	**0.250**
Cs	Total	µg/L	–	–	0.2	30	0	**0.100**	0.100	0.100	0.100	0.100	**0.100**
	Dissolved	µg/L			0.2	30	0	**0.100**	0.100	0.100	0.100	0.100	**0.100**
Cr	Total	µg/L	–	–	0.1-5	144	29	**0.050**	0.500	1.357	2.500	2.500	**2.500**
	Dissolved	µg/L			0.1-5	144	29	0.110	0.500	1.356	2.500	2.500	**2.500**
Cu	Total	µg/L	–	2, variable, 4, 2[(d)]	0.05-0.9	144	38	0.130	0.250	0.403	0.450	0.828	1.810
	Dissolved	µg/L			0.05-0.9	143	106	**0.100**	0.450	0.843	1.200	1.629	2.570
Dy	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			2	9	0	**1.000**	1.000	1.000	1.000	1.000	**1.000**
Er	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			0.5	9	0	**0.250**	0.250	0.250	0.250	0.250	**0.250**
Eu	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			0.4	9	0	**0.200**	0.200	0.200	0.200	0.200	**0.200**
Fe	Total	µg/L	–	300	1-100	144	86	**5.0**	39.9	87.0	68.3	173.4	1980.0
	Dissolved	µg/L			1-100	143	80	**2.5**	21.5	53.5	50.0	107.6	1020.0
Gd	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			0.5	9	0	**0.3**	0.3	0.3	0.3	0.3	**0.3**
Hg	Total	µg/L	–	0.026	0.01-0.1	136	0	**0.005**	0.050	0.044	0.050	0.050	**0.050**
	Dissolved	µg/L			0.01-0.1	136	0	**0.005**	0.050	0.044	0.050	0.050	**0.050**
Ho	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			0.3	9	0	**0.150**	0.150	0.150	0.150	0.150	**0.150**
Ir	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			2	9	0	**1.000**	1.000	1.000	1.000	1.000	**1.000**
K	Total	µg/L	–	–	50-200	144	143	**100**	827	955	1013	1485	2100
	Dissolved	µg/L			50-200	144	143	**100**	825	984	1078	1500	2200

Parameter		Unit	CCME Guideline[a]		Detection Limit (DL)	All Stations							
Metals	Type	-	Short Term	Long Term	-	# of Samples	# of Samples Above DL	Minimum	25th Percentile	Average	75th Percentile	95th Percentile	Maximum
La	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			0.3	9	0	**0.150**	0.150	0.150	0.150	0.150	**0.150**
Li	Total	µg/L	–	–	0.5-5	144	7	**0.250**	1.000	1.541	2.500	2.500	**2.500**
	Dissolved	µg/L			0.5-5	144	5	**0.250**	1.000	1.538	2.500	2.500	**2.500**
Lu	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			1	9	0	**0.500**	0.500	0.500	0.500	0.500	**0.500**
Mg	Total	µg/L	–	–	50	144	144	930	2743	3606	4425	6487	9900
	Dissolved	µg/L			50	144	144	990	2800	3718	4570	6855	10400
Mn	Total	µg/L	Equation[e]	Variable[e]	0.05-2	144	141	**1.00**	6.3	49.3	26.3	129.6	1400.0
	Dissolved	µg/L			0.05-2	144	103	0.30	1.0	30.8	11.4	126.0	1300.0
Mo	Total	µg/L	–	73	0.05-1	144	74	0.198	0.426	0.537	0.590	1.077	2.000
	Dissolved	µg/L			0.05-1	144	74	0.106	0.500	0.525	0.587	0.859	1.400
Na	Total	µg/L	–	–	50-100	144	144	230	475	730	747	1885	2500
	Dissolved	µg/L			50-100	144	144	0.4	480	739	775	1914	2510
Nd	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			2	9	0	**1.000**	1.000	1.000	1.000	1.000	**1.000**
Ni	Total	µg/L	–	25, variable, 150, 25[f]	0.02-1	144	30	0.094	0.500	0.459	0.500	0.500	1.200
	Dissolved	µg/L			0.02-1	144	30	0.097	0.500	0.555	0.500	0.500	14.000
P	Total	µg/L	–	4	2-100	94	30	3.5	9.1	13.0	10.0	50.0	**50.0**
	Dissolved	µg/L			2-100	94	29	2.7	4.7	35.8	50.0	50.0	**50.0**
Pb	Total	µg/L	–	1, variable, 7, 1[g]	0.005-0.5	144	32	**0.0025**	0.100	0.225	0.250	0.250	3.900
	Dissolved	µg/L			0.005-0.5	144	28	**0.0025**	0.100	0.151	0.250	0.250	**0.250**
Pd	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			1	9	0	**0.500**	0.500	0.500	0.500	0.500	**0.500**
Pr	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			0.4	9	0	**0.200**	0.200	0.200	0.200	0.200	**0.200**
Pt	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			3	9	0	**1.500**	1.500	1.500	1.500	1.500	**1.500**
Rb	Total	µg/L	–	–	0.2	30	30	0.780	1.525	1.709	1.900	2.055	2.400
	Dissolved	µg/L			0.2	30	30	0.730	1.500	1.768	2.000	2.255	2.500
Ru	Total	µg/L	–	–	–	0	–						
	Dissolved	µg/L			0.2	9	0	**0.100**	0.100	0.100	0.100	0.100	**0.100**
S	Total	µg/L	–	–	3000	79	0	**1500**	1500	1500	1500	1500	**1500**
	Dissolved	µg/L			3000	79	0	**1500**	1500	1500	1500	1500	**1500**
Sb	Total	µg/L	–	–	0.02-0.5	144	1	**0.010**	0.250	0.202	0.250	0.250	**0.250**
	Dissolved	µg/L			0.02-0.5	144	1	**0.010**	0.250	0.202	0.250	0.250	**0.250**
Sc	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			3	9	0	**1.500**	1.500	1.500	1.500	1.500	**1.500**
Se	Total	µg/L	–	1	0.04-2	144	3	**0.020**	0.050	0.473	1.000	1.000	**1.000**
	Dissolved	µg/L			0.04-2	144	0	**0.020**	0.050	0.473	1.000	1.000	**1.000**
Si	Total	µg/L	–	–	50-100	143	143	810	1500	1790	1970	2664	4200
	Dissolved	µg/L			50-100	143	143	860	1525	1832	2000	2792	4100
Sm	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			2	9	0	**1.000**	1.000	1.000	1.000	1.000	**1.000**
Sn	Total	µg/L	–	–	0.2-5	144	0	**0.100**	0.500	1.114	2.500	2.500	**2.500**
	Dissolved	µg/L			0.2-5	144	0	**0.100**	0.500	1.114	2.500	2.500	**2.500**
Sr	Total	µg/L	–	–	0.05-1	143	143	8.0	11.6	13.7	15.0	20.0	28.0
	Dissolved	µg/L			0.05-1	143	143	8.2	11.6	13.7	15.0	20.0	29.0

Parameter		Unit	CCME Guideline [a]		Detection Limit (DL)	All Stations							
Metals	Type	-	Short Term	Long Term	-	# of Samples	# of Samples Above DL	Minimum	25th Percentile	Average	75th Percentile	95th Percentile	Maximum
Tb	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			1	9	0	**0.500**	0.500	0.500	0.500	0.500	**0.500**
Te	Total	µg/L	–	–	1-2	65	0	**0.500**	0.500	0.731	1.000	1.000	**1.000**
	Dissolved	µg/L			1-2	65	0	**0.500**	0.500	0.731	1.000	1.000	**1.000**
Th	Total	µg/L	–	–	1-2	74	0	**0.500**	0.500	0.682	1.000	1.000	**1.000**
	Dissolved	µg/L			1-2	74	0	**0.500**	0.500	0.682	1.000	1.000	**1.000**
Tm	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			0.3	9	0	**0.150**	0.150	0.150	0.150	0.150	**0.150**
Ti	Total	µg/L	–	–	0.5-5	144	8	**0.250**	2.500	2.159	2.500	2.500	12.300
	Dissolved	µg/L			0.5-5	144	0	**0.250**	2.500	2.047	2.500	2.500	**2.500**
Tl	Total	µg/L	–	0.8	0.002-0.05	144	21	**0.001**	0.005	0.014	0.025	0.025	**0.025**
	Dissolved	µg/L			0.002-0.05	144	21	**0.001**	0.005	0.014	0.025	0.025	**0.025**
U	Total	µg/L	33	15	0.002-0.1	144	69	**0.05**	0.05	0.09	0.11	0.22	0.50
	Dissolved	µg/L			0.002-0.1	144	61	0.043	0.050	0.084	0.092	0.236	0.490
V	Total	µg/L	–	–	0.2-5	144	2	**0.100**	0.250	1.013	2.500	2.500	**2.500**
	Dissolved	µg/L			0.2-5	144	0	**0.100**	0.250	1.001	2.500	2.500	**2.500**
W	Total	µg/L	–	–	1	82	0	**0.500**	0.500	0.500	0.500	0.500	**0.500**
	Dissolved	µg/L			1	82	0	**0.500**	0.500	0.500	0.500	0.500	**0.500**
Y	Total	µg/L	–	–	2-3.2	133	0	**1.00**	1.00	1.08	1.00	1.60	**1.60**
	Dissolved	µg/L			2	133	0	**1.00**	1.00	1.00	1.00	1.00	**1.00**
Yb	Total	µg/L	–	–	–	0	–	–	–	–	–	–	–
	Dissolved	µg/L			3	9	0	**1.50**	1.50	1.50	1.50	1.50	**1.50**
Zn	Total	µg/L	Variable[h]	Variable[h]	0.1-5	144	33	0.53	2.5	2.5	2.5	2.5	27.0
	Dissolved	µg/L			0.1-5	144	33	0.97	2.5	3.2	2.5	5.3	53.0
Zr	Total	µg/L	–	–	0.1-1	127	0	**0.050**	0.050	0.280	0.500	0.500	**0.500**
	Dissolved	µg/L			0.1-1	127	1	**0.050**	0.050	0.281	0.500	0.500	**0.500**

Notes:
Bold numbers are values under detection limits and are adjusted to half values of detection for analysis purpose.
(a) CCME Water Quality Guidelines for the Protection of Aquatic Life (CCME 1999a).
(b) https://ccme.ca/en/chemical/4.
(c) https://ccme.ca/en/chemical/20.
(d) https://ccme.ca/en/chemical/71.
(e) https://ccme.ca/en/chemical/129.
(f) https://ccme.ca/en/chemical/139.
(g) https://ccme.ca/en/chemical/124.
(h) https://ccme.ca/en/chemical/229.
CCME = Canadian Council of Ministers of the Environment; – = not applicable.

8.4.2.4 Sediment Quality

8.4.2.4.1 Sediment Quality in Local Study Area

Table 8-17 presents summary statistics of general parameters, anions, nutrients and metals (presented in Table 8-10) at all stations. The lab results indicated that:

- Sediment samples at lake and watercourse (stream) stations were generally sand dominated, except two samples at Daviault Lake and Molar Lake, which were found to be dominated with silt, and showed some seasonal variations in grain sizes of clay, sand, and silt. The grain size distribution showed that clay, sand, and silt contents ranged from <2% to 29%, 23% to 98%, and <2% to 51%, respectively. While the sediment texture at lakes ranged from clay loam to loamy sand, the sediment texture at watercourses was generally described as sand, nothing that variation to loamy sand texture was also observed at three watercourse (stream) stations.
- TOC in the LSA ranged from 500 to 150,000 mg/kg with an average of 41,230 mg/kg. Nitrogen ranged from <0.01% to 1.6%, while calculated total Kjeldahl nitrogen ranged from <100 to 16,000 µg/g. Both nitrate and nitrite were observed below the detection limit at most lake station except Duley, Molar and Mills Lakes where nitrite was observed once above RDL in October 2023.
- Sediment samples at lakes and watercourse stations were below relevant sediment quality guidelines, with the exception of some metal (i.e., arsenic, cadmium, chromium, copper, lead, mercury, and zinc) that were found elevated in some lake samples at eight stations and arsenic and chromium that were found to be elevated in some samples at five watercourse (stream) stations.

Sediment quality parameters at lake and watercourse (stream) stations were also compared to historical results (Stantec 2012) and were found to generally demonstrate similar characteristics. Historical sediment quality results (Stantec 2012) also showed exceedances of CCME ISQG for chromium (at Molar Lake and Duley Lake), cadmium (at Molar Lake), copper (at Molar Lake) and zinc (at Molar Lake); however, the concentrations were reported below CCME PEL. For details, refer to the surface water baseline report included in Annex 2A of the EIS.

Table 8-17: Summary Statistics of Concentrations of Sediment Quality Parameters (physical, anion, nutrients, and metals) in the Local Study Area

Parameter	Unit	CCME Guideline [a]		Detection Limit	All Stations							
Physical Parameters	–	ISQG	PEL	–	# of Samples	# of Samples Above DL	Minimum	25th Percentile	Average	75th Percentile	95th percentile	Maximum
Clay	%	–	–	2	30	20	**1.0**	1.0	6.1	7.4	18.1	29.0
Sand	%	–	–	2	30	30	23.0	68.3	79.2	96.8	98.0	98.0
Silt	%	–	–	2	30	20	**1.0**	1.0	14.6	25.8	45.9	51.0
Texture	n/a	–	–	–	30	–	–	–	–	–	–	–
Moisture	%	–	–	1	55	55	11.0	22.5	50.8	89.5	93.0	94.0
Anions and Nutrients												
Nitrogen (N)	%	–	–	0.01	55	49	**0.005**	0.023	0.334	0.625	1.330	1.600
TOC	mg/kg	–	–	500	55	55	500	7050	41235	68500	136000	150000
Calculated total Kjeldahl nitrogen	ug/g	–	–	100	55	49	**50**	224.5	3361	6235	13360	16000
NO_2	ug/g	–	–	0.5	55	3	**0.25**	0.25	0.28	0.25	0.38	0.9
NO_3	ug/g	–	–	2	55	0	**1**	1	1	1	1	**1**
NO_2 + NO_3	ug/g	–	–	3	55	0	**1.5**	1.5	1.5	1.5	1.5	**1.5**
Metals												
Ag	ug/g	–	–	0.2-1	55	16	**0.10**	0.10	0.17	0.23	0.42	0.50
Al	ug/g	–	–	50-250	55	55	400	3650	8151	13000	16300	30000
As	ug/g	5.9	17	1-5	55	30	**0.50**	0.50	1.52	1.75	4.97	7.40
B	ug/g	–	–	5-25	55	0	**2.5**	2.5	2.7	2.5	2.5	**12.5**
Ba	ug/g	–	–	0.5-2.5	55	55	25	82	534	535	1760	7000
Be	ug/g	–	–	0.2-1	55	23	**0.10**	0.10	0.21	0.32	0.50	0.59
Bi	ug/g	–	–	1-5	55	0	**0.50**	0.50	0.54	0.50	0.50	**2.50**
Ca	ug/g	–	–	50-250	55	55	320	2800	5582	6350	9480	34000
Cd	ug/g	0.6	3.5	0.1-0.5	55	33	**0.05**	0.05	0.30	0.52	0.93	0.99
Co	ug/g	–	–	0.1-0.5	55	55	2.1	4.6	8.1	9.9	18.0	31.0
Cr	ug/g	37	90	1-5	55	55	2.0	18.5	34.5	49.5	65.8	85.0
Cu	ug/g	35.7	197	0.5-2.5	55	55	1.4	3.7	13.1	21.5	30.6	46.0
Fe	ug/g	–	–	50-250	55	55	6400	26500	48769	60000	112000	170000
Hg	ug/g	0.17	0.486	0.05-0.25	55	19	**0.025**	0.025	0.061	0.097	0.160	0.230
K	ug/g	–	–	200-1000	55	52	**100**	520	1189	1450	3260	3700
Mg	ug/g	–	–	50-250	55	55	180	2750	4511	5300	9150	20000
Mn	ug/g	–	–	1-50	55	55	100	905	7591	9300	31500	66000
Mo	ug/g	–	–	0.5-2.5	55	51	**0.25**	1.15	6.48	5.55	22.90	73
Na	ug/g	–	–	50-250	55	38	**25**	25	80	110	150	250
Ni	ug/g	–	–	0.5-2.5	55	55	1.9	9.9	21.2	27.0	50.3	61.0
P	ug/g	–	–	50-250	55	55	97	580	1002	1300	2150	4800
Pb	ug/g	35	91.3	1-5	55	53	**0.5**	2.6	10.6	13.0	34.8	58.0
Sb	ug/g	–	–	0.2-1	55	1	**0.1**	0.1	0.1	0.1	0.1	**0.5**
Se	ug/g	–	–	0.5-2.5	55	22	**0.25**	0.3	0.7	1.1	1.7	2.4
Sn	ug/g	–	–	1-5	55	6	**0.5**	0.5	0.8	0.5	1.9	9.6
Sr	ug/g	–	–	1-5	55	55	2.7	12.0	15.7	19.5	26.6	37.0
Tl	ug/g	–	–	0.05-0.25	55	49	**0.025**	0.099	0.268	0.320	0.607	2.100
U	ug/g	–	–	0.05-0.25	55	55	0.095	1.050	4.476	6.600	13.600	17.000
V	ug/g	–	–	5-25	55	53	**2.5**	12.3	22.3	32.0	40.3	49.0
Zn	ug/g	123	315	5-25	55	55	7.4	25.5	64.9	90.5	140.0	220.0

Notes:
Bold numbers are values under detection limits and adjusted to half values of detection for analysis purpose.
(a) CCME Sediment Quality Guidelines for the Protection of Aquatic Life Freshwater and Marine ISQG/PEL 1999b.
CCME = Canadian Council of Ministers of the Environment; DL = detection limit; ISQG = Interim Sediment Quality Guidelines; PEL = Probable Effect Level; – = not applicable.

8.5 Effects Assessment

8.5.1 Methods

8.5.1.1 Effect Pathway Screening

Interactions between Project components or activities, and the corresponding potential changes to the environment that could result in a potential effect to the surface water VEC were identified by an effect pathway screening. The effect pathway screening was used to inform the residual Project and cumulative effects analyses for the surface water VEC. Each pathway was initially assumed to have an interaction that would results in potential effects on surface water quantity and quality.

Potential pathways from Project activities to surface water quantity and quality were identified using the following:

- review of the Chapter 2, Project Description and scoping of potential effects by the EIS team for the Project
- input from engagement (Chapter 22, Engagement)
- scientific knowledge
- review of EISs for similar mining projects, including the previous EIS (Alderon 2012)
- previous experience with mining projects
- consideration of key issues (Section 8.3.1, Key Issues)

Potential adverse effects of the Project were then identified, and practicable mitigation was applied to avoid, minimize and/or rehabilitate effects on surface water quantity, surface water and sediment quality. Avoidance and minimization are widely recognized as the most important for biodiversity conservation (BBOP 2015). Avoidance designs and actions integrated into the Project were developed iteratively by the Project's EIS team. The effectiveness of mitigation measures proposed for each effect pathway was assessed to determine whether the mitigation would address the potential Project effect such that the pathway was eliminated, would result in a negligible adverse effect on surface water quantity, surface water and sediment quality or if residual adverse effects on surface water quantity, surface water and sediment and quality from the Project remained.

This effect pathway screening was a preliminary assessment that was intended to focus the effects analysis on effect pathways that required a more quantitative or comprehensive assessment of effects on VECs. Using scientific knowledge, feedback from consultation, logic, experience with similar developments, and an understanding of the effectiveness of mitigation (i.e., level of certainty that the proposed mitigation would work), each effect pathway was categorized as one of the following:

- **No effect pathway**—The effect pathway could be removed (i.e., the effect would be avoided) by avoidance measures and/or additional mitigation so that the Project would result in no measurable environmental change relative to existing conditions or guideline values (e.g., air, soil, or water quality guidelines), and therefore would have no residual effect on surface water quantity or quality.
- **Negligible effect pathway—**With the application of mitigation, the effect pathway could result in a measurable but minor environmental change relative to existing conditions or guideline values, but the change is sufficiently small that it would have a negligible residual effect on surface water quantity or quality (e.g., an increase in a water quality parameter that is negligible compared to the range of existing/background values and is well within regulatory threshold for that parameter). Therefore, further detailed assessment of the residual effect is not warranted as the effect pathway would not be expected to result in a significant residual Project or cumulative effect on surface water quantity, surface water quality or sediment quality.
- **Residual effect pathway—**Even with the application of mitigation, the effects pathway is still likely to result in a measurable environmental change relative to existing conditions or guideline values that could cause a greater than negligible adverse or positive effect on surface water quantity surface water quality or sediment quality and warrants additional assessment.

Project interactions determined as no effect pathway or negligible effect pathways were not carried forward for further assessment (Section 8.5.3). Residual effect pathways that could result in changes to the environment with one or more associated measurable parameter and have the potential to cause a greater than negligible effect on surface water quantity surface water or sediment quality were carried forward to the residual Project effects analysis (Section 8.5.3) and residual cumulative effects analysis (Section 8.5.4).

8.5.1.2 Residual Project Effect Analysis

The residual effects analysis measures and describes the effects of the Project on the surface water quantity, surface water and sediment quality relative to existing/background conditions and exceeding criteria/thresholds. The residual effects analysis was conducted using the temporal snapshot identified for the assessment (Section 8.3.3, Assessment Boundaries). Residual effects are described for each of the measurement indicators for the residual effect pathways identified.

For the residual effect pathways identified for surface water quantity and quality in the LSA, residual effects were described for each of the measurement indicator (Section 8.5.2.3, Residual Effect Pathways):

- **Surface water quantity**–provides a comparative quantitative assessment of changes to flows and water levels in receiving environment for pre-mine and mine conditions
- **Surface water quality**–provides a comparative qualitative assessment of the changes to COPCs (Section 8.5.1.2.2, Constituent of Potential Concern) in the LSA with respect to water quality thresholds for the protection of aquatic and terrestrial life (Section 8.5.1.2.3, Development of Water Quality Criteria/Thresholds)

For any residual effect pathways identified for sediment quality in the LSA, residual effects were described for the measurement indicator (Section 8.5.2.3):

- **Sediment quality**–provides a comparative qualitative assessment of the changes in sediment quality parameters in relation to changes in surface water quality in the LSA with respect to sediment quality thresholds for the protection of aquatic and terrestrial life

The emphasis of the surface water quantity assessment was the comparison of modelled flows and water levels at key receiving waterbodies (Duley Lake and Pike Lake) for pre-mine and mine conditions, whereas the emphasis of surface water quality assessment was the comparison of modelled water quality COPC concentrations in the receiving environment for Construction, Operations, and Closure and the far future (Post-closure) relative to existing conditions and established water quality criteria/thresholds for the Project. Note that for waterbodies and streams (watercourses) that did not directly receive Project effluent and but were impacted by the Project footprint were evaluated by the simple water balance (Section 8.5.1.2.1, Methods to Conduct Residual Effect Analysis) to estimate changes in water quantity. This process provided the opportunity to evaluate the extent and duration of the predicted changes to surface water quantity and quality. The models/approaches developed to support the surface water quantity and quality assessment are described in Section 8.5.1.2.1.

After surface water quality modelling/assessment was complete, surface water COPCs (modelled parameters) were screened on the basis that, if elevated above baseline/background conditions and/or criteria/thresholds in the receiving environment as a result of the Project, they may potentially pose a risk to aquatic and terrestrial life. The methods used to determine the COPCs and to develop the Project-specific thresholds are summarized in Section 8.5.1.2.2 and Section 8.5.1.2.3. The analysis of potential changes to sediment quality parameters was conducted through a qualitative evaluation of proposed Project-related direct discharges and deposition of site air emissions to the receiving environment and the modelled interaction of the sediment-water interface based on projected water quality changes.

Models developed to support the surface water quantity and quality are briefly described in Section 8.5.1.2.1.

8.5.1.2.1 Methods to Conduct Residual Effect Analysis

The residual effect analysis was conducted through the development and integration of the following models:

- Site-Wide Water Balance and Water Quality Model (WBWQM)
- Duley Lake Conceptual Site Model (DLCSM)
- Local Water Balance Model (LWBM)

The purpose of the WBWQM was to predict the quantity and quality of water leaving the Project (i.e., run-off and treated effluent discharge) and entering the receiving environment (Duley Lake and Pike Lake). The results of the DLCSM provided modelled inputs to the WBWQM, which predicted effects on surface water quality in the near-field area of the discharge locations. The purpose of DLCSM was to assess quantify mixing and dilution in a localized area surrounding the discharge locations in Duley Lake (i.e., within 100 m of point of discharge) for the diffuser. The WBWQM quantified mixing and dilution ratios from the DLCSM to describe treated effluent characteristics so that mixed concentration of these water could be calculated. While the WBWQM provided the model output of surface water quantity and quality at key locations, LWBM was also used to predict changes to surface water quantity in waterbodies (lakes) and streams (watercourses) not modelled in the WBWQM. Summary descriptions of WBWQM, DLCSM, and LWBM follow.

Site-Wide Water Balance and Water Quality Model

A Site-Wide Water Balance and Water Quality Model (WBWQM) was developed to represent the Construction, Operations, and Closure phases as well as the Post-closure period of the Project (TSD VI). The WBWQM was constructed in GoldSim (version 15.0), a versatile and flexible platform developed by the GoldSim Technology Group and well suited for visualizing and simulating dynamic systems such as mine site water and load (water quality) balances.

WBWQM for the Project included for two conditions: pre-mine condition (i.e., pre-development, natural case) and base case (i.e., with Project). Details of both conditions/cases are as follows:

Pre-mine (pre-development) case—The pre-mine module of the WBWQM considered no mine area footprints and/or water-related management activities. Under pre-mine conditions:

- Duley Lake receives inflows from Riordan Lake, Waldorf River, and Mills Lake, with Mills Lake receiving inflows from Molar Lake. Duley Lake then discharges through the Duley Lake outlet.
- Elfie and End Lakes and Upper Mid Lake drain into Mid Lake, which then flows into Rose Lake. Rose Lake feeds into Pike Lake, which subsequently flows into Pike Lake North. Pike Lake North then discharges into the Walsh River, which ultimately flows into the Duley Lake outlet.
- Daviault Lake and Rectangle Lake have no known surface and sub-surface flow connection to the natural catchments where the Project is planned to be constructed.

Mine (base) case—Mine (base) case module of the WBWQM had mine plan and water management activities with the Project fully encoded. Under the mine case, the surface water assessments considered surface water quantity and quality effects that may occur from the Project during the Construction, Operations, Closure phases and Post-closure period. Specific details of Project activities/effects considered during each Project phase are as follows:

- **Construction and Operations** (Construction [Year -1], and Operations [years 0 through 24])
    - Under the Construction and Operations phase:
        - The maximum Project footprint is represented by this phase.
        - Rose Pit receives groundwater seepage from nearby lakes, with the majority of seepage from Pike Lake.
        - Mid Lake run-off is diverted to Pike Lake to facilitate redirect clean, non-contact water around the pit.
        - Additional water is transferred from Duley Lake to Pike Lake to mitigate the residual effects of groundwater seepage from Pike Lake, thereby maintaining lake levels.
        - All contact water is collected and routed through a series of ponds prior to discharge to Duley Lake.
        - No contact water is discharged to Pike Lake.
        - Rose Pit collection pond (also referred to as Rose Pit sedimentation pond; receiving discharge from Rose Pit sump, pumped flow from the overburden stockpile collection pond and retention basin 0-2 and mine rock stockpile north collection ponds) and tailings storage facility pond report to Duley Lake.
        - Run-off from water retention basins (0 through 9) is modelled as non-contact run-off and is integrated into overall water management infrastructure.
        - In addition to water transfers from Duley Lake to Pike Lake and tailings storage facility mill, Duley Lake also supplies fresh water to the worker accommodations.
        - Sewage treatment effluent reports to Duley Lake.
- **Closure** (Pit flooding period; years 25 through 36)
    - Under the Closure phase:
        - Accelerated flooding of the Rose Pit occurs with water transfers from Duley Lake, stockpile collection ponds and the tailings storage facility impoundment.
        - Water management layout is kept in place, including the water transfers from Duley Lake to Pike Lake.
        - No discharge from mine facilities to the surrounding environment is assumed.
        - Closure phase groundwater seepage rates are assumed as a function of pit lake elevation.
        - Pit filling strategy includes the collection of mine rock stockpile seepage and overburden stockpile run-off, then conveyance of these waters to the bottom of the Rose Pit.
        - Groundwater inflow to the pit is assumed to be evenly distributed between the bottom and upper pit layers.

- **Post-closure** (years 37 through 73)
  - Post-closure (i.e., far-future) effects were included in the water quality assessment because, for surface water quality, the duration of effects from the Project could occur well beyond Closure. The far-future effects considered the potential for the long-term, extremely slow migration of COPCs from the tailing management facility, mine rock stockpile, overburden stockpile via the groundwater pathway to the receiving environment. While it is not possible to accurately predict potential effects thousands of years into the future, the temporal extent and mass loading inputs of the far-future assessment have been developed so that the modelled results provide a reasonable, conservative representation of the maximum potential changes to surface water quality in receiving lakes and the downstream environment. The assessment of effects in the Post-closure period (i.e., far-future) includes the following assumptions:
    - Rose Pit is flooded and discharges to Pike Lake.
    - Mine rock stockpile is revegetated, with seepage from the mine rock stockpile continuing to be pumped into the bottom layer of the Rose Pit.
    - Surface run-off from the mine rock stockpile is directed to the surrounding environment, including Duley Lake, Mills Lake, and Waldorf River.
    - Seepage and surface run-off from the overburden stockpile flows into Pike Lake.
    - Tailing storage facility is assumed regraded and revegetated, with no ponded water formation allowed on the surface.
    - Surface run-off from the tailing storage facility impoundment flows into Riordan Lake.
    - Seepage from both the tailing storage facility impoundment and dam embankment discharges to the surrounding environment, including Duley Lake, Riordan Lake, Waldorf River and Rectangle Lake.

As a part of WBWQM development, analysis of climate data and comparison of regional and global datasets were also completed. Multiple realizations (n=40) of the WBWQM model were run so that each year of the mine life is run with all the possible combinations of the natural climate series. Forward model simulations incorporated projected temperature, and precipitation increases due to climate change. Climate change scenario data for the Project were obtained from downscaled (10 km x 10 km) and bias-adjusted CMIP6 simulations. SSP2-4.5 scenario, a middle-of-the road scenario, was adopted. A watershed model was also constructed to represent natural (non-contact) catchment flows as a function of climate and landform type. The outputs from this watershed model were used as inputs to the site-wide water balance model. Watershed model calibration was conducted by adjusting key parameters related to evapotranspiration, soil properties, snow dynamics, and routing to regional observations of flow from Water Survey of Canada. Per TSD VI, the specific mine water balance modelling approach were developed depending on the mine component or facility in each question. Key model inputs and assumptions for mine component water balances were based on studies and supporting water management plans developed for the Kami pre-feasibility study. For details about input and assumption, refer to TSD VI.

For water quality modelling, background surface water quality source terms have been derived as mean values from the measured data collected from June 2023 through October 2024 (Table 2-15 of TSD VI). Background groundwater quality terms were derived from measured bedrock water quality reported in the Alderon 2012 EIS (Alderon 2012). Geochemical source terms were derived from geochemical characterization studies advanced by Okane (2024a, 2025) and informed by previous studies conducted by Stantec (2013). Mine rock stockpile source terms are based on kinetic test data associated with neutral mine drainage (e.g., non-acidic conditions). Source term for seepage from the overburden stockpile was derived from a single kinetic test. Additional contact water sources included effluent from the Project. Additional contact water sources include sewage effluent from the Project to Duley Lake. Sewage is managed in a tertiary biological treatment plant with effluent discharge rates consistent with potable water supply intake rates (250 m^3/day) and assumed nitrate and ammonia concentrations of 1 mg/L and 37.5 mg/L (as N), respectively (BBA 2024).

The WBWQM outputs are produced for all phases of the Project including Construction (Year -1), Operations (Year 0 through Year 24), Closure (Year 25 through Year 36) and Post-closure period (Year 37 through Year 73). Three selected flow scenarios were simulated based on annual precipitation. The selected model flow scenarios are as follows:

1) **Mean annual precipitation (MAP)**, representing one of the climate years closest to the mean annual precipitation value of 890 mm (2016)
2) **25th percentile (P25)**, corresponding to the climate year closest to the 25th percentile of the precipitation record at 780 mm (1994)
3) **75th percentile (P75)**, representing the climate year closest to the 75th percentile of the precipitation record at 960 mm (2014)

Water balance model outputs by phase include:

- Rose Pit (Operations, Closure, and Post-closure)
- Pit Collection Pond (Operations)
- Duley Lake (Operations and Closure)
- Pike Lake (Operations and Closure)

Water quality model outputs by phase include:

- Mine Discharge (Operations)
  - Mine Effluent (Combined discharge from pit collection pond and tailings storage facility)
- Receiving Environment
  - Duley Lake Initial Dilution Zone (IDZ) (Operations)
  - Duley Lake (Operations, Closure, and Post-closure)
  - Duley Lake outlet (Operations, Closure, and Post-closure)
  - Pike Lake (Operations, Closure, and Post-closure)
  - Walsh River (Operations, Closure, and Post-closure)
  - Rose Pit Lake (Post-closure)
  - Mills Lake (Post-closure)
  - Waldorf River (Post-closure)
  - Riordan Lake (Post-closure)
  - Rectangle Lake (Post-closure)

Duley Lake Conceptual Site Model

Duley Lake Conceptual Site Model (DLCSM) for effluent mixing and dilution processes within Duley Lake has been developed to inform the water quality modelling approach (WQWBM) (TSD VI). DLCSM was developed using a Cornell Mixing Zone Expert System model, a physically based mixing zone modelling platform (Jirka et al. 1991). The Cornell Mixing Zone Expert System model, recognized by the United States Environmental Protection Agency for mixing zone analysis, was used to quantify dilution and mixing of treated effluent discharge within the near-field mixing zone of the outfall diffusor and within the far-field mixing zone of Duley Lake.

The DLCSM was developed to assess the potential water quality effects from mine discharges (water treatment plant [WTP] effluent) from the diffuser to Duley Lake within the assumed regulated mixing zone (RMZ) of 100 m of discharge point during Operations, which is when these Project discharges are planned to occur. Minimum dilution ratios at the centre of the effluent plume 100 m from the diffuser were determined for a range of mine effluent discharge rates for the following three seasonal lake scenarios:

- **Spring/fall**—The lake is homogeneous at a density of 4°C, the currents are 2 cm/s. The effluent is fresh water at 4°C.
- **Summer**—The lake is stratified with an 8 m thick epilimnion at 17°C and a hypolimnion at 7°C. The currents are 2 cm/s. The effluent is fresh water at 17°C.
- **Winter**—The lake is ice covered (1 m thick ice) and reversely stratified with a 1 m thick epilimnion at 1°C and a hypolimnion at 4°C. The currents are 0.04 mm/s. The effluent is fresh water at 4°C.

Local Water Balance Model

An LWBM was developed to predict changes to water quantity in lake and stream (watercourse) watersheds that were not modelled in above-mentioned WBWQM. Note that both the WBWQM and the LWBM apply climate-driven water balance processes. There are differences between these models in methodology and parameterization, particularly for climate; however, both approaches allow for a direct comparison of pre-mine (i.e., pre-development, natural case) and base case (i.e., post-development with Project) conditions. A summary of WBWQM is presented in section above; for details about WBWQM refer to TSD VI.

The LWBM employs Environment Canada water budget procedure (Johnstone & Louie, 1983). This method describes water flux in a unit area of soil annually, based on a balance of precipitation (rainfall and snowmelt), evapotranspiration (ET), soil storage, and surplus. The water budget can be summarized as follows:

$$\text{Rainfall} + \text{Snowmelt} - \text{ET} - \text{Change in Soil Storage} = \text{Surplus}$$

The various water budget components associated with catchment areas are typically presented in millimetres (mm) over their respective sub-catchments and represent the amount of water per unit of watershed area. The water budget model combines accumulated rainfall and snowmelt to estimate total precipitation. Rainfall represents precipitation when daily mean temperatures are greater than 0°C. Snowmelt is initiated when snow is on the ground and daily mean temperatures are greater than 0°C. Hence, snowmelt is based on the depletion of snow storage (accumulated precipitation during periods of sub-zero temperatures).

The potential or maximum ET is estimated, in this case, by the empirical Thornthwaite equation (using average monthly temperature and hours of daylight) and represents the amount of water that would be evaporated or transpired under saturated soil-water scenarios. The actual ET is the total evapotranspiration based on evapotranspiration demand, available soil-water storage, and the rate at which that soil water is drawn from the ground (as defined by an established drying curve specific to the soil type).

The maximum soil storage is quantified using a water holding capacity (WHC) that is based on guidelines provided in the Stormwater Management Planning and Design Manual (MOE 2003). The WHC represents the total amount of water that can be stored in the soil capillaries and is defined as the water content between the field capacity and wilting point (the practical maximum and minimum soil water content, respectively). WHCs are specific to the soil type and land use, whereby values typically range from approximately 50 mm for shallow rooted crops over sand to 350 mm for mature forest over clay.

For temperate region watersheds, soil storage is relatively stable year-round, remaining at or near field capacity except for the typical mid- to late-summer dry period. As such, the change in soil storage is a minor component in the water budget, particularly at an annual scale. Occasionally, open water areas must also be accounted for in water balances. In the case of water bodies, the WHC is generally assumed to be not applicable, since most years generally generate a positive surplus and the volume of water available in large bodies generally exceeds the amount that may be withdrawn by evaporation annually.

Surplus water remains in the system after actual ET has been removed (ET demand is met) and the maximum WHC is exceeded (soil-water storage demand is met). Additionally, for impervious areas (urban areas, paved roads, gravel roads, basins), 10% of annual precipitation is assumed lost to evaporation with the remaining 90% of annual precipitation assumed as surplus. Lakes and ponds, which serve as relatively stable surface water storage features, can contribute to seasonal variability in evaporation losses. These water bodies were considered in the water balance where appropriate, particularly in areas with notable open water coverage. Mean monthly lake evaporation values were represented by average monthly lake evaporation rate reported at Gander International A (Station ID: 8401700) and Stephenville A station (Station ID: 8403800) based on 1981 to 2020 station data (ECCC 2025).

The Meteorological Service Data Analysis and Archive division of Environment Canada provides monthly water budget summaries for meteorological stations with greater than 20 years of meteorological data. These monthly water budgets include monthly values for all parts of the water budget (rainfall, snowmelt, potential evaporation) for each of the years in the historical record, as well as average monthly values over the entire record.

For the Project, the Environment Canada water budget data (1961 to 2023) for the Wabush Airport (Station ID: 8504177) were used in the water budget analysis. The Environment Canada water budget shows an average annual precipitation of 851 mm, average annual potential or maximum ET of 428 mm and an average annual temperature of -3.2°C (1961 to 2023). Annual lake evaporation based on Environment Canada data (ECCC 2025) is 436 mm.

Annual surplus estimates are further portioned into run-off and infiltration estimates using an infiltration factor. Infiltration factor represents the proportion of infiltration as compared to the total surplus, with the remainder of the surplus assumed to be run-off. Land slope, soil type, and cover features are used to estimate the respective infiltration factor of the soil; flat, open soils with dense vegetation cover, for instance, would be expected to generate more infiltration (proportional to the total surplus) than a steep tight clay soil with row crops. Total infiltration factor for each land use is, then, estimated as the sum of the cover, soil type, and topography (cover) factors (MOE 2003). Annual infiltration is estimated as the annual surplus multiplied by the total infiltration factor, and annual run-off is estimated as the difference between surplus and infiltration.

The water balance was modelled monthly. The water balance model requires the input of climate information, local land use, geographical, and environmental characteristics to further identify site-specific conditions. Using climate information, aerial photography, geographic information system applications, regional soil data, and soil information from Annex 3A (Terrain and Soils Baseline Report), parameters best representing the landscape surrounding the LSA are as follows:

- **type of land use**—forest, grass/shrub/moss, wetland, urban areas, and open water
- **soil type**—sandy loam

These parameters were used in the water balance model to accurately represent the hydrological characteristics of the local watersheds and provide a detailed environmental water balance for watershed of lakes and streams (watercourses) not modelled in the WBWQM.

8.5.1.2.2 Constituent of Potential Concern

The following guidelines were used to identify COPCs (referred as modelled parameters in TSD VI) for surface water assessment:

- Ambient surface water quality guidelines for the protection of aquatic life established by the Canadian Council of Ministers of the Environment (CCME)
- Federal Water Quality Guidelines (FWQG)

A list of water quality COPCs (modelled parameters) for surface water quality assessment is as follows:

- **general parameters**—total dissolved solids (TDS)
- **anions and nutrients**—fluoride, chloride, sulphate, nitrite, nitrate, and ammonia (total)
- **metals**—aluminum, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, sodium, strontium, tin, thallium, tungsten, uranium, vanadium, zinc

Predicted concentrations of above-mentioned COPCs were compared to respective MDMER discharge standards (Table 8-19) and water quality guidelines (Table 8-18) for all Project phases to screen out and identify constituents of interest (COIs) for further analysis and assessment. Project screening was conducted for all phases of the Project and for all flow scenarios (TSD VI).

8.5.1.2.3 Development of Water Quality Threshold

Applicable water quality regulations and standards that apply to the Project are:

- *Metal and Diamond Mining Effluent Regulations* (MDMER) (Government of Canada 2023), which apply to controlled discharges from the Project during Operations, which are exclusive to Duley Lake
- Ambient surface water quality guidelines for the protection of aquatic life established by the Canadian Council of Ministers of the Environment (CCME), and Federal Water Quality Guidelines (FWQG)

Table 8-18 and Table 8-19 present maximum authorized monthly mean concentrations for prescribed deleterious substances (MDMER Schedule 4; Canada [2023]) and CCME, and FWQG, respectively.

Table 8-18: *Metal and Diamond Mining Effluent Regulations* Discharge Limits

Parameter	Maximum Authorized Monthly Mean Concentration
Total arsenic	0.10 mg/L
Total copper	0.10 mg/L
Total cyanide	0.50 mg/L
Total lead	0.08 mg/L
Total nickel	0.25 mg/L
Total zinc	0.40 mg/L
Total suspended solids	15.0 mg/L
Total radium 226	0.37 Bq/L
Un-ionized ammonia nitrogen (as N)	0.50 mg/L

Source: TSD VI, Site Wide Water Balance and Water Quality Modelling Report.

Bq/L = becquerels per litre.

Table 8-19: Canadian Council of Ministers of the Environment and Federal Water Quality Guideline

Parameter	Unit	CCME[(a)] Guideline and FWQG[(b)]	
		Short Term	Long Term
General Parameters			
Alkalinity	mg/L as $CaCO_3$	–	–
Acidity	mg/L as $CaCO_3$	–	–
TDS	mg/L	–	–
Anions and Nutrients			
Fluoride	mg/L	–	0.12
Chloride	mg/L	640	120
Sulphate	mg/L	–	–
Nitrite	mg/L as N	–	0.06
Nitrate	mg/L as N	124	2.9
Phosphorous	mg/L	–	Guidance Framework
Ammonia (total)	mg/L as N	–	variable (temp, pH), 1.54
Metals			
Silver	µg/L	–	0.25[(c)]
Aluminum	µg/L	–	variable (DOC, hardness, pH), 557[(c)]
Arsenic	µg/L	–	5[(c)]
Boron	µg/L	29,000[T]	1,500[(c)]
Barium	µg/L	–	–
Beryllium	µg/L	–	–
Bismuth	µg/L	–	–
Calcium	µg/L	–	–
Cadmium	µg/L	variable (hardness), 0.76[(c)]	variable, 0.07[(c)]
Cobalt	µg/L	–	variable (hardness), 0.67[(c)]
Chromium	µg/L	–	5[(c)]
Copper	µg/L	–	variable (temp, pH, DOC, hardness), 2.6[(d)]; variable (hardness), 2[(c)]
Iron	µg/L	–	variable (DOC, pH), 2,230[(c)]
Mercury	µg/L	–	0.026[(c)]
Potassium	µg/L	–	–
Lithium	µg/L	–	–
Magnesium	µg/L	–	–
Manganese	µg/L	variable (hardness), 2,770[(d)]	variable (hardness), 350[(d)]
Molybdenum	µg/L	–	73[T]
Sodium	µg/L	–	–
Nickel	µg/L	–	variable (hardness), 25[(c)]
Lead	µg/L	–	variable (DOC, hardness), 6.2[(d)]
Sulfur	mg/L	–	–
Antimony	µg/L	–	–
Selenium	µg/L	–	1[T]
Silicon	µg/L	–	–
Tin	µg/L	–	–
Strontium	µg/L	–	2,500[(d)]
Thorium	µg/L	–	–
Titanium	µg/L	–	–
Thallium	µg/L	–	0.8[(c)]
Uranium	µg/L	33[(T)]	15[(c)]
Vanadium	µg/L	–	120[(c)]
Tungsten	µg/L	–	–

Parameter	Unit	CCME[(a)] Guideline and FWQG[(b)]	
		Short Term	Long Term
Yttrium	µg/L	–	–
Zinc	µg/L	variable (hardness, DOC), 46[(d)]	variable (pH, hardness, DOC), 11[(d)]

Source: TSD VI, Site Wide Water Balance and Water Quality Modelling Report.

(a) CCME 2024.

(b) ECCC 2024.

(c) Guideline applicable to total metal concentration.

(d) Guideline applicable to dissolved metal fraction.

$CaCO_3$ = total hardness; CCME = Canadian Council of Ministers of the Environment; DOC = dissolved organic carbon; FWQG = Federal Water Quality Guidelines; TDS = total dissolved solids; – = not applicable.

In addition to above water quality thresholds/guidelines, site specific water quality objectives (SSWQOs) for selenium for Duley Lake (TSD VII, Selenium Site-Specific Water Quality Objectives Modelling Summary) and cobalt (TSD VIII, Cobalt Site-Specific Water Quality Objectives Modelling Summary) were developed to provide protection against long-term effects on aquatic life under site-specific conditions predicted for all phases of the Project.

Selenium is a naturally occurring nutrient that is essential for health of humans and animals; it accumulates in aquatic organism tissue through dietary update. If concentrations are excessive, adverse effects linked to selenium accumulation in aquatic species can occur, particularly in fish and aquatic birds exposed through feeding on aquatic life. To predict risks of selenium under future development scenarios for the Project, the predicted increases of selenium and the consequences of those increases on health of aquatic life were investigated. Considering assessment results and acknowledging the screening level of the analysis (i.e., conservative assumptions used in the face of uncertainty), the generic water quality guideline value of 1.5 µg/L from US EPA (2016) was selected as an interim site-specific water quality objective protective against long-term effects of selenium (TSD VII) for Duley Lake.

Cobalt is also a naturally occurring element and an essential micronutrient required for health of aquatic life. Although the toxic mode of action of cobalt is not fully understood, at high concentrations it can affect enzymes and influence respiration and metabolism. To predict risks of cobalt under future development scenarios for the Project, both the predicted increases of total cobalt and the consequences of those increases on health of aquatic life were investigated. The method used to derive SSWQO followed the federal guidance for development of site-specific objectives. Based on assessment, long-term hardness-dependent cobalt SSWQO equation yielded values for total cobalt that ranged between 2.7 and 3.2 µg/L for affected waterbodies (Duley lake and Pike Lake). The study concluded that the proposed long-term hardness-dependent equation for total cobalt using Type A species sensitivity distribution derived hazard concentration of 5th percentile (HC_5) of 3.9 µg/L is protective against long-term effects on aquatic life under site-specific conditions in the receiving environment (TSD VIII).

8.5.1.2.4 Residual Effect Classification

The residual effects analysis used a reasoned narrative to describe anticipated changes to each measurable parameter caused by the Project. This narrative description of anticipated effects is the foundation for the residual effects classification. Residual effects are summarized or classified in tabular form using effects criteria, which is intended to provide structure and comparability across VECs assessed for the Project. The residual effects classification uses nature, magnitude, geographic extent, duration, timing, frequency, reversibility, and probability of occurrence as criteria. The approach to classify each residual effect criterion is provided in Table 8-20. Following classification of residual Project effects, the analysis also evaluates the significance of residual Project effects using threshold criteria or standards beyond which a residual effect is considered significant. The definition of a significant effect for the surface water quantity and quality is provided in Section 8.5.1.4, Significance Determination.

Table 8-20: Definitions Applied to Effects Criteria Classifications for the Assessment of Surface Water

Criterion	Rating	Definition
Nature	Positive	Change in measurable parameter results in net improvement or benefit to the surface water VEC(s)
	Neutral	Change in measurable parameter results in no change to the surface water VEC(s)
	Adverse	Change in measurable parameter results in net degradation or loss to the surface water VEC(s)

Criterion	Rating	Definition
Magnitude	Qualitative narrative or numeric quantification	Change in measurable parameter is described by effect size as follows for water quantity: – Negligible <5% – Low 5-10% – Medium 10-25% – High >25%
		For water and sediment quality: – Negligible - no measurable Project effect (i.e., no change in baseline conditions) – Low - effect is detectable but within normal variability of baseline conditions and Project thresholds/objectives – Moderate - effect occurs beyond normal variability of baseline conditions and exceed Project thresholds/objectives, but most parameters remain below Project thresholds/objectives – High - effect occurs beyond normal variability of baseline conditions and most parameters exceed Project thresholds/objectives
Geographic extent	Site Assessment Area	Change in measurable parameter is confined to the SSA
	Local	Change in measurable parameter extends outside the SSA but within the LSA
	Regional	Change in measurable parameter extends beyond the LSA but is confined to the RSA
	Beyond regional	Change in measurable parameter extends beyond the RSA
Duration	Qualitative narrative or numeric quantification	Change in measurable parameter is described by effect duration (e.g., months, years, decades, permanent)
Timing	Qualitative narrative or numeric quantification	Change in measurable parameter is described with a focus on seasonality (e.g., as applicable with description of how seasonal aspects may affect a VEC or not applicable, where seasonal aspects are unlikely to affect a VEC)
Frequency	Occasional	Change in measurable parameter is expected to occur rarely (e.g., once or a few times)
	Periodic	Change in measurable parameter is expected to occur consistently at regular intervals or associated with temporal events (e.g., during hot, dry climatic conditions)
	Continuous	Change in measurable parameter is expected to occur all the time
Reversibility	Reversible	Change in measurable parameter is reversible within a clearly defined time period
	Irreversible	Change in measurable parameter is predicted to influence the component indefinitely
Probability of occurrence	Unlikely	Change in measurable parameter is not expected to occur, but not impossible
	Possible	Change in measurable parameter may occur, but is not likely
	Probable	Change in measurable parameter is likely to occur, but is uncertain
	Certain	Change in measurable parameter will occur
Ecological and socioeconomic context	Qualitative narrative or numeric quantification	Change in measurable parameter is described by the perception of an effect that considers sensitivity and resilience of VECs (ecological context), and the cultural and social significance placed on certain VECs and the unique values, customs or aspirations of local communities or Indigenous groups

LSA = local study area; RSA = regional study area; SSA = site study area; VEC = valued environmental component.

While most criteria for surface water quality can be assigned categorical ratings, the predicted effects are often described in specific terms (narrative or numeric quantification) in Table 8-34. Duration is also described specifically (e.g., years, decades). Using categorical ratings for criteria like magnitude can lead to confusion or misinterpretation, as additional context is needed to properly characterize the effects. Universal effect size boundaries, such as a 25% change in a measurement indicator, often fail to consider the ecological and cumulative context. For instance, a 25% change in one constituent might be required to cause a high-magnitude effect, while a 25% change in another might result in a low-magnitude effect. Applying a timeline category rating to reversibility for surface water quality involves assessing effects into the Closure phase and far-future (Post-closure) period. Reversibility is determined by whether the water quality in the receiving environment returns to conditions similar to baseline within the assessment period.

8.5.1.3 Residual Cumulative Effect Analysis

The cumulative effects assessment builds on the results of the residual Projects effects assessment and considers the incremental changes that were predicted to have a likely residual adverse effect on surface water quantity and quality. This would include the effects of past and current projects or past climate-related changes (i.e., forest fires), which contribute to existing conditions upon which residual Project effects are assessed. For the EIS, the description of the existing environment characterizes the environment already affected by past and current projects and activities; therefore, the cumulative effects assessment focused on analyzing the effects of other RFDs in combination with the Project. Although positive residual effects are characterized in the residual Project effects analysis, they are not carried forward to the cumulative effects analysis, as the Project benefits from other past, present and RFDs or activities are unlikely to be known or publicly disclosed (e.g., Benefit Agreements with Indigenous groups or local community stakeholders).

The cumulative effects assessment followed a three-step process:

- Identify RFDs and potential cumulative effects that overlap in time and space with residual effects.
- Identify and describe any additional mitigation measures, if applicable.
- Characterize residual cumulative effects, using the same criteria defined for the residual Project effects analysis (Section 8.5.1.2).

Chapter 4, Effects Assessment Methodology lists known RFDs and physical activities with potential residual effects that could overlap spatially and temporally with the Project's residual environmental effects. This list was considered in the identification of RFDs for the assessment of cumulative effects on surface water quantity and quality. Following the identification of applicable RFDs, residual Project effects on surface water quantity and quality were evaluated for temporal and spatial overlap with the effects of RFDs to identify potential cumulative effects. The evaluation was completed qualitatively based on publicly available information (e.g., Project Registrations or EIS reports) describing the environmental effects of RFDs. If effects from these RFDs overlapped spatially or temporally with the residual Project effects on surface water quantity and quality, then potential cumulative effects were identified. If no spatial or temporal overlap existed for the residual Project effects and RFDs identified in Chapter 4, Effects Assessment Methodology, then a cumulative effects assessment was not required.

Based on the assessment of potential cumulative effects, an assessment was made regarding whether additional mitigation measures, beyond those proposed for the Project, were required to address potential cumulative effects. Where applicable, additional mitigation measures were identified.

Residual cumulative effects were characterized using the same criteria assessed for residual Project effects (Section 8.5.1.2). The same measurable parameters were used to assess the cumulative effe of other RFDs on surface water. Where applicable, additional mitigation measures were described.

Following classification of residual cumulative effects, the analysis also evaluated the significance of residual Project effects using threshold criteria or standards beyond which a residual environmental effect was considered significant. The definition of a significant effect for the surface water quantity and quality is provided in Section 8.5.1.4.

8.5.1.4 Significance Determination

Surface water VECs do not have assessment endpoints or significance criteria. Instead, the significance of project residual effects on surface water VECs are evaluated in the context of net project effects on measurement parameters compared to pre-mine condition and/or environmental thresholds/guidelines for the Project. Therefore, the assessment of significance of residual project effects was informed by the changes to measurable parameters of surface water quantity and quality, with consideration to the residual project effects characteristics.

The significance levels are defined as:

- **Significant**–Residual effects were considered significant if the net change to surface water quantity and quality exceeded the environmental Project thresholds/guidelines (e.g., CCME, SSWQOs) and they represented a management concern.
- **Not significant**–Residual effects were considered not significant if net change to surface water quantity and quality did not exceed the environmental Project thresholds/guidelines (e.g., CCME) and they represented a no management concern.

For details about assessment of significance with respect to human health guidelines, refer to TSD XI, Human Health Risk Assessment Modelling Report.

8.5.2 Effect Pathway Screening

The effect pathway screening predicts potential effects pathways that are then evaluated considering proposed mitigation to predict whether the effect pathway had the potential to cause residual adverse or positive effects. The effectiveness of mitigation measures proposed for each effect pathway was assessed to determine whether the mitigation would address the potential Project effect such that the effect pathway was eliminated or would result in a negligible adverse effect on a VEC.

As described in Section 8.5.1.1, each effect pathway was categorized as one of the following:

- **no effect pathway** (i.e., avoidance measures and/or mitigation results in no residual effect on surface water VEC)
- **negligible effect pathway** (i.e., mitigation results in negligible effect of surface water VEC)
- **residual effect pathway** (i.e., effect that is greater than negligible and carried forward for further assessment)

The effects pathway screening is summarized in Table 8-21. The subsections following the table provide rationale used to assign potential effects on the no effect pathway and negligible effect pathway categories and list residual effect pathways. Each Project component/activity identified as a residual effect pathway was carried forward for detailed assessment in Section 8.5.3.

Table 8-21: Potential Effects Pathways for Surface Water Quantity, Surface Water, and Sediment Quality

Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening
Project components/activities that contribute to emissions and deposition of fugitive dust during the Construction, Operations, and Closure phases: **Construction** – Site preparation, including vegetation clearing and earthworks – Handling and storage of overburden – Road development, including culverts and bridge installation – Construction of facilities and infrastructure – Construction of TMF starter dam – Handling and storage of mine rock – Construction of water management infrastructure – Operating mobile mining equipment – Site traffic, including transportation of personnel and materials to and from site **Operations** – Open pit mining, including blasting and crushing ore and mine rock – Operating mobile mining equipment – Handling and storage of overburden, mine rock and ore – Operation and management of the TMF – Site traffic, including transportation of personnel and materials to and from site **Closure** – Removal of infrastructure, restoration and revegetation of facilities and infrastructure – Site traffic, transportation of personnel and materials to and from the site	**Deposition of fugitive dust emissions on waterbodies and watercourses** – Deposition of fugitive dust emissions (e.g., particulate matter, metals) during Construction, Operations and Closure on local and regional waterbodies and watercourses may adversely affect surface water and sediment quality.	– Minimize areas of vegetation clearing and soil disturbance to reduce generation of fugitive dust – Cover crushed iron ore stockpiles with dust collection technology to minimize fugitive dust and silica from crushed ore stockpiles – Implement progressive re-grading and reclamation of the overburden stockpile (starting during Operations, where applicable), and the mine rock stockpile (Starting during Operations, where applicable) and TMF (starting during Closure) – Optimize haul routes to reduce fuel consumption and emissions – Apply water and/or dust suppressants to site roads, including the access road, as necessary – Apply water sprays to stockpiles or areas that have visible dust, as necessary – Limit vehicle speed on unpaved roads to reduce fugitive dust – Maintain mobile mining equipment and vehicles and operate the equipment within parameters for engine exhaust system design – Limit idling of vehicles and equipment to the extent practicable – Develop and implement a Project-specific Environmental Protection Plan that includes mitigation to reduce fugitive dust emissions during all Project phases – Develop and implement the Environmental Effects Monitoring Program (Annex 5E) that includes ambient air monitoring and surface water quality monitoring	Negligible effect pathway
Project components/activities that contribute to emissions and deposition of air quality COCs during the Construction, Operations, and Closure phases: **Construction** – Site preparation, including vegetation clearing and earthworks – Handling and storage of overburden – Road development, including culverts and bridge installation – Construction of facilities and infrastructure – Construction of TMF starter dam – Handling and storage of mine rock – Construction of water management infrastructure – Power generation – Operating mobile mining equipment – Site traffic, including transportation of personnel and materials to and from site **Operations** – Open pit mining, including blasting and crushing ore and mine rock – Operating mobile mining equipment – Handling and storage of overburden, mine rock and ore – Operation and management of the TMF – Railcar loading and transportation – Site traffic, including transportation of personnel and materials to and from site – Worker accommodations, mine services area, and office operation **Closure** – Removal of infrastructure, restoration and revegetation of facilities and infrastructure – Site traffic, transportation of personnel and materials to and from the site	**Deposition of air quality COC emissions on waterbodies and watercourses** – Deposition of COC emissions (e.g., particulate matter, sulphur, nitrogen oxides) during Construction, Operations and Closure on local and regional waterbodies and watercourses may adversely affect surface water and sediment quality.	– Evaluate the opportunities to reduce fuel combustion requirement of infrastructure and equipment, to the extent practicable, during detailed design – Install the transmission line at early stage of construction to minimize consumption of diesel fuel for power – Minimize areas of vegetation clearing and soil disturbance – Optimize haul routes to reduce fuel consumption and emissions – Use electric drills and shovels to reduce diesel exhaust emissions from the mining fleet. – Use and maintain emissions control devices on combustion-based equipment, where practicable or feasible – Limit idling of vehicles and equipment to the extent practicable – Maintain mobile mining equipment and vehicles and operate the equipment within parameters for engine exhaust system design – Identify and implement procurement criteria to confirm stationary and mobile engines meet applicable performance standards – Use the best available pollution control technology at material transfer points – Develop and implement a Project-specific Environmental Protection Plan – Develop and implement the Environmental Effects Monitoring Program that includes ambient air monitoring and surface water quality monitoring	Negligible effect pathway

Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening
Project components/activities that may affect surface water quantity in waterbodies due to water taking during Construction, Operations, and Closure: **Construction** – Site preparation, including vegetation clearing and earthworks – Road development, including culverts and bridge installation – Construction of facilities and infrastructure – Construction of TMF starter dam – Construction of water management infrastructure – Dewatering activities **Operations** – Open pit mining, including blasting and crushing ore and mine rock – Pit dewatering and site water management – Water intake for fresh water and process water – Worker accommodations, mine services area, and office operation **Closure** – Accelerated pit flooding – Removal of infrastructure, restoration and revegetation of facilities and infrastructure	**Water withdrawal** – Water withdrawal during Construction, Operations and Closure may affect surface water quantity (flow and water level) in nearby waterbodies and/or streams.	– Water withdrawal will be completed in accordance with provincial and federal standards and licence/permit conditions and industry best standards – Recycle and re-use of process water to reduce fresh water intake and release to environment, to the extent practicable – Wells will be equipped suitably (i.e., with variable-frequency drive pumps) to allow effective control of dewatering rates within permitted rates. – Implement water transfers from Duley Lake to Pike Lake as a key water management tool. – Develop and implement a Project-specific Environmental Protection Plan – Develop and Implement a Project-specific Waste Management Plan (Annex 5H) and site water management procedures – Develop and implement the Environmental Effects Monitoring Program that includes surface water and sediment quality monitoring to confirm the effectiveness of mitigation measures as well as to maintain compliance with regulatory permits/approvals – Develop and implement a Closure and Reclamation Plan for the Project to return the landscape, as close as possible, to it is undisturbed condition	Residual effect pathway
Project components/activities that may affect surface water quantity and quality through treated effluent discharges during the Construction, Operations, and Closure phases: **Construction** – Handling and storage of overburden – Road development, including culverts and bridge installation – Construction of facilities and infrastructure – Construction of TMF starter dam – Handling and storage of mine rock – Construction of water management infrastructure – Dewatering activities – Collection, treatment and disposal of domestic sewage from construction site **Operations** – Handling and storage of overburden, mine rock and ore – Handling, management and storage of potentially acid generating mine rock – Pit dewatering and site water management – Handling, storage and discharge of non-contact water – Handling, storage, treatment and discharge of contact water – Sewage collection, treatment and surface discharge **Closure** – Removal of infrastructure, restoration and revegetation of facilities and infrastructure	**Discharge of treated effluent** – Direct discharge of treated effluent and treated sewage during Construction, Operations, and Closure may affect surface water quantity and quality in receiving waterbodies and watercourses and farther downstream.	– Design, construct and operate water management infrastructure in accordance with applicable permits, approvals, and best industry practices to minimize impact to surface water in receiving waterbodies – Recycle and re-use process water to reduce fresh water intake and release to environment including Duley Lake, to the extent practicable – Design the treated effluent diffuser to provide effective mixing and dilution of the effluent to limit the area of the receiving environment affected by mine discharge – Develop a site-specific WTP to treat contaminants in effluent to appropriate release limits in accordance with site-specific water quality objectives, federal and provincial standards and regulations, and permit conditions. – Construct and operate a wastewater treatment plant to treat sanitary sewage and wastewater to appropriate release limits in accordance with provincial standards and permit conditions – Design diffuser/outfall such that discharged flow does not interact with bed sediment – Locate proposed treated effluent diffuser away from sensitive or unique habitats to the extent practicable – Collect, store and routinely monitor contact water to confirm discharge water meets water quality objectives and criteria appropriate for release – Monitor treated effluent flow and quality – Develop and implement a monitoring plan that defines actions levels and documents steps to be taken to mitigate elevated concentrations of COPCs in treated effluent discharge to acceptable levels – Monitor treated sewage flow and quality – Characterize, identify, and manage potentially acid generating mine rock to prevent localized acid mine drainage and minimize metal leaching – Develop and Implement a Project-specific Waste Management Plan (Annex 5H) and site water management procedures – Develop and implement a Project-specific Environmental Protection Plan – Develop and implement an Environmental Effects Monitoring Program that includes monitoring treated effluent and surface water and sediment quality – Develop and implement a Rehabilitation and Closure Plan for the Project to maintain protection of surface water and return the landscape, as close as possible, to it is undisturbed condition	Residual effect pathway

Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening
Project components/activities that contribute to TSS loading (i.e., change to sediment quality) through treated effluent discharges during Construction, Operations, and Closure: **Construction** – Handling and storage of overburden – Road development, including culverts and bridge installation – Construction of facilities and infrastructure – Construction of TMF starter dam – Handling and storage of mine rock – Construction of water management infrastructure – Dewatering activities **Operations** – Handling and storage of overburden mine rock and ore – Pit dewatering and site water management – Handling storage and discharge of non-contact water – Handling storage, treatment and discharge of contact water – Water intake for fresh water and process water – Sewage collection, treatment and discharge **Closure** – Removal of infrastructure, restoration and revegetation of facilities and infrastructure	**Discharge of treated effluent and sewage affecting TSS loadings and sediment quality** – Direct discharge of treated effluent and treated sewage during Construction, Operations and Closure can contribute to TSS loadings and may affect sediment quality in receiving waterbodies and watercourses and farther downstream.	– Design, construct and operate water management infrastructure in accordance with applicable permits, approvals, and best industry practices to minimize impact to surface water in receiving waterbodies – Recycle and re-use process water to reduce fresh water intake and release to Duley Lake, to the extent practicable – Design the treated effluent diffuser and treated sewage outfall to provide effective mixing and dilution of the effluent to limit the area of the receiving environment affected by mine discharge – Design diffuser/outfall such that discharged flow does not interact with sediment – Locate proposed treated effluent diffuser away from sensitive or unique habitats, to the extent practicable – Collect, store, and routinely monitor contact water to confirm discharge water meets water quality criteria appropriate for release – Develop and implement Erosion and Sediment Control Plan (Annex 5F) – Treat effluent and sewage prior to release, when required – Monitor treated effluent and treated sewage flow and quality – Implement a Project-specific Environmental Protection Plan – Develop and Implement Environmental Effects Monitoring Program that includes monitoring surface water and sediment quality – Implement a Project-specific Waste Management Plan (Annex 5H) and site water management procedures	Negligible effect pathway
Project components/activities that may change surface water quantity, and surface water and sediment quality through direct site run-off during Construction, Operations, and Closure: **Construction** – Site preparation including vegetation clearing and earthworks – Road development including culverts and bridge installation – Construction of facilities and infrastructure – Construction of TMF starter dam – Handling and storage of mine rock – Construction of water management infrastructure **Operations** – Handling and storage of overburden, mine rock, and ore – Operation and management of the TMF – Pit dewatering and site water management – Progressive reclamation **Closure** – Handling and storage of mine rock – Removal of infrastructure, restoration and revegetation of facilities and infrastructure	**Site drainage and run-off during Construction and Operations** – Altered site drainage and run-off from the site during Construction and Operations may cause changes to water levels and flows, stream channel/bank stability, and sediment and constituent loading, affecting surface water quantity, and surface water and sediment quality in local waterbodies and watercourses. **Site drainage and run-off during and following Closure** – Altered site drainage and run-off from site during Closure and following Closure may cause changes to water levels and flows, stream channel/bank stability, and sediment and constituent loading, affecting surface water quantity, and surface water and sediment quality in local waterbodies and watercourses.	– Design, construct and operate water management infrastructure and facilities (including waterbody crossings) in accordance with applicable permits, approvals, and best industry practices to minimize impact to surface water in receiving waterbodies – Provide adequate contact water storage capacity to manage run-off, seepage and inflows from the pit, Project infrastructure and disturbed areas – Develop and implement an Erosion and Sediment Control Plan (Annex 5F) – Minimize areas of vegetation clearing and soil disturbance – Limit steepness and length of slopes of disturbed areas and stockpiled soils – Avoid placing soil stockpiles near waterbodies (i.e., maintaining 150 m buffer from waterbodies and watercourses), and near natural drainage features, unless required for temporary storage – To the extent practicable, work in sensitive areas (i.e., erosive soils, wetland features, and fish habitats) will be scheduled to avoid periods that may result in high flow volumes and/or increase erosion and sedimentation (e.g., spring freshet) – Implement progressive reclamation and revegetation of disturbed areas no longer required, where practicable – Reclaim and revegetate areas where non-permanent Project facilities have been decommissioned – Perform routine inspection and maintenance of water containment and conveyance structures (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment – Implement a Project-specific Environmental Effects Monitoring Program that includes monitoring surface water and sediment quality – Develop and implement a Project-specific Waste Management Plan (Annex 5J) and site contact water management procedures under the Environmental Protection Plan – Implement a Project-specific Environmental Protection Plan – Develop and implement a Rehabilitation and Closure Plan for the Project to return the landscape, as close as possible, to it is undisturbed condition	Residual effect pathway

Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening
Project components/activities that may potentially change surface water quality during the Construction and Operations phases and following the Closure phase: **Construction** – Handling and storage of mine rock **Operations** – Handling and storage of overburden mine rock and ore – Operation and management of the TMF **Closure** – Accelerated pit flooding – Handling and storage of mine rock – Removal of infrastructure, restoration and revegetation of facilities and infrastructure	**Seepage from overburden stockpile, mine rock stockpile and tailing management facility during Construction, Operations and following Closure** – Seepage from overburden stockpile, mine rock stockpile and tailing management facility during Construction, Operations, Closure and following Closure, may affect groundwater quality and surface water quality in receiving waterbodies and watercourses and farther downstream.	– Characterize, identify, and manage potentially acid generating mine rock to prevent localized acid mine drainage and minimize metal leaching. – Use of impermeable material (e.g., HDPE) geomembrane) to seal dam slopes and collection ditches/ponds – Construct run-off and seepage collection ditches around the overburden stockpile, mine rock stockpile, TMF and other Project facilities and divert seepage to collection ponds and WTP, as required, to meet site-specific water quality objectives and regulatory requirements (see Chapter 2, Project Description and TSD II for details about water management infrastructure) – Install engineered cover system on mine rock stockpile, and the TMF during Closure to promote positive passive drainage, limit ponding, and support revegetation – Collect run-off and seepage water in drainage ditches around the mine rock stockpile and overburden stockpile and direct to the collection ponds, and pump to Rose Pit to facilitate flooding during Closure. – Collect seepage water in drainage ditches around the mine rock stockpile following reclamation and pump to the bottom of the Rose Pit during Post-closure. – Routinely test surface and seepage water during Closure – Maintain water management infrastructure during Closure until water quality in the Rose Pit has reached acceptable discharge quality – Implement a Project-specific Waste Management Plan (Annex 5H) and site contact water management procedures – Implement a Project-specific Environmental Protection Plan – Develop and implement an Environmental Effects Monitoring Program that includes monitoring groundwater, surface water and sediment quality – Develop and implement a Rehabilitation and Closure Plan for the Project to return the landscape, as close as possible, to it is undisturbed condition	Residual effect pathway
Project components/activities that change surface water and sediment quality through blasting activities during the Construction, Operations, and Closure phases: **Construction** – Site preparation, including vegetation clearing and earthworks – Road development, including culverts and bridge installation – Construction of facilities and infrastructure – Construction of TMF starter dam – Construction of water management infrastructure **Operations** – Open pit mining, including blasting and crushing ore and mine rock **Closure** – Removal of infrastructure, restoration and revegetation of facilities and infrastructure	**Wash-off of explosive spills and residues from blasting activities** – Wash-Off of explosive spills and residues from blasting activities during Construction and Operations may affect surface water and sediment quality of receiving waterbodies and watercourses	– Transport and store explosives in accordance with federal and provincial legislation, where applicable – Do not use ammonium nitrate and fuel oil – Use explosives in emulsion or emulsion blend to mitigate potential dissolution and poor explosive performance in the presence of water – Carry out blasting activities in accordance applicable permits and approvals – Prepare and implement a blasting and communication management protocol, within the Environmental Protection Plan, that describes specific measures that would be implemented when blasting is required – Safely dispose detonated discarded explosives or return to the explosives' distributor – Safely transport raw materials for the manufacture of explosives, if prepared on site – Explosives and/or accessories stored on site will be at a safe distance from the Project infrastructure – Establish drill and blast specifications and use controlled blasting techniques, where required – Develop and implement a Project-specific Environmental Protection Plan that includes measures for the management of ammonia contaminant	Residual effect pathway

COCs = contaminants of concern; HDPE = high-density polyethylene; TMF = tailing management facility; TSS = total suspended solids; WTP = water treatment plant.

8.5.2.1 No Effect Pathways

There are no Project interactions predicted to result in no effect pathway to surface water quantity and/or surface water and sediment quality and are not carried forward in the assessment.

8.5.2.2 Negligible Effect Pathways

The following Project interactions are predicted to result in negligible effect pathways to surface water quantity and/or surface water and sediment quality and are not carried forward in the assessment.

8.5.2.2.1 Deposition of Fugitive Dust Emissions

Activities such as site preparation including vegetation clearing and earthworks, construction of facilities and infrastructure, site traffic, and handling of overburden, mine rock and ore during Construction and Operations, as well as activities associated with the removal of infrastructure, restoration and revegetation of facilities and infrastructure during Closure, have the potential to generate fugitive dust (including particulate matter and metals). Fugitive dust can deposit directly on the waterbodies and/or land and vegetation adjacent to the Project activity and may adversely affect surface water and sediment quality in local and regional waterbodies and watercourses. Accumulated fugitive dust deposition within terrestrial area may also enter local and regional waterbodies and watercourses via overland run-off, particularly if accumulated over the winter and mobilized in the spring freshet.

Generation of fugitive dust from the Project would be expected to occur primarily through the summer months, as minimal fugitive dust is anticipated to be generated under winter conditions. Snow- and ice-covered road surfaces and freezing temperatures provide a natural mitigation associated with, or afforded by, winter conditions. Golder (2012) showed that the natural mitigation of winter conditions suppressed approximately 96% of dust generation and dust fall. Because it is anticipated that there would be little generation and accumulation of fugitive dust through the winter months, the spring freshet would be unlikely to carry a high load of any dust fall to local and regional waterbodies and watercourses.

In the summer, the terrestrial components of the local and regional watersheds may accumulate fugitive dust from aerial dust plumes around Project activities. However, Project design and mitigation policies and procedures are anticipated to limit fugitive dust emissions from the Project during summer months. Project optimization and/or environmental design features with respect to air quality are provided in **Chapter 2, Project Description**, and **Chapter 4, Effects Assessment Methodology**. Mitigation and enhancement measures to minimize the dust generation during Project activities would include:

- Minimize areas of vegetation clearing and soil disturbance to reduce generation of fugitive dust.
- Cover crushed ore stockpile with dust collection technology to minimize fugitive dust and silica from crushed ore stockpile.
- Implement progressive re-grading and reclamation of the overburden stockpile (starting during Operations, where applicable), and the mine rock stockpile (starting during Operations, where applicable) and tailings management facility (TMF) (starting during Closure).
- Optimize haul routes to reduce fuel consumption and emissions.
- Apply water and/or dust suppressants to site roads, including the access road, as necessary.
- Apply water sprays to stockpiles or areas that have visible dust, as necessary.
- Limit vehicle speed on unpaved roads to reduce fugitive dust.
- Maintain mobile mining equipment and vehicles and operate the equipment within parameters for engine exhaust system design.
- Limit idling of vehicles and equipment to the extent practicable.
- Develop and implement a Project-specific Environmental Protection Plan that includes mitigation to reduce fugitive dust emissions during all Project phases.
- Develop and implement the Environmental Effects Monitoring Program (Annex 5E) that includes ambient air monitoring and surface water quality monitoring.

With respect to the effectiveness of road watering, Golder (2012) showed that road watering during summer months resulted in approximately 80% suppression of dust generation, which maintained its efficacy for periods between four and six hours after watering.

A Project-specific Environmental Protection Plan that includes mitigation to reduce fugitive dust emissions during all Project phases will be developed and implemented. Similarly, the Environmental Effects Monitoring Program includes monitoring sediment and water quality during the Project lifespan.

Air quality modelling was used to predict maximum ground-level concentrations using air dispersion model during Operations (see Chapter 5, Air Quality and Climate), whereas Construction and Closure phases were assessed qualitatively. Total particulate matter was predicted to have modelled concentrations above their respective 24-hour averaging period at cabin and community locations; however, the model predicts that concentrations above the limits at the cabins and community locations were infrequent, occurring for <1%, three days per year at cabins and <1%, one day of the year at Duley Lake South. The Project effects of individual metals were also determined from the maximum predicted 24-hour total particulate matter concentration, assuming the concentrations of metals in the total particulate matter was equal to the 95th percentile of metal concentrations, of the ore and mine rock assays for the Project (Okane 2024b). Concentrations were predicted highest closest to the emission source but disperse with distance from the Project and are generally below the respective standards within 4 km of the Project infrastructure. Predicted results did not show exceedance above the guidelines.

Dust deposition to waterbodies and terrestrial areas from the Project activities that have the potential to generate fugitive dust is expected to be limited in terms of loading and extent through the application of mitigations and enhanced measures. As a result, it is expected that direct deposition would be negligible and most of the land deposition would be incorporated into the surface soil and vegetation and be effectively immobilized. Therefore, a measurable residual effect on surface water and sediment quality is not expected, and the pathway was not carried forward in the assessment.

8.5.2.2.2 Deposition of Air Quality Contaminants of Concern Emissions

Deposition of air quality contaminants of concern (COCs) (e.g., particulate matter, carbon, nitrogen, and sulphur oxides) on waterbodies and terrestrial areas from the emissions associated with Project activities are expected to occur from the combustion of fossil fuels in large equipment used in and around the Project, such as power generation, the operation of aircraft, trucks, and vehicles, and the burning of non-hazardous waste materials (e.g., food garbage) during Construction and Operations, as well as from the site traffic and activities associated with removal of infrastructure, restoration and revegetation of facilities and infrastructure during Closure phase.

COCs include particulate matter (PM_{10} and $PM_{2.5}$) and combustion gases (CO, NO_2, and SO_2). Criteria air contaminant emission can deposit directly on the waterbodies and/or land and vegetation adjacent to the Project activity and may adversely affect surface water and sediment quality in local and regional waterbodies and watercourses. Accumulated COCs deposition within terrestrial areas may enter local and regional waterbodies and watercourses via overland run-off, particularly if accumulated over the winter and mobilized in the spring freshet. Unlike fugitive dust, where natural mitigation during the winter would limit the generation of dust from Project activities, COC emissions would be generated year-round. This may result in a localized accumulation of COCs over the winter months within the snowpack in the vicinity of the Project, as the deposited dust and associated COCs would not be mobilized by run-off during the winter. Following the accumulation over the winter months, the spring freshet may carry an increased load to local and regional waterbodies and watercourses. In the summer, a substantial proportion of any directly deposited COCs is more likely to be incorporated into the surface soil of the terrestrial landscape and be effectively immobilized.

Project optimization and/or environmental design features with respect to air quality are provided in **Chapter 5, Air Quality and Climate**. Project design, and mitigation and enhancement measures to minimize COC emissions during Project activities would include:

- Evaluate the opportunities to reduce fuel combustion requirement of infrastructure and equipment, to the extent practicable, during detailed design.
- Install the transmission line at an early stage of Construction to minimize consumption of diesel fuel for power.
- Minimize areas of vegetation clearing and soil disturbance.
- Optimize haul routes to reduce fuel consumption and emissions.
- Use electric drills and shovels to reduce diesel exhaust emissions from the mining fleet.
- Use and maintain emissions control devices on combustion-based equipment, where practicable/feasible.
- Limit idling of vehicles and equipment to the extent practicable.
- Maintain mobile mining equipment and vehicles and operate the equipment within parameters for engine exhaust system design.
- Identify and implement procurement criteria to confirm stationary and mobile engines meet applicable performance standards.
- Use the best available pollution control technology at material transfer points.
- Develop and implement a Project-specific Environmental Protection Plan.
- Develop and implement the Environmental Effects Monitoring Program that includes ambient air monitoring and surface water quality monitoring.

Air quality modelling was used to predict maximum ground-level concentrations using air dispersion model during Operations (see **Chapter 5**, **Air Quality and Climate**), whereas Construction and Closure phases were assessed qualitatively. PM_{10} was predicted to have modelled concentrations above their respective 24-hour averaging period at cabin and community locations; however, the model predicted that concentrations above the limits at the cabins and community locations were infrequent, occurring for 4%, 13 days of the year at cabin locations, 1%, 5 days per year at Duley Lake South and <1%, 2 days per year at Fermont. Other COCs (e.g., $PM_{2.5}$, carbon, sulphur, and nitrogen oxides) were not predicted to exceed guidelines.

Environmental design features, mitigation and enhancement measures, and monitoring program are anticipated to minimize generation and deposition of COC emissions from the Project. Mobilization of deposited COCs to the receiving environment would, therefore, be limited to the spring freshet period with snow melt, which could result in a potential minor localized change to surface water and sediment quality. However, it is anticipated that any COCs released from the terrestrial component of the respective watersheds, combined with the high volume of water released during freshet, would disperse quickly in the receiving environment, resulting in negligible residual effects on the surface water and sediment quality. Therefore, the pathway was not carried forward in the assessment.

8.5.2.2.3 Treated Effluent and Treated Sewage Affecting Total Suspended Solids Loadings and Sediment Quality

Project activities (e.g., site preparation including vegetation clearing and earthworks, construction of facilities and infrastructure, site traffic, and handling of overburden, mine rock and ore, removal of infrastructure and facilities) can lead to increased TSS loading in water that is collected and managed in the site contact water management infrastructure. Domestic water and treated sewage could also potentially contain suspended solids that could lead to increased TSS loading in the water management system. Discharges from the water treatment plant (WTP) and wastewater treatment plan (WWTP) may change sediment quality in receiving lakes and downstream environment due to higher levels of TSS in the discharge water compared to that in the receiving waterbodies.

The waste water treatment plant is expected to remove a large portion of TSS because of their treatment processes, which would comply with the requirement that discharge of treated effluent and treated sewage from these plants regulated discharge thresholds for TSS, such as the maximum authorized monthly mean concentration of 15 mg/L (Table 8-18). Water and wastewater treatment plants will meet the requirements of *SOR/2002-222 – Metal and Diamond Mining Effluent Regulations* (MDMER) and *SOR/2012-139 – Wastewater Systems Effluent Regulations* under *Fisheries Act* and *NLR65/03 – Newfoundland and Labrador Environmental Control Water and Sewage Regulations, 2003* under the *Water Resources Act*. These regulatory limits are designed to be protective of the aquatic environment. Sewage will undergo tertiary biological treatment and wastewater discharge rates will be consistent with potable water supply intake rates. Wastewater treatment effluent from advanced (tertiary) treatment will be suitable for direct discharge to the environment (BBA 2024). The diffuser and outfall designs for the WTP and wastewater treatment plant, respectively, would also provide effective mixing and dispersion of the treated discharges, which would result in reducing TSS in the receiving environment. Diffuser/outfall will be designed such that discharged flow would not interact with the bed sediment and the outfall will be located away from sensitive or unique habitats to the extent practicable. Regular monitoring of treated effluent discharges would be conducted to confirm water quality objectives are met for discharge, which includes TSS. More specifically for the WTP, the rate of discharge would also be managed by having adequate surface water storage capacity to allow for controlled release rates, as required; the storage ponds can also promote settlement of solids, which would reduce TSS concentrations in the treated effluent and treated sewage to be discharged.

Water management infrastructure and facilities will be constructed to collect, divert, manage and treat contact water from the Project component. Details of water management facilities and infrastructure are provided in **Chapter 2, Project Description**. Ditches, dikes, and diversion dams will be designed along the edges of all mine facilities, access roads, and around building pads to allow run-off to flow via gravity into the closest collection pond where it will be pumped to the closest water treatment facility. Collection ponds, pumping facilities, and treatment plant will be constructed to facilitate retention, diversion, and treatment of contact water and to confirm that the discharge water would meet water quality criteria prior to release to the environment. Process water will be recycled and re-used to reduce fresh water withdrawal from Duley Lake and to minimize effluent release to environment including Duley Lake, to the extent practicable.

- Surface water in the receiving environment downstream of the Project would be protected and managed through the Environmental Protection Plan and the Environmental Effects Monitoring Program . Erosion and Sediment Control Plan (Annex 5F) will be developed and implement to minimize sediment in run-off being collected using water management infrastructure and facilities. The Environmental Effects Monitoring Program provide a basis for monitoring surface water and sediment quality on site and in the receiving environment, which includes monitoring for TSS concentrations. The WTP and wastewater treatment plant are Project facilities that would fall under the oversight of these plans.

It is expected that the TSS present in discharges from the Project to receiving lake (Duley Lake) will be regulated to permitted limits at the points of discharge and will disperse rapidly within the regulated mixing zone (RMZ), resulting in minor, localized changes to water and sediment quality in the immediate receiving environment of lake. This discharge and deposition are not expected to affect surface water or sediment quality on a scale beyond the proposed RMZ for the discharges. Changes are expected to have a negligible residual effect on sediment quality; therefore, the pathway was not carried forward in the assessment.

8.5.2.3 Residual Effect Pathways

The following Project interactions were predicted to be residual effect pathways to surface water quantity and/or surface water and sediment quality and were advanced for further assessment of residual effects (Section 8.5.3).

8.5.2.3.1 Water Withdrawal

The Construction phase may require short-term water taking may from surface water or both the surface water and groundwater sources for construction water supply. During the Operations and Closure phases, a long-term fresh water withdrawal from Duley Lake for processing of iron ore, sanitary use, water transfer from Duley Lake to Pike lake to maintain water levels in Pike Lake, dewatering of the Rose Pit, and/or accelerated flooding of the Rose Pit will be required. These water takings could result in changes to surface water quantity in the form of reductions in streamflows and/or water levels at nearby waterbodies. The specific locations for water takings, as well as the anticipated water taking duration and volumes, will be determined during the permitting and detailed design stage of the Project. These water takings may include:

- dewatering of excavations for development of roads, facilities and infrastructure
- dewatering that may occur during exploration drilling
- dewatering of Rose Pit
- water diversion to create and maintain a dry work area for the construction of waterbody crossings and tailing management facility starter dam, if required
- water for drilling
- water for on-site concrete mixing and earthworks (compaction)
- water for washing concrete mixing equipment, concrete delivery systems, vehicles, and equipment as well as for work sites, and construction worker accommodations
- water for dust suppression at work sites and along access roads
- water for drinking and sanitation at worker accommodations, mine service area, and offices
- water for processing of iron ore

To minimize the potential effects on the surface water quantity of receiving waterbodies due to Project activities, mitigation and enhancement measures will include the following:

- Take water in accordance with provincial and federal standards and licence/permit conditions and industry best standards.
- Locate proposed intakes away from sensitive or unique habitats to the extent practicable.
- Recycle and re-use of process water to reduce fresh water intake and release to environment, to the extent practicable.
- Develop and Implement a Project-specific Waste Management Plan (Annex 5H) and site water management procedures.
- Develop and implementing Environmental Effects Monitoring Program that includes surface water and sediment quality monitoring to confirm the effectiveness of mitigation measures as well as to maintain compliance with regulatory permits/approvals.
- Develop and implement a Rehabilitation and Closure Plan for the Project to return the landscape, as close as possible, to it is undisturbed condition.

Measurable changes (i.e., residual effects) to surface water quantity (streamflows and/or water levels at waterbodies (specific to or adjacent to the source of the water taking) are expected to occur as a result of water taking activities, even with the effective implementation of the mitigation measures identified above; therefore, the pathway is carried forward in the assessment.

8.5.2.3.2 Discharge of Treated Effluent

Discharges of water from Project activities during the Construction, Operations and Closure phases could result in changes to both surface water quantity and quality if not effectively mitigated. Discharges could result in an increase to flows and/or water levels in receiving lakes/waterbodies as well as an increase to the concentrations of chemical constituents in the same receivers. Sources of treated effluent/water from WTP and WWTP include:

- construction water from dewatering activities during excavations for road development, facilities and infrastructure
- water from aggregates and concrete batch plants
- wash water from cleaning concrete mixing equipment and concrete delivery systems on work sites
- wash water from vehicle and equipment wash facilities on work sites, at temporary construction worker accommodations, and at temporary laydown areas
- contact water from overburden and mine rock storage areas, Rose pit collection pond (also referred to as Rose Pit sedimentation pond), and tailing management facility and other Project facilities
- effluent from ore process plant
- sanitary wastewater and grey water from temporary construction worker accommodations, site offices and facilities

To minimize the potential effects on the surface water quantity and quality of receiving waterbodies due to Project activities, mitigation and enhanced measures will be as follows:

- Water management infrastructure and facilities will be constructed to collect, divert, manage and treat water from the Project component. Details of water management infrastructure and facilities are provided in **Chapter 2, Project Description**. Ditches, dikes, and diversion dams will be designed along the edges of all mine facilities, access roads, and around building pads to allow rainwater to flow via gravity into the closest collection pond where it will be pumped to the water treatment facility. Collection ponds, pumping facilities, and treatment plants will be constructed to facilitate retention, diversion and treatment of contact water and to confirm discharge water meets water quality criteria prior to release to the environment.
- Process water will be recycled and re-used to reduce fresh water intake from Duley Lake and to minimize effluent release to environment including Duley Lake, to the extent practicable.
- A WTP will be constructed and operated to treat the effluent from Rose Pit collection pond, tailing management facility and other Project facilities to appropriate release limits in accordance with provincial standards and licence/permit conditions. Effluent diffuser to dispose treated effluent will be designed to provide effective mixing and dilution of the effluent to limit the area of the receiving environment affected by mine discharge. Diffuser/outfall will be designed such that discharged flow would not interact with the bed sediment and the outfall will be located away from sensitive or unique habitats to the extent practicable.
- Treated effluent flow and quality will be monitored and comply with provincial standards and licence/permit conditions (e.g., *Newfoundland and Labrador Environmental Control Water and Sewage Regulations* [NL Reg. 65/03], *Metal and Diamond Mining Effluent Regulations* [SOR/2002-222], *Wastewater Systems Effluent Regulations* [SOR/2012-139]), and, where applicable, site-specific water quality objectives.
- A WTP capable of advanced (tertiary) treatment will be constructed and operated to treat sanitary sewage to appropriate release limits in accordance with provincial standards and licence/permit conditions. The outfall to dispose treated sewage effluent will be designed to provide effective mixing and dilution of the effluent to limit the area of the receiving environment affected by the discharge. Outfall will be designed such that the discharged flow will not interact with the bed sediment.
- Treated sewage flow and quality will be monitored and comply with provincial standards and licence/permit conditions.
- A monitoring plan will be developed and implemented that defines actions levels and documents steps to be taken to mitigate elevated concentrations of COPCs in treated effluent discharge to acceptable levels.
- Potentially acid generating mine rock will be characterized, identified, and managed to prevent localized acid mine drainage and minimize metal leaching.
- The Environmental Effects Monitoring Program will be implemented and would include monitoring surface water levels and flows. A Project-specific Waste Management Plan (Annex 5H) and site water management procedures will be developed and implemented. A Rehabilitation and Closure Plan for the Project will be developed and periodically updated to reflect changing site-specific conditions and surface water effects, and to reflect mitigations necessary to maintain protection of surface water and return the landscape, as close as possible, to it is undisturbed condition.

Even with the effective implementation of mitigation and enhancement measures outlined above and summarized in Table 8-21, measurable changes (i.e., residual effects) to surface water quantity (increase in flows and/or water levels at receiving waterbodies) and surface water quality (increase to the concentrations of chemical constituents in receiving waterbodies) are expected to occur as a result of treated effluent/water discharges; therefore, the pathway is carried forward in the assessment.

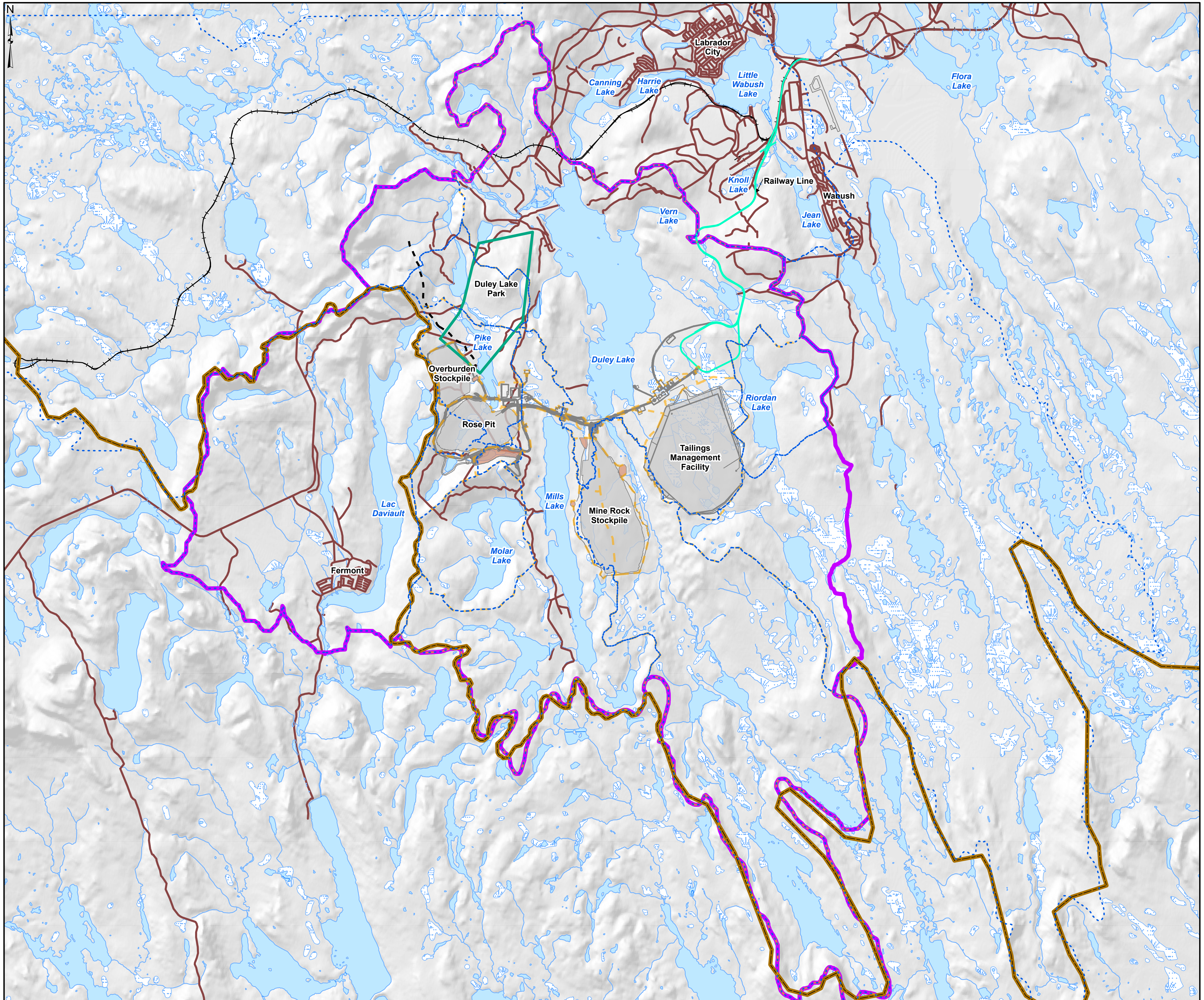
8.5.2.3.3 Site Drainage and Run-Off

Project activities (e.g., site preparation including vegetation clearing and earthworks, construction of facilities and infrastructure, site traffic, and handling of overburden, mine rock and ore) for the construction of Project components/footprint (e.g., Rose Pit, overburden stockpile, mine rock stock pile, tailing management facility) during Construction phase can lead to changes to local watershed causing alterations to land cover, drainage patterns, catchment areas, and associated run-off (volumes) and erosion/sedimentation processes. Altered catchment areas and drainage patterns during Construction phase are expected to continue to exist throughout the Project lifespan. Additionally, the activities associated with the removal of Project infrastructure, restoration and revegetation of facilities and infrastructure during Closure phase may also lead to changes in drainage patterns, run-off and erosion of soil.

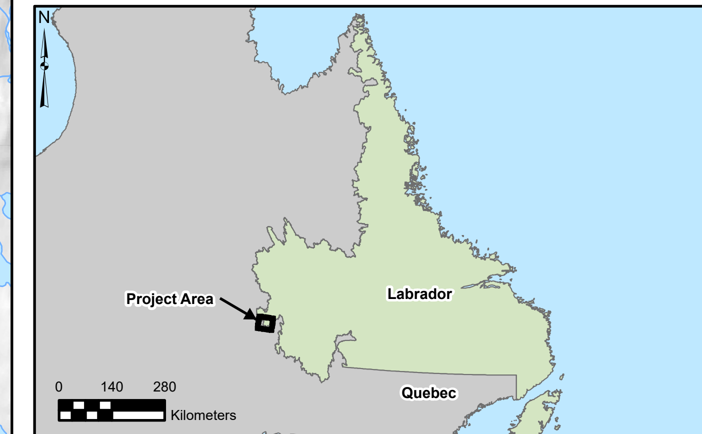
This alteration to drainage area can cause a local increase in run-off and sediment loading in water if not collected, managed and treated (if required) on site (e.g., direct run-off from the catchment area of the Project to the waterbodies/streams). Altered drainage patterns and changes to flows and water levels may also affect stream channel and bank stability in the downstream environment, leading to increased sediment loading from the resulting erosion. By extension, the identified increase in streamflows with the potential for higher rates of sediment erosion/transport (all of which are tied to surface water quantity) may result in an associated increase to the concentrations of total suspended solids and acid rock drainage/metal leaching (surface water quality and sediment quality) in the respective waterbodies. However, in some catchments, reduction in run-off is also expected that can potentially lower the water levels in the downstream environment and may affect the watercourse's capacity to carry sediment/nutrient transport, thus affecting aquatic habitat in those streams.

Watershed alterations in SSA will take several forms, including lake and stream removal, watercourse diversion, land cover changes, as well as potential changes to run-offs, baseflows, water levels and/or sediment transportation and erosion characteristics. The changes/alterations to local natural watersheds by the Project activities/components are shown in Figure 8-12 and Table 8-22. Project components (e.g., Rose Pit, overburden stockpile, mine rock stockpile, tailing management facility, process plant and associated Project infrastructure including rail line and roads) are expected to modify drainage patterns in the watersheds of Duley Lake, Pike Lake (referred to as Pike Lake South; Figure 8-12), Rose Lake, Mid and Upper Mid Lakes, Elfie and End Lakes, Riordan Lake, Waldorf River, Rectangle Lake and Mills Lake. Table 8-22 provides summary of modifications to natural watershed in terms of variation/changes to areas of local watersheds of waterbodies (lakes). The run-off and seepage from the area of a watershed lost due to Project footprint will be managed using water management infrastructure and facilities and return to Duley Lake after necessary treatment. See Section 8.5.1.2.1 for details about water management during Project phases (Construction, Operations, and Closure) and Post-closure period. After Operations, Project disturbed areas will be rehabilitated and returned to their respective watersheds. Run-off and seepage (except for mine rock stockpile) will also continue to drain to the nature environment.

Development of the Rose Pit will alter local drainage patterns permanently and will affect flows and water levels if not mitigated. Drainage patterns in Rose Pit mine catchment area (i.e., Rose Lake watershed) will be altered through the lateral development of the Rose Pit. This will include two components, including the collection and dewatering of all incident precipitation – run-off within the Rose Pit footprint and the construction and maintenance of Rose Pit perimeter ditching to prevent overland flow into the Rose Pit. The hydrological effects will be related to the change in water balance due to the increase in run-off coefficient and reduction in evapotranspiration associated with Rose Pit development. Natural drainage patterns in the headwater area upstream of the Rose Pit (i.e., Upper Mid Lake, Mid Lakes, Elfie Lake, and End Lake) are also expected to change. While the development of Rose Pit (where most drainage-related alterations are expected to occur) will require removal of Rose Lake, a watershed alteration will be required to replace the existing watercourses connecting End Lake, Elfie Lake and Mid Lake to Pike Lake via Rose Lake. Non-contact run-off water coming from Upper Mid Lake and Mid Lake watersheds will be diverted around the pit to Pike Lake via a clean water diversion and pumping station. Run-off from End and Elfie Lake watersheds will mingle with contact water from the pit and stockpiles within the Rose Pit collection pond (Rose Pit sedimentation pond). Following Closure, these diversions and retaining structures will be removed and these watersheds will be restored to their natural water courses following pit flooding.



KEY MAP



Scale: 1:20,000,000

Legend

- River/Stream
- Existing Railway
- Existing Road
- Potential Access Road
- Proposed Project Infrastructure (Linear)
- Proposed Access Road and Railway Corridor
- Natural Watershed Limit
- New Infrastructure Subwatershed Boundary
- Duley Lake Park
- Surface Water Local Study Area (LSA)
- Labrador/Quebec Boundary
- Proposed Project Infrastructure
- Proposed Sedimentation Pond
- Bog/Wetland
- Waterbody

0 1,250 2,500 5,000
1:120,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT
CHAMPION IRON MINES LTD.

PROJECT
KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE
PROJECT FOOTPRINT ON LOCAL WATERSHEDS AND SUB W-WATERSHEDS OF WATERBODIES IN THE LOCAL STUDY AREA

CONSULTANT

Kami

YYYY-MM-DD	2025-06-27
DESIGNED	----
PREPARED	MS
REVIEWED	MS
APPROVED	CD

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0013	0	8-12

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

Table 8-22: Summary of Land Cover Changes to Local Natural Watersheds in the Local Study Area

Name of Watershed	Original Watershed Area (ha)	Operations		
		Post-Development Watershed Area (ha)	Change to Watershed Area (ha)[f]	% Change[g]
Duley Lake[a]	7,274	6,066	-1,208[e]	-16.6
Pike Lake South/Pike Lake	917	483	-434[e]	-47.4
Rose Lake/Rose Pit	165	0[b]	-165	-100
Mid and Upper Mid Lakes	285	0[c]	-285	-100
Elfie and End lakes	80	0[d]	-80	-100
Pike Lake North	656	656	0	0
Riordan Lake	980	976	-4[e]	-0.39
Waldorf River	7,054	6,473	-581[e]	-8.24
Rectangle Lake	1,807	1,804	-3[e]	-0.17
Mills Lake	3,629	3,505	-124[e]	-3.42
Molar Lake	1,180	1,180	0	0
Daviault Lake	6,414	6,414	0	0

(a) Duley Lake watershed presented in this table represents local natural watershed draining directly into Duley Lake. Note that Duley Lake also receives water from the LSA sub-watershed (listed above), excluding Daviault Lake and Rectangle Lake; however, the list includes the Walsh River watershed. The total watershed area of Duley Lake, including sub-watersheds, is approximately 90,388 ha (i.e., watershed area of WC-09 [Duley Lake outlet] in Table 8-29); therefore, change due to the Project footprint is estimated as -2.1%. For a discussion about the assessment of Project effects due to changes in the watershed area, refer to the sub-section on LWBM in Section 8.5.3.1.1.

(b) Rose Lake natural watershed will be lost due to development of Rose Pit. Run-off collected within Rose Lake/Rose Pit will be managed and transferred to Duley Lake via water management infrastructure after necessary treatment.

(c) Mid and Upper Mid Lakes will have a loss of natural drainage patterns. The run-off will be conveyed downstream to Pike Lake via water management infrastructure.

(d) Elfie and End lakes will have a loss of natural drainage patterns. The run-off will be conveyed to the WTP, this watershed being the location of the Rose Pit collection pond (also referred to as Rose Pit sedimentation pond).

(e) During Operations and Closure phases, run-off and seepage from Project footprint will be managed using water management infrastructure and will be returned to Duley Lake after necessary treatment.

(f) After rehabilitation, Project-disturbed areas will be returned back to their respective watersheds. Run-off and seepage (except for mine rock stockpile seepage) will continue to discharge to the natural environment.

(g) During the Post-closure period, after the rehabilitation of Project disturbed areas, changes to landcover will reverse and watershed conditions are expected to return to near pre-mine (pre-development) conditions.

LWBM = Local Water Balance Model.

Rose Pit groundwater seepage collection and dewatering may also alter upstream headwater watercourse baseflows within Rose Pit's hydrogeological zone of influence and there is also a potential for Rose Pit surface and groundwater dewatering to affect water levels in the small headwater lakes (i.e., Upper Mid Lake, Mid Lake, Elfie Lake, and End Lake).

Overall, Rose Lake, Mid and Upper Mid Lakes, and Elfie and End Lakes will have a complete loss of natural drainage patterns and as discussed natural watercourse will be replaced/mitigated with the help of water management infrastructure and facilities (that would include Mid Lake dam, Elfie Lake dam, and End Lake dam, and drainage ditches to drain non-contact water downstream to Pike Lake). Note that the Rose Lake, Mid and Upper Mid Lakes, and Elfie and End Lakes are sub-watersheds of Pike Lake South, that ultimately drain to Pike Lake (Pike Lake South). In addition, the changes due to land cover (i.e., removal of vegetation, increase in soil compact, surface grading, and slope angles) will result a change in water balance due to the increase in run-off coefficient and reduction in evapotranspiration associated with the Rose Pit development.

Drainage patterns in the Pike Lake (Pike Lake South) watershed will also be altered due to the development of overburden stockpile. Catchment ditches will be built on the perimeter of the overburden stockpile to direct contact run-off and seepage to the collection pond. A pumping system will be used to pump contact water through an above-ground high-density polyethylene pipeline over a 4.2 km distance to the Rose Pit collection pond (Rose Pit sedimentation pond).

The development of tailing management facility (TMF), situated between Riordan Lake on the east, Waldorf River on the west and Duley Lake to the north, is expected to alter the local drainage pattern. The TMF will be constructed at the headwater catchment of two watercourses which drain the TMF footprint to the Duley Lake. To mitigate the effect on water quantity and quality, TMF will include starter dam, TMF pond, seepage collection sumps, pumping and treatment systems. The proposed TMF pond, located within the TMF, will collect direct precipitation, water discharged from the process plant with the tailings and water pumped back from the downstream perimeter seepage collection sumps around the TMF. During the Operations phase, water will be pumped from the pond via a reclaim system back to the process plant for re-use. Excess water will be treated within the WTP located within the process plant and discharged to the Duley Lake.

The development of mine rock stockpile located between the Mills Lake on the west and Waldorf River on the east, will also affect drainage patterns within its footprint. However, due to their headwater locations in their catchment areas, alterations will have minimal effects on external drainage and watersheds will continue to drain to their respective existing receiving waters of Mills Lake and Waldorf River. Three collection ponds will be designed to manage contact water from the mine rock stockpile. Catchment ditches will be built on the perimeter of the mine rock stockpile to direct contact run-off and seepage to the collection ponds. A pumping system will be used to pump contact water from the collection ponds to the Rose Pit collection pond (Rose Pit sedimentation pond) for water management and treatment prior to release to environment.

Other Project infrastructure such as railway line, access roads, and ore processing facilities (i.e., process plant) are also expected to affect local drainage. A newly constructed railway, referred to as the Kami Railway Line, will be developed to connect the mine south of Wabush to the Québec North Shore & Labrador Railway line, north of the Wabush Airport. Two new proposed access roads, the east access road and west access road, will be constructed. The east access road will facilitate initial access to the site at the initial stages of construction and will be maintained during the remaining Project phases to act as a secondary entrance. The west access road will provide site access, specifically to the Rose Pit and overburden stockpile to facilitate the development of the Rose Pit quarry during Construction. Further, on-site roads consisting of roads for light vehicle traffic (i.e., pick-up trucks), haul roads for heavy vehicle traffic (i.e., mining haul trucks and equipment) and multi-purpose roads which will be used by both light and heavy vehicles, will be constructed. The roads and railway line proposed for the Project will require the installation of water crossing features, depending on the planned span length and traffic volumes. There are currently eight water crossings proposed for the access roads and nine water crossings for the railway line, as well as several water crossings within the mine site. Culverts will also be used to span small creeks and streams intersected by the access roads, on-site roads or the railway line to maintain flow and fish passage. A total of 17 culverts will be installed to cross existing water features intersected by the proposed east access road (3), west access road (5) and Kami railway line (9). In addition to changes to land cover effect site drainage and run-off due to construction of Project infrastructure, the installation of waterbody crossing structures during the Construction and Operations phase may also result in a localized increase or reduction to flow velocities, shear stresses, water levels, and erosion–sedimentation processes at locations upstream or downstream of the crossing, if not mitigated. By extension, an increase to erosion and shear stress processes (both of which are tied to surface water quantity) in the vicinity of the waterbody crossing structure may result in an effect on surface water and sediment quality. To mitigate the Project effects, mitigation and enhancement measures during design, construction, and operation and maintenance stages will be completed in accordance with applicable permits and approvals, and best industry practices.

Remedial drainage works (including side ditches, waterbody crossings, and culverts) to convey cross-drainage will be required. Ditches will be designed along the edges of all mine facilities, access roads, and around building pads to allow rainwater to flow via gravity into the closest site run-off collection basin, where it would eventually be pumped into the closest collection pond or into the TMF for treatment and further discharge. Each collection basin would be located in a natural low point to minimize the number of pumps required to manage precipitation and run-off into the treatment plant.

To mitigate the effects to surface water quantity, surface water and sediment quality, construction footprint will be minimized, and natural drainage will be maintained, where possible. Water management infrastructure and facilities (briefly discussed above) will be constructed to collect, divert, manage and treat water from the Project components (e.g., Rose Pit, overburden stockpile, mine rock stockpile, tailing management facility, and associated Project infrastructure). Details of water management infrastructure and facilities are provided in **Chapter 2, Project Description**. As discussed above, ditches, dikes, and diversion dams will be designed along the edges of all mine facilities, access roads, and around building pads to allow run-off to flow via gravity into the closest collection pond where it will be pumped to the treatment facility. Collection ponds, pumping facilities, and treatment plant will be constructed to facilitate retention, diversion and treatment of contact water before discharging to the natural environment.

The rate of discharge from the water management infrastructure and facilities (including WTP) would also be managed by having adequate surface water storage capacity to allow for controlled release rates, if required. A minimum 150 m buffer between soil/rock stockpiles and waterbodies or drainages would be maintained (unless temporary soil/rock storage is required), and all containment and conveyance structures (e.g., ditches and culverts) would be routinely inspected and maintained to limit risk of road wash-out or potential sediment release.

An Erosion and Sediment Control Plan (Annex 5F) will be implemented. Sediment control measures would be implemented during Construction phase (e.g., temporary sediment ponds, silt curtains, sediment traps), and erosion control measures would be used as required during Construction, Operations, and Closure phases.

Progressive reclamation and revegetation will be implemented, where practicable, and non-permanent features would be reclaimed and revegetated as they are decommissioned.

The Environmental Effects Monitoring Program will be implemented and would include monitoring surface water levels and flows. Site contact water will be intercepted and managed to reduce potential for effects on the surrounding environment in accordance with the Environmental Protection Plan. More specifically, work required in areas of the Project that may be more prone to erosion from surface water run-off and changes in surface water levels, flows, and drainage areas would be scheduled to avoid the time of year when erosion has the greatest potential (i.e., spring freshet).

A Rehabilitation and Closure Plan for the Project will be During Construction and Operations, a Preliminary Decommissioning and Reclamation Plan would be developed and periodically updated to reflect changing site-specific conditions and surface water effects, and. Prior to transitioning to Closure phase, a Detailed Decommissioning and Reclamation Plan would be developed to reflect mitigations necessary to maintain protection of surface water and return the landscape, as close as possible, to it is undisturbed condition.

During Closure, Project disturbed areas will be regraded and revegetated. Upon rehabilitation, Project areas will again continue to discharge to natural environment; therefore, Project effects are expected to be largely mitigated during the Post-closure period.

Environmental design features, mitigation and enhancement measures, and monitoring are anticipated to minimize changes in surface water quantity and surface water and sediment quality. However, changes to surface water patterns from the Project could result in a measurable change (i.e., residual effects) to surface water quantity, surface water quality, and sediment quality during the Construction and Operations phases; therefore, the pathway is carried forward in the assessment.

8.5.2.3.4 Seepage from Overburden Stockpile, Mine Rock Stockpile, and Tailing Management Facility

Seepage from the overburden stockpile, mine rock stockpile and tailing management facility is expected to migrate through the overburden and shallow bedrock towards discharge points at the closest streams, lakes or wetlands. Based on the topography and drainage characteristics of the Project, ground water transport pathways from a source (e.g., tailing management facility) and a receiving stream or lake are likely to be short (less than a few 100 m) and, in the absence of identified well users, the primary receptor of contaminated seepage from the tailing management facility or mine rock stockpile is the surface water.

The anticipated sources of contaminants in seepage water include acid rock drainage, metal leaching, red water and nitrogen from blasting residuals including ammonia, nitrate and nitrite. Seepage water has the potential to adversely affect the surface water quality of receivers through release of contaminant, if not mitigated.

Mitigation measures during Project lifespan to limit the degree of seepage include:

- Characterize, identify, and manage potentially acid generating mine rock to prevent localized acid mine drainage and minimize metal leaching.
- Use impermeable material e.g., (high-density polyethylene geomembrane) to seal dam slopes and collection ditches/ponds.
- Construct run-off and seepage collection ditches around the overburden stockpile, mine rock stockpile, TMF and other Project facilities and divert seepage to collection ponds and WTP, as required, to meet site-specific water quality objectives and regulatory requirements (see **Chapter 2, Project Description**, and TSD II: Water Management Infrastructure Design Report for details about water management infrastructure).
- Implement a Project-specific Waste Management Plan (Annex 5H) and site contact water management procedures.
- Implement a Project-specific Environmental Protection Plan.
- Develop and implement an Environmental Effects Monitoring Program that includes monitoring groundwater, surface water and sediment quality.
- Develop and implement a Rehabilitation and Closure Plan for the Project.

Even after the Closure phase, the main ongoing potential groundwater effect would be continued seepage from the TMF, overburden stockpile and mine rock stockpile through the overburden and bedrock. A short distance of travel is expected with seepage ultimately discharging to adjacent wetland, streams or lake. To mitigate the concern, these facilities will be revegetated prior to directing seepage water to natural environment; however, seepage from mine rock stockpile will continue to be pumped to bottom layers of Rose Pit.

In addition to Post-closure monitoring of water quality and water levels, mitigation may include:

- installing engineered cover on mine rock stockpile
- installing engineered cover system on the TMF during Closure to promote positive passive drainage, limit ponding, and support revegetation
- collecting run-off and seepage water in drainage ditches around the mine rock stockpile and overburden stockpile and directing to the collection ponds and pumping to the Rose Pit to facilitate flooding during Closure
- collecting seepage water in drainage ditches around the mine rock stockpile following reclamation and pumping to the bottom of the Rose Pit during Post-closure
- routinely testing surface and seepage water during Closure
- maintaining water management infrastructure during Closure until water quality in the Rose Pit has reached acceptable discharge quality
- developing and implementing a Rehabilitation and Closure Plan for the Project

Per (TSD VI) the acid generating potential and metal leaching potential for Kami mine rock units is generally low. Further, potentially acid generating material will be managed through strategic blending to prevent acid rock drainage and minimize metal leaching. The run-off and intercepted groundwater seepage quality from Project facilities will be controlled during Project lifespan and during Post-closure, seepage from mine rock stockpile will continue to be collected and pumped to Rose Pit. Even with the implementation of environmental design features, mitigation and enhancement measures, and a monitoring program, seepage from the TMF, overburden stockpile and/or mine rock stockpile is expected to result in measurable changes to water quality of receiving environmental. In consideration of the above measures, residual effects from mine operations are anticipated to occur; therefore, the pathway is carried forward in the assessment.

8.5.2.3.5 Wash-Off of Explosive Spills and Residues from Blasting Activities

During the Construction phase, blasting may be required for aggregate extraction from nearby pits and quarries and to facilitate excavation for rail, access roads, Project facilities and infrastructure where other options are not feasible. During Operations phase, blasting will be necessary component of open pit (Rose Pit) mining operation. The blasting agents employed for excavations and/or extraction of ore can be accidentally released during storage, transfer, or loading. These blasting activities may result in changes to surface water and sediment quality, recognizing that explosives spills and residues could be washed off into nearby waterbodies during a run-off event and, if occurring in high enough volumes, may result in changes to the concentrations of chemical constituents in receiving waters.

To mitigate the potential effects during Construction phase, blasting activities will abide by the hours of operation and any blasting restrictions, to mitigate potential effects on the environment. Ammonium nitrate and fuel oil will not be used. Explosives will be in emulsion or emulsion blend to mitigate potential dissolution and poor explosive performance in the presence of water, noting that emulsion type explosives are highly water resistant. Transportation and storage of explosives will follow applicable federal and provincial legislation/regulations. Only qualified persons with appropriate training and experience to carry out the transportation and handling of explosives will be employed. Good housekeeping practices will be observed during loading of explosives with a plan to immediately clean up spills and undetonated explosives. Proper loading techniques will be implemented to minimize the use of excess explosives and the potential for spillage. Mine rock and aggregates are expected to be free of blasting residues.

A blasting and communication management protocol that describes specific measures to be taken during blasting activities will be prepared and included in the Environmental Protection Plan. Blasting operations will be completed in accordance with the Environmental Protection Plan.

During Operations phase, high demand of explosives is anticipated for mine pit (Rose Pit) operations. Raw materials for the manufacture of explosives will be transported by truck from the Town of Wabush to the plant. Explosives and/or accessories will be stored at a safe distance from Project infrastructure. Drill and blast specifications will be established according to material type and whether the rock is ore or mine rock. Controlled blasting techniques will be used including buffer blasts and pre-splits. Measures for the management of ammonia contaminant will be included in the Environmental Protection Plan and implemented.

To predict the changes to water quality parameters (including ammonia) in receiving lakes (Duley Lake and Pike Lake), a side-wide water quality and water balance model (TSD VI) was developed that accounted for release of ammonia to receiving waterbodies due to blasting in Rose Pit for ore mining. The concentration of ammonia was not predicted to exceed CCME guidelines in the receiving lakes due to blasting activities. For further details about the prediction model and results refer to TSD VI.

With the effective implementation of the mitigation measures identified above, measurable changes to surface water and sediment quality (i.e., residual effects) at nearby waterbodies during Construction and Operations phases due to the wash-off of explosives spills and residues from the blasting activities in the Rose Pit are expected to occur; therefore, the pathway is carried forward in the assessment.

8.5.3 Residual Project Effects Analysis

This section provides results of the residual Project effects analysis for surface water quantity and surface water and sediment quality for the residual effects pathways identified in Section 8.5.2.3. Methods for completing the residual Project effects analysis for surface water is presented in Section 8.5.1.2.

8.5.3.1 Residual Project Effects Characterization

This sub-section assesses the predicted changes to receiving environment surface water quantity and surface water and sediment quality from the residual effect pathways identified in Section 8.5.2.3.

The effects of primary pathways on surface water quantity and quality were calculated numerically by integrating these pathways into WBWQM developed for each phase (i.e., the base case including Construction, Operations, Closure and Post-closure) as presented in Section 8.5.1.2.1. The results presented are the net results of Project-related changes associated with the identified residual pathways. Project effects were discussed in terms of changes to modelled parameters within the LSA, which is the predicted spatial limit or boundary of where direct and indirect effects on surface water quantity, surface water and sediment quality are likely to be detectable. Farther downstream of the Duley Lake outlet, changes to surface water quantity, surface water and sediment quality were considered likely to be negligible.

The predicted residual effect analysis for surface water quantity and quality during Project lifespan (Construction, Operations, and Closure phases) and far-future (Post-closure period) is structure using separate sub-section for models/assessments (WBWQM, DLCSM, and LWBM). Predicted discharges, water levels at receiving waterbodies and water balance components under pre-mine and mine conditions are used to classify residual Project effects for surface water quantity. Predicted trend of modelled water quality parameters (i.e., COPCs) are described for screened COPCs (i.e., COIs exceeding criteria/thresholds and/or background concentrations). These predicted trends are used to classify residual effects for surface water quality at key waterbodies within the LSA. Figures are provided in subsequent sections showing trends over time for representative COIs, with results for all COPCs at the key waterbodies within the LSA available in TSD VI. Predicted trends of sediment quality were assessed qualitatively and semi-quantified manners (for key sediment quality parameters) based on changes in water quality. These predicted changes are used to classify residual effects for sediment quality at key waterbodies within the LSA.

8.5.3.1.1 Surface Water Quantity

8.5.3.1.1.1 Site-Wide Water Balance and Water Quality Model

To predict the changes to surface water flows and water levels in receiving waterbodies (Duley Lake and Pike Lake), WBWQM (TSD VI) was developed that accounted for the changes to drainage pattern (including headwater areas upstream) and run-off to the receiving waterbodies, water takings, effluent discharges, seepage flows and water transfers between the Duley Lake and Pike Lake, and fugitive loadings from explosive spills. Local watersheds of Duley Lake and Pike Lake represent watersheds that will subject to the most land cover changes due to Project footprint (-16.6% and -47.7%, respectively [Table 8-22]). Noting that the land cover changes to the entire watershed of Duley Lake, including all sub-watersheds draining into Duley Lake are estimated as -2.1% (see watershed of WC-09 [Duley Lake outlet] in Table 8-29).

Discharges at Duley Lake and Pike Lake outlets and water levels at Pike Lake were predicted for pre-mine and mine conditions. Water transfers from the Rose Pit collection pond (Rose Pit sedimentation pond) to Duley Lake increase over time as the stockpile footprint grows and the open pit develops. By the end of Operations, WBWQM predicted an annual discharge from the collection pond to Duley Lake to reach 24 million cubic metres (Mm^3). A summary of predicted average monthly discharges at Duley Lake under pre-mine and mine conditions for MAP scenario during Year 24 (end-of-mine) and Closure phase are presented in Table 8-23 and Table 8-24.

Table 8-23: Predicted Monthly Duley Lake Average Discharge Under Pre-mine vs. Mine Conditions for the Mean Annual Precipitation (MAP) Scenario for the End-of-Mine (Year 24)

Month	Pre-mine Conditions (m^3/s)	Mine Conditions (m^3/s)	Project Impact (%)
January	1.8	2.1	12%
February	3.3	3.4	5%
March	0.9	1.0	18%
April	10.5	10.5	0%
May	68.5	67.3	-2%
June	40.0	39.4	-1%
July	21.0	20.9	0%
August	19.6	19.5	0%
September	17.3	17.2	0%
October	18.8	18.7	0%
November	21.2	21.1	-1%
December	4.0	4.2	6%
Average	**18.9**	**18.8**	**-1%**

Source: TSD VI, Site Wide Water Balance and Water Quality Modelling Report.

Table 8-24: Predicted Monthly Duley Lake Average Discharge under Pre-mine vs. Mine Conditions for the Mean Annual Precipitation (MAP) Scenario during Closure Phase (years 25 to 36)

Month	Pre-mine Conditions (m^3/s)	Mine Conditions (m^3/s)	Project Impact (%)
January	2.0	1.7	-16%
February	3.3	2.9	-12%
March	0.9	0.8	-14%
April	11.3	10.3	-9%
May	65.0	62.2	-4%
June	39.4	37.2	-5%
July	21.1	19.5	-8%
August	19.9	18.3	-8%
September	17.5	16.1	-8%
October	19.2	17.9	-7%
November	21.5	19.9	-8%
December	4.1	3.5	-14%
Total	**18.8**	**17.5**	**-7%**

Source: TSD VI, Site Wide Water Balance and Water Quality Modelling Report.

The end-of-mine (Year 24) shows monthly average discharge reductions from Duley Lake ranging from -2% to 18%, with increased flow during winter due to effects from pit dewatering, which are conservative. Overall, the annual average discharge at Duley Lake outlet at the end of Operations (Table 8-23) is projected to be 1% lower than the pre-mine conditions. During the Closure phase, average monthly discharge reductions are expected to range from -5% to -16%, with the largest flow reduction occurring during the winter due to effects from water transfers to accelerate pit flooding. Overall, the annual average discharge at Duley Lake outlet during Closure phase is projected to be 7% lower than the pre-mine conditions (Table 8-24).

Further analysis of modelling results indicates that the net discharge of water to/from Duley and Pike Lakes from the Project activities during the Project lifespan and far future is expected to result in small changes to average water levels, such as an increase of the average monthly water surface elevation by 1.3, 1.5 and 2.1 cm in Pike Lake under P25, MAP and P75 scenarios, respectively. The expected change to average monthly discharges of Pike Lake are 5.49%, -0.01% and -3.36% under P25, MAP and P75 scenarios, respectively, whereas the expected change to average monthly discharges of Duley Lake are -1.92%, -1.55% and -1.48%, respectively, under P25, MAP and P75 scenarios, respectively. Table 8-25 provides summary of predicted changes to Duley Lake and Pike Lake average monthly discharges during each Project phase. The time series of modelled monthly flows and water levels at Duley Lake outlet, Pike Lake and Pike Lake outlet under P25, MAP and P75 scenarios are presented in Figure 8-13 through

Figure 8-15, whereas time series of annual discharge rates and water levels under MAP scenario are provided in Figure 8-16 and Figure 8-18.

Table 8-25: Summary of Predicted Changes to Average Annual Discharges During Different Project Phases Based on Model Predictions

Phase	Percent Change (%) to Average Monthly Discharge					
	Duley Lake Outlet			Pike Lake		
	P25	MAP	P75	P25	MAP	P75
Construction	-1.38	-1.24	-1.23	-0.23	-12.14	-12.80
Construction and Operations	-0.85	-0.86	-0.72	-1.17	-12.43	-12.35
Closure	-8.75	-6.65	-6.23	-4.38	-11.11	-12.67
End of mine (Construction, Operations, and Closure)	-3.41	-2.68	-2.49	-2.21	-12.01	-12.45
Post-closure	-0.46	-0.37	-0.50	13.07	12.57	5.47
All phases (Construction, Operations, Closure, and Post-closure)	-1.92	-1.55	-1.48	5.49	-0.01	-3.36

Source: TSD VI, Site Wide Water Balance and Water Quality Modelling Report.

MAP = mean annual precipitation.

At Pike Lake and Duley Lake outlets, net change to average monthly discharges under pre-mine conditions compared to mine conditions for the MAP scenario during Project lifespan (Construction, Operations, and Closure) is estimated to -12.01% and -2.68%, respectively. Considering the far future (Post-closure period), the net change is predicted to be reversible and reduces to -0.01% and -1.55%, respectively, under the MAP scenario. While at Pike Lake the predicted net change to average discharges exceeds ±10%, the net change to Duley Lake (located downstream of Pike Lake) discharges, that represent the end point of the LSA, are predicted to be within ±10% during the Project lifespan and far future.

Note that the value of ±5% is regarded within the typical error of a streamflow measurement and output from a hydrologic/hydraulic model (Fulford, Thibodeaux, & Kaehrle, 1994; James, 2005), whereas according to Richter et al. (2011) and guidance provided by Fisheries and Oceans Canada (DFO 2013) a high level of ecological protection is provided when flow alterations are within 10% of the natural flow; therefore, reduction to the flows at the end-of-mine, especially considering the net change to discharges at the Duley Lake outlet, is expected to be low.

Further to above, as discussed in Section 8.5.2.3 (Site Drainage and Run-off), while the Rose Lake will be completely removed due to development of Rose Pit, drainage patterns in the Mid and Upper Mid Lakes, and Elfie and End Lakes will also be lost due to development of Rose Pit. To mitigate Project effects due to changes to land cover/drainage patterns, and ground water seepage from Pike Lake to Rose Pit, water management infrastructure and facilities (see **Chapter 2, Project Description**, for details) to manage run-off via dams at local watersheds and convey downstream to Pike Lake via diversion/drainage ditches/pumping facility, and water transfer from Duley Lake to Pike Lake during Operations and Closure phases are planned. According to TSD VI, Site-Wide Water Balance and Water Quality Modelling Report, under the MAP scenario, Pike Lake discharge is expected to remain above the seasonal minimum discharge threshold rates (0.03 m^3/s for Dec–April and 0.25 m^3/s for May–Nov) established by MacCarthy (2024). However, in the P25 scenario, Pike Lake discharge rates are projected to fall below the minimum threshold during the winter months in the early years of the Closure phase coincident with pit filling (Figure 8-19).

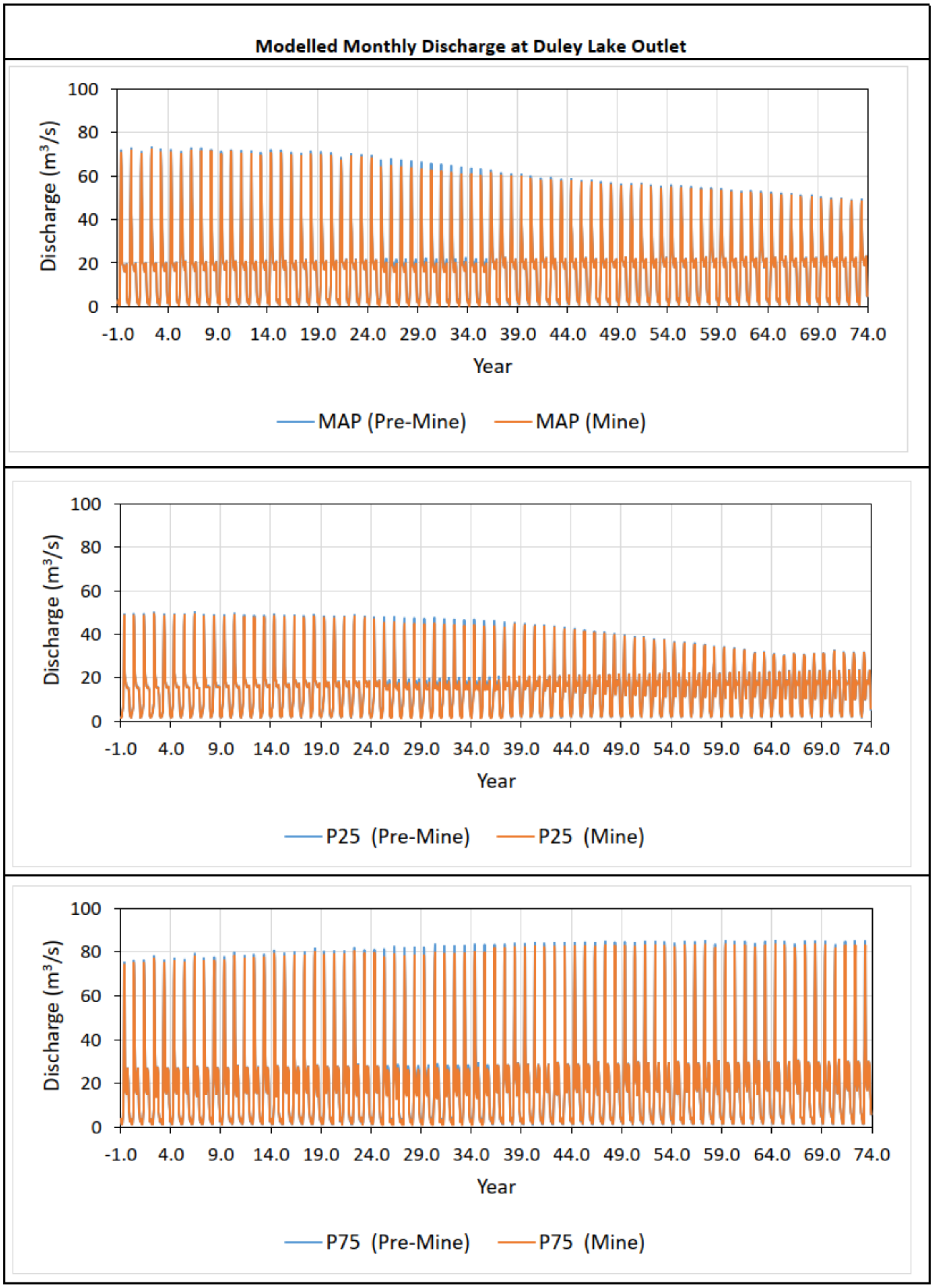


Figure 8-13: Time Series of Modelled Monthly Discharge Rates at the Duley Lake Outlet

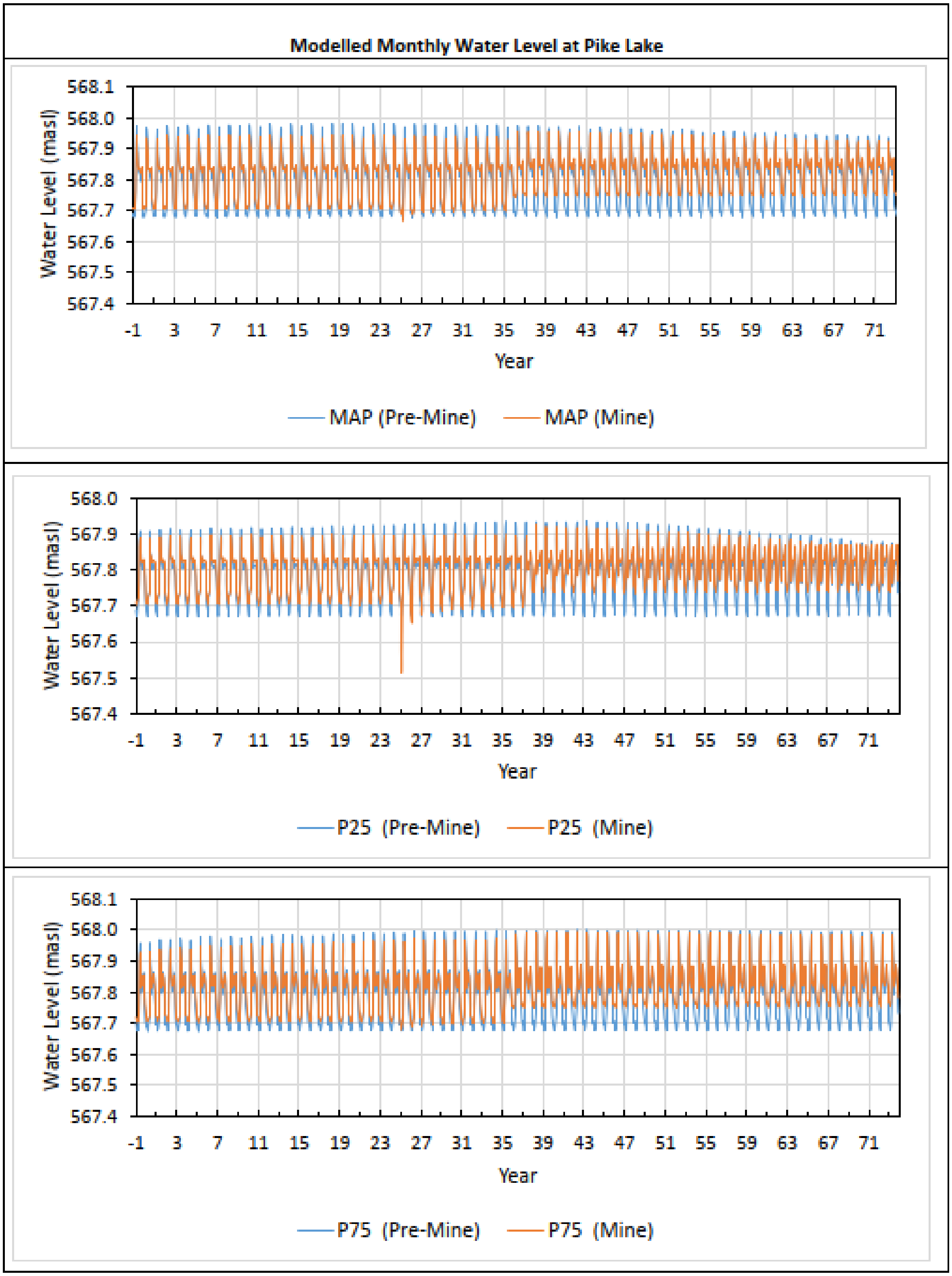


Figure 8-14: Time Series of Modelled Monthly Water Levels at Pike Lake

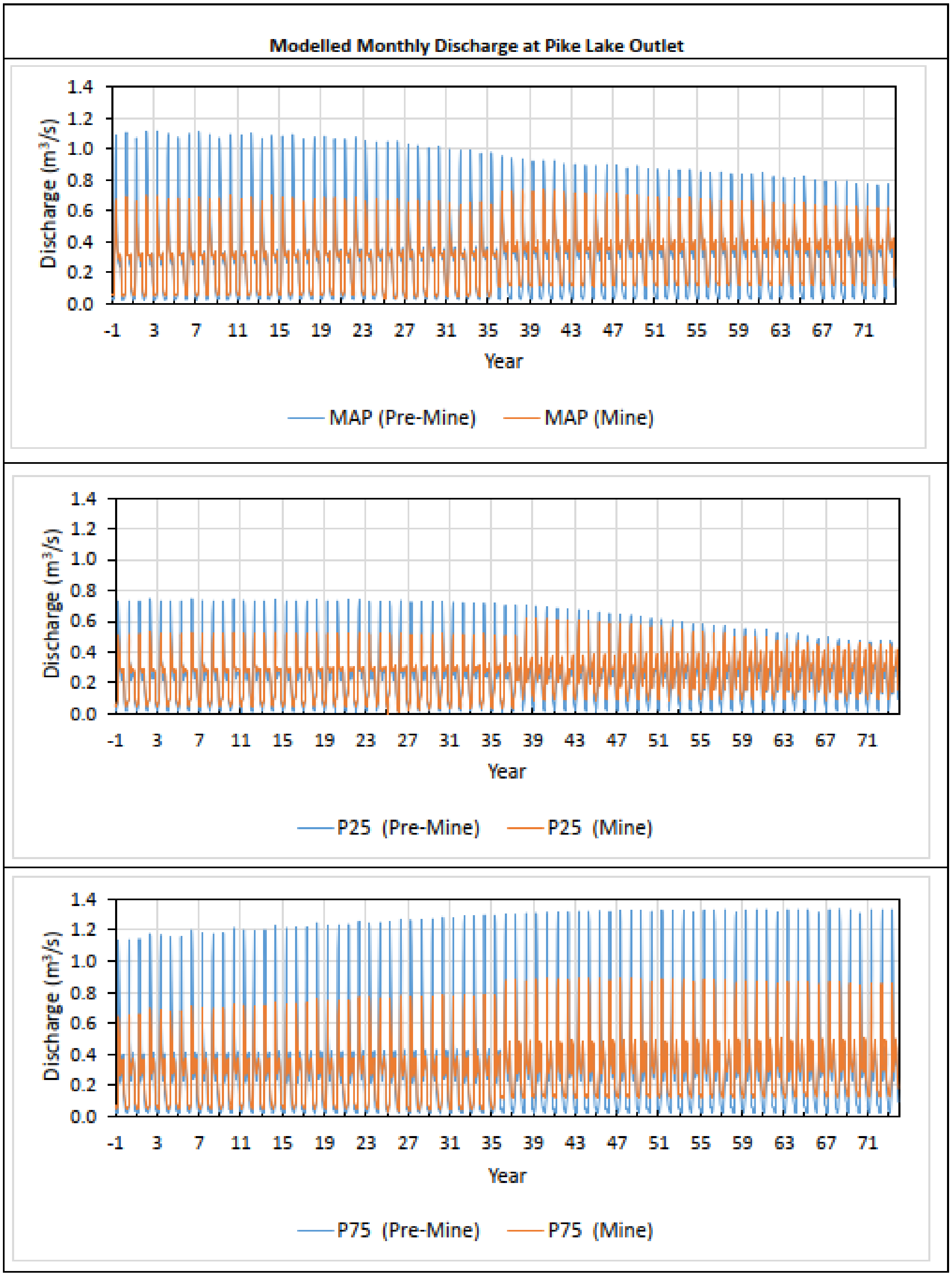


Figure 8-15: Time Series of Modelled Monthly Discharge Rates at the Pike Lake Outlet

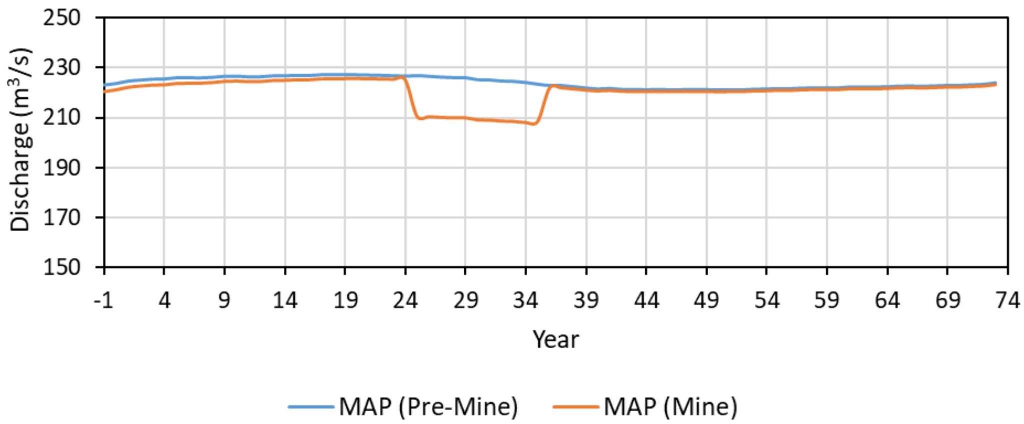


Figure 8-16: Time Series of Annual Discharge Rates at the Duley Lake Outlet

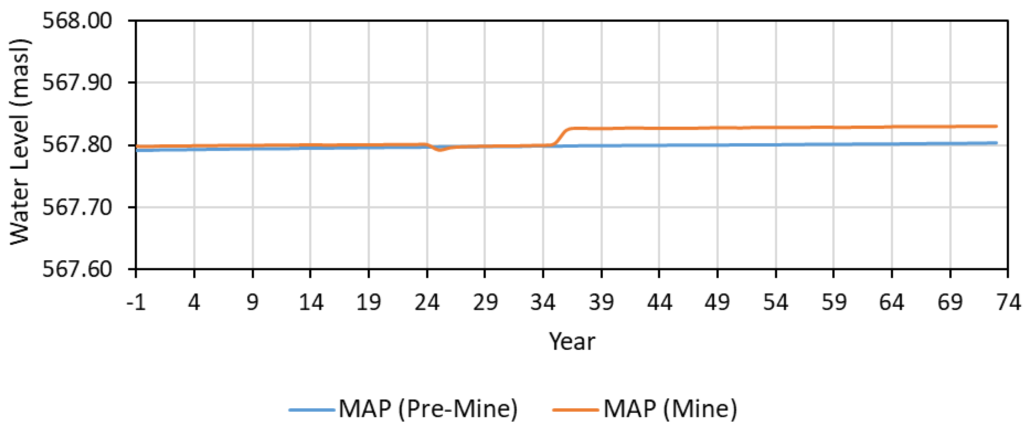


Figure 8-17: Time Series of Annual Water Levels at Pike Lake

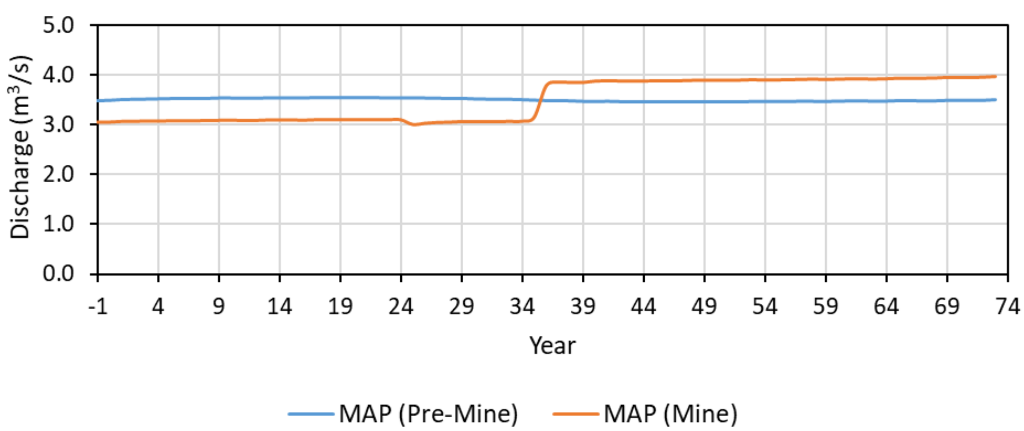


Figure 8-18: Time Series of Annual Discharge Rates at the Pike Lake Outlet

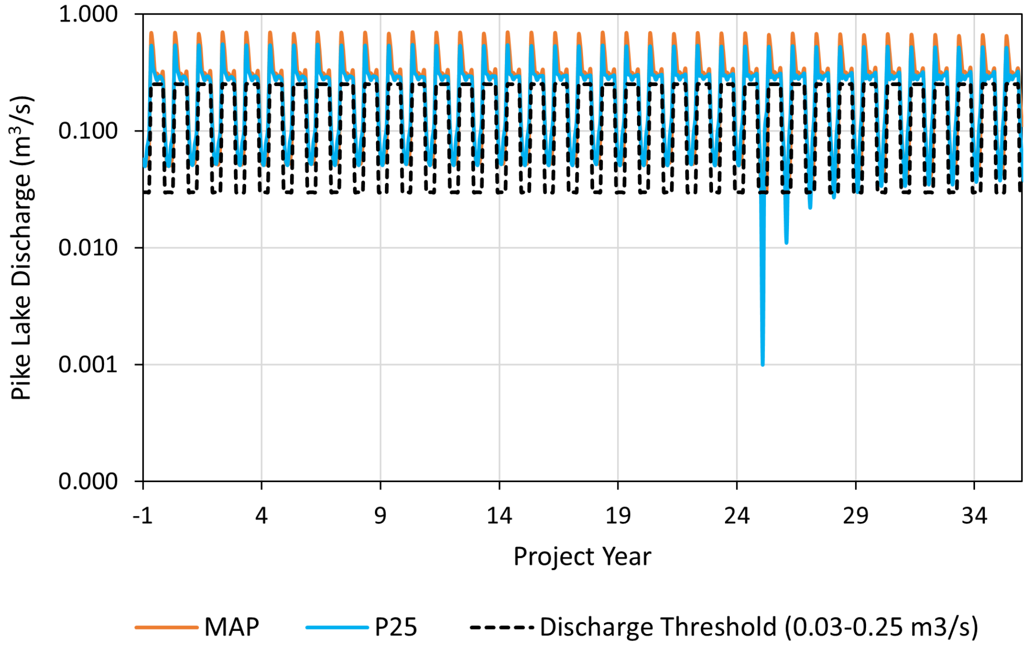


Figure 8-19: Time Series of Predicted Monthly Pike Lake Discharge (in Log Scale) for Mean Annual Precipitation and 25th Percentile Scenarios During the Construction, Operations, and Closure Phases, Compared to the Seasonal Minimum Threshold Discharge Rates Established by MacCarthy (2024) (0.03 m^3/s for December to April and 0.25 m^3/s for May to November)

Sources: MacCarthy 2024; TSD VI, Site Wide Water Balance and Water Quality Modelling Report.

8.5.3.1.1.2 *Local Water Balance Model*

LWBM was used to estimate changes to flows/run-offs in lakes (i.e., other than the Pike and Duley Lakes) watersheds in the LSA that were not modelled in WBWQM. The results of water balance assessment are provided in Appendix 8B. For watersheds of local streams, changes to local stream(watercourse) watershed area were used as a proxy to changes to water balance components.

In addition to changes to watershed areas, changes in groundwater flows to the Rose Pit due to pit dewatering during Operations were also considered in the assessment. In 2024, AtkinsRéalis's preliminary estimate of groundwater inflow to the Rose Pit was performed using a numerical model of the area (AtkinsRéalis 2024; TSD V, Hydrogeology Modelling Report). The results of pit dewatering and groundwater inflow at the end of operations (Year 26) are provided in Table 8-26.

Table 8-26: Rose Pit Dewatering Rates and Lake Contributions at the End of Operations (Year 25)

Numerical Dewatering Scenario	Pit Outflow Rate (m^3/day)	Inflow Rate, (m^3/day)/(% of Pit Outflow Rate)				
		Pike lake	Mills Lake	Daviault Lake	Molar Lake	Other Sources[(a)]
Base case[(b)]	12,432	7,051/(56.7%)	520/(4.2%)	1,133/(9.1%)	84/(0.7%)	3,644/(29.3%)
Selected case[(c)]	40,849	29,460/(72.1%)	525/(1.3%)	7,017/(17.2%)	110/(0.3%)	3,737/(9.1%)

Source: AtkinsRéalis 2024.

Notes:

For details about groundwater flow modelling and Rose Pit dewatering, refer to TSD V: Hydrogeology Modelling Report (AtkinsRéalis 2024).

(a) The numbers represent balance of groundwater inflow and its outflow from the pit. No other sources (i.e., precipitation) were considered.

(b) The base case represents the calibrated scenario, with faults connection through the overburden and $K_{faults} = 1x10^{-5}$ m/s.

(c) The selected case represents a conservative scenario (higher dewatering flow rate) selected for the water infrastructure design, with faults connection through the overburden and $K_{faults} = 5x10^{-5}$ *m/s.*

To assess Project effects due to dewatering of Rose Pit, groundwater inflows from the surrounding lakes (Table 8-26) to Rose Pit were compared to annual surplus and measured flows under pre-mine (pre-development) conditions in the respective lake watersheds for base case numerical dewatering scenarios and net loss to annual flows was estimated. Measured annual flows, changes to surpluses due to changes to watershed area and groundwater flows (i.e., loss of water from the watershed) to Rose Pit at the end of Operations (Year 25), and net loss to annual flows are provided in Table 8-26.

Table 8-27: Measured Annual Flows, Change to Surpluses with Respect to Pre-mine Conditions Due to Groundwater Inflows to Rose Pit at the End of Operations (Year 25) and Estimated Loss to Net Annual Measured Flows

Watershed Name	Measured Annual Flows (L/s)[(a)]	Change to Surplus Due to Watershed Land Changes (%)	Change to Surplus Due to Groundwater Inflows to Pit (%)[(b)]	Loss Due to Watershed Land Change (L/s)[(c)]	Loss Due to Groundwater Inflows (L/s)[(c)]	Estimated Net Loss to Annual Measured Flows (L/s)
Mills Lake	872	-3.4	-1.2	30	10	40
Daviault Lake	1325	0	-1.5	0	20	20
Molar Lake	224	0	-0.6	0	1.3	1.3

(a) Measured annual flows are calculated using 2023–2024 continuous flow measurements. For details about flow measurements, refer to the Surface Water Baseline Report (Annex 2A).

(b) Based on base case numerical dewatering scenario. See Table 8-26 and/or refer to TSD V: Hydrogeology Modelling Report (AtkinsRéalis 2024) for details about modelling scenarios.

(c) Percentage change/reduction to flow is assumed to be the same as the percentage change to surplus.

Compared to pre-mine (pre-development) annual surpluses, groundwater flows to Rose Pit for base case numerical dewatering scenarios at the end of operations (Year 25) from the Mills Lake, Daviault Lake and Molar Lake are predicted to be within ±5%. Assuming the percentage change to surplus would also represent the percentage change to downstream flows from these watersheds, estimated change/loss to downstream flows, based on the 2023-2024 measured flows, would be approximately 10 L/s, 20 L/s and 1.3 L/s at the outlets of Mills Lake, Daviault Lake and Molar Lake under the base case numerical dewatering scenario. Cumulating losses at Mills Lake watershed due to watershed land changes and groundwater inflow provide a net change of -4.6% to surplus that translates to estimate loss of 40 L/s to annual flows. Overall, the predicated change/loss to surplus due to groundwater flows to Rose Pit is within 10%; therefore, Project effects are expected to be minor. Groundwater flow effects from other sources were not assessed since specific details (associated watersheds/lakes) were not provided in TSD V (AtkinsRéalis 2024).

Significant changes to flows and water levels at the Pike Lake are anticipated due to Rose Pit and these were modelled using WBWQM (TSD VI). Project effects on Pike Lake will be managed by water transfer from Duley Lake to Pike Lake. Refer to the sub-section above (Site-Wide Water Balance and Water Quality Model [WBWQM]) for details about changes to Pike Lake discharge rates and water levels.

At the watersheds of Waldorf River, Mills Lake, Riordan Lake, Rectangle Lake, Molar Lake and Riordan Lake, changes to water balance components (surplus, infiltration and run-off) during Operations and the Post-closure period compared to pre-mine (pre-development) conditions were estimated using LWBM and results are summarized in Table 8-28. Results for Operations phase show that the predicted changes to annual surpluses are within the natural variations (i.e., ±10%). The sub-components of surplus (i.e., run-off and infiltration) estimated using infiltration factors, that depend on the land cover features, showed minor variations due to Project associated watershed land cover changes. However, the predicted changes to run-off and infiltration are also within the natural variation (±10%), except for Waldorf River watershed where decrease to run-off is predicted to be -10.3% (slightly exceeding -10%). Project associated land changes at Waldorf River watershed are located near the downstream end of the watershed prior to draining into Duley Lake. These land changes are dominated by the mine rock stockpile footprint. The run-off and seepage generated from the mine rock stockpile during Operations phase will be managed with the help of water management infrastructure and facilities (see **Chapter 2, Project Description**, for details). All contact water will be collected and routed through a series of ponds to a treatment facility prior to discharge to Duley Lake; therefore, as such, the overall Project effects due to change in flows to the local downstream natural environment (i.e., Duley Lake) are predicted to be low.

During the Post-closure period, all disturbed areas are planned to be rehabilitated (i.e., regraded and revegetated) and returned to their respective watersheds. The run-off and seepage from the Project rehabilitated areas (except seepage from mine rock stockpile that will continue to be pumped into the bottom layer of the Rose Pit) are planned to discharge to natural environment. Results of LWBM during Post-closure show that the predicted changes to surplus are negligible and as such the Post-closure conditions are predicted to return to near pre-mine (pre-development) conditions. Like surplus, predicted changes to run-off and infiltration, upon decommission and rehabilitation, are also predicted to be negligible and return to near Pre-mine (pre-development) conditions.

Table 8-28: Changes to Surface Water Balance Components with Respect to Pre-mine (pre-development) Conditions

Watershed Name	Operations				Post-Closure (decommissioned and rehabilitated)			
	Percentage Change to Watershed Area[(a)]	Change to Water Balance Components (%)			Percentage Change to Watershed Area[(c)]	Change to Water Balance Components (%)		
		Surplus	Infiltration[(b)]	Run-Off[(b)]		Surplus	Infiltration[(c)]	Run-off[(c)]
Waldorf River	-8.24	-8.3	-7.4	-10.3	0	-4.8	-7.1	0.8
Mills Lake	-3.42	-4.7[(e)]	-4.6[(d),(e)]	-4.8	0	-0.7	-1.1	0.3
Riordan Lake	-0.39	-0.4	-0.4	-0.6	0	0.0	0.0	0.1
Rectangle Lake	-0.17	-0.2	-0.2	-0.2	0	0.0	0.0	0.1
Molar Lake	0	-0.6[(e)]	-0.8[(e)]	0.0	0	0.0	0.0	0.0
Daviault Lake	0	-1.5[(e)]	-2.2[(e)]	0.0	0	0.0	0.0	0.0

(a) See Table 8-22 for watershed areas.

(b) Run-off and seepage from Project footprint will be managed using water management infrastructure and facilities. See Section 8.5.1.2.1 for details about water management during Project phases (Construction, Operations, and Closure) and Post-closure period.

(c) Project disturbed areas were assumed rehabilitated and returned to their respective watersheds. Run-off and seepage (except for mine rock stockpile) were assumed to drain to the nature environment. Rehabilitated land cover was assumed as grass and shrubs.

(d) Run-off and seepage from Project footprint will drain to natural environment (except seepage from mine rock stockpile that will continue to be pumped to bottom layers of Rose Pit). See Section 8.5.1.2.1 for details about water management during Project phases (Construction, Operations, Closure and Post-closure).

(e) Includes predicted loss due to groundwater inflow to Rose Pit under base case numerical dewatering scenario.

To assess the changes to surface water quantity in local streams (watercourses) in the LSA, the percentage change to the overall watershed area of 16 watercourses (where flow measurements were conducted during 2023–2024 baseline study) and 5 selected watercourses (where the Project footprint is expected to be significant) were estimated. Table 8-29 summarizes natural watershed areas and change due to Project footprint. Figure 8-20 and Figure 8-21 show watersheds of local stream (watercourse) and the Project footprint. Recognizing that the area associated with the Project footprint will not discharge to natural environment, instead the run-off and seepage from the Project components will be managed using water management infrastructure and facilities (see **Chapter 2, Project Description**, for details), change to local watershed area can be considered as a proxy or analog for change to water balance components (i.e., surplus, infiltration and run-off). LWBM results of lake watersheds (Table 8-28) show that the change to watershed area is generally directly proportional to change to surplus. Table 8-29 shows that estimated changes to watershed areas for most stream (watercourse) watersheds are less than 10%, except for the watersheds of WC-01, WC-02, WC-06, WC-07, MIL-WC-A, WR-WC-A, WR-WC-B, and PL-WC-A.

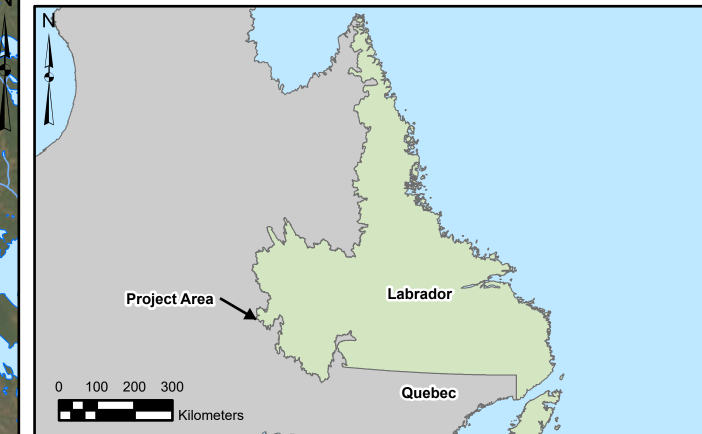
Watershed of WC-01 is located south of Pike Lake and includes Rose Lake/Rose Pit, Mid and upper Mid Lakes, Elfie and End Lakes. Watershed will be affected by the development of Rose Pit. Lower reach of watercourse will be completely lost. Discharge from the Rose Pit and run-off from the Mid and Upper Mid Lakes and Elfie and End lakes will be managed using water management infrastructure (see **Chapter 2** for details). Rose Pit will drain to pit collection pond (Rose Pit sedimentation pond) that will discharge to Duley Lake after necessary treatment. Run-off from Mid and Upper Mid Lakes will be diverted to Pike Lake via the clean water diversion and pumping facility. Elfie and End lakes will be diverted to Duley Lake via treatment as they will be part of Rose Pit collection pond (Rose Pit sedimentation pond). Overall, the Project effects on local environment downstream of WC-01 will be managed with the help of water management infrastructure and transfer of water from Duley Lake. Similar to WC-01, Project effects at WC-02 due to changes to local watershed will be managed with the help of water management infrastructure and transfer of water from Duley lake. Pike Lake discharges were modelled using WBWQM (TSD VI). Modelling results (discussed in section above; Table 8-25) showed -12.35% reduction to average monthly flows during Construction and Operations phase compared to pre-mine conditions; however, under the MAP scenario, Pike Lake discharge is expected to remain above the seasonal minimum discharge threshold rates (0.03 m^3/s for Dec–April and 0.25 m^3/s for May–Nov) established by MacCarthy (2024). Project effects on fish and fish habitat in watersheds of WC-01 and WC-02 are expected due to loss of stream (watercourse) reaches as well as changes to natural drainage patterns/flows. These Project effects will be mitigated and compensated with the implementation of an offsetting plan, as discussed in the Project TSD IX, Fish and Fish Habitat Offsetting Plan.

The watersheds of WC-06, WC-07, MIL-WC-A, WR-WC-A, WR-WC-B and PL-WC-A will be impacted by the development of Project components (e.g., tailing management facility, mine rock stockpile, overburden stockpile and associated facilities). Local changes to flows due to loss of watershed area during Operations will be significant. Upper reaches of streams (watercourses) are anticipated to be completely lost. Even after the planned rehabilitation, upper reaches of streams (watercourses) are not anticipated to be restored to pre-mine conditions. Anticipated Project effects on fish habitat from decreased surface water quantity will be mitigated and compensated with the implementation of an offsetting plan, as discussed in the Project TSD IX.

Table 8-29: Land Cover Changes Natural Watershed of Streams in the Local Study Area

Watershed Name	Description	Watershed Area (ha)	Operations	
			Area of Watershed After Change (ha)	% Change to Watershed Area
WC-01	Unnamed stream – reporting to Pike Lake from the southwest	579	350	-39.5
WC-02	Unnamed stream – immediately downstream of Pike Lake outlet	1439	918	-36.2
WC-03	Unnamed stream – reporting to Mills Lake from the west	1186	1186	0.0
WC-04	Unnamed stream – reporting to Duley Lake from the southwest	4949	4900	-1.0
WC-05	Waldorf River – reporting to Duley Lake from the south	6554	6077	-7.3
WC-06	Unnamed stream – reporting to Duley Lake from the southeast	355	119	-66.4
WC-07	Unnamed stream – reporting to Duley Lake from the southeast	1053	483	-54.1
WC-08	Unnamed stream – reporting to Duley Lake from the east	1984	1982	-0.1
WC-09	Unnamed stream – immediately downstream of Duley Lake outlet	90388	88533	-2.1
WC-10	Walsh River - reporting to Duley Lake from the northwest	67351	67351	0.0
WC-11	Unnamed stream – immediately downstream of Riordan Lake	939	935	-0.4
WC-12	Unnamed stream – immediately downstream of Daviault Lake	6388	6388	0.0
WC-13	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake from the east	222	222	0.0
WC-14	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake northwest	133	133	0.0
WC-15	Proposed railway crossing – unnamed stream reporting to Little Wabush Lake from the southeast	16560	16560	0.0
WC-16	Proposed railway crossing – unnamed stream reporting to Elephant Head Lake from the southeast	1004	1000	-0.4
Molar lake WC-A (MOL-WC-A)	Unnamed stream – reporting to Molar Lake from the north	50	50	-0.1
Mills Lake WC-A (MIL-WC-A)	Unnamed stream – reporting to a stream located downstream of Mills Lake from the south	87	32	-63.1
Waldorf River WC-A (WR-WC-A)	Unnamed stream – reporting to Waldorf River from the east	264	26	-90.2
Waldorf River WC-B (WR-WC-B)	Unnamed stream – reporting to Waldorf River from the east	181	41	-77.3
Pike Lake WC-A (PL-WC-A)	Unnamed stream – reporting to Pike Lake from the west	155	113	-26.9

KEY MAP



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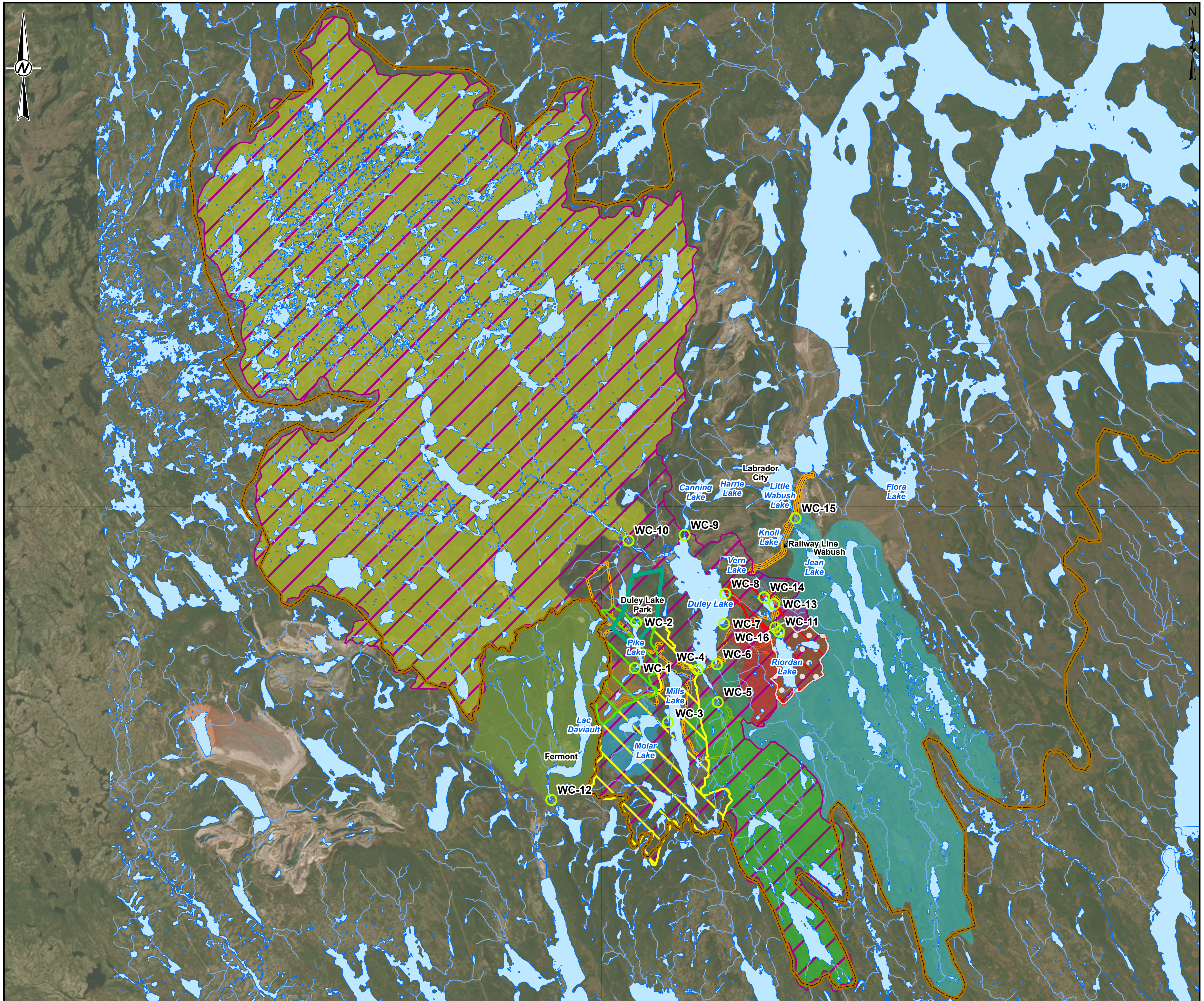


LEGEND

SITE STUDY AREA (SSA)	WC-6
LABRADOR/QUEBEC BOUNDARY	WC-7
DULEY LAKE PARK	WC-8
CATCHMENT AREA POUR POINT	WC-9
WATERBODY	WC-10
RIVER/STREAM	WC-11
STREAM WATERSHED	WC-12
WC-1	WC-13
WC-2	WC-14
WC-3	WC-15
WC-4	WC-16
WC-5	

0 0.75 1.5 3

1:85,000 KILOMETRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS: WORLD IMAGERY: EARTHSTAR GEOGRAPHICS
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE

LOCAL WATERSHEDS OF STREAMS (WATERCOURSES)

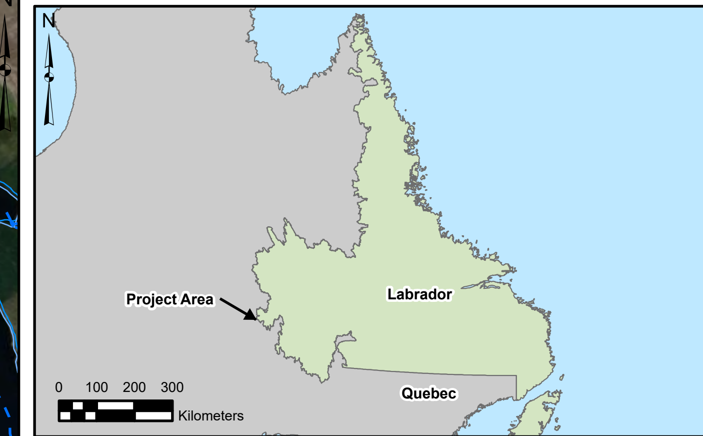
CONSULTANT

Kami

YYYY-MM-DD	2025-06-27
DESIGNED	----
PREPARED	MS
REVIEWED	MS
APPROVED	CD

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0016	0	8-20

KEY MAP



SCALE 1:20,000,000

LEGEND

- PROPOSED PROJECT INFRASTRUCTURE
- SITE STUDY AREA (SSA)
- LABRADOR/QUEBEC BOUNDARY
- DULEY LAKE PARK
- CATCHMENT AREA POUR POINT
- RIVER/STREAM
- WATERCOURSE HAZARD
- FLOW DIRECTION

STREAM WATERSHED

- MIL-WC-A
- MOL-WC-A
- PL-WC-A
- WR-WC-A
- WR-WC-B

0 0.75 1.5 3

1:85,000 KILOMETRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS: WORLD IMAGERY: EARTHSTAR GEOGRAPHICS
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE

SUB-WATERSHEDS OF LOCAL STREAMS (WATERCOURSES) WITH FLOW DIRECTIONS

CONSULTANT

Kami

YYYY-MM-DD	2025-06-27
DESIGNED	----
PREPARED	MS
REVIEWED	MS
APPROVED	CD

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0016	0	8-21

8.5.3.1.2 Surface Water Quality

8.5.3.1.2.1 Site-Wide Water Balance and Water Quality Model

As discussed in Section 8.5.1.2, a water quality model (WBWQM; TSD VI) was developed to simulate water quality in receiving waterbodies in the LSA for the base case. Surface water COPC concentrations were predicted to generally increase above the average background concentrations during Project phases for all flow scenarios. For water quality constituent concentrations, Project residual effects on COPC concentrations would generally gradually increase towards the end of Operations phase followed by the Closure phase and Post-closure period where COPC concentrations generally decreased to near average background concentrations and remained below Project guidelines/thresholds. Time series trends for all modelled parameters (water quality COPCs) at Duley Lake outlet (the end point of the LSA) are plotted in Appendix 8B.

Predicted concentrations of COPCs were compared to Project water quality guidelines/thresholds and SSWQOs. Project effluent simulations were within MDMER discharge limits for all phases and flow scenarios. Some metals exceeded guidelines (CCME and FWQG) in the receiving environment. Despite the increase in COPC concentrations due to Project activities, most COPC concentrations remained below their respective thresholds throughout the Project lifespan and into the far future. Table 8-30 summarizes CCME exceedance screening of modelled water quality by the Project phase. A parameter or constituent that exceeded the respective CCME or FWQG is denoted with "CCME" (Table 8-19). As discussed previously (Section 8.5.1.2), aquatic life water quality guidelines are used to identify COIs in the receiving environment and are not applicable to the site effluent discharges. COIs identified from the screening process include cobalt and selenium. Mercury was excluded from the list of COIs because total mercury levels were above the CCME guideline due to high background surface water quality measurements, influenced by a method detection limit higher than the guideline. However, these elevated levels were not caused by Project effects from effluent discharge, so total mercury was not considered a COI (TSD VI).

The receiving waterbodies where COIs (excluding mercury) exceeded guidelines/thresholds include Duley Lake IDZ (discussed in the following section), Duley Lake, Pike Lake, Walsh River, and the Duley Lake outlet.

Simulations for Duley Lake show ambient conditions due to Project effluent discharge. Time series of modelled predictions of total selenium, and total cobalt for P25, MAP and P75 scenarios are presented in Figure 8-22 and Figure 8-23. Model results show the following:

- Total cobalt levels exceed CCME guideline during the Operations phase starting around Year 9 under MAP scenario, but the Project effects are reversible and do not persist beyond Operations phase (Figure 8-22). Compared to cobalt SSWQO for Duley Lake, total cobalt levels during all Project phases were below hardness-dependent cobalt SSWQO (TSD VIII) levels that ranged from 2.7 to 3.2 µg/L (i.e., 0.0027 to 0.0032 mg/L).
- Total selenium levels exceed CCME guideline during the Operations phase starting around Year 16. Project effects are seasonal, reversible, and do not persist beyond Operations (Figure 8-23). Compared to selenium SSWQO of 1.5 µg/L (i.e., 0.0015 mg/L), total selenium levels during all Project phases were below selenium SSWQO (TSD VII).

Project effects on Pike Lake differ between the Operations phase and Post-closure period. During the Operations phase, Project effects are linked to water transfers from Duley Lake and its ambient water quality due to Project effluent discharges, whereas during the Post-closure period, these are due to passive seepage from the overburden stockpile. Due to the differences in the characteristics of Pike Lake and Duley Lake, the selenium SSWQO is not an applicable guideline to determine Project effects to Pike Lake. Time series of modelled predictions of total cobalt and total selenium for P25, MAP, and P75 scenarios are presented in Figure 8-24 and Figure 8-25. Model results show the following:

- Total cobalt levels exceed CCME guideline starting around Year 11, but these Project effects are reversible and do not persist beyond Operations phase (Figure 8-24). Compared to cobalt SSWQO for Pike Lake, total cobalt levels during all Project phases were below hardness-dependent cobalt SSWQO (TSD VIII) levels that ranged from 2.7 to 3.2 µg/L (i.e., 0.0027 to 0.0032 mg/L).
- Total selenium levels seasonally exceed CCME guideline from approximately Year 19 to Year 24. These effects do not persist above the guideline during Closure when the Rose Pit is being flooded. However, starting in Year 36, total selenium levels consistently exceed CCME guideline (Figure 8-25), which is currently attributed to seepage from the overburden stockpile (TSD VI).

Like Pike Lake, Project effects in the Walsh River (located downstream of Pike Lake and upstream of Duley Lake) are also divided into the Operations phase and Post-closure period. During Operations, Project effects are limited to total cobalt due to water transfers from Duley Lake as required to meet fish and fish habitat demands in Pike Lake, whereas during the Post-closure period Project effects are associated with passive discharge from the overburden stockpile. Time series of modelled predictions of total cobalt and total selenium for P25, MAP and P75 scenarios are presented in Figure 8-26 and Figure 8-27. Model results show the following:

- Project effects on total cobalt occur late in Operations (around Year 19), are seasonally limited to P25 flow events, are reversible, and do not persist beyond operations (Figure 8-26).
- Total selenium levels are not expected to exceed CCME guidelines until around Year 39+ (after Closure) and are associated with passive discharge from the overburden stockpile. Project effects on total selenium are seasonally limited to P25 flow events, are reversible, and infrequent (Figure 8-27). Noting that the Walsh River represents a waterbody connecting Pike Lake and Duley Lake, selenium concentrations were also compared to the selenium SSWQO for Duley Lake. Compared to selenium SSWQO for Duley Lake (located downstream of Walsh River) of 1.5 µg/L (i.e., 0.0015 mg/L), total selenium levels during all Project phases were below selenium SSWQO for Duley Lake.

Duley Lake outlet simulations represent the combined discharge from Duley Lake and the Walsh River, showing the cumulative effect of the Project on existing/background conditions. Project effects on water quality at the Duley Lake outlet relevant to surface water quality is limited to total cobalt. Time series of modelled predictions of total cobalt for P25, MAP and P75 scenarios are presented in Figure 8-28. Model results show the following:

- Total cobalt levels are predicted to seasonally exceed CCME guideline late in operations (around Year 17+). These effects are reversible and do not persist beyond the Operations phase. Compared to cobalt SSWQO total cobalt levels during all Project phases are below hardness-dependent cobalt SSWQO (TSD VIII) levels that ranged from 2.7 to 3.2 µg/L (i.e., 0.0027 to 0.0032 mg/L) at Duley Lake.

Project effects on surface water quality at Mills Lake, Waldorf River, Riordan Lake and Rectangle Lake were considered for Post-closure period, as the run-off from mine rock stockpile and seepage and run-off from tailing storage facility impoundment were allowed to discharge to receiving environment (these waterbodies). The screening of COPCs with respect to average background conditions showed increases relative to average background concentrations; however, the COPC concentrations were not predicted to exceed water quality guidelines/thresholds.

For other Project phases (Construction through Closure), there are no discharges to Mills Lake, Waldorf River, Riordan Lake and Rectangle Lake. As there is no effect pathway, no Project effects on water quality are anticipated for these water bodies. The model results indicate some variability in water quality over time for these water bodies. This is due to variability between the initial condition for each waterbody and water quality assigned to non-contact runoff, as outlined in the WBWQM (Table 2-15 of TSD VI). These minor variations in water quality over time are not due to Project effects and do not constitute an anticipated change in water quality due to the Project.

Concentrations of COPCs in other lakes within the LSA (e.g., Daviault Lake, Molar Lake) were not predicted because the Project effects were anticipated to be negligible due to limited Project footprint and activities in the watersheds of those lakes (Table 8-22). Further, there is no direct pathway for the Project to affect water quality in these watersheds.

Table 8-30: Summary of Canadian Council of Ministers of the Environment Exceedance Modelled Parameters (constituents of potential concern) at Receiving Environment

Station	Phase	Construction			Operations			Closure			Post-closure		
	Model Scenario	P25	MAP	P75	P25	MAP	P75	P25	MAP	P75	P25	MAP	P75
Duley Lake IDZ	Total cobalt	–	–	–	CCME	CCME	CCME	–	–	–	–	–	–
	Total selenium	–	–	–	CCME	CCME	CCME	–	–	–	–	–	–
Duley Lake	Total cobalt	–	–	–	CCME	CCME	CCME	CCME	CCME	CCME	–	–	–
	Total selenium	–	–	–	CCME	CCME	CCME	CCME	–	–	–	–	–
Duley Lake outlet	Total cobalt	–	–	–	CCME	CCME	CCME	–	–	–	–	–	–
Pike Lake	Total cobalt	–	–	–	CCME	CCME	CCME	CCME	CCME	CCME	–	–	–
	Total selenium	–	–	–	CCME	–	CCME	CCME	CCME	CCME	CCME	CCME	CCME
Walsh River	Total cobalt	–	–	–	CCME	–	–	–	–	–	–	–	–
	Total selenium	–	–	–		–	–	–	–	–	CCME	–	–

Source: TSD VI, Site Wide Water Balance and Water Quality Modelling Report.

CCME = Canadian Council of Ministers of the Environment; MAP = mean annual precipitation; – = no CCME exceedance.

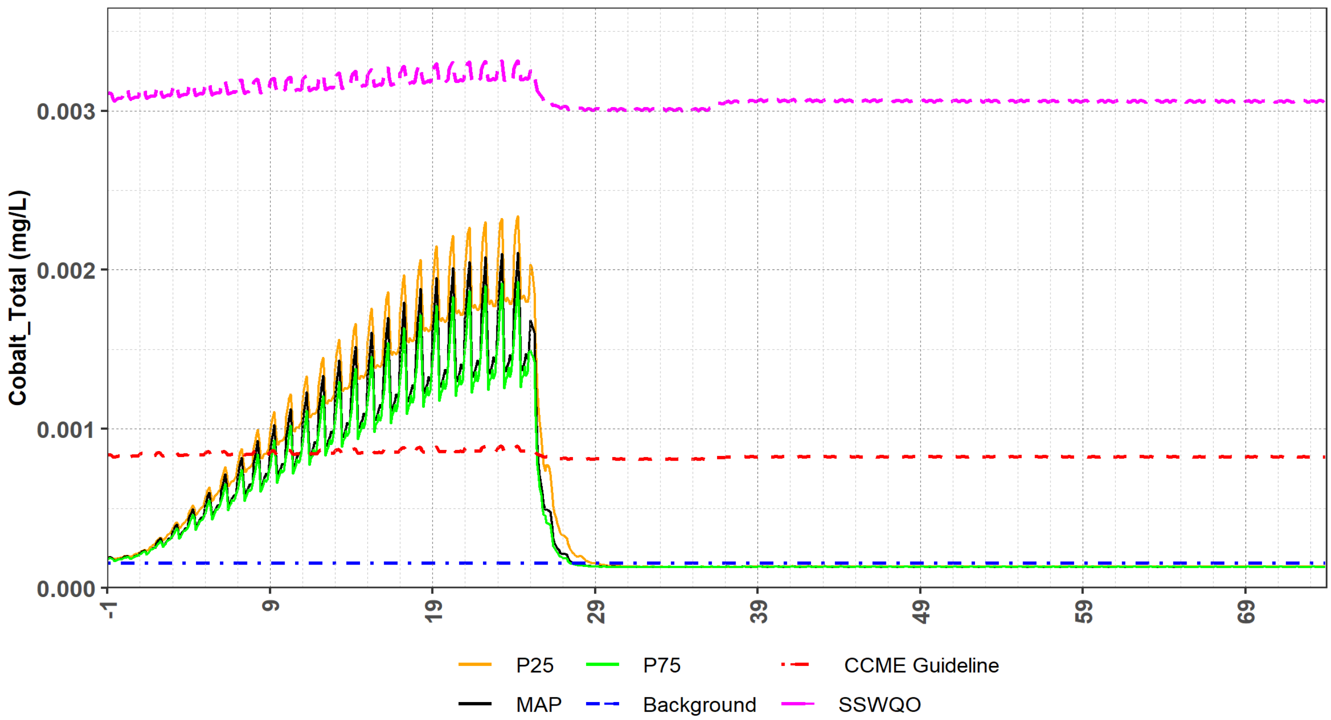


Figure 8-22: Time Series of Modelled Predictions of Total Cobalt for 25th Percentile, Mean Annual Precipitation, and 75th Percentile Model Scenarios at Duley Lake

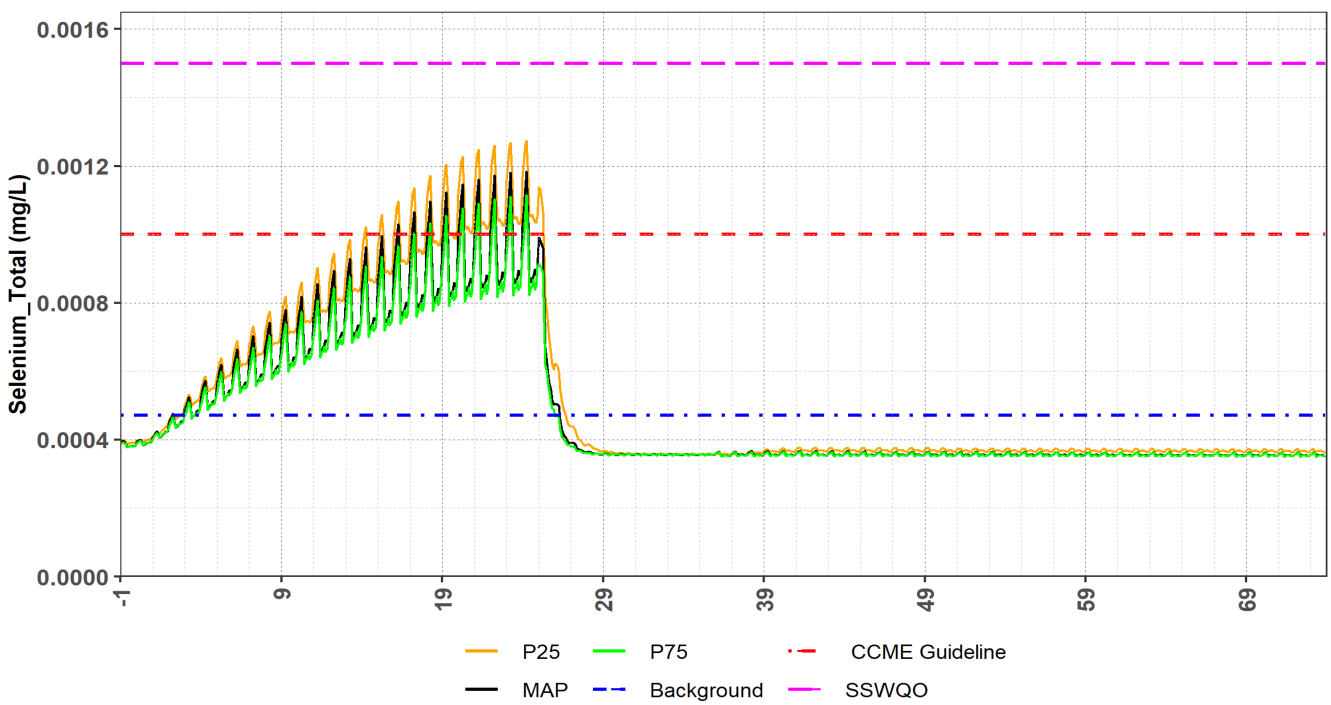


Figure 8-23: Time Series of Modelled Predictions of Total Selenium for 25th Percentile, Mean Annual Precipitation, and 75th Percentile Model Scenarios at Duley Lake

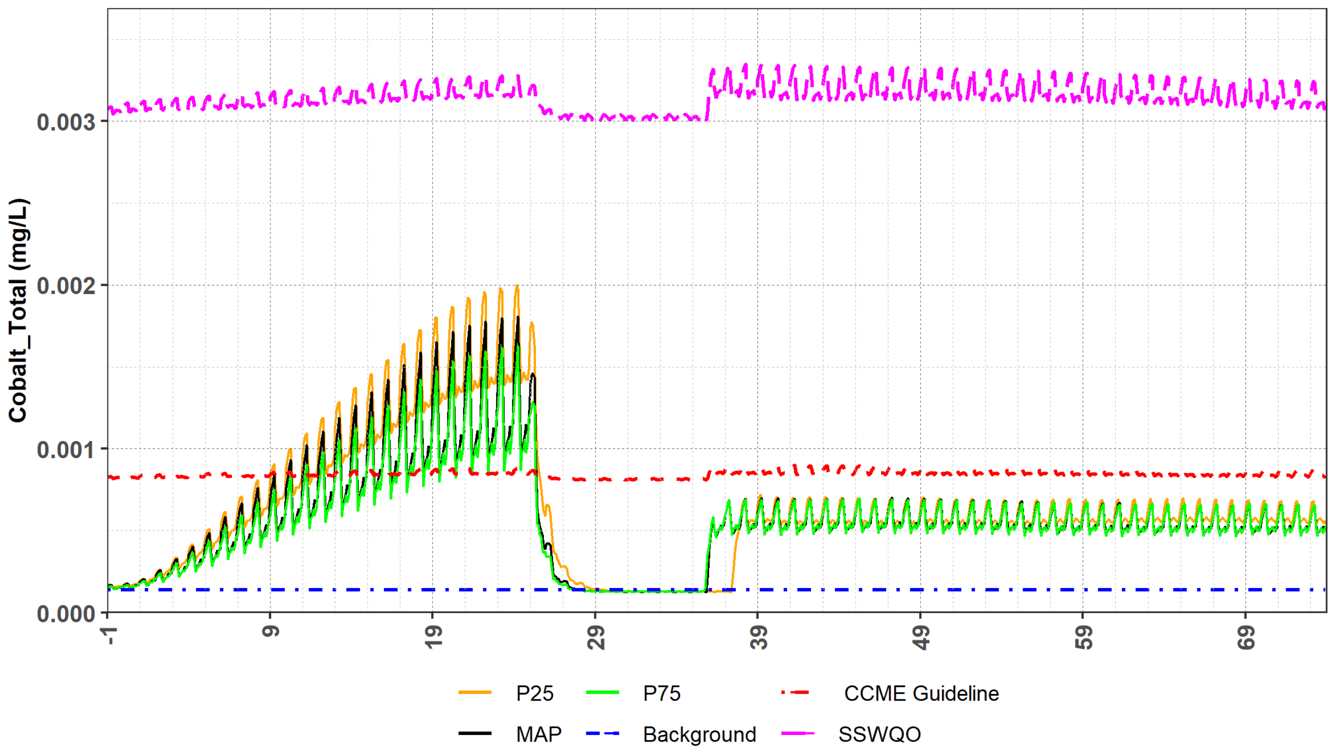


Figure 8-24: Time Series of Modelled Predictions of Total Cobalt for 25th Percentile, Mean Annual Precipitation, and 75th Percentile Model Scenarios for Pike Lake

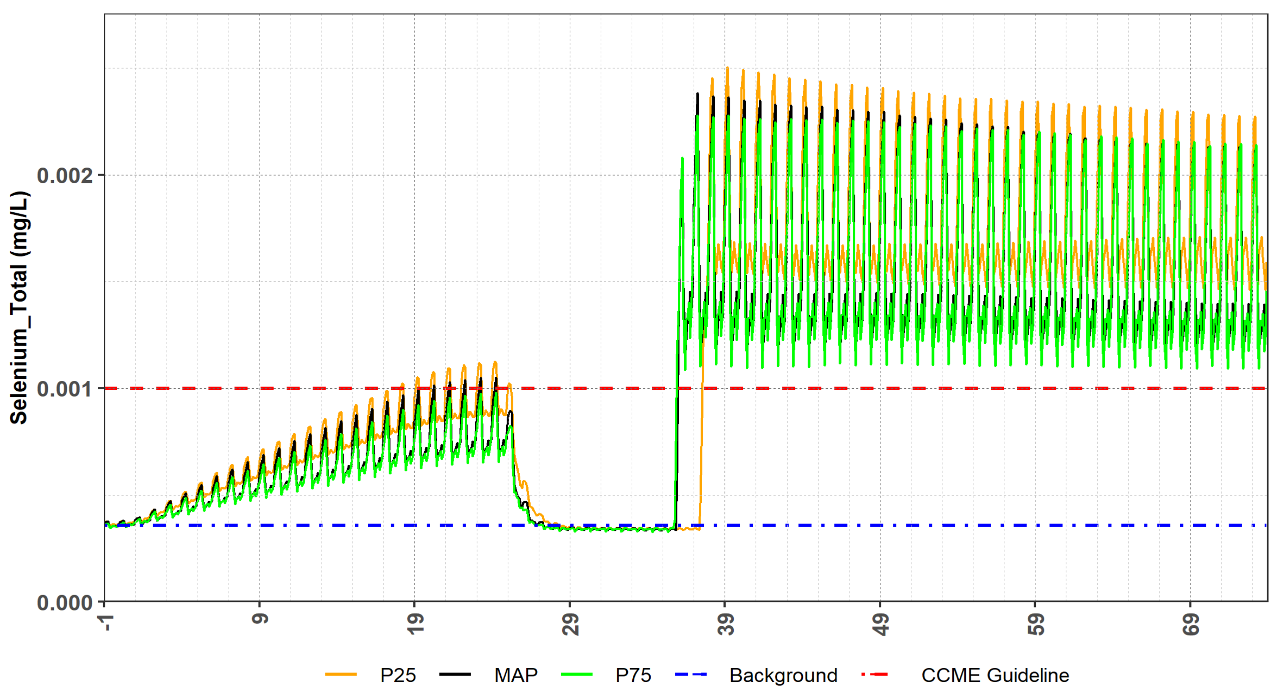


Figure 8-25: Time Series of Modelled Predictions of Total Selenium for 25th Percentile, Mean Annual Precipitation, and 75th Percentile Model Scenarios for Pike Lake

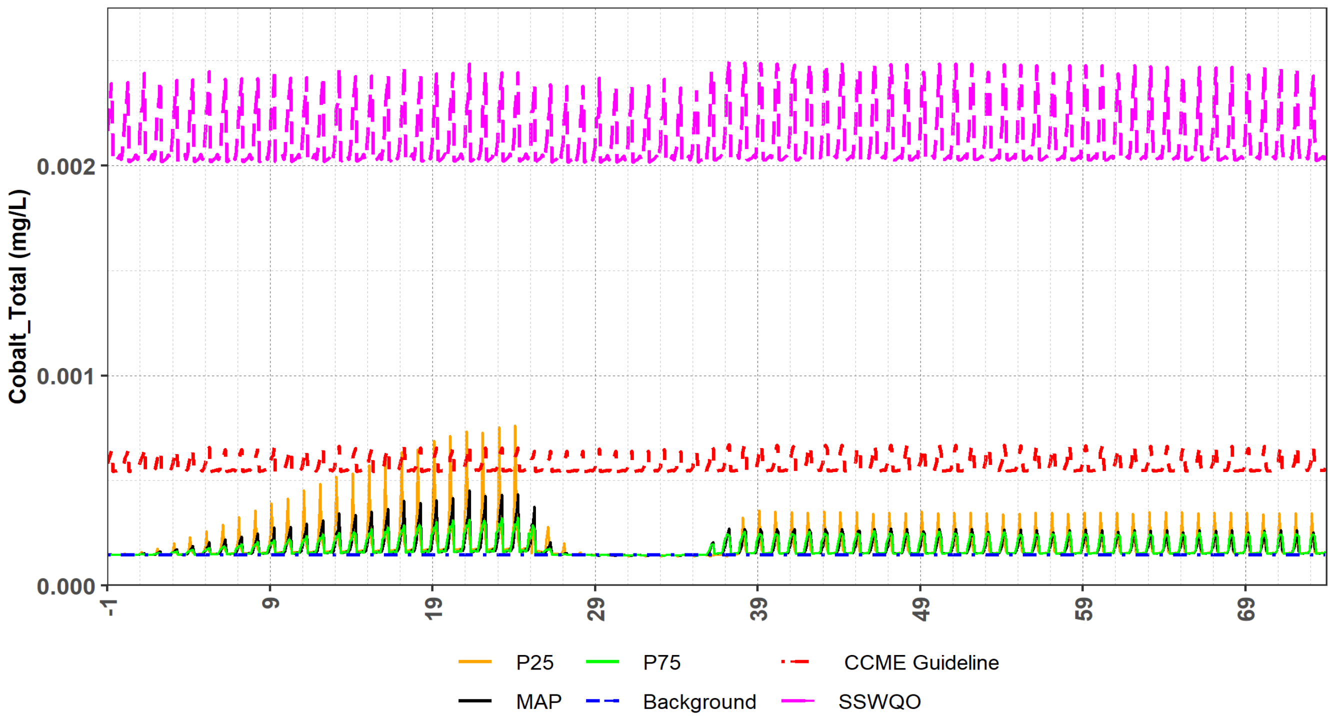


Figure 8-26: Time Series of Modelled Predictions of Total Cobalt for 25th Percentile, Mean Annual Precipitation, and 75th Percentile Model Scenarios for Walsh River

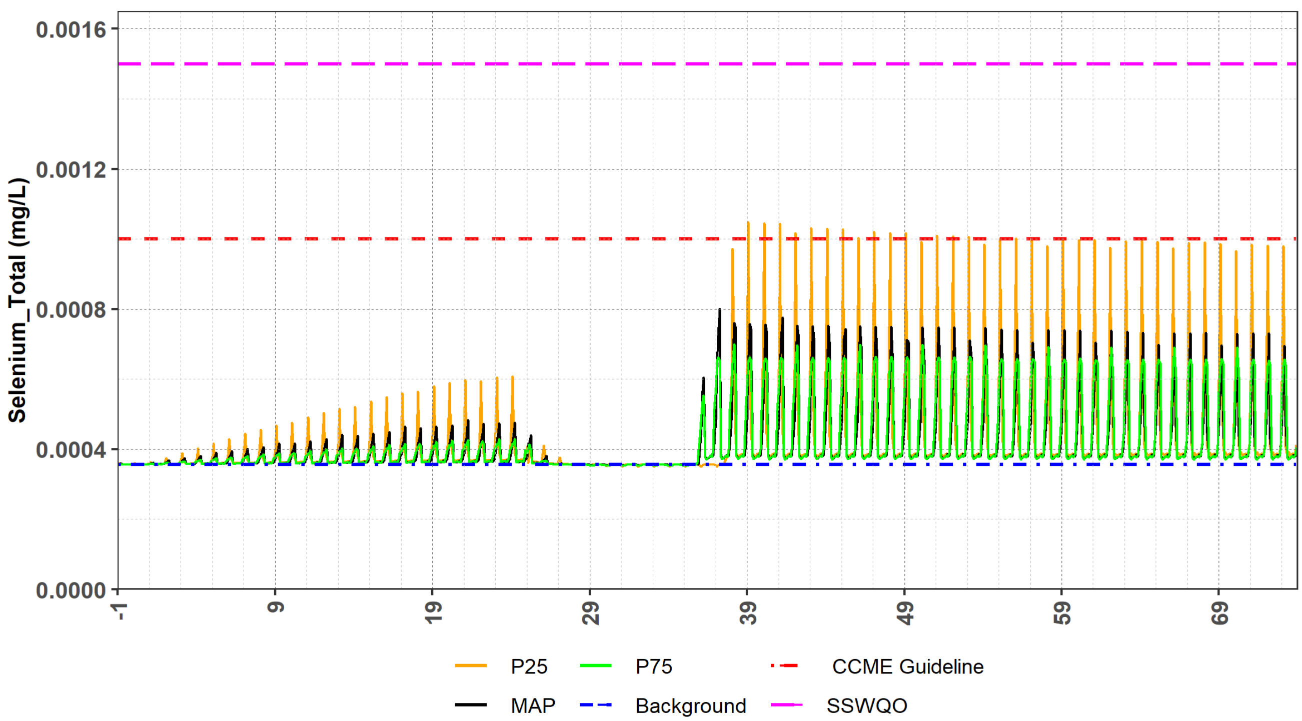


Figure 8-27: Time Series of Modelled Predictions of Total Selenium for 25th Percentile, Mean Annual Precipitation, and 75th Percentile Model Scenarios for Walsh River

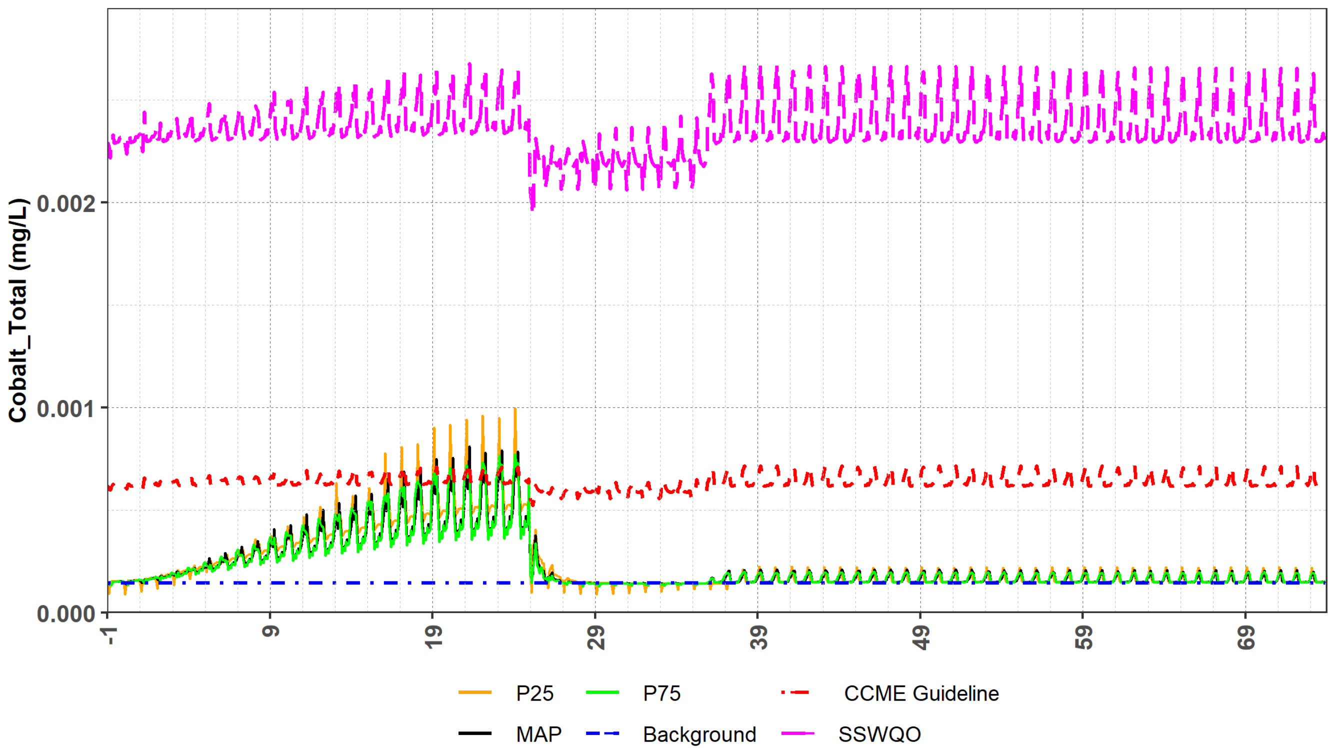


Figure 8-28: Time Series of Modelled Predictions of Total Cobalt for 25th Percentile, Mean Annual Precipitation, and 75th Percentile Model Scenarios for the Duley Lake Outlet

8.5.3.1.2.2 Duley Lake Conceptual Site Model

DLCSM was developed to predicted water quality at Duley Lake Initial Dilution Zone (IDZ). Duley Lake IDZ simulations represent the centre of the effluent discharge plume approximately 100 m from the diffuser. Time series of modelled predictions of total cobalt, and total manganese, and total selenium for P25, MAP and P75 scenarios are presented in Figure 8-29 and Figure 8-30. Model results show the following:

- Total cobalt levels exceed CCME guideline during the Operations phase starting around Year 9 (Figure 8-29). These Project effects are reversible and do not persist beyond Operations. Compared to cobalt SSWQO for Duley Lake, total cobalt levels during all Project phases are below hardness-dependent cobalt SSWQO (TSD VIII) levels that ranged from 2.7 to 3.2 µg/L (i.e., 0.0027 to 0.0032 mg/L).
- Total selenium levels exceed CCME guideline during the Operations phase starting around Year 13 (Figure 8-30). These effects are reversible and do not persist beyond operations. Compared to selenium SSWQO of 1.5 µg/L (i.e., 0.0015 mg/L) for Duley Lake, total selenium levels during all Project phases are below selenium SSWQO (TSD VII).

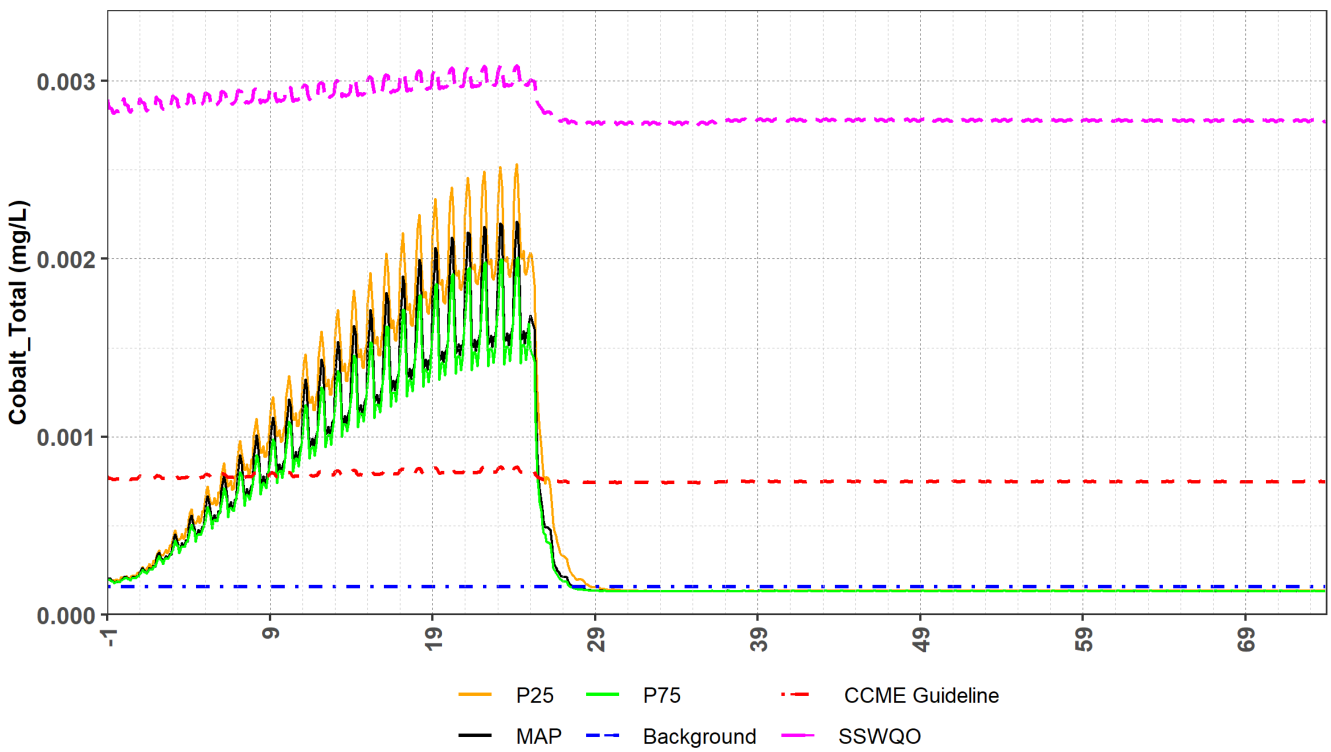


Figure 8-29: Time Series of Modelled Predictions of Total Cobalt for 25th Percentile, Mean Annual Precipitation, and 75th Percentile Model Scenarios for Duley Lake IDZ

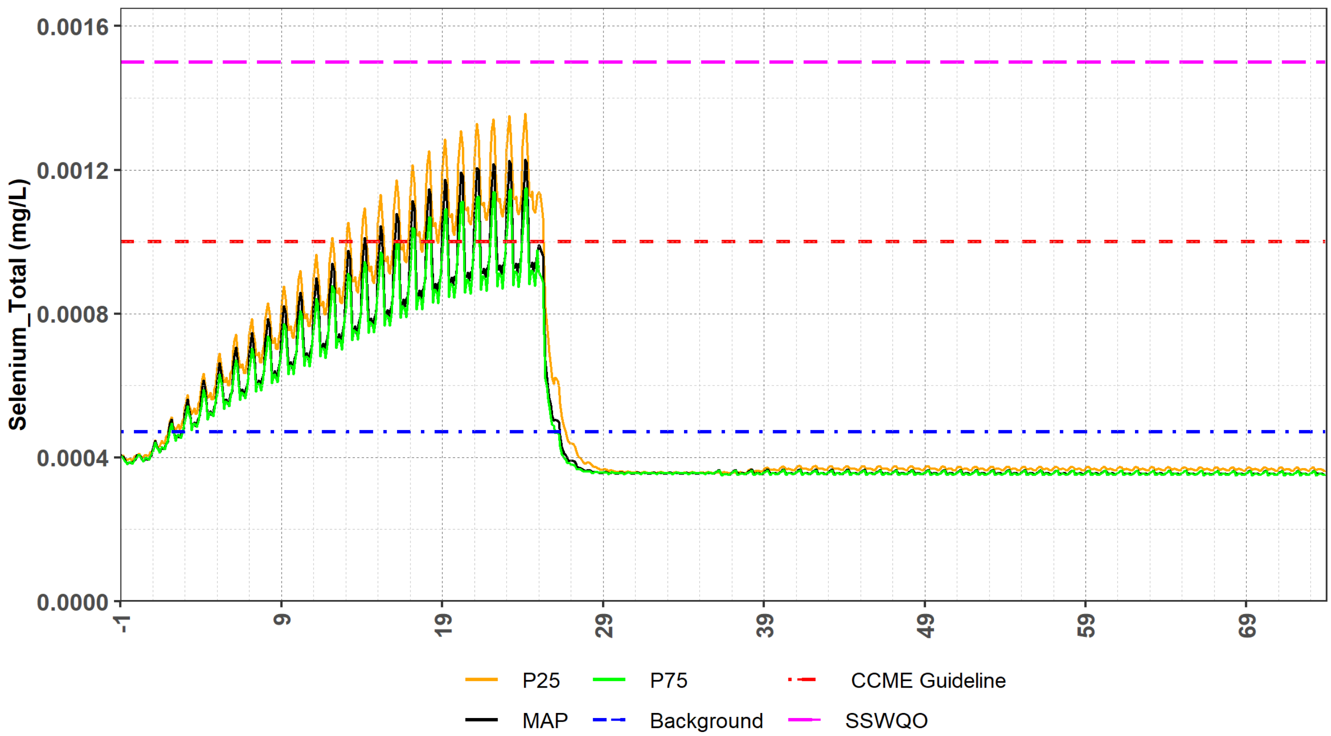


Figure 8-30: Time Series of Modelled Predictions of Total Selenium for 25th Percentile, Mean Annual Precipitation, and 75th Percentile Model Scenarios for Duley Lake IDZ

8.5.3.1.3 Sediment Quality

As discussed earlier in Section 8.5.2.2, Negligible Effect Pathways (Deposition of fugitive dust emissions, Deposition of air quality contaminants of concern [COCs] emissions, and Treated effluent and treated sewage affecting TSS Loadings and Sediment Quality) changes to sediment quality due to Project activities were expected to be negligible, therefore, the above noted pathways were not carried forward to the residual effect assessment. However, since the sediment quality is linked to water quality, residual Project effects on sediment quality from the changes in surface water quality are expected, based on the WQWBM (TSD VI) which predicted some water quality parameters (COPCs) will exceed CCME guidelines. Sediment chemistry typically reflects long-term contaminant levels more accurately than water chemistry, as contaminants accumulate in sediments over time and can capture periodic or storm-related contamination events. These accumulated contaminants may enter the aquatic food web if sediments are resuspended or become bioavailable. Changes in water concentrations can affect sediment chemistry through mechanisms such as adsorption of dissolved metals into stream sediments, precipitation or formation of colloids that settle into sediments, and direct loading of particulate-bound metals (Manahan 1984). Fine materials like clay, silt, or organic matter are particularly prone to binding dissolved metals, incorporating them into sediments (Manahan 1984). Additionally, factors such as pH, water hardness, and the presence of iron and manganese complexes can influence metal bioavailability (Salomons et al. 1987).

The approach for assessing potential Project effects on sediment quality is qualitative and assumes sediment quality will follow predicted water quality trends in the receiving environment. Modelled results of predicted water quality parameters (discussed in Section 8.5.3.1.2) showed that there would be minor changes to water quality (i.e., COPC concentrations) with respect to average background conditions and most water quality COPCs concentration would not exceed CCME guidelines/thresholds, except two parameters (total cobalt and total selenium) in Pike Lake, Duley Lake, Duley Lake outlet and Walsh River. These parameters were generally predicted to exceed CCME guidelines/thresholds during Operations and return below CCME guidelines/thresholds during the Closure phase and Post-closure period except selenium that persisted above CCME during the Post-closure period at Pike Lake; however, both selenium and cobalt did not exceed their respective selenium (for Duley Lake) and cobalt SSWQOs (TSD VII and TSD VIII) during Project lifespan and far future. Considering elevated levels, they (cobalt and selenium) are likely to indirectly effect sediment quality. However, CCME guidelines/thresholds for sediment quality do not exist for cobalt and selenium.

Sediment water quality parameters with CCME guidelines/thresholds include arsenic, cadmium, chromium, copper, mercury, lead and zinc. The assessment of changes to these parameters in Pike Lake and Duley Lake (receiving water bodies) and Duley Lake outlet (the end point of the LSA) was completed in a semi-quantified manner, where the potential influence of surface water COPCs (total metals) represent the key driver to changes in respective sediment quality parameters. Percentage change to sediment quality parameter was assumed to be same as the predicted change to respective water quality parameter.

Table 8-31 through Table 8-33 show the predicted concentration of arsenic, cadmium, chromium, copper, mercury, lead and zinc at Pike Lake , Duley Lake, and Duley lake outlet based on percentage change to average concentrations of respective water quality parameter during Project phases under MAP Scenario.

At Pike Lake, sediment quality baseline condition results showed exceedance of chromium and mercury above the CCME-Interim Sediment Quality Guideline (ISQG); however, exceedance above CCME Probable Effect Level (PEL) were not observed. CCME ISQG is a guideline level below which adverse effects are unlikely, while PEL is a level at/above which adverse effects are more probable. Similar to the baseline conditions, assessment of sediment quality parameters in relation to changes in water quality showed exceedance of chromium and mercury during Construction and Operations phase; however, during the Closure phase these were assessed below CCME ISQG as the water quality COPCs return to near existing/background conditions (Table 8-31). Further, during Post-closure period, predicted average concentration of zinc showed exceedance above CCME ISQG. Predicted concentration of zinc (177 µg/g; 30% higher than ISQG) during Post-closure is closer to CCME ISQG (123 µg/g) compared to CCME PEL (315 µg/g; 156% higher than CCME ISQG). Note that the sediment quality baseline condition results have shown exceedance of zinc at Daviault Lake, Duley Lake, and Mills Lake above the CCME ISQG (Annex 2A) and historical results (Stantec 2012) also reported zinc exceedance at Molar Lake. Further, within the LSA, background zinc concentrations in sediment were found to range from 7.4 µg/g to 220 µg/g (Table 8-17). Predicted concentration of sediment quality parameters with CCME guidelines/thresholds showed a general decrease in value towards the Closure phase and then increase towards Post-closure period. During the Closure phase, predicted concentrations are generally near or below the background conditions. Table 8-31 also showed that none of the sediment quality parameters with CCME guidelines/thresholds was predicted to exceed CCME PEL at Pike Lake during Project lifespan and far future.

At Duley Lake, sediment quality baseline condition results showed exceedances of arsenic, cadmium, chromium, lead, and zinc above the CCME ISQG; however, exceedances above CCME PEL were not observed. Similar to baseline conditions, assessment of sediment quality parameters in relation to changes in water quality showed exceedance of arsenic, cadmium, chromium and zinc during Construction and Operations phase (Table 8-32). While lead was not predicted to exceed CCME ISQG, copper showed exceedance above CCME ISQG during Construction and Operations phase only. Predicted concentration of copper (63.6 µg/g; 78% higher than CCME ISQG) during Construction and Operations phase was found closer to CCME ISQG (35.7 µg/g) compared to CCME PEL (197 µg/g; 452% higher than CCME ISQG). Note sediment quality baseline condition results have shown exceedance of copper above CCME ISQG at Daviault Lake within the LSA (Annex 2A) and historical results (Stantec 2012) also reported copper exceedance at Molar Lake. Farther within the LSA, background copper concentrations in sediment were found to range from 1.4 to 46 µg/g. During the Closure phase, only cadmium, chromium and zinc continued to exceed CCME ISQG and during the Post-closure period only cadmium and chromium were predicted to exceed CCME ISQG. Predicted concentration of sediment quality parameters with CCME guidelines/thresholds showed a general decrease in value towards the Closure phase and Post-closure period. During the Closure phase, predicted concentrations are below the existing/background conditions. Table 8-32 also showed that none of the sediment quality parameters with CCME guidelines/thresholds was predicted to exceed CCME PEL at Duley Lake during Project lifespan and far future.

Assuming background sediment quality at Duley Lake outlet is the same as the Duley Lake, assessment of sediment quality parameters with CCME guidelines/thresholds was completed. As discussed above, sediment quality baseline conditions at Duley Lake showed exceedances of arsenic, cadmium, chromium, lead, and zinc above the CCME ISQG; however, exceedances above CCME PEL were not observed. Similar to the baseline conditions at Duley Lake, assessment of sediment quality parameters in relation to changes in water quality at Duley Lake outlet showed exceedance of cadmium, chromium, and zinc during Project lifespan (Construction and Operations, Closure) and far future (Post-closure period); no exceedance of arsenic and lead was predicted (Table 8-33). In addition to above sediment quality parameters, copper was also predicted to exceed CCME ISQG during Project lifespan and far future. Average predicted concentration of copper (51.9 µg/g; 45% higher than CCME ISQG) during Project lifespan and far future was found closer to CCME ISQG (35.7 µg/g) compared to CCME PEL (197 µg/g; 452% higher than CCME PEL). Predicted concentration of these parameters showed a general decrease in value towards the Closure phase and Post-closure period. During the Closure phase, predicted concentrations of most parameter are generally near or below the existing/background conditions. Table 8-33 also showed that none of the sediment quality parameters with CCME guidelines/thresholds was predicted to exceed CCME PEL at Duley Lake outlet during Project lifespan and far future.

In summary, assessment of sediment quality parameters with CCME guidelines/thresholds, based on changes in water quality parameters, showed that sediment quality parameters (with background concentrations exceeding CCME ISQG) are also likely to exceed CCME ISQG during Project lifespan and far future, except lead at Duley Lake and Duley Lake outlet and arsenic at Duley Lake outlet that are not predicted to exceed during Project lifespan in this semi-quantitative assessment. Further, in far future, only zinc at Pike Lake and copper at Duley Lake and Duley Lake outlet showed exceedance above CCME ISQG; however, exceedances were found relatively closer to CCME-ISQG thresholds (below which adverse effects are unlikely) than CCME-PEL threshold (at or above which adverse effects are more probable). Overall, the changes to sediment quality parameters are not predicted to exceed CCME PEL, above which adverse biological effects are expected to occur more frequently.

Since the sediment quality tend to reflect long-term contaminant levels, the predicted concentrations of sediment quality parameters due to residual Project effects showed only two new parameters (zinc at Pike Lake and copper at Duley lake outlet) that only exceeded CCME ISQG and the exceedance levels were predicted relatively closer to CCME ISQG compared to CCME PEL. Note that the sediment quality baseline condition and historical results have shown exceedances of zinc and copper above the CCME ISQG (Annex 2A) in lakes within the LSA; therefore, based on the semi-quantified assessment, the residual Project effects on sediment quality constituents in relation to changes in water quality constituents (COPCs) are expected to be low and reversible as the parameters (see Table 8-31 through Table 8-33) were predicted to return to near/below background conditions during the Closure phase and the Post-closure period (far-future) and/or behave similar to baseline conditions (i.e., exceedance of same parameters above CCME ISQG in the LSA), and none exceeded CCME PEL above which adverse biological effects are expected to occur more frequently.

Table 8-31: Predicted Average Concentrations of Sediment Quality Parameters at Pike Lake Based on Percentage Change to Water Quality Under Mean Annual Precipitation Scenario

Parameter		Unit	CCME Guidelines		Sediment Quality at Pike Lake	% Change to Water Quality with Respect to Background Water Quality			Predicted Sediment Quality Based on % Change to Water Quality[a]		
Name	Symbol	–	ISQG	PEL	Background Concentration	Construction and Operations	Closure	Post-closure	Construction and Operations	Closure	Post-closure
Arsenic	As	µg/g	5.9	17	1.8	51.7	2.0	157.4	2.7	1.8	4.6
Cadmium	Cd	µg/g	0.6	3.5	0.38	56.8	5.5	25.6	0.6	0.4	0.5
Chromium	Cr	µg/g	37	90	36	5.6	-5.3	-1.0	38.0	34.1	35.6
Copper	Cu	µg/g	35.7	197	18.3	1.8	-55.8	92.0	18.6	8.1	35.1
Mercury	Hg	µg/g	0.17	0.486	0.18	-5.5	-5.9	-11.1	0.2	0.169	0.16
Lead	Pb	µg/g	35	91.3	15	-78.8	-81.0	-79.9	3.2	2.8	3.0
Zinc	Zn	µg/g	123	315	72	63.7	1.7	145.8	117.9	73.2	177.0

Notes:

Shaded cells represent exceedance with respect to CCME ISQG. Shaded and bold cells represent exceedance with respect to CCME PEL. In case of background sediment quality, at least one sediment quality sample exceeded CCME ISQG or PEL.

(a) Change to sediment quality parameter is assumed to be same as change to water quality parameter.

CCME = Canadian Council of Ministers of the Environment; ISQG = Interim Sediment Quality Guidelines; PEL = Probable Effect Level.

Table 8-32: Predicted Average Concentrations of Sediment Quality Parameters at Duley Lake Based on Percentage Change to Water Quality Under Mean Annual Precipitation Scenario

Parameter		Unit	CCME Guidelines		Sediment Quality at Duley Lake	% Change to Water Quality with Respect to Background Water Quality			Predicted Sediment Quality based on % Change to Water Quality[a]		
Name	Symbol	–	ISQG	PEL	Background Concentration	Construction and Operation	Closure	Post-closure	Construction and Operations	Closure	Post-closure
Arsenic	As	µg/g	5.9	17	4.84	38.7	-14.5	-20.9	6.7	4.1	3.8
Cadmium	Cd	µg/g	0.6	3.5	0.89	42.2	-10.0	-28.1	1.3	0.8	0.6
Chromium	Cr	µg/g	37	90	60.6	-7.1	-18.3	-22.3	56.3	49.5	47.1
Copper	Cu	µg/g	35.7	197	27.6	130.4	-12.7	-5.9	63.6	24.1	26.0
Mercury	Hg	µg/g	0.17	0.486	0.118	-7.2	-5.5	-12.6	0.1	0.1	0.1
Lead	Pb	µg/g	35	91.3	25.4	-17.7	-23.8	-40.7	20.9	19.3	15.1
Zinc	Zn	µg/g	123	315	152	63.6	-7.9	-19.3	248.7	140.0	122.6

Notes:

Shaded cells represent exceedance with respect to CCME ISQG. Shaded and bold cells represent exceedance with respect to CCME PEL. In case of background sediment quality, at least one sediment quality sample exceeded CCME ISQG or PEL.

(a) Change to sediment quality parameter is assumed to be same as change to water quality parameter.

CCME = Canadian Council of Ministers of the Environment; ISQG = Interim Sediment Quality Guidelines; PEL = Probable Effect Level.

Table 8-33 Predicted Average Concentrations of Sediment Quality Parameters at Duley Lake Outlet Based on Percentage Change to Water Quality Under Mean Annual Precipitation Scenario

Parameter		Unit	CCME Guidelines[a]	Sediment Quality at Duley Lake Outlet[a]		% Change to Water Quality with Respect to Background Water Quality			Predicted Sediment Quality based on % Change to Water Quality[b]		
Name	Symbol	–	ISQG	PEL	Background Concentration	Construction and Operation	Closure	Post-closure	Construction and Operations	Closure	Post-closure
Arsenic	As	µg/g	5.9	17	4.84	18.2	0.2	8.1	5.7	4.8	5.2
Cadmium	Cd	µg/g	0.6	3.5	0.89	25.9	7.6	5.2	1.1	1.0	0.9
Chromium	Cr	µg/g	37	90	60.6	1.4	-1.9	-2.4	61.5	59.4	59.2
Copper	Cu	µg/g	35.7	197	27.6	111.1	69.6	83.3	58.3	46.8	50.6
Mercury	Hg	µg/g	0.17	0.486	0.118	-1.8	-1.6	-3.0	0.1	0.1	0.1
Lead	Pb	µg/g	35	91.3	25.4	-67.4	-68.2	-69.6	8.3	8.1	7.7
Zinc	Zn	µg/g	123	315	152	19.7	4.4	5.8	181.9	158.7	160.8

Notes:

Shaded cells represent exceedance with respect to CCME ISQG. Shaded and bold cells represent exceedance with respect to CCME PEL. In the case of background sediment quality, at least one sediment quality sample exceeded CCME ISQG or PEL.

(a) Sediment quality at the Duley Lake outlet is assumed to be same as Duley Lake.

(b) Change to sediment quality parameter is assumed to be same as change to water quality parameter.

CCME = Canadian Council of Ministers of the Environment; ISQG = Interim Sediment Quality Guidelines; PEL = Probable Effect Level.

8.5.3.2 Characterization of Residual Project Effects

Residual effects were classified for Project lifespan, consisting of a 37-year period that encompasses Construction, Operations, and Closure; however, consideration was also given to far-future (Post-closure period), that encompasses the long-term effects that may occur to surface water quality following Closure phase. Characterization of residual effects on surface water are summarized according to nature, magnitude, geographic extent, duration, timing, reversibility, frequency, probability of occurrence, and ecological and socio-economic context following the methods described in Section 8.5.1.2. Residual effects classification considered the implementation of mitigation and enhancement measures outlined in Section 8.5.2 and summarized in Table 8-21.

8.5.3.2.1 Surface Water Quantity

Project effects during the Project lifespan (i.e., Construction, Operations and Closure phases) are anticipated to be adverse in nature for surface water quantity, as the flows and water levels would change/fluctuate from the background (i.e., pre-mine) conditions. While the changes in Pike Lake are predicted to exceed ±10% range, according to WQWBM predictions under the MAP scenario, Pike Lake discharge is also expected to remain above the seasonal minimum discharge threshold rates (0.03 m^3/s for Dec-April and 0.25 m^3/s for May-Nov). The net change to discharges at Duley Lake (located downstream of Pike Lake), that represent the end point of the LSA, are predicted to be within 10%. Since, the net change at Duley Lake outlet during Project lifespan is predicted to range from -0.86% to -6.18% with an average of -2.62%, the overall magnitude of residual effect is expected to be low, noting that overall change is within 5% of existing/background condition (pre-mine) and a high level of ecological protection is provided when flow alterations are within ±10% (Richter et al. 2011; DFO 2013). Note that the assessment of Project effects on surface water quantity in terms of changes to water balance components (surplus) of other local watershed within the LSA (e.g., Waldorf River, Mills Lake, Riordan Lake, Rectangle Lake, Molar Lake, and Daviault Lake) during Operations phase showed predicted changes within ±5%, except for Waldorf River where predicted changes was -8.3% (within ±10%). After decommissioning and rehabilitation (i.e., Post-closure period), predicted changes to surpluses were predicted to return to near existing/background (pre-mine) conditions.

Similarly, assessment of changes to 21 watersheds of local streams (watercourses) as a proxy to changes to water balance components (i.e., surplus) during Operations showed predicted changes at 12 watersheds within ±5%, 1 within ±5 to ±10% and 8 exceeding ±10%. Watershed of local streams (watercourses) with predicted change over ±10 will experience localized residual Project effects. However, effects on downstream natural environment will be managed using water management infrastructure and will be mitigated and compensated with the implementation of an offsetting plan, as discussed in the Project TSD IX.

The changes to flows are anticipated to extend beyond Duley Lake outlet; however, changes would remain within ±5% (±5% is regarded within the typical error of a streamflow measurement and output from a hydrologic/hydraulic model) in the downstream LSA. Therefore, the geographical extent of the residual effects on the surface water quantity would be local. The maximum duration of Project-related changes to surface water quantity measurement indicators would be 74 years, which includes the 25-year period of the Project (i.e., from Construction through to the start of Closure), followed by Closure (a period of 12 years [Year 25 to Year 36]) for pit flooding) and Post-closure (a period of 37 years [Year 37 to Year 73]). Note that changes to flows at Duley Lake outlet were predicted to be high during the early stages of pit flooding during the Closure phase compared to the Construction and Operations phase and Post-closure period where the changes were close to the existing/background conditions; therefore, the duration of residual effects on surface water quantity is anticipated to persist for decades and is reversible.

Regarding the timing, the water intake from and discharge to Duley Lake, and transfer of water from Duley Lake to Pike Lake are anticipated to be continuous during the Construction, Operations, and Closure phases and therefore changes are expected to persist year round. The frequency of these effects is anticipated to be periodic. For the water quantity measurement indicator, the probability of residual effects is possible because the flows and water levels in the receiving environment are not predicted to fluctuate/change beyond the natural variation of flows. The Project effects are anticipated to effect ecological function that is expected to remain largely typical when compared to other lake systems in the region and to pre-development conditions.

8.5.3.2.2 Surface Water Quality

Project effects during the Project lifespan (i.e., Construction, Operations, and Closure phases) are anticipated to be adverse in nature for surface water quality, as most COPC concentrations would increase from the average existing/background concentrations during Project lifespan. To mitigate Project effects, planned mitigation and environmental protection measures, as discussed in Section 8.5.2 and summarized in Table 8-21 are proposed and to confirm effectiveness of mitigation measures, monitoring and adaptive management will be implemented. The incremental changes to COPC concentrations were predicted to extend beyond Duley Lake; however, most COPC concentrations would remain below water quality guidelines/thresholds and/or SSWQOs (selenium for Duley Lake and cobalt) in the downstream LSA waterbodies. Within the LSA, selenium concentration at Pike Lake is predicted to exceed CCME during the Post-closure period. Changes to predicted selenium concentrations following flooding of Rose Pit may have measurable effects on fish health; however, these effects are potentially reversible in fish as the high selenium levels are expected to be isolated to Pike Lake, and fish may migrate out of the lake. See **Chapter 9, Fish and Fish Habitat**, for details about the residual effect to fish and planned mitigations measures and monitoring program. At Walsh River (located downstream of Pike Lake and discharging to Duley Lake), selenium concentrations are predicted to reduce relative to Pike Lake and remain below selenium SSWQO for Duley Lake. Overall, the geographical extent of the residual effects on the water quality would be local and overall magnitude would be low.

The maximum duration of Project-related changes to surface water quality would be 74 years, which includes the 26-year Operations phase where maximum COPC concentrations were projected, followed by a period of 49 years (Closure and Post-closure) where COPC concentrations decrease to near average background concentrations and remain below Project thresholds. For the water quality constituent concentrations, Project residual effects on COPC concentrations would reach a maximum towards the end of the Operations phase; these residual effects were most obvious in Pike Lake and Duley Lake. Therefore, the duration of residual effects on surface water quality is anticipated to be long-term.

The assessment results indicated that the Project-related changes to predicted COPC concentrations in Duley Lake and waterbodies in the LSA would be irreversible during Construction and Operations; however, during Closure and Post-closure, changes would be reversible because most COPC concentrations would achieve near background concentrations after the cessation of site discharges at the end of the Operations phase. However, the predicted selenium concentrations in Pike Lake are irreversible according to the WBWQM (TSD VI) predictions and will persist above CCME.

The frequency of these effects is anticipated to be continuous as the Project discharges to the receiving environment would occur continuously over the Project lifespan. Although COPC concentrations would increase, the predicted concentrations of most COPCs do not exceed guidelines/thresholds and generally do not persist beyond Operations phase. Further, most COPC thresholds would be met at the proposed 100 m RMZ boundaries associated with WTP discharges, limiting the extent of potential risk to aquatic and terrestrial life and water quality in the receiving environment, except cobalt and selenium that were predicted to exceed guidelines for a relatively short duration during Operations phase.

For the water quality constituent concentrations measurement indicators, the probability of residual effects is certain because COPC concentrations in the receiving environment would be affected throughout the Project lifespan. The Project effects are anticipated to effect ecological function that is expected to remain largely typical when compared to other lake systems in the region and to pre-development conditions.

8.5.3.2.3 Sediment Quality

Since the sediment quality is largely qualitatively assessed in relation to predictions of water quality, the characterization of Project residual effects is also expected to generally follow the water quality predictions. Project effects during the Project lifespan (i.e., Construction, Operations, and Closure phases) are anticipated to be adverse in nature for sediment quality, as the minor changes to sediment quality parameters during the lifespan of the Project are expected to occur due to change in water quality of receiving environment. To mitigate Project effects, planned mitigation and environmental protection measures, as discussed in Section 8.5.2 and summarized in Table 8-21 are proposed and to confirm effectiveness of mitigation measures, monitoring and adaptive management will be implemented.

Semi-quantified assessment of sediment water quality parameters with CCME guidelines/thresholds showed that due to Project effects sediment quality parameters, whose background concentrations exceeded CCME ISQG, would generally exceed CCME ISQG during the Operations phase; however, predicted concentrations would generally return to near existing/background conditions during the Closure phase and Post-closure period. Other parameters that showed exceedance due to Project residual effects included zinc at Pike Lake and copper at Duley Lake and Duley Lake outlet. None of the parameters with CCME guidelines/thresholds exceeded CCME-PEL threshold above which adverse biological effects are expected to occur more frequently.

Like water quality, the geographical extent of the residual effects on the water quality would be local and the magnitude would be low. The duration of residual Project effects on sediment quality is anticipated to persist for decades. The assessment results in relation to water quality indicated that the Project-related changes to sediment quality parameters in Duley Lake and waterbodies in the LSA would be irreversible during the Construction and Operations phases; however, during the Closure phase and Post-closure period changes would be reversible because water quality would improve and achieve near background concentrations after the cessation of site discharges at the end of Operations.

The frequency of these effects is anticipated to be continuous as the Project discharges to the receiving environment would occur continuously over the Project lifespan. For the sediment quality constituent concentrations measurement indicators, the probability of residual effects is possible because there is no direct relationship between the water quality and sediment quality and due to flows events/flushing of lakes/waterbodies, the anticipate effect on sediment quality might even be less than perceived. The Project effects are anticipated to effect ecological function that is expected to remain largely typical (except for Pike Like with respect to selenium levels during Post-closure) when compared to other lake systems in the region and to pre-development conditions.

Table 8-34: Characterization of Residual Effects on Surface Water Measurable Parameters

Residual Effect	Criterion	Rating/Effect Size
Surface water quantity (changes to flows, water levels and water balance components)	Nature	Adverse
	Magnitude	Low; watersheds of some local streams(watercourses) within will experience >10% changes; however, the Project effects will be mitigated (TSD IX)
	Geographic extent	Local
	Duration	Long term
	Timing	Year-round
	Reversibility	Reversible
	Frequency	Periodic
	Probability of occurrence	Possible
	Ecological and socioeconomic context	Ecological
Surface water quality (changes to constituent concentrations)	Nature	Adverse
	Magnitude	Low; most COPCs increase in concentration above background, but projections remain below Project thresholds, except cobalt and selenium that showed exceedances above CCME during the Project lifespan; however, these were below SSWQOs
	Geographic extent	Local; COPC changes are more pronounced in Pike Lake and Duley Lake; effects diminished downstream through the LSA except cobalt, which stays elevated towards the end of Operations (but does not exceed SSWQO) and then falls below CCME guidelines; within the LSA selenium persists above CCME at Pike Lake during the Post-closure period.
	Duration	Decades; as the Project affected COPC achieve maximum concentrations towards the end of Operations before falling near background concentrations during the Closure phase and the far future
	Timing	Year-round; more pronounced during Operations
	Reversibility	Reversible; as most COPCs would achieve near background concentrations after the cessation of site discharges at the end of Operations, and remain below Project thresholds/SSWQOs; selenium at Pike Lake is irreversible as the predicted concentrations increases during Post-closure and exceeds CCME
	Frequency	Continuous, as surface run-off and effluent discharge terms for COPCs persist in the receiving environment; however, at Duley Lake outlet (end point of the LSA) only cobalt seasonally exceeded CCME towards the end of Operations but remained below SSWQO.
	Probability of occurrence	Certain; as the Project affected COPC concentrations above background persist in the receiving environment
	Ecological and socioeconomic context	Ecological
Sediment quality (changes to constituent concentrations)	Nature	Adverse
	Magnitude	Low
	Geographic extent	Local
	Duration	Decades
	Timing	Year-round
	Reversibility	Reversible
	Frequency	Continuous
	Probability of occurrence	Possible
	Ecological and socioeconomic context	Ecological

COPCs = constituents of potential concern; CCME = Canadian Council of Ministers of the Environment; LSA = local study area; SSWQO = site-specific water quality object.

8.5.3.3 Significance Determination

An assessment of the significance of Project residual effects on surface water quantity, surface water and sediment and quality follows.

8.5.3.3.1 Surface Water Quantity

The residual effects on surface water quantity for Duley Lake (the end point of the LSA) are not significant, as predicted changes to modelled discharges under the MAP scenario are within 10%. This threshold is based on case studies and guidance (Richter et al. [2011] and Fisheries and Oceans Canada [DFO 2013]) indicating that flow alterations within 10% of natural flow provide a high level of ecological protection.

At Pike Lake, the net change to discharges under MAP scenario exceeds ±10% during the Construction, Operation, and Closure phases and Post-closure period; however, according to TSD VI, Pike Lake discharge is expected to remain above the seasonal minimum discharge threshold rates (0.03 m^3/s for Dec-April and 0.25 m^3/s for May-Nov). Note that the overall change, considering all phases (Construction, Operations, and Closure) and Post-closure period, is predicted to be -0.01%.

At Waldorf River watershed (with land area change of -8.24%), the change to surplus was predicted within ±10%. All other local watersheds (Lakes) in the LSA showed within ±10% change to water balance components. A small number of watersheds of local streams (watercourses) are expected to have localized change exceeding ±10% and thus will experience localized residual Project effects. However, the Project effects on the local downstream environment will be managed using water management infrastructure and will be mitigated and compensated with the implementation of an offsetting plan, as discussed in the Project TSD IX.

Overall, at the LSA boundary (Duley Lake outlet), with planned mitigation and environmental measures, and environmental monitoring and adaptive management, residual Project effects on water quantity are predicted to be not significant.

8.5.3.3.2 Surface Water Quality

The predicted residual Project effects on surface water quality are predicted to be not significant as effluent will comply with MDMER requirements and changes to water quality parameters at Duley Lake outlet (the end point of the LSA) will mostly be within CCME guidelines/thresholds and/or SSWQOs (selenium for Duley Lake and cobalt) and no management concerns are expected. The concentration of most COPCs in receiving waterbodies (Duley Lake and Pike Lake), immediately downstream of discharge points, are expected to generally gradually increase towards the end of Operations phase followed by the Closure phase and Post-closure period where COPC concentrations were predicted to decreased to near background concentrations and remain below Project thresholds/guidelines, except for selenium at Pike Lake during Post-closure period. Predicted concentrations of selenium and cobalt were also compared to SSWQOs and were found below SSWQOs, noting that an SSWQO for Pike Lake has not been developed. At Walsh River (located downstream of Pike Lake and upstream of Duley Lake), selenium concentrations were also predicted below selenium SSWQO for Duley Lake. See Chapter 9, Fish and Fish Habitat for details about effects of selenium on fish and planned mitigation measures and monitoring program.

With planned mitigation and environmental protection measures, and environmental monitoring and adaptive management, the overall residual Project effects on the surface water quality are predicted to be not significant.

8.5.3.3.3 Sediment Quality

Sediment quality is assessed qualitative and assumes sediment quality will follow predicted surface water quality trends in the receiving environment. Although there will be minor change to surface water quality of the receiving environment with respect to existing/background conditions, only two parameters (cobalt and selenium) were predicted to generally increase above CCME guidelines/thresholds, but remain below respective SSWQOs, during Operations and then return below Project guidelines/threshold during the Closure phase and Post-closure period, with the exception of selenium that persisted above CCME during the Post-closure period at Pike Lake. Further, only one COPC (i.e., cobalt) at Duley Lake outlet (the end point of the LSA) was predicted to exceed seasonally towards end of Operations. Cobalt levels did not exceed cobalt SSWQO; the exceedance was predicted reversible and not persistent beyond Operations phase.

In addition to qualitative assessment, changes to sediment quality parameters with CCME guidelines/thresholds were assessed in a semi-quantified manner. Assessment showed that due to Project effects sediment quality parameters (e.g., arsenic, cadmium, chromium, and zinc), whose background concentrations exceeded CCME ISQG, would generally exceed CCME ISQG during the Project Operations phase; however, predicted concentrations would generally return to near/below background conditions during the Closure phase and Post-closure period. Only zinc and copper are the additional new parameters that were predicted to exceed CCME ISQG in far future due to Project residual effects. None of the parameters with CCME guidelines/thresholds exceeded the

CCME-PEL threshold above which adverse biological effects are expected to occur more frequently. Therefore, Project residual effects on sediment quality in relation to changes in water quality are likely to indirectly affect sediment quality; however, the magnitude is assessed to be low, localized and reversible.

With planned mitigation, environmental protection measures, and environmental monitoring and adaptive management, the overall residual Project effects on the sediment quality are considered to be not significant.

8.5.4 Residual Cumulative Effects Analysis

8.5.4.1 Reasonably Foreseeable Developments and Potential Cumulative Effects

Following the effects assessment discussed in the Sections 8.5.2 and 8.5.3, assessment of potential cumulative effects was conducted for other projects and/or activities within the RSA that have the potential to interact with the Project. Four projects were identified that have the potential to contribute to the cumulative effects. These projects range from approximately 13 to 25 km from the Project. Table 8-35 provides summary of other projects and activities considered in the cumulative effects assessment and Figure 8-31 shows the locations of these other projects and activities.

The Scully Mine Tailings Impoundment Area Expansion Project is not expected to cause changes to water drainage patterns and water quality at the final discharge point. Tailing deposition will eventually fill in the Flora South Basin pushing water farther south; however, overall drainage patterns will be maintained. All flows will drain northward into Flora North, maintaining existing drainage patterns from there to Flora River. All effluent discharges are proposed to meet the water quality discharge limits. Water quality in Flora Lake is in compliance with MDMER guidelines and *Environmental Control Water and Sewer Regulations* and the acute lethality criteria in the MDMER. Typical water quality as measured and reported also meets or exceeds the CCME criteria for Protection of Freshwater Aquatic Life (Tacora 2021). The Environmental Assessment Registration (Tacora 2021) for this project concluded that the project is not expected to cause any changes to water quality at the final discharge point which would negatively affect receiving waterbodies and the track record of achieving environmental compliance for surface water discharge is expected to be maintained through project implementation. While this project footprint is outside of the LSA, the flow from Flora Lake ends in Wabush Lake, within the RSA. The effects of this project have been assessed as negligible.

The Rio Tinto IOC Western Hillside Tailings Pipeline Project is not expected to have significant effect on drainage patterns for Wabush Lake. The effluent released by the project will be monitored to ensure it meets the federal (MDMER and CCME guidelines) and provincial Certificate of Approval (CoA) criteria. No additional interactions or adverse effects on the water resources are anticipated during operations (SEM 2024). The Environmental Assessment Registration (SEM 2024) for this project concludes that water management activities associated with the project's operations are not anticipated to have significant adverse effects on the natural environment; therefore, the effects of this project have been assessed as negligible.

The Humphrey South Extension Project is unlikely to have an increase in interaction with water resources during the mining operations. All discharged water is proposed to meet provincial and federal discharge criteria. Project activities can potentially effect Wabush Lake via run-off from White Lake. However, project controls and mitigation measures are expected to eliminate effects on water resources during construction and operations (GEMTEC 2020). The Environmental Assessment Registration (GEMTEC 2020) of this project concludes that the project should not result in significant adverse effects on surface water resources; therefore, the effects of this project have been assessed as negligible.

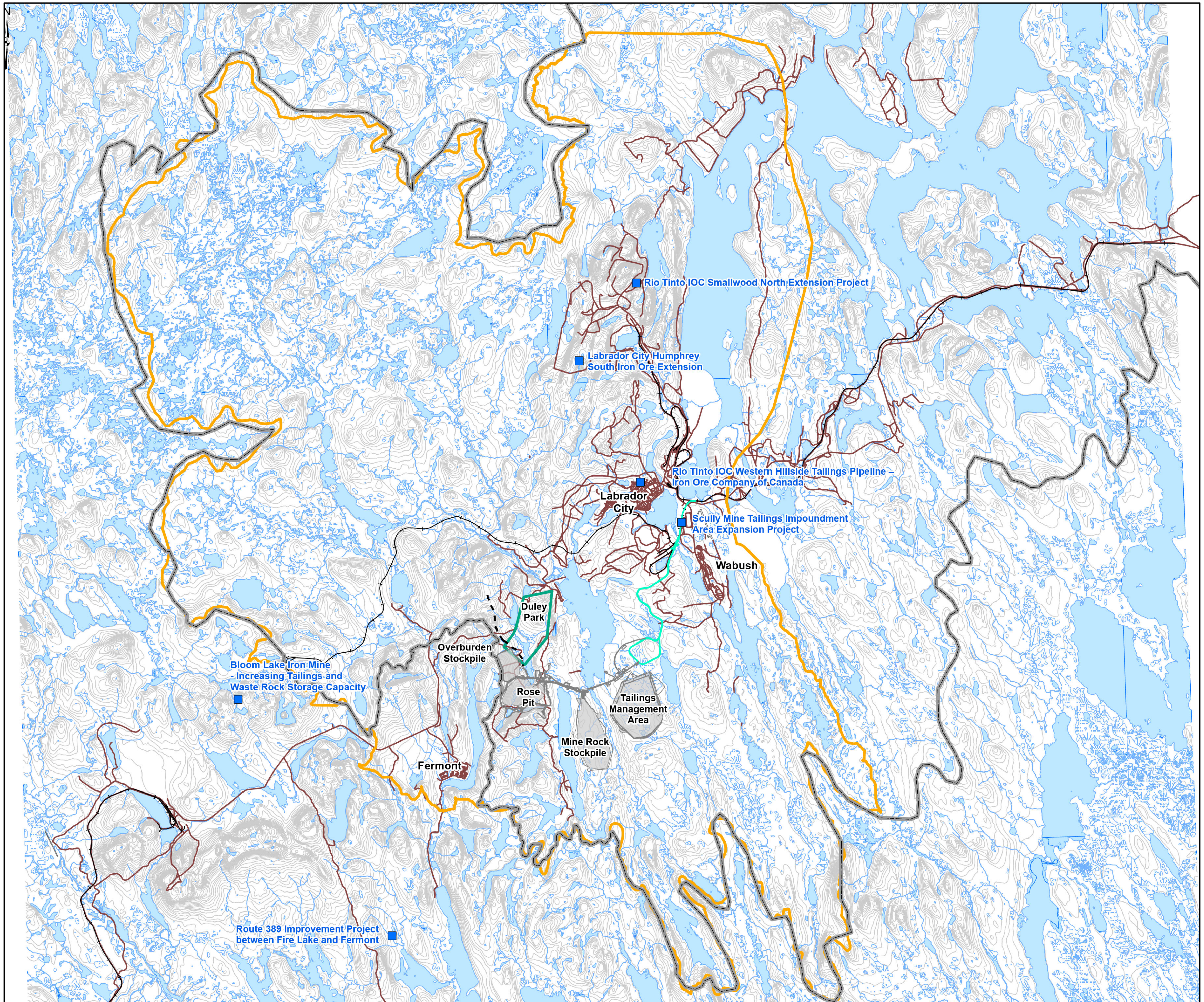
The Rio Tinto IOC Smallwood North Extension project is unlikely to have an increase in interaction with water resources during the mining operations. All discharged water is proposed to meet provincial and federal discharge criteria. The project activities can potentially effect Wabush Lake via run-off from Loraine Lake. However, project controls and mitigation measures are expected to eliminate run-off into nearby waterbodies. The Environmental Assessment Registration (GEMTEC 2021) of this project concludes that water management activities associated with the operations of the project are not anticipated to result in significant adverse effects on the natural environment; therefore, the effects of this project have been assessed as negligible.

The overall assessment conclusion is that potential residual cumulative effects with identified RFDs are unlikely to result in greater than negligible contributions to the Project's residual effects assessment.

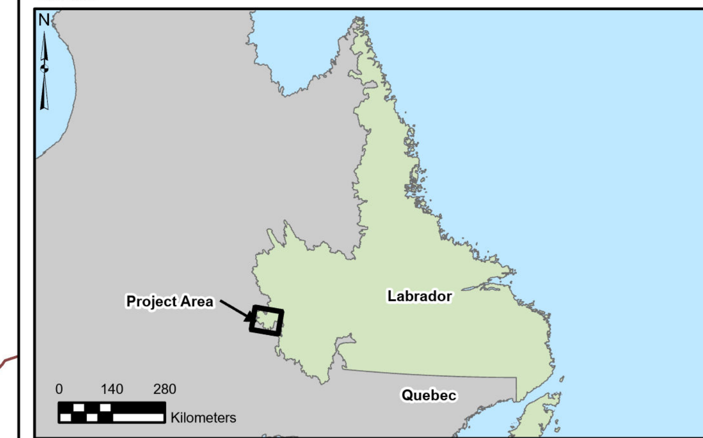
Table 8-35: Other Projects and Activities Considered in the Cumulative Effects Assessment

Project Name or Physical Activity	Description of Project Effects	Approximate Direct Distance from Kami Mining Project	Status/Timing	Interaction with Residual Effects on Surface Water from Kami Mining Project
Scully Mine Tailings Impoundment Area Expansion Project	Tacora Resources Inc. is proposing to expand the tailings impoundment area of the Scully Mine, an iron ore mine located in Wabush, Newfoundland and Labrador. As proposed, the Scully Mine Tailings Impoundment Area Expansion Project would expand the existing tailings impoundment area by up to 1,411 ha, allowing for the full use of the mine's ore reserves and for operations to continue until 2047. The existing tailings impoundment area is expected to reach full capacity around 2025.	13 km	– Minister of Environment and Climate change determined that the project does not require an Environmental. Assessment in July 2022 – Anticipated start in 2025 and expand operations by 22 years.	– Adverse affects to water quality at final discharge point of project are not expected – Effluent/discharges to comply with MDMER guidelines and *Environmental Control Water and Sewer Regulations* – **No cumulative effects predicted**
Rio Tinto IOC Western Hillside Tailings Pipeline – Iron Ore Company of Canada	New tailings management plan that would include optimizing available space of the existing Wabush Lake tailings storage facility and utilizing the Western Hillside. The Project would include the development of an access road and pipeline alignment, transmission lines, pumps and pumphouses, and a modified strategy for deposition of tailings into Wabush Lake.	15 km	– Minister announced the project is released from an Environmental Assessment on May 17, 2024. – Work anticipated to start in 2024 and continue into 2033.	– Adverse effects on the natural environment are not anticipated – Effluent to federal (MDMER and CCME guidelines) and provincial Certificate of Approval criteria – **No cumulative effects predicted**
Labrador City Humphrey South Iron Ore Extension	A 370 ha extension to the Humphrey South Pit iron ore deposit that will include development into the White Lake area to support its existing operations in Labrador City. The project consists of an extension of the Humphrey South Pit to the east and south, development of a waste dump south of White Lake, extension of the Carol waste dump, power lines, dewatering wells, and surface water-handling systems.	20 km	– Condition of release from Environmental Assessment met on December 11, 2024 – Construction to start in 2024 and operations anticipated by 2026	– There is no predicted interaction with surface water – **No cumulative effects predicted**
Rio Tinto IOC Smallwood North Extension Project	Expansion to the boundaries of the existing Smallwood Pit to support ongoing operations in Labrador City. The proposed extension of Smallwood Pit is located within Rio Tinto IOC's existing mining leases and encompasses approximately 160 ha. The proposed project includes extending the Smallwood North pit to the north, development of a new waste dump, construction of new power lines, construction of new pit dewatering wells and the development of surface water handling systems.	25 km	– The Minister announced that the project was released from an Environmental Assessment on July 21, 2021. – Construction start in summer 2024 into 2030	– Lorraine Lake borders the project, which sits above Wabush Lake on its western edge and drains into it. – There is no predicted interaction with surface water – **No cumulative effects predicted**

IOC = Iron Ore Company of Canada; MDMER = *Metal and Diamond Mining Effluent Regulations*; CCME = Canadian Council of Ministers of the Environment.



KEY MAP



SCALE 1:20,000,000

LEGEND

PROJECT INFRASTRUCTURE

- Proposed Project Infrastructure
- Surface Water Regional Study Area (RSA)
- Proposed Project Infrastructure (Linear)
- Proposed Access Road and Railway Corridor
- Potential Access Road
- Reasonably Foreseeable Developments

BASEMAP INFORMATION

- Duley Lake Park
- Labrador/Quebec Boundary
- Bog/Wetland
- Waterbody
- River/Stream
- Existing Railway
- Existing Road

0 2,000 4,000 8,000

1:230,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT
CHAMPION IRON MINES LTD.

PROJECT
KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE
OTHER PROJECT AND ACTIVITIES CONSIDERED IN THE CUMULATIVE EFFECTS ASSESSMENT FOR SURFACE WATER

CONSULTANT

YYYY-MM-DD	2025-07-02
DESIGNED	----
PREPARED	MS
REVIEWED	JM
APPROVED	CD

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0025	0	8-31

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

8.5.4.2 Climate Change

In addition to human activities, climate change and related effects (e.g., extreme weather, increased frequency and intensity of extreme weather events, wildfires) may contribute cumulatively to further contribute to surface water quantity, quality and sediment quality. Current climate change projections under a high greenhouse gas emissions model (Shared Socioeconomic Pathway 5-8.5) predict summer temperatures to rise by +1.9°C and winter temperatures to rise by +6.0°C by 2060 in Happy Valley-Goose Bay (roughly 530 km east of the Project area) (Neilsen 2023). A Climate Projections Study (Finnis and Daraio 2018) projects similar changes by mid-century in Wabush where daily mean temperatures are predicted to rise by +2.8ºC in the summer and as much as 5.8ºC in the winter (Finnis and Daraio 2018). These increases would result in noticeable changes in precipitation, rising ambient temperatures, shorter winters, and permafrost thaw (Neilsen 2023). These climate changes will in turn affect the hydrology and water quality of lakes and rivers.

Changes to climate could also result in an increase in frequency and intensity of extreme weather events. Labrador is subject to severe weather events like heavy rainfall, blizzards, and hurricanes, all of which could result in habitat loss and alteration. The northwestern Atlantic Ocean, the Labrador Sea, and the Gulf of St. Lawrence are some of the stormiest areas in North America (Savard et al. 2016). Climate projections suggest that substantial changes in wind speed are unlikely to be impacted by climate change but there is likely to be a northward shift in storm tracks that will affect storm frequency and intensity in the East Coast region (Loder et al. 2013). Storms, like hurricanes, can result in substantial habitat loss and alteration. Storms moving up the eastern seaboard or across the continent impact precipitation events in Labrador (Lemmen and Warren 2016). Thus, more frequent and intense storms, together with increased precipitation due to ocean warming, is expected to increase the risk of floods (US EPA 2022).

Changes to climate could also result in an increase in frequency and intensity of wildfires. Labrador is prone to wildfires, with the most recent fire occuring in 2024, covering an area of 19,059 ha. An increase in the frequency and intensity of wildfires could reduce natural sediment and erosion controls such as trees and vegetation, resulting in additional sedimentation events during extreme weather events that result in high intensity precipitation.

Because of the uncertainty in direction and magnitude, it was conservatively assumed that climate change would have an adverse cumulative effect on surface water.

8.6 Prediction Confidence and Uncertainty

A key element of a comprehensive EA is the prediction of future conditions of the environment as a result of the Project from previous and existing projects and activities and RFDs. Given that environments change naturally and continually through time and across space, assessments of effects and predictions about future conditions embody some degree of uncertainty (CEA Agency 2018).

The purpose of the Prediction Confidence and Uncertainty section is to identify the key sources of uncertainty and qualitatively describe how uncertainty was addressed for surface water to increase the level of confidence that effects would not be larger than predicted, including the potential need for monitoring and adaptive management that can reduce uncertainty over time (Section 8.7).

Confidence in effects analyses can be related to many elements for Surface Water, including the following:

- adequacy of the baseline data for providing an understanding of the existing/background conditions and range of natural and seasonal variation (e.g., underestimated precipitation data from Wabush A climate station)
- the nature, magnitude, and spatial extent of future fluctuations in ecological, cultural, and socio-economic variables, independent of effects from the Project and other developments (e.g., climate change, fire, flood)
- assumptions, conditions, and constraints of quantitative model inputs
- accuracy and reliability of the source terms, the models and modelling software
- understanding of Project-related effects on complex social-ecological systems that contain interactions across different scales of time and space (e.g., how and why the Project would influence fish and fish habitat)
- knowledge and experience with the type of effect in the system
- knowledge of the effectiveness of proposed Project environmental design features or mitigation for avoiding or minimizing effects
- uncertainties associated with the exact location, physical footprint, activity level, and the timing and rate of future developments

Uncertainty was managed by:

- reviewing historical data and relevant studies completed in the LSA and RSA
- conducting regional analysis of hydroclimate baseline data
- performing quality assurance and quality control on baseline data
- incorporating conservative estimates, inputs, and assumptions
- using known constituent concentrations for similar site analogues when the information was unavailable
- developing robust water management infrastructure and mitigation measures to address potential uncertainties (e.g., capture and routing of contact water to a central discharge location)
- calibrating the prediction models to measured data
- conducting sensitivity analysis on key parameters

Uncertainty related to the baseline data was used to establish existing surface water conditions for pre-mine discharges and COPC concentrations in the base case. It includes the precision and variability of measured water levels and flows and analytical data from the water quality and sediment sample analyses during the baseline studies, especially as constituents approach a detection limit. Flow data at some flow measurement stations were affected by the spring freshet and beaver activity. To obtain existing conditions for flows, where required, a second-stage discharge relationship to represent flows during spring freshet were developed. Analytical data reported below detection or close to the detection limit introduce additional uncertainty in the surface water quality assessment. For developing the existing water quality conditions for each waterbody, detection limit values were used to calculate statistics. To calculate the baseline average, half of the detection limit value was used for constituent data reported as below the detection limit. The average concentration was then used as the base case input concentrations for COPCs in the water quality models. This approach provides a measure of conservatism in the assessment, ensuring that modelling projections are unlikely to underestimate future conditions. Additionally, constituents measured below detection limits tend not to drive predicted effects; therefore, while values reported below detection limits introduce uncertainty to the assessment, these constituents rarely impact the residual effects classifications.

The surface water quantity and quality assessment for the Project is based on the modelling to predict future surface water quantity and quality conditions in the receiving environment (i.e., waterbodies in the LSA) under the base case. As with all modelling approaches, these predictions involve some degree of uncertainty. To address this, a robust climate dataset was derived to stress test the water management infrastructure for a wide range of climate conditions that included effects from climate change. Further, the assessment applied a precautionary approach, identifying the greatest magnitude, duration, and geographic extent of potential adverse effects when multiple outcomes were possible. This approach effectively managed uncertainty, thereby increasing confidence that the assessed residual effects on surface water quality accurately reflected the potential impacts from Project interactions. For details on WBWQM and DLCSM uncertainties, underlying assumptions and conservatisms refer to TSD VI.

Overall, the confidence level of residual Project effects assessment was considered to be high for surface water quantity, surface water quality residual effects because baseline/background data were available for a majority of the site, the Project-related effects are mostly understood, and the moderate to high level of certainty associated with the effectiveness of proposed mitigation strategies, and consideration of uncertainties, and conservatism in the prediction models. The level of confidence associated with the predicted residual effects on sediment quality from changes in water quality is moderate. This is because the mechanism through which changes in water quality lead to changes in sediment quality are not fully understood; however, sediment releases from the Project will be kept to a minimum.

8.7 Monitoring, Follow-Up, and Adaptive Management

This section presents a summary of the identified monitoring and follow-up required to confirm effects predictions and address uncertainty identified in Section 8.5.4.2, Prediction Confidence and Uncertainty.

Specifically, follow-up and monitoring programs will be used to:

- verify that the water management infrastructure and facilities are operating as designed and evaluate effectiveness of the surface water protection plans
- monitor Project effluent (WTP and WWTP) quantity and quality discharged to the receiving environment
- monitor changes to surface water quantity, surface water and sediment quality in the receiving environment due to Project activities
- track the trajectory of COPCs that were identified to exceed thresholds (e.g., cobalt and selenium) in receiving environment and farther downstream

- verify the predictions of the EIS and confirm that the aquatic ecosystem in the receiving environment is protected
- evaluate the effectiveness of reclamation and other mitigation actions, and modify or enhance as necessary through monitoring and developing updated mitigation measures (if needed)
- contribute to the overall continual improvement of the Project

Monitoring program will begin to confirm the Project activities remain in compliance with applicable legislation/regulations and permits/approvals and to assess the performance of mitigations and enhancement measures. Monitoring program will include:

- Environmental Protection Plan (including surface water and groundwater; blasting and communication management protocol; ammonia contaminant management)
- Environmental Effects Monitoring Program (including air, surface water, sediment and groundwater)
- Waste Management Plan
- Erosion and Sediment Control Plan
- Decommissioning and Reclamation Plan

In addition to follow-up and monitoring programs outlined above, a Real-Time Monitoring Network will also be established, as it was a condition of release for the previous EIS (Alderon 2012)—referenced in the Environmental Assessment Bulletin (Government of NL 2014) dated January 10, 2014. A Real-Time Monitoring Network Agreement in consultation with the Water Resources Management Division will be prepared and submitted to the Minister of Environment and Conservation, to receive the Minister's approval for the Real-Time Monitoring Network Agreement prior to the start of Construction.

8.8 Predicted Future Conditions Should the Project Not Proceed

If the Project does not proceed forward, the future condition of surface water in the environment is unlikely to undergo significant changes due to near-term climate change. The most probable effect on the area will come from other mining projects and activities. With numerous mines already present and being proposed, increased economic pressures could lead to further mine development. A future mining project and/or activities in the area could adversely affect surface water.

Climate change effects surface water by altering its quantity, quality, and distribution. Specifically, it can cause fluctuations in lake water levels, changes in precipitation patterns, and variations in run-off, which in turn affect sedimentation and erosion processes. These changes can lead to the dilution or concentration of pollutants and dissolved substances in water bodies, posing a threat to water quality.

8.9 Key Findings and Conclusions

The objectives of this chapter were to provide a comprehensive assessment of all potential Project-specific effects and cumulative effects with RFDs on surface water quantity, surface water quality and sediment quality. These objectives were met with a robust site-wide WBWQM that informed the development of a comprehensive water management plan designed to minimize Project effects. Further, the WBWQM predicted surface water flows and water levels in waterbodies/streams and water quality COPC concentrations in the LSA during the Project lifespan and in a far future for a wide range of climate conditions that incorporated Project effects from climate change. Model estimates for Project effects were compared with flows and water levels to pre-mine conditions and concentrations to background and Project guidelines/thresholds. Sediment quality changes in the LSA were also predicted in relation to changes in water quality.

A summary of key findings for surface water quantity, surface water quality and sediment quality follows:

- While at some watersheds of local streams (watercourses), predicted net change to surface water quantity (flows, discharges, surpluses) exceeded ±10%, the net change to Duley Lake outlet discharges, that represents the end point of the LSA, was predicted to be within ±10% during the Project lifespan. The net change to the flows at the end-of-mine (Closure phase), especially considering that the net change to discharges at the Duley Lake outlet, was considered to be within the natural variation of flows. The Project effects on local watersheds will be managed and mitigated using water management infrastructure (i.e., water diversion from Duley Lake).
- Water quality COPCs were predicted to generally increase above the existing/background concentrations during Project phases for all flow scenarios; however, the COPC concentrations were predicted to be generally below Project guidelines/thresholds in the receiving environment downstream of the Project LSA in the base case. Within the LSA, only two parameters (cobalt and selenium) were predicted to seasonally increase above CCME guidelines/thresholds during Operations and then return below water quality guidelines/thresholds during the Closure phase and Post-closure period, with the

exception of selenium that persisted during the Post-closure period in Pike Lake. Only one COPC (i.e., cobalt) at the Duley Lake outlet (the end point of the LSA) was predicted to exceed seasonally towards the end of Operations; the exceedance was predicted to be reversible and not persistent beyond Operations.

- Site-specific water quality objectives (SSWQOs) for selenium for Duley Lake (TSD VII) and cobalt (TSD VIII) were developed to provide protection against long-term effects on aquatic life under site-specific conditions predicted for all phases of the Project. Predicted concentrations of cobalt and selenium were also compared to SSWQOs. Though the predicted concentrations of selenium and cobalt exceeded CCME guidelines (as discussed above), these were found below their respective SSWQOs during all Project phases, noting that selenium SSWQO for Pike Lake has not been developed.
- Direct changes to sediment quality due to Project activities were assessed to be negligible in effect pathway screening. However, sediment quality could be affected due to changes in water quality; therefore the residual Project effect assessment of sediment quality was also completed qualitatively and in a semi-quantified manner in relation to predictions of water quality. Semi-quantified assessment of changes to sediment quality parameters with CCME guidelines/thresholds at Pike Lake, Duley Lake and Duley Lake outlet showed that the sediment quality parameters (e.g., arsenic, cadmium, chromium, and zinc), whose background concentrations exceeded CCME ISQG, would generally exceed CCME ISQG during Project Operations; however, the predicted concentrations would generally return to near/below background conditions during the Closure phase and Post-closure period. Only zinc (at Pike Lake in far future) and copper (at Duley Lake in Construction and Operations phases and Duley Lake outlet in Project lifespan and far future) were the additional new parameters that exceeded CCME ISQG due to Project residual effects. However, sediment quality baseline condition (Annex 2A) and historical results (Stantec 2012) have also shown the exceedances of zinc and copper above the CCME ISQG (but not the CCME PEL) in waterbodies/lakes within the LSA. Based on the assessment, the residual Project effects on sediment quality constituents are expected to be low and reversible as most parameters were predicted to return to near/below background conditions during the Closure phase and Post-closure period (far-future) and none exceeded CCME PEL.
- Based on the assessment results, planned mitigation and environmental protection measures, and environmental monitoring and adaptive management, the overall residual Project effects on surface water quantity, surface water quality and sediment quality were assessed to be not significant.
- A residual cumulative effects analysis was conducted to determine the potential effects of the Project and RFDs on surface water. RFDs within RSA were considered to result in potential residual cumulative effects assessment to surface water. The cumulative assessment results found that no significant cumulative effects are expected to result from these RFDs when combined with the effects from the Project.
- Monitoring and follow-up are required to confirm effects predictions and to address Project uncertainties. Monitoring program will begin after the Project approval and initiation to confirm that the Project activities remain in compliance with applicable legislation/regulations and permits/approvals and to assess the performance of proposed mitigations and enhancement measures.
- To fulfill the commitments under Environmental Assessment Bulletin (Government of NL 2014) dated January 10, 2014, the Project will also adhere to mitigation measures, monitoring commitments, and development of environmental protection plan requirements. Further, to fulfill commitment regarding monitoring network, a Real-Time Monitoring Network will also be established prior to the start of construction.
- Key information from the surface water assessment was carried forward to other disciplines for consideration in the assessment of disciplines (e.g., including groundwater, fish and fish habitat, vegetation, wetlands and protected areas, wildlife, land and resource use, and groundwater community health and well-being).

The overall conclusion of this assessment is similar to the previous EIS (Alderon 2012), as the effect assessment results of the previous assessment were summarized to result in localized changes to surface water that would be low in magnitude. However, the addition of planning tools such as the Hydrogeology Model (TSD V) and WBWQM (TSD VI), and description, design and proposed implementation of environmental design features such as the water management infrastructure (Chapter 2 and TSD II) have increased the level of confidence of this assessment. The water balance and water quality modelling (TSD VI) were not completed for the previous EIS, and in absence of this modelling, the findings from the previous EIS in regards to hydrology and surface water quality are not comparable to the outcomes of the updated assessment for potential residual effects to surface water.

Overall, the residual Project effects and cumulative effects were concluded to be likely not significant. To confirm effluent and run-off would be treated and meet applicable provincial and federal requirements, mitigation measures and monitoring were proposed in the previous EIS. To fulfill the commitments under the Environmental Assessment Bulletin (Government of NL 2014) dated January 10, 2014, the Project will adhere to mitigation measures, monitoring commitments, and development of environmental protection plan requirements.

Appendix 8A: Water Balance Results

WaL9W-b 9cDd-e9W9f LD-. agDW- dDKhWcK

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L40A,840I

Table 1: Mills Lake Water Balance - Pre-Mine

					Forest			Wetland			Grass/Shrub/Moss			Open Water									
					WHC	300 mm		WHC	300 mm		WHC	150 mm		WHC	Precip.-Lake Evap								
					Total Area (m^2)	24,043,500		Total Area (m^2)	118,610		Total Area (m^2)	3,771,830		Total Area (m^2)	8,369,230								
					Infiltration Factor	0.7		Infiltration Factor	0.7		Infiltration Factor	0.60		Infiltration Factor	1.00								
Month	Days	Temp	Precipitation	Potential Evapotranspiration	Actual Evapotranspiration	Surplus(1)		Actual Evapotranspiration	Surplus(1)		Actual Evapotranspiration	Surplus(1)		Actual Evapotranspiration(2)	Surplus(1)		Total Surplus	Total Surplus (Runoff and Infiltration)		Total Infiltration		Total Runoff	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(L/s)	(L/min)	(m^3)	(L/s)	(m^3)	(L/s)
January	31	-21.9	51.0	0	0	1	24,044	0	1	119	0	1	3,772	0	51	426,831	454,765	170	10,187	446,007	167	8,757	3
February	28	-20.6	39.0	0	0	2	48,087	0	2	237	0	2	7,544	0	39	326,400	382,268	158	9,481	364,753	151	17,515	7
March	31	-13.6	50.0	1	1	9	216,392	1	9	1,067	1	9	33,946	0	50	418,462	669,867	250	15,006	591,051	221	78,816	29
April	30	-4.7	51.0	6	6	70	1,683,045	6	70	8,303	6	70	264,028	0	51	426,831	2,382,207	919	55,144	1,769,191	683	613,016	237
May	31	3.5	57.0	42	42	209	5,025,092	42	209	24,789	42	209	788,312	47	11	87,877	5,926,070	2,213	132,752	4,095,781	1,529	1,830,289	683
June	30	10.3	86.0	93	93	25	601,088	93	25	2,965	93	25	94,296	101	-15	-121,354	576,995	223	13,356	358,061	138	218,934	84
July	31	13.8	111.0	117	117	9	216,392	117	9	1,067	117	9	33,946	110	1	7,951	259,356	97	5,810	180,540	67	78,816	29
August	31	12.6	107.0	99	99	10	240,435	99	10	1,186	99	10	37,718	96	11	91,225	370,564	138	8,301	282,990	106	87,574	33
September	30	7.2	92.0	54	54	21	504,914	54	21	2,491	54	21	79,208	63	29	242,708	829,320	320	19,197	645,416	249	183,905	71
October	31	0.4	79.0	15	15	40	961,740	15	40	4,744	15	40	150,873	20	59	492,529	1,609,887	601	36,064	1,259,592	470	350,295	131
November	30	-7.9	71.0	1	1	24	577,044	1	24	2,847	1	24	90,524	0	71	594,215	1,264,630	488	29,274	1,054,453	407	210,177	81
December	31	-17.4	57.0	0	0	2	48,087	0	2	237	0	2	7,544	0	57	477,046	532,914	199	11,938	515,399	192	17,515	7
Total			***851.0***	***428.0***	***428***	***422***	***10,146,357***	***428***	***422***	***50,053***	***428***	***422***	***1,591,712***	***436***	***415***	***3,470,720***	***15,258,842***	***5,775***	***346,511***	***11,563,234***	***4,379.4***	***3,695,608***	***1,396***
Average		***-3.2***																***888.5***			***673.8***		***214.7***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

Table 2: Riordan Lake Water Balance - Pre-Mine

	Forest	Wetland	Grass/Shrub/Moss	Open water
WHC	300 mm	300 mm	150 mm	Precip.-Lake Evap
Total Area (m^2)	3,843,680	155,060	3,245,200	2,557,000
Infiltration Factor	0.7	0.7	0.60	1.00

Month	Days	Temp	Precipitation	Potential Evapotranspiration	Forest: Actual Evapotranspiration	Forest: Surplus(1)		Wetland: Actual Evapotranspiration	Wetland: Surplus(1)		Grass/Shrub/Moss: Actual Evapotranspiration	Grass/Shrub/Moss: Surplus(1)		Open water: Actual Evapotranspiration(2)	Open water: Surplus(1)		Total Surplus	Total Surplus (Runoff and Infiltration)		Total Infiltration		Total Runoff	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(L/s)	(L/min)	(m^3)	(L/s)	(m^3)	(L/s)
January	31	-21.9	51.0	0	0	1	3,844	0	1	155	0	1	3,245	0	51	130,407	137,651	51	3,084	135,153	50	2,498	1
February	28	-20.6	39.0	0	0	2	7,687	0	2	310	0	2	6,490	0	39	99,723	114,211	47	2,833	109,215	45	4,995	2
March	31	-13.6	50.0	1	1	9	34,593	1	9	1,396	1	9	29,207	0	50	127,850	193,045	72	4,324	170,566	64	22,479	8
April	30	-4.7	51.0	6	6	70	269,058	6	70	10,854	6	70	227,164	0	51	130,407	637,483	246	14,757	462,644	178	174,839	67
May	31	3.5	57.0	42	42	209	803,329	42	209	32,408	42	209	678,247	47	11	26,849	1,540,832	575	34,517	1,018,812	380	522,020	195
June	30	10.3	86.0	93	93	25	96,092	93	25	3,877	93	25	81,130	101	-15	-37,077	144,022	56	3,334	81,579	31	62,443	24
July	31	13.8	111.0	117	117	9	34,593	117	9	1,396	117	9	29,207	110	1	2,429	67,625	25	1,515	45,145	17	22,479	8
August	31	12.6	107.0	99	99	10	38,437	99	10	1,551	99	10	32,452	96	11	27,871	100,311	37	2,247	75,334	28	24,977	9
September	30	7.2	92.0	54	54	21	80,717	54	21	3,256	54	21	68,149	63	29	74,153	226,276	87	5,238	173,824	67	52,452	20
October	31	0.4	79.0	15	15	40	153,747	15	40	6,202	15	40	129,808	20	59	150,479	440,237	164	9,862	340,329	127	99,908	37
November	30	-7.9	71.0	1	1	24	92,248	1	24	3,721	1	24	77,885	0	71	181,547	355,402	137	8,227	295,457	114	59,945	23
December	31	-17.4	57.0	0	0	2	7,687	0	2	310	0	2	6,490	0	57	145,749	160,237	60	3,590	155,241	58	4,995	2
Total			***851.0***	***428.0***	***428***	***422***	***1,622,033***	***428***	***422***	***65,435***	***428***	***422***	***1,369,474***	***436***	***415***	***1,060,388***	***4,117,331***	***1,559***	***93,526***	***3,063,300***	***1,160.7***	***1,054,030***	***398***
Average		***-3.2***																***239.8***			***178.6***		***61.2***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

Table 3: Rectangle Lake* Water Balance - Pre-Mine

					Grass/Shrub/Moss			Forest			Open water									
					WHC	150 mm		WHC	300 mm		WHC	Precip.-Lake Evap								
					Total Area (m^2)	7,544,481		Total Area (m^2)	9,296,319		Total Area (m^2)	1,229,200								
					Infiltration Factor	0.6		Infiltration Factor	0.7		Infiltration Factor	1.00								
Month	Days	Temp	Precipitation	Potential Evapotranspiration	Actual Evapotranspiration	Surplus(1)		Actual Evapotranspiration	Surplus(1)		Actual Evapotranspiration(2)	Surplus(1)		Total Surplus	Total Surplus (Runoff and Infiltration)		Total Infiltration		Total Runoff	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(L/s)	(L/min)	(m^3)	(L/s)	(m^3)	(L/s)
January	31	-21.9	51.0	0	0	1	7,544	0	1	9,296	0	51	62,689	79,530	30	1,782	73,723	28	5,807	2
February	28	-20.6	39.0	0	0	2	15,089	0	2	18,593	0	39	47,939	81,620	34	2,024	70,007	29	11,613	5
March	31	-13.6	50.0	1	1	9	67,900	1	9	83,667	0	50	61,460	213,027	80	4,772	160,767	60	52,260	20
April	30	-4.7	51.0	6	6	70	528,114	6	70	650,742	0	51	62,689	1,241,545	479	28,739	835,077	322	406,468	157
May	31	3.5	57.0	42	42	209	1,576,796	42	209	1,942,931	47	11	12,907	3,532,634	1,319	79,136	2,319,036	866	1,213,598	453
June	30	10.3	86.0	93	93	25	188,612	93	25	232,408	101	-15	-17,823	403,197	156	9,333	258,029	100	145,167	56
July	31	13.8	111.0	117	117	9	67,900	117	9	83,667	110	1	1,168	152,735	57	3,421	100,475	38	52,260	20
August	31	12.6	107.0	99	99	10	75,445	99	10	92,963	96	11	13,398	181,806	68	4,073	123,739	46	58,067	22
September	30	7.2	92.0	54	54	21	158,434	54	21	195,223	63	29	35,647	389,304	150	9,012	267,363	103	121,940	47
October	31	0.4	79.0	15	15	40	301,779	15	40	371,853	20	59	72,338	745,970	279	16,711	513,703	192	232,268	87
November	30	-7.9	71.0	1	1	24	181,068	1	24	223,112	0	71	87,273	491,452	190	11,376	352,092	136	139,361	54
December	31	-17.4	57.0	0	0	2	15,089	0	2	18,593	0	57	70,064	103,746	39	2,324	92,133	34	11,613	4
Total			***851.0***	***428.0***	***428***	***422***	***3,183,771***	428	422	3,923,047	***436***	***415***	***509,749***	***7,616,567***	***2,878***	***172,704***	***5,166,144***	***1,952.9***	***2,450,422***	***925***
Average		***-3.2***													***442.8***			***300.5***		***142.4***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

*Land-use (i.e. percentage of forest and grass and shrub areas on local watershed) was assumed similar to a nearby lake watershed (Riordan Lake)

Table 4: Waldorf River Water Balance - Pre-Mine

	Forest	Wetland	Grass/Shrub/Moss	Open Water
WHC	300 mm	300 mm	150 mm	Precip.-Lake Evap
Total Area (m^2)	37,967,840	387,240	23,292,510	8,917,110
Infiltration Factor	0.7	0.7	0.60	1.00

Month	Days	Temp	Precipitation	Potential Evapotranspiration	Forest Actual Evapotranspiration	Forest Surplus[(1)]		Wetland Actual Evapotranspiration	Wetland Surplus[(1)]		Grass/Shrub/Moss Actual Evapotranspiration	Grass/Shrub/Moss Surplus[(1)]		Open Water Actual Evapotranspiration[(2)]	Open Water Surplus[(1)]		Total Surplus	Total Surplus (Runoff and Infiltration)		Total Infiltration		Total Runoff	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(L/s)	(L/min)	(m^3)	(L/s)	(m^3)	(L/s)
January	31	-21.9	51.0	0	0	1	37,968	0	1	387	0	1	23,293	0	51	454,773	516,420	193	11,569	495,597	185	20,824	8
February	28	-20.6	39.0	0	0	2	75,936	0	2	774	0	2	46,585	0	39	347,767	471,062	195	11,683	429,415	178	41,647	17
March	31	-13.6	50.0	1	1	9	341,711	1	9	3,485	1	9	209,633	0	50	445,856	1,000,684	374	22,417	813,272	304	187,412	70
April	30	-4.7	51.0	6	6	70	2,657,749	6	70	27,107	6	70	1,630,476	0	51	454,773	4,770,104	1,840	110,419	3,312,457	1,278	1,457,647	562
May	31	3.5	57.0	42	42	209	7,935,279	42	209	80,933	42	209	4,868,135	47	11	93,630	12,977,976	4,845	290,725	8,625,859	3,221	4,352,117	1,625
June	30	10.3	86.0	93	93	25	949,196	93	25	9,681	93	25	582,313	101	-15	-129,298	1,411,892	545	32,683	891,303	344	520,588	201
July	31	13.8	111.0	117	117	9	341,711	117	9	3,485	117	9	209,633	110	1	8,471	563,300	210	12,619	375,888	140	187,412	70
August	31	12.6	107.0	99	99	10	379,678	99	10	3,872	99	10	232,925	96	11	97,196	713,672	266	15,987	505,437	189	208,235	78
September	30	7.2	92.0	54	54	21	797,325	54	21	8,132	54	21	489,143	63	29	258,596	1,553,196	599	35,954	1,115,901	431	437,294	169
October	31	0.4	79.0	15	15	40	1,518,714	15	40	15,490	15	40	931,700	20	59	524,772	2,990,676	1,117	66,995	2,157,734	806	832,941	311
November	30	-7.9	71.0	1	1	24	911,228	1	24	9,294	1	24	559,020	0	71	633,115	2,112,657	815	48,904	1,612,892	622	499,765	193
December	31	-17.4	57.0	0	0	2	75,936	0	2	774	0	2	46,585	0	57	508,275	631,570	236	14,148	589,923	220	41,647	16
Total			***851.0***	***428.0***	***428***	***422***	***16,022,428***	***428***	***422***	***163,415***	***428***	***422***	***9,829,439***	***436***	***415***	***3,697,926***	***29,713,208***	***11,235***	***674,103***	***20,925,680***	***7,916.2***	***8,787,529***	***3,319***
Average		***-3.2***																***1,728.5***			***1,217.9***		***510.6***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

Table 5: Daviault Lake Water Balance - Pre-Mine

	Forest		Wetland		Grass/Shrub/Moss		Urban		Open Water	
WHC		300 mm		300 mm		150 mm		90% Precip		Precip.-Lake Evap
Total Area (m^2)		39,660,220		275,690		13,107,740		3,165,160		7,953,850
Infiltration Factor		0.7		0.7		0.60		0.00		1.00

					Forest			Wetland			Grass/Shrub/Moss			Urban			Open Water									
Month	Days	Temp	Precipitation	Potential Evapotranspiration	Actual Evapotranspiration	Surplus[1]		Actual Evapotranspiration	Surplus[1]		Actual Evapotranspiration	Surplus[1]		Actual Evapotranspiration	Surplus[1]		Actual Evapotranspiration[2]	Surplus[1]		Total Surplus	Total Surplus (Runoff and Infiltration)		Total Infiltration		Total Runoff	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(L/s)	(L/min)	(m^3)	(L/s)	(m^3)	(L/s)
January	31	-21.9	51.0	0	0	1	39,660	0	1	276	0	1	13,108	0	51	161,423	0	51	405,646	620,113	232	13,891	441,466	165	178,647	67
February	28	-20.6	39.0	0	0	2	79,320	0	2	551	0	2	26,215	0	39	123,441	0	39	310,200	539,729	223	13,386	381,840	158	157,889	65
March	31	-13.6	50.0	1	1	9	356,942	1	9	2,481	1	9	117,970	0	50	157,629	0	50	397,693	1,032,714	386	23,134	720,071	269	312,643	117
April	30	-4.7	51.0	6	6	70	2,776,215	6	70	19,298	6	70	917,542	1	50	157,647	0	51	405,646	4,276,349	1,650	98,990	2,913,031	1,124	1,363,318	526
May	31	3.5	57.0	42	42	209	8,288,986	42	209	57,619	42	209	2,739,518	8	49	153,982	47	11	83,515	11,323,620	4,228	253,665	7,569,850	2,826	3,753,771	1,401
June	30	10.3	86.0	93	93	25	991,506	93	25	6,892	93	25	327,694	18	68	213,676	101	-15	-115,331	1,424,436	550	32,973	780,164	301	644,272	249
July	31	13.8	111.0	117	117	9	356,942	117	9	2,481	117	9	117,970	23	88	277,701	110	1	7,556	762,650	285	17,084	329,934	123	432,715	162
August	31	12.6	107.0	99	99	10	396,602	99	10	2,757	99	10	131,077	20	87	276,368	96	11	86,697	893,501	334	20,016	444,895	166	448,607	167
September	30	7.2	92.0	54	54	21	832,865	54	21	5,789	54	21	275,263	11	81	257,211	63	29	230,662	1,601,789	618	37,078	982,877	379	618,912	239
October	31	0.4	79.0	15	15	40	1,586,409	15	40	11,028	15	40	524,310	3	76	240,608	20	59	468,084	2,830,438	1,057	63,406	1,900,875	710	929,562	347
November	30	-7.9	71.0	1	1	24	951,845	1	24	6,617	1	24	314,586	0	71	224,097	0	71	564,723	2,061,868	795	47,728	1,424,398	550	637,470	246
December	31	-17.4	57.0	0	0	2	79,320	0	2	551	0	2	26,215	0	57	180,414	0	57	453,369	739,871	276	16,574	525,009	196	214,862	80
Total			***851.0***	***428.0***	***428***	***422***	***16,736,613***	***428***	***422***	***116,341***	***428***	***422***	***5,531,466***	***85***	***766***	***2,424,196***	***436***	***415***	***3,298,462***	***28,107,078***	***10,632***	***637,927***	***18,414,409***	***6,966.3***	***9,692,669***	***3,666***
Average		***-3.2***																			***1,635.7***			***1,071.7***		***564.0***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

Table 6: Molar Lake Water Balance - Pre-Mine

	Forest	Wetland	Grass/Shrub/Moss	Open Water
WHC	300 mm	300 mm	150 mm	Precip.-Lake Evap
Total Area (m^2)	6,066,900	31,270	2,890,210	2,815,180
Infiltration Factor	0.7	0.7	0.60	1.00

Month	Days	Temp	Precipitation	Potential Evapotranspiration	Forest Actual Evapotranspiration	Forest Surplus(1)		Wetland Actual Evapotranspiration	Wetland Surplus(1)		Grass/Shrub/Moss Actual Evapotranspiration	Grass/Shrub/Moss Surplus(1)		Open Water Actual Evapotranspiration(2)	Open Water Surplus(1)		Total Surplus	Total Surplus (Runoff and Infiltration)		Total Infiltration		Total Runoff	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(L/s)	(L/min)	(m^3)	(L/s)	(m^3)	(L/s)
January	31	-21.9	51.0	0	0	1	6,067	0	1	31	0	1	2,890	0	51	143,574	152,563	57	3,418	149,577	56	2,986	1
February	28	-20.6	39.0	0	0	2	12,134	0	2	63	0	2	5,780	0	39	109,792	127,769	53	3,169	121,798	50	5,971	2
March	31	-13.6	50.0	1	1	9	54,602	1	9	281	1	9	26,012	0	50	140,759	221,654	83	4,965	194,785	73	26,870	10
April	30	-4.7	51.0	6	6	70	424,683	6	70	2,189	6	70	202,315	0	51	143,574	772,761	298	17,888	563,773	218	208,987	81
May	31	3.5	57.0	42	42	209	1,267,982	42	209	6,535	42	209	604,054	47	11	29,559	1,908,131	712	42,745	1,284,154	479	623,977	233
June	30	10.3	86.0	93	93	25	151,673	93	25	782	93	25	72,255	101	-15	-40,820	183,889	71	4,257	109,251	42	74,638	29
July	31	13.8	111.0	117	117	9	54,602	117	9	281	117	9	26,012	110	1	2,674	83,570	31	1,872	56,700	21	26,870	10
August	31	12.6	107.0	99	99	10	60,669	99	10	313	99	10	28,902	96	11	30,685	120,569	45	2,701	90,714	34	29,855	11
September	30	7.2	92.0	54	54	21	127,405	54	21	657	54	21	60,694	63	29	81,640	270,396	104	6,259	207,700	80	62,696	24
October	31	0.4	79.0	15	15	40	242,676	15	40	1,251	15	40	115,608	20	59	165,673	525,209	196	11,765	405,787	152	119,421	45
November	30	-7.9	71.0	1	1	24	145,606	1	24	750	1	24	69,365	0	71	199,878	415,599	160	9,620	343,946	133	71,653	28
December	31	-17.4	57.0	0	0	2	12,134	0	2	63	0	2	5,780	0	57	160,465	178,442	67	3,997	172,471	64	5,971	2
Total			***851.0***	***428.0***	***428***	***422***	***2,560,232***	***428***	***422***	***13,196***	***428***	***422***	***1,219,669***	***436***	***415***	***1,167,455***	***4,960,552***	***1,878***	***112,657***	***3,700,656***	***1,401.8***	***1,259,896***	***476***
Average		***-3.2***																***288.9***			***215.7***		***73.2***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

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Table 7: Waldorf River Water Balance - Operations

	Forest	Open Water	Wetland	Grass/Shrub/Moss	MRS Basins (East, West and North)	Basins	TMF
WHC	300 mm	Precip.-Lake Evap	300 mm	150 mm	75 mm	90% Precip	Precip.-Lake Evap
Total Area (m^2)	36,410,840	8,852,840	384,000	19,085,280	5,579,000	95,000	136,000
Infiltration Factor	0.7	1.0	0.7	0.6	0.5	0.0	1.0

Month	Days	Temp	Precipitation	Potential Evapotranspiration	Forest: Actual Evapotranspiration	Forest: Surplus[1]		Open Water: Actual Evapotranspiration[2]	Open Water: Surplus[1]	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)
January	31	-21.9	51.0	0	0	1	36,411	0	51	451,495
February	28	-20.6	39.0	0	0	2	72,822	0	39	345,261
March	31	-13.6	50.0	1	1	9	327,698	0	50	442,642
April	30	-4.7	51.0	6	6	70	2,548,759	0	51	451,495
May	31	3.5	57.0	42	42	209	7,609,866	47	11	92,955
June	30	10.3	86.0	93	93	25	910,271	101	-15	-128,366
July	31	13.8	111.0	117	117	9	327,698	110	1	8,410
August	31	12.6	107.0	99	99	10	364,108	96	11	96,496
September	30	7.2	92.0	54	54	21	764,628	63	29	256,732
October	31	0.4	79.0	15	15	40	1,456,434	20	59	520,990
November	30	-7.9	71.0	1	1	24	873,860	0	71	628,552
December	31	-17.4	57.0	0	0	2	72,822	0	57	504,612
Total			***851.0***	***428.0***	***428***	***422***	***15,365,374***	***436***	***415***	***3,671,273***
Average		***-3.2***								

Month	Wetland: Actual Evapotranspiration	Wetland: Surplus[1]		Grass/Shrub/Moss: Actual Evapotranspiration	Grass/Shrub/Moss: Surplus[1]		MRS Basins: Actual Evapotranspiration	MRS Basins: Surplus[1]	
	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)
January	0	1	384	0	1	19,085	0	1	5,579
February	0	2	768	0	2	38,171	0	2	11,158
March	1	9	3,456	1	9	171,768	1	9	50,211
April	6	70	26,880	6	70	1,335,970	6	71	396,109
May	42	209	80,256	42	209	3,988,824	42	209	1,166,011
June	93	25	9,600	93	25	477,132	93	25	139,475
July	117	9	3,456	117	9	171,768	115	9	50,211
August	99	10	3,840	99	10	190,853	97	10	55,790
September	54	21	8,064	54	21	400,791	54	22	122,738
October	15	40	15,360	15	40	763,411	15	42	234,318
November	1	24	9,216	1	24	458,047	1	24	133,896
December	0	2	768	0	2	38,171	0	3	16,737
Total	***428***	***422***	***162,048***	***428***	***422***	***8,053,988***	***424***	***427***	***2,382,233***
Average									

Month	Basins: Actual Evapotranspiration	Basins: Surplus[1]		TMF: Actual Evapotranspiration[2]	TMF: Surplus[1]		To Waldorf River Watershed: Total Surplus	To Waldorf River Watershed: Total Surplus (Runoff and Infiltration)	
	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(L/s)	(L/min)
January	0	51	4,845	0	51	6,936	507,375	189	11,366
February	0	39	3,705	0	39	5,304	457,021	189	11,335
March	0	50	4,731	0	50	6,800	945,563	353	21,182
April	1	50	4,732	0	51	6,936	4,363,103	1,683	100,998
May	8	49	4,622	47	11	1,428	11,771,900	4,395	263,707
June	18	68	6,413	101	-15	-1,972	1,268,637	489	29,367
July	23	88	8,335	110	1	129	511,331	191	11,455
August	20	87	8,295	96	11	1,482	655,297	245	14,680
September	11	81	7,720	63	29	3,944	1,430,215	552	33,107
October	3	76	7,222	20	59	8,004	2,756,194	1,029	61,743
November	0	71	6,726	0	71	9,656	1,969,675	760	45,594
December	0	57	5,415	0	57	7,752	616,372	230	13,808
Total	***85***	***766***	***72,761***	***436***	***415***	***56,399***	***27,252,683***	***859***	***618,340***
Average								***858.8***	

Month	To Waldorf River Watershed: Total Infiltration		To Waldorf River Watershed: Total Runoff		Loss from the Watershed: Total Surplus	Loss from the Watershed: Total Infiltration		Loss from the Watershed: Total Runoff	
	(m^3)	(L/s)	(m^3)	(L/s)	(m^3)	(m^3)	(L/s)	(m^3)	(L/s)
January	488,702	182	18,673	7	17,360	9,726	4	7,635	3
February	419,676	173	37,345	15	20,167	10,883	4	9,284	4
March	777,510	290	168,053	63	61,742	31,906	12	29,837	11
April	3,056,024	1,179	1,307,079	504	407,777	204,991	79	202,786	78
May	7,869,334	2,938	3,902,566	1,457	1,172,061	584,434	218	587,627	219
June	801,823	309	466,814	180	143,916	67,766	26	76,151	29
July	343,278	128	168,053	63	58,675	25,235	9	33,440	12
August	468,572	175	186,726	70	65,567	29,377	11	36,190	14
September	1,038,091	400	392,124	151	134,402	65,313	25	69,089	27
October	2,009,292	750	746,903	279	249,543	125,163	47	124,381	46
November	1,521,533	587	448,142	173	150,278	76,604	30	73,674	28
December	579,027	216	37,345	14	29,904	16,121	6	13,784	5
Total	***19,372,861***	***7,329.7***	***7,879,822***	***2,976***	***2,511,393***	***1,247,516***	***471.4***	***1,263,877***	***477***
Average		***610.8***		***248.0***			***39.3***		***39.8***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual avapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

Table 8: Mills Lake Water Balance - Operations

					Forest			Wetland			Grass/Shrub/Moss		
					WHC	300 mm		WHC	300 mm		WHC	150 mm	
					Total Area (m^2)	23,309,620		Total Area (m^2)	113,520		Total Area (m^2)	3,264,510	
					Infiltration Factor	0.7		Infiltration Factor	0.7		Infiltration Factor	0.6	
Month	Days	Temp	Precipitation	Potential Evapotranspiration	Actual Evapotranspiration	Surplus(1)		Actual Evapotranspiration	Surplus(1)		Actual Evapotranspiration	Surplus(1)	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)
January	31	-21.9	51.0	0	0	1	23,310	0	1	114	0	1	3,265
February	28	-20.6	39.0	0	0	2	46,619	0	2	227	0	2	6,529
March	31	-13.6	50.0	1	1	9	209,787	1	9	1,022	1	9	29,381
April	30	-4.7	51.0	6	6	70	1,631,673	6	70	7,946	6	70	228,516
May	31	3.5	57.0	42	42	209	4,871,711	42	209	23,726	42	209	682,283
June	30	10.3	86.0	93	93	25	582,741	93	25	2,838	93	25	81,613
July	31	13.8	111.0	117	117	9	209,787	117	9	1,022	117	9	29,381
August	31	12.6	107.0	99	99	10	233,096	99	10	1,135	99	10	32,645
September	30	7.2	92.0	54	54	21	489,502	54	21	2,384	54	21	68,555
October	31	0.4	79.0	15	15	40	932,385	15	40	4,541	15	40	130,580
November	30	-7.9	71.0	1	1	24	559,431	1	24	2,724	1	24	78,348
December	31	-17.4	57.0	0	0	2	46,619	0	2	227	0	2	6,529
Total			***851.0***	***428.0***	***428***	***422***	***9,836,660***	***428***	***422***	***47,905***	***428***	***422***	***1,377,623***
Average		***-3.2***											

	Open Water			Rose Pit			MRS and MRS Basins (East, West and North)			Basins		
	WHC	Precip.-Lake Evap		WHC	90% Precip		WHC	75 mm		WHC	90% Precip	
	Total Area (m^2)	8,369,620		Total Area (m^2)	120,000		Total Area (m^2)	430,000		Total Area (m^2)	690,000	
	Infiltration Factor	1.0		Infiltration Factor	0.0		Infiltration Factor	0.5		Infiltration Facto	0.0	
Month	Actual Evapotranspiration(2)	Surplus(1)		Actual Evapotranspiration	Surplus(1)		Actual Evapotranspiration	Surplus(1)		Actual Evapotranspiration	Surplus(1)	
	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)
January	0	51	426,851	0	51	6,120	0	1	430	0	51	35,190
February	0	39	326,415	0	39	4,680	0	2	860	0	39	26,910
March	0	50	418,481	0	50	5,976	1	9	3,870	0	50	34,363
April	0	51	426,851	1	50	5,977	6	71	30,530	1	50	34,367
May	47	11	87,881	8	49	5,838	42	209	89,870	8	49	33,568
June	101	-15	-121,359	18	68	8,101	93	25	10,750	18	68	46,581
July	110	1	7,951	23	88	10,528	115	9	3,870	23	88	60,538
August	96	11	91,229	20	87	10,478	97	10	4,300	20	87	60,248
September	63	29	242,719	11	81	9,752	54	22	9,460	11	81	56,072
October	20	59	492,552	3	76	9,122	15	42	18,060	3	76	52,452
November	0	71	594,243	0	71	8,496	1	24	10,320	0	71	48,853
December	0	57	477,068	0	57	6,840	0	3	1,290	0	57	39,330
Total	***436***	***415***	***3,470,881***	***85***	***766***	***91,908***	***424***	***427***	***183,610***	***85***	***766***	***528,471***
Average												

	To Mills Lake Watershed							Loss from the Watershed				
Month	Total Surplus(3)	Total Surplus (Runoff and Infiltration)		Total Infiltration(3)		Total Runoff		Total Surplus	Total Infiltration		Total Runoff	
	(m^3)	(L/s)	(L/min)	(m^3)	(L/s)	(m^3)	(L/s)	(m^3)	(m^3)	(L/s)	(m^3)	(L/s)
January	437,418	163	9,799	429,086	160	8,333	3	41,740	215	0	41,525	16
February	365,230	151	9,058	348,565	144	16,665	7	32,450	430	0	32,020	13
March	642,550	240	14,394	567,555	212	74,995	28	44,209	1,935	1	42,274	16
April	2,279,386	879	52,764	1,696,094	654	583,292	225	70,874	15,265	6	55,609	21
May	5,649,480	2,109	126,556	3,907,936	1,459	1,741,544	650	129,276	44,935	17	84,341	31
June	530,232	205	12,274	321,913	124	208,319	80	65,432	5,375	2	60,057	23
July	232,020	87	5,198	157,025	59	74,995	28	74,937	1,935	1	73,002	27
August	341,985	128	7,661	258,658	97	83,327	31	75,026	2,150	1	72,876	27
September	787,560	304	18,231	612,572	236	174,988	68	75,283	4,730	2	70,553	27
October	1,543,938	576	34,586	1,210,628	452	333,310	124	79,634	9,030	3	70,604	26
November	1,219,147	470	28,221	1,019,161	393	199,986	77	67,669	5,160	2	62,509	24
December	514,324	192	11,522	497,658	186	16,665	6	47,460	645	0	46,815	17
Total	***14,543,270***	***459***	***330,263***	***11,026,851***	***4,176.3***	***3,516,419***	***1,328***	***803,989***	***91,805***	***34.7***	***712,184***	***270***
Average		***458.7***			***348.0***		***110.7***			***2.9***		***22.5***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

(3) Includes predicted loss due to groundwater inflow to Rose pit under base case numerical dewatering scenario

Table 9: Riordan Lake Water Balance - Operations

	Forest	Wetland	Grass/Shrub/Moss	Open water	TMF
WHC	300 mm	300 mm	150 mm	Precip.-Lake Evap	Precip.-Lake Evap
Total Area (m^2)	3,829,610	154,520	3,219,690	2,556,210	40,000
Infiltration Factor	0.7	0.7	0.6	1.0	1.0

Month	Days	Temp (°C)	Precipitation (mm)	Potential Evapotranspiration (mm)	Forest: Actual Evapotranspiration (mm)	Forest: Surplus[(1)] (mm)	Forest: Surplus[(1)] (m^3)	Wetland: Actual Evapotranspiration (mm)	Wetland: Surplus[(1)] (mm)	Wetland: Surplus[(1)] (m^3)
January	31	-21.9	51.0	0	0	1	3,830	0	1	155
February	28	-20.6	39.0	0	0	2	7,659	0	2	309
March	31	-13.6	50.0	1	1	9	34,466	1	9	1,391
April	30	-4.7	51.0	6	6	70	268,073	6	70	10,816
May	31	3.5	57.0	42	42	209	800,388	42	209	32,295
June	30	10.3	86.0	93	93	25	95,740	93	25	3,863
July	31	13.8	111.0	117	117	9	34,466	117	9	1,391
August	31	12.6	107.0	99	99	10	38,296	99	10	1,545
September	30	7.2	92.0	54	54	21	80,422	54	21	3,245
October	31	0.4	79.0	15	15	40	153,184	15	40	6,181
November	30	-7.9	71.0	1	1	24	91,911	1	24	3,708
December	31	-17.4	57.0	0	0	2	7,659	0	2	309
Total			***851.0***	***428.0***	***428***	***422***	***1,616,095***	***428***	***422***	***65,207***
Average		***-3.2***								

Month	Grass/Shrub/Moss: Actual Evapotranspiration (mm)	Grass/Shrub/Moss: Surplus[(1)] (mm)	Grass/Shrub/Moss: Surplus[(1)] (m^3)	Open water: Actual Evapotranspiration[(2)] (mm)	Open water: Surplus[(1)] (mm)	Open water: Surplus[(1)] (m^3)	TMF: Actual Evapotranspiration[(2)] (mm)	TMF: Surplus[(1)] (mm)	TMF: Surplus[(1)] (m^3)
January	0	1	3,220	0	51	130,367	0	51	2,040
February	0	2	6,439	0	39	99,692	0	39	1,560
March	1	9	28,977	0	50	127,811	0	50	2,000
April	6	70	225,378	0	51	130,367	0	51	2,040
May	42	209	672,915	47	11	26,840	47	11	420
June	93	25	80,492	101	-15	-37,065	101	-15	-580
July	117	9	28,977	110	1	2,428	110	1	38
August	99	10	32,197	96	11	27,863	96	11	436
September	54	21	67,613	63	29	74,130	63	29	1,160
October	15	40	128,788	20	59	150,433	20	59	2,354
November	1	24	77,273	0	71	181,491	0	71	2,840
December	0	2	6,439	0	57	145,704	0	57	2,280
Total	***428***	***422***	***1,358,709***	***436***	***415***	***1,060,060***	***436***	***415***	***16,588***
Average									

Month	To Riordan Lake Watershed: Total Surplus (m^3)	Total Surplus (Runoff and Infiltration) (L/s)	Total Surplus (Runoff and Infiltration) (L/min)	Total Infiltration (m^3)	Total Infiltration (L/s)	Total Runoff (m^3)	Total Runoff (L/s)	Loss from the Watershed: Total Surplus (m^3)	Total Infiltration (m^3)	Total Infiltration (L/s)	Total Runoff (m^3)	Total Runoff (L/s)
January	137,571	51	3,082	135,087	50	2,483	1	2,040	2,040	1	0	0
February	114,100	47	2,830	109,134	45	4,966	2	1,560	1,560	1	0	0
March	192,645	72	4,316	170,297	64	22,348	8	2,000	2,000	1	0	0
April	634,634	245	14,691	460,816	178	173,818	67	2,040	2,040	1	0	0
May	1,532,439	572	34,329	1,013,468	378	518,971	194	420	420	0	0	0
June	143,030	55	3,311	80,953	31	62,078	24	0	-580	0	580	0
July	67,263	25	1,507	44,915	17	22,348	8	38	38	0	0	0
August	99,901	37	2,238	75,070	28	24,831	9	436	436	0	0	0
September	225,410	87	5,218	173,265	67	52,145	20	1,160	1,160	0	0	0
October	438,586	164	9,825	339,261	127	99,325	37	2,354	2,354	1	0	0
November	354,383	137	8,203	294,788	114	59,595	23	2,840	2,840	1	0	0
December	160,112	60	3,587	155,145	58	4,966	2	2,280	2,280	1	0	0
Total	***4,100,072***	***129***	***93,135***	***3,052,198***	***1,156.5***	***1,047,875***	***396***	***17,168***	***16,588***	***6.3***	***580***	***0***
Average		***129.4***			***96.4***		***33.0***			***0.5***		***0.0***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

Table 10: Rectangle Lake* Water Balance - Operations

	Grass/Shrub/Moss	Forest	Open water	TMF
WHC	150 mm	300 mm	Precip.-Lake Evap	Precip.-Lake Evap
Total Area (m^2)	7,544,481	9,266,319	1,229,200	30,000
Infiltration Factor	0.6	0.7	1.0	1.0

Month	Days	Temp	Precipitation	Potential Evapotranspiration	Grass/Shrub/Moss: Actual Evapotranspiration	Grass/Shrub/Moss: Surplus(1)		Forest: Actual Evapotranspiration	Forest: Surplus(1)		Open water: Actual Evapotranspiration(2)	Open water: Surplus(1)		TMF: Actual Evapotranspiration(2)	TMF: Surplus(1)	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)
January	31	-21.9	51.0	0	0	1	7,544	0	1	9,266	0	51	62,689	0	51	1,530
February	28	-20.6	39.0	0	0	2	15,089	0	2	18,533	0	39	47,939	0	39	1,170
March	31	-13.6	50.0	1	1	9	67,900	1	9	83,397	0	50	61,460	0	50	1,500
April	30	-4.7	51.0	6	6	70	528,114	6	70	648,642	0	51	62,689	0	51	1,530
May	31	3.5	57.0	42	42	209	1,576,796	42	209	1,936,661	47	11	12,907	47	11	315
June	30	10.3	86.0	93	93	25	188,612	93	25	231,658	101	-15	-17,823	101	-15	-435
July	31	13.8	111.0	117	117	9	67,900	117	9	83,397	110	1	1,168	110	1	29
August	31	12.6	107.0	99	99	10	75,445	99	10	92,663	96	11	13,398	96	11	327
September	30	7.2	92.0	54	54	21	158,434	54	21	194,593	63	29	35,647	63	29	870
October	31	0.4	79.0	15	15	40	301,779	15	40	370,653	20	59	72,338	20	59	1,766
November	30	-7.9	71.0	1	1	24	181,068	1	24	222,392	0	71	87,273	0	71	2,130
December	31	-17.4	57.0	0	0	2	15,089	0	2	18,533	0	57	70,064	0	57	1,710
Total			***851.0***	***428.0***	***428***	***422***	***3,183,771***	***428***	***422***	***3,910,387***	***436***	***415***	***509,749***	***436***	***415***	***12,441***
Average		***-3.2***														

Month	To Rectangle Lake Watershed: Total Surplus	Total Surplus (Runoff and Infiltration)		Total Infiltration		Total Runoff		Loss from the Watershed: Total Surplus	Total Infiltration		Total Runoff	
	(m^3)	(L/s)	(L/min)	(m^3)	(L/s)	(m^3)	(L/s)	(m^3)	(m^3)	(L/s)	(m^3)	(L/s)
January	79,500	30	1,781	73,702	28	5,798	2	1,530	1,530	1	0	0
February	81,560	34	2,023	69,965	29	11,595	5	1,170	1,170	0	0	0
March	212,757	79	4,766	160,578	60	52,179	19	1,500	1,500	1	0	0
April	1,239,445	478	28,691	833,607	322	405,838	157	1,530	1,530	1	0	0
May	3,526,364	1,317	78,996	2,314,647	864	1,211,717	452	315	315	0	0	0
June	402,447	155	9,316	257,504	99	144,942	56	0	-435	0	435	0
July	152,465	57	3,415	100,286	37	52,179	19	29	29	0	0	0
August	181,506	68	4,066	123,529	46	57,977	22	327	327	0	0	0
September	388,674	150	8,997	266,922	103	121,751	47	870	870	0	0	0
October	744,770	278	16,684	512,863	191	231,908	87	1,766	1,766	1	0	0
November	490,732	189	11,360	351,588	136	139,145	54	2,130	2,130	1	0	0
December	103,686	39	2,323	92,091	34	11,595	4	1,710	1,710	1	0	0
Total	***7,603,907***	***239***	***172,417***	***5,157,282***	***1,949.6***	***2,446,624***	924	***12,876***	***12,441***	***4.7***	***435***	***0***
Average		***239.5***			***162.5***		***77.0***			***0.4***		***0.0***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

*Land-use (i.e. percentage of forest and grass and shrub areas on local watershed) was assumed similar to a nearby lake watershed (Riordan Lake)

Table 11: Daviault Lake Water Balance - Operations

	Forest	Wetland	Grass/Shrub/Moss	Urban	Open Water
WHC	300 mm	300 mm	150 mm	90% Precip	Precip.-Lake Evap
Total Area (m^2)	39,660,220	275,690	13,107,740	3,165,160	7,953,850
Infiltration Factor	0.7	0.7	0.60	0.00	1.00

Month	Days	Temp (°C)	Precipitation (mm)	Potential Evapotranspiration (mm)
January	31	-21.9	51.0	0
February	28	-20.6	39.0	0
March	31	-13.6	50.0	1
April	30	-4.7	51.0	6
May	31	3.5	57.0	42
June	30	10.3	86.0	93
July	31	13.8	111.0	117
August	31	12.6	107.0	99
September	30	7.2	92.0	54
October	31	0.4	79.0	15
November	30	-7.9	71.0	1
December	31	-17.4	57.0	0
Total			***851.0***	***428.0***
Average		***-3.2***		

Month	Forest: Actual Evapotranspiration (mm)	Forest: Surplus(1) (mm)	Forest: Surplus(1) (m^3)	Wetland: Actual Evapotranspiration (mm)	Wetland: Surplus(1) (mm)	Wetland: Surplus(1) (m^3)
January	0	1	39,660	0	1	276
February	0	2	79,320	0	2	551
March	1	9	356,942	1	9	2,481
April	6	70	2,776,215	6	70	19,298
May	42	209	8,288,986	42	209	57,619
June	93	25	991,506	93	25	6,892
July	117	9	356,942	117	9	2,481
August	99	10	396,602	99	10	2,757
September	54	21	832,865	54	21	5,789
October	15	40	1,586,409	15	40	11,028
November	1	24	951,845	1	24	6,617
December	0	2	79,320	0	2	551
Total	***428***	***422***	***16,736,613***	***428***	***422***	***116,341***

Month	Grass/Shrub/Moss: Actual Evapotranspiration (mm)	Grass/Shrub/Moss: Surplus(1) (mm)	Grass/Shrub/Moss: Surplus(1) (m^3)	Urban: Actual Evapotranspiration (mm)	Urban: Surplus(1) (mm)	Urban: Surplus(1) (m^3)
January	0	1	13,108	0	51	161,423
February	0	2	26,215	0	39	123,441
March	1	9	117,970	0	50	157,629
April	6	70	917,542	1	50	157,647
May	42	209	2,739,518	8	49	153,982
June	93	25	327,694	18	68	213,676
July	117	9	117,970	23	88	277,701
August	99	10	131,077	20	87	276,368
September	54	21	275,263	11	81	257,211
October	15	40	524,310	3	76	240,608
November	1	24	314,586	0	71	224,097
December	0	2	26,215	0	57	180,414
Total	***428***	***422***	***5,531,466***	***85***	***766***	***2,424,196***

Month	Open Water: Actual Evapotranspiration(2) (mm)	Open Water: Surplus(1) (mm)	Open Water: Surplus(1) (m^3)	Total Surplus(3) (m^3)	Total Surplus (Runoff and Infiltration) (L/s)	Total Surplus (Runoff and Infiltration) (L/min)	Total Infiltration(3) (m^3)	Total Infiltration(3) (L/s)	Total Runoff (m^3)	Total Runoff (L/s)
January	0	51	405,646	584,990	218	13,105	406,343	152	178,647	67
February	0	39	310,200	508,005	210	12,599	350,116	145	157,889	65
March	0	50	397,693	997,591	372	22,347	684,948	256	312,643	117
April	0	51	405,646	4,242,359	1,637	98,203	2,879,041	1,111	1,363,318	526
May	47	11	83,515	11,288,497	4,215	252,879	7,534,727	2,813	3,753,771	1,401
June	101	-15	-115,331	1,390,446	536	32,186	746,174	288	644,272	249
July	110	1	7,556	727,527	272	16,298	294,811	110	432,715	162
August	96	11	86,697	858,378	320	19,229	409,772	153	448,607	167
September	63	29	230,662	1,567,799	605	36,292	948,887	366	618,912	239
October	20	59	468,084	2,795,315	1,044	62,619	1,865,752	697	929,562	347
November	0	71	564,723	2,027,878	782	46,942	1,390,408	536	637,470	246
December	0	57	453,369	704,748	263	15,787	489,886	183	214,862	80
Total	***436***	***415***	***3,298,462***	***27,693,533***	***10,475***	***628,485***	***18,000,864***	***6,809.0***	***9,692,669***	***3,666***
Average					***1,611.5***			***1,047.5***		***564.0***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

(3) Includes predicted loss due to groundwater inflow to Rose pit under base case numerical dewatering scenario

Table 12: Molar Lake Water Balance - Operations

	Forest		Wetland		Grass/Shrub/Moss		Open Water	
	WHC	300 mm	WHC	300 mm	WHC	150 mm	WHC	Precip.-Lake Evap
	Total Area (m^2)	6,066,900	Total Area (m^2)	31,270	Total Area (m^2)	2,890,210	Total Area (m^2)	2,815,180
	Infiltration Factor	0.7	Infiltration Factor	0.7	Infiltration Factor	0.60	Infiltration Factor	1.00

Month	Days	Temp	Precipitation	Potential Evapotranspiration	Forest: Actual Evapotranspiration	Forest: Surplus(1)		Wetland: Actual Evapotranspiration	Wetland: Surplus(1)		Grass/Shrub/Moss: Actual Evapotranspiration	Grass/Shrub/Moss: Surplus(1)		Open Water: Actual Evapotranspiration(2)	Open Water: Surplus(1)		Total Surplus(3)	Total Surplus (Runoff and Infiltration)		Total Infiltration(3)		Total Runoff	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(L/s)	(L/min)	(m^3)	(L/s)	(m^3)	(L/s)
January	31	-21.9	51.0	0	0	1	6,067	0	1	31	0	1	2,890	0	51	143,574	149,959	56	3,359	146,973	55	2,986	1
February	28	-20.6	39.0	0	0	2	12,134	0	2	63	0	2	5,780	0	39	109,792	125,417	52	3,111	119,446	49	5,971	2
March	31	-13.6	50.0	1	1	9	54,602	1	9	281	1	9	26,012	0	50	140,759	219,050	82	4,907	192,181	72	26,870	10
April	30	-4.7	51.0	6	6	70	424,683	6	70	2,189	6	70	202,315	0	51	143,574	770,241	297	17,830	561,253	217	208,987	81
May	31	3.5	57.0	42	42	209	1,267,982	42	209	6,535	42	209	604,054	47	11	29,559	1,905,527	711	42,687	1,281,550	478	623,977	233
June	30	10.3	86.0	93	93	25	151,673	93	25	782	93	25	72,255	101	-15	-40,820	181,369	70	4,198	106,731	41	74,638	29
July	31	13.8	111.0	117	117	9	54,602	117	9	281	117	9	26,012	110	1	2,674	80,966	30	1,814	54,096	20	26,870	10
August	31	12.6	107.0	99	99	10	60,669	99	10	313	99	10	28,902	96	11	30,685	117,965	44	2,643	88,110	33	29,855	11
September	30	7.2	92.0	54	54	21	127,405	54	21	657	54	21	60,694	63	29	81,640	267,876	103	6,201	205,180	79	62,696	24
October	31	0.4	79.0	15	15	40	242,676	15	40	1,251	15	40	115,608	20	59	165,673	522,605	195	11,707	403,183	151	119,421	45
November	30	-7.9	71.0	1	1	24	145,606	1	24	750	1	24	69,365	0	71	199,878	413,079	159	9,562	341,426	132	71,653	28
December	31	-17.4	57.0	0	0	2	12,134	0	2	63	0	2	5,780	0	57	160,465	175,838	66	3,939	169,867	63	5,971	2
Total			***851.0***	***428.0***	***428***	***422***	***2,560,232***	***428***	***422***	***13,196***	***428***	***422***	***1,219,669***	***436***	***415***	***1,167,455***	***4,929,892***	***1,866***	***111,957***	***3,669,996***	***1,390.1***	***1,259,896***	***476***
Average		***-3.2***																***287.1***			***213.9***		***73.2***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

(3) Includes predicted loss due to groundwater inflow to Rose pit under base case numerical dewatering scenario

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Table 13: Waldorf River Water Balance - Post-Closure Conditions

Month	Days	Temp	Precipitation	Potential Evapotranspiration	Forest: Actual Evapotranspiration	Forest: Surplus[(1)]		Open Water: Actual Evapotranspiration[(2)]	Open Water: Surplus[(1)]	
					WHC: 300 mm			WHC: Precip.-Lake Evap		
					Total Area (m^2): 36,410,840			Total Area (m^2): 8,852,840		
					Infiltration Factor: 0.7			Infiltration Factor: 1.0		
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)
January	31	-21.9	51.0	0	0	1	36,411	0	51	451,495
February	28	-20.6	39.0	0	0	2	72,822	0	39	345,261
March	31	-13.6	50.0	1	1	9	327,698	0	50	442,642
April	30	-4.7	51.0	6	6	70	2,548,759	0	51	451,495
May	31	3.5	57.0	42	42	209	7,609,866	47	11	92,955
June	30	10.3	86.0	93	93	25	910,271	101	-15	-128,366
July	31	13.8	111.0	117	117	9	327,698	110	1	8,410
August	31	12.6	107.0	99	99	10	364,108	96	11	96,496
September	30	7.2	92.0	54	54	21	764,628	63	29	256,732
October	31	0.4	79.0	15	15	40	1,456,434	20	59	520,990
November	30	-7.9	71.0	1	1	24	873,860	0	71	628,552
December	31	-17.4	57.0	0	0	2	72,822	0	57	504,612
Total			***851.0***	***428.0***	***428***	***422***	***15,365,374***	***436***	***415***	***3,671,273***
Average		***-3.2***								

Month	Wetland: Actual Evapotranspiration	Wetland: Surplus[(1)]		Grass/Shrub/Moss: Actual Evapotranspiration	Grass/Shrub/Moss: Surplus[(1)]		MRS and MRS Basins (East, West and North)/ Grass: Actual Evapotranspiration	MRS and MRS Basins (East, West and North)/ Grass: Surplus[(1)]	
	WHC: 300 mm			WHC: 150 mm			WHC: 150 mm		
	Total Area (m^2): 384,000			Total Area (m^2): 19,085,280			Total Area (m^2): 5,579,000		
	Infiltration Factor: 0.7			Infiltration Factor: 0.6			Infiltration Factor: 0.6		
	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)
January	0	1	384	0	1	19,085	0	1	5,579
February	0	2	768	0	2	38,171	0	2	11,158
March	1	9	3,456	1	9	171,768	1	9	50,211
April	6	70	26,880	6	70	1,335,970	6	70	390,530
May	42	209	80,256	42	209	3,988,824	42	209	1,166,011
June	93	25	9,600	93	25	477,132	93	25	139,475
July	117	9	3,456	117	9	171,768	117	9	50,211
August	99	10	3,840	99	10	190,853	99	10	55,790
September	54	21	8,064	54	21	400,791	54	21	117,159
October	15	40	15,360	15	40	763,411	15	40	223,160
November	1	24	9,216	1	24	458,047	1	24	133,896
December	0	2	768	0	2	38,171	0	2	11,158
Total	***428***	***422***	***162,048***	***428***	***422***	***8,053,988***	***428***	***422***	***2,354,338***

Month	Basins/Grass: Actual Evapotranspiration	Basins/Grass: Surplus[(1)]		TMF/Grass: Actual Evapotranspiration	TMF/Grass: Surplus[(1)]		To Waldorf River Watershed: Total Surplus[(3)]	Total Surplus (Runoff and Infiltration)		Total Infiltration[(3)]		Total Runoff	
	WHC: 150 mm			WHC: 150 mm									
	Total Area (m^2): 95,000			Total Area (m^2): 136,000									
	Infiltration Factor: 0.6			Infiltration Factor: 0.6									
	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(L/s)	(L/min)	(m^3)	(L/s)	(m^3)	(L/s)
January	0	1	95	0	1	136	509,838	190	11,421	488,841	183	20,997	8
February	0	2	190	0	2	272	461,946	191	11,457	419,953	174	41,993	17
March	1	9	855	1	9	1,224	967,726	361	21,678	778,757	291	188,969	71
April	6	70	6,650	6	70	9,520	4,535,485	1,750	104,988	3,065,726	1,183	1,469,759	567
May	42	209	19,855	42	209	28,424	12,286,583	4,587	275,237	7,898,301	2,949	4,388,282	1,638
June	93	25	2,375	93	25	3,400	1,330,202	513	30,792	805,288	311	524,914	203
July	117	9	855	117	9	1,224	533,495	199	11,951	344,526	129	188,969	71
August	99	10	950	99	10	1,360	679,923	254	15,231	469,958	175	209,966	78
September	54	21	1,995	54	21	2,856	1,481,929	572	34,304	1,041,002	402	440,928	170
October	15	40	3,800	15	40	5,440	2,854,698	1,066	63,949	2,014,836	752	839,863	314
November	1	24	2,280	1	24	3,264	2,028,777	783	46,962	1,524,859	588	503,918	194
December	0	2	190	0	2	272	621,297	232	13,918	579,304	216	41,993	16
Total	***428***	***422***	***40,090***	***428***	***422***	***57,392***	***28,291,901***	***892***	***641,889***	***19,431,351***	***7,351.7***	***8,860,550***	***3,346***
Average								***891.5***			***612.6***		***278.9***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual avapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

(3) Seepage from Mine Rock Stockpile (that will continue to be pumped to the Rose Pit) is assumed loss from surplus and infiltration

Table 14: Mills Lake Water Balance - Post-Closure

	Forest	Wetland	Grass/Shrub/Moss	Open Water	Rose Pit/ Rose Lake	MRS and MRS Basins (East, West and North)/ Grass	Basins/Grass
WHC	300 mm	300 mm	150 mm	Precip.-Lake Evap	Precip.-Lake Evap	150 mm	150 mm
Total Area (m^2)	23,309,620	113,520	3,264,510	8,369,620	120,000	430,000	690,000
Infiltration Factor	0.7	0.7	0.6	1.0	1.0	0.6	0.6

Month	Days	Temp	Precipitation	Potential Evapotranspiration	Forest: Actual Evapotranspiration	Forest: Surplus(1)		Wetland: Actual Evapotranspiration	Wetland: Surplus(1)	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)
January	31	-21.9	51.0	0	0	1	23,310	0	1	114
February	28	-20.6	39.0	0	0	2	46,619	0	2	227
March	31	-13.6	50.0	1	1	9	209,787	1	9	1,022
April	30	-4.7	51.0	6	6	70	1,631,673	6	70	7,946
May	31	3.5	57.0	42	42	209	4,871,711	42	209	23,726
June	30	10.3	86.0	93	93	25	582,741	93	25	2,838
July	31	13.8	111.0	117	117	9	209,787	117	9	1,022
August	31	12.6	107.0	99	99	10	233,096	99	10	1,135
September	30	7.2	92.0	54	54	21	489,502	54	21	2,384
October	31	0.4	79.0	15	15	40	932,385	15	40	4,541
November	30	-7.9	71.0	1	1	24	559,431	1	24	2,724
December	31	-17.4	57.0	0	0	2	46,619	0	2	227
Total			***851.0***	***428.0***	***428***	***422***	***9,836,660***	***428***	***422***	***47,905***
Average		***-3.2***								

Month	Grass/Shrub/Moss: Actual Evapotranspiration	Grass/Shrub/Moss: Surplus(1)		Open Water: Actual Evapotranspiration(2)	Open Water: Surplus(1)		Rose Pit/ Rose Lake: Actual Evapotranspiration(2)	Rose Pit/ Rose Lake: Surplus(1)	
	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)
January	0	1	3,265	0	51	426,851	0	51	6,120
February	0	2	6,529	0	39	326,415	0	39	4,680
March	1	9	29,381	0	50	418,481	0	50	6,000
April	6	70	228,516	0	51	426,851	0	51	6,120
May	42	209	682,283	47	11	87,881	47	11	1,260
June	93	25	81,613	101	-15	-121,359	101	-15	-1,740
July	117	9	29,381	110	1	7,951	110	1	114
August	99	10	32,645	96	11	91,229	96	11	1,308
September	54	21	68,555	63	29	242,719	63	29	3,480
October	15	40	130,580	20	59	492,552	20	59	7,062
November	1	24	78,348	0	71	594,243	0	71	8,520
December	0	2	6,529	0	57	477,068	0	57	6,840
Total	***428***	***422***	***1,377,623***	***436***	***415***	***3,470,881***	***436***	***415***	***49,764***
Average									

Month	MRS and MRS Basins: Actual Evapotranspiration	MRS and MRS Basins: Surplus(1)		Basins/Grass: Actual Evapotranspiration	Basins/Grass: Surplus(1)	
	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)
January	0	1	430	0	1	690
February	0	2	860	0	2	1,380
March	1	9	3,870	1	9	6,210
April	6	70	30,100	6	70	48,300
May	42	209	89,870	42	209	144,210
June	93	25	10,750	93	25	17,250
July	117	9	3,870	117	9	6,210
August	99	10	4,300	99	10	6,900
September	54	21	9,030	54	21	14,490
October	15	40	17,200	15	40	27,600
November	1	24	10,320	1	24	16,560
December	0	2	860	0	2	1,380
Total	***428***	***422***	***181,460***	***428***	***422***	***291,180***
Average						

Month	To Mills Lake Watershed: Total Surplus(3)	Total Surplus (Runoff and Infiltration)		Total Infiltration(3)		Total Runoff	
	(m^3)	(L/s)	(L/min)	(m^3)	(L/s)	(m^3)	(L/s)
January	460,520	172	10,316	451,740	169	8,781	3
February	386,194	160	9,578	368,633	152	17,561	7
March	672,428	251	15,063	593,401	222	79,027	30
April	2,361,446	911	54,663	1,746,794	674	614,652	237
May	5,847,018	2,183	130,982	4,011,842	1,498	1,835,176	685
June	565,642	218	13,094	346,123	134	219,519	85
July	256,012	96	5,735	176,985	66	79,027	30
August	368,033	137	8,244	280,226	105	87,807	33
September	824,742	318	19,091	640,346	247	184,396	71
October	1,601,600	598	35,878	1,250,370	467	351,230	131
November	1,263,955	488	29,258	1,053,217	406	210,738	81
December	539,008	201	12,075	521,446	195	17,561	7
Total	***15,146,598***	***478***	***343,978***	***11,441,123***	***4,333.5***	***3,705,475***	***1,399***
Average		***477.7***			***361.1***		***116.6***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

(3) Seepage from Mine Rock Stockpile (that will continue to be pumped to the Rose Pit) is assumed loss from surplus and infiltration

Table 15: Riordan Lake Water Balance - Post-Closure

					Forest			Wetland			Grass/Shrub/Moss		
					WHC	300 mm		WHC	300 mm		WHC	150 mm	
					Total Area (m^2)	3,829,610		Total Area (m^2)	154,520		Total Area (m^2)	3,219,690	
					Infiltration Factor	0.7		Infiltration Factor	0.7		Infiltration Factor	0.6	
Month	Days	Temp	Precipitation	Potential Evapotranspiration	Actual Evapotranspiration	Surplus(1)		Actual Evapotranspiration	Surplus(1)		Actual Evapotranspiration	Surplus(1)	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)
January	31	-21.9	51.0	0	0	1	3,830	0	1	155	0	1	3,220
February	28	-20.6	39.0	0	0	2	7,659	0	2	309	0	2	6,439
March	31	-13.6	50.0	1	1	9	34,466	1	9	1,391	1	9	28,977
April	30	-4.7	51.0	6	6	70	268,073	6	70	10,816	6	70	225,378
May	31	3.5	57.0	42	42	209	800,388	42	209	32,295	42	209	672,915
June	30	10.3	86.0	93	93	25	95,740	93	25	3,863	93	25	80,492
July	31	13.8	111.0	117	117	9	34,466	117	9	1,391	117	9	28,977
August	31	12.6	107.0	99	99	10	38,296	99	10	1,545	99	10	32,197
September	30	7.2	92.0	54	54	21	80,422	54	21	3,245	54	21	67,613
October	31	0.4	79.0	15	15	40	153,184	15	40	6,181	15	40	128,788
November	30	-7.9	71.0	1	1	24	91,911	1	24	3,708	1	24	77,273
December	31	-17.4	57.0	0	0	2	7,659	0	2	309	0	2	6,439
Total			***851.0***	***428.0***	***428***	***422***	***1,616,095***	***428***	***422***	***65,207***	***428***	***422***	***1,358,709***
Average		***-3.2***											

	Open water			TMF/Grass			To Riordan Lake Watershed						
	WHC	Precip.-Lake Evap		WHC	150 mm								
	Total Area (m^2)	2,556,210		Total Area (m^2)	40,000								
	Infiltration Factor	1.0		Infiltration Factor	0.6								
Month	Actual Evapotranspiration(2)	Surplus(1)		Actual Evapotranspiration	Surplus(1)		Total Surplus	Total Surplus (Runoff and Infiltration)		Total Infiltration		Total Runoff	
	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(L/s)	(L/min)	(m^3)	(L/s)	(m^3)	(L/s)
January	0	51	130,367	0	1	40	137,611	51	3,083	135,111	50	2,499	1
February	0	39	99,692	0	2	80	114,180	47	2,832	109,182	45	4,998	2
March	0	50	127,811	1	9	360	193,005	72	4,324	170,513	64	22,492	8
April	0	51	130,367	6	70	2,800	637,434	246	14,755	462,496	178	174,938	67
May	47	11	26,840	42	209	8,360	1,540,799	575	34,516	1,018,484	380	522,315	195
June	101	-15	-37,065	93	25	1,000	144,030	56	3,334	81,553	31	62,478	24
July	110	1	2,428	117	9	360	67,623	25	1,515	45,131	17	22,492	8
August	96	11	27,863	99	10	400	100,301	37	2,247	75,310	28	24,991	9
September	63	29	74,130	54	21	840	226,250	87	5,237	173,769	67	52,481	20
October	20	59	150,433	15	40	1,600	440,186	164	9,861	340,221	127	99,965	37
November	0	71	181,491	1	24	960	355,343	137	8,226	295,364	114	59,979	23
December	0	57	145,704	0	2	80	160,192	60	3,589	155,193	58	4,998	2
Total	***436***	***415***	***1,060,060***	***428***	***422***	***16,880***	***4,116,952***	***130***	***93,517***	***3,062,326***	***1,160.3***	***1,054,627***	***398***
Average								***129.9***			***96.7***		***33.2***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

Table 16: Rectangle Lake* Water Balance - Post-Closure

					Grass/Shrub/Moss			Forest			Open water			TMF/Grass										
					WHC	150 mm		WHC	300 mm		WHC	Precip.-Lake Evap		WHC	150 mm									
					Total Area (m²)	7,544,481		Total Area (m²)	9,266,319		Total Area (m²)	1,229,200		Total Area (m²)	30,000									
					Infiltration Factor	0.6		Infiltration Factor	0.7		Infiltration Factor	1.0		Infiltration Factor	0.6		To Rectangle Lake Watershed							
Month	Days	Temp	Precipitation	Potential Evapotranspiration	Actual Evapotranspiration	Surplus(1)		Actual Evapotranspiration	Surplus(1)		Actual Evapotranspiration(2)	Surplus(1)		Actual Evapotranspiration	Surplus(1)		Total Surplus	Total Surplus (Runoff and Infiltration)		Total Infiltration		Total Runoff		
		(°C)	(mm)	(mm)	(mm)	(mm)	(m³)	(mm)	(mm)	(m³)	(mm)	(mm)	(m³)	(mm)	(mm)	(m³)	(m³)	(L/s)	(L/min)	(m³)	(L/s)	(m³)	(L/s)	
January	31	-21.9	51.0	0	0	1	7,544	0	1	9,266	0	51	62,689	0	1	30	79,530	30	1,782	73,720	28	5,810	2	
February	28	-20.6	39.0	0	0	2	15,089	0	2	18,533	0	39	47,939	0	2	60	81,620	34	2,024	70,001	29	11,619	5	
March	31	-13.6	50.0	1	1	9	67,900	1	9	83,397	0	50	61,460	1	9	270	213,027	80	4,772	160,740	60	52,287	20	
April	30	-4.7	51.0	6	6	70	528,114	6	70	648,642	0	51	62,689	6	70	2,100	1,241,545	479	28,739	834,867	322	406,678	157	
May	31	3.5	57.0	42	42	209	1,576,796	42	209	1,936,661	47	11	12,907	42	209	6,270	3,532,634	1,319	79,136	2,318,409	866	1,214,225	453	
June	30	10.3	86.0	93	93	25	188,612	93	25	231,658	101	-15	-17,823	93	25	750	403,197	156	9,333	257,954	100	145,242	56	
July	31	13.8	111.0	117	117	9	67,900	117	9	83,397	110	1	1,168	117	9	270	152,735	57	3,421	100,448	38	52,287	20	
August	31	12.6	107.0	99	99	10	75,445	99	10	92,663	96	11	13,398	99	10	300	181,806	68	4,073	123,709	46	58,097	22	
September	30	7.2	92.0	54	54	21	158,434	54	21	194,593	63	29	35,647	54	21	630	389,304	150	9,012	267,300	103	122,003	47	
October	31	0.4	79.0	15	15	40	301,779	15	40	370,653	20	59	72,338	15	40	1,200	745,970	279	16,711	513,583	192	232,388	87	
November	30	-7.9	71.0	1	1	24	181,068	1	24	222,392	0	71	87,273	1	24	720	491,452	190	11,376	352,020	136	139,433	54	
December	31	-17.4	57.0	0	0	2	15,089	0	2	18,533	0	57	70,064	0	2	60	103,746	39	2,324	92,127	34	11,619	4	
Total			***851.0***	***428.0***	***428***	***422***	***3,183,771***	***428***	***422***	***3,910,387***	***436***	***415***	***509,749***	***428***	***422***	***12,660***	***7,616,567***	***240***	***172,704***	***5,164,878***	***1,952.5***	***2,451,688***	***926***	
Average		***-3.2***																***239.9***			***162.7***		***77.2***	

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

*Land-use (i.e. percentage of forest and grass and shrub areas on local watershed) was assumed similar to a nearby lake watershed (Riordan Lake)

Table 17: Daviault Lake Water Balance - Post-Closure

Land Cover	WHC	Total Area (m^2)	Infiltration Factor
Forest	300 mm	39,660,220	0.7
Wetland	300 mm	275,690	0.7
Grass/Shrub/Moss	150 mm	13,107,740	0.60
Urban	90% Precip	3,165,160	0.00
Open Water	Precip.-Lake Evap	7,953,850	1.00

Month	Days	Temp	Precipitation	Potential Evapotranspiration	Forest: Actual Evapotranspiration	Forest: Surplus[1]		Wetland: Actual Evapotranspiration	Wetland: Surplus[1]		Grass/Shrub/Moss: Actual Evapotranspiration	Grass/Shrub/Moss: Surplus[1]		Urban: Actual Evapotranspiration	Urban: Surplus[1]		Open Water: Actual Evapotranspiration[2]	Open Water: Surplus[1]		Total Surplus	Total Surplus (Runoff and Infiltration)		Total Infiltration		Total Runoff	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(L/s)	(L/min)	(m^3)	(L/s)	(m^3)	(L/s)
January	31	-21.9	51.0	0	0	1	39,660	0	1	276	0	1	13,108	0	51	161,423	0	51	405,646	620,113	232	13,891	441,466	165	178,647	67
February	28	-20.6	39.0	0	0	2	79,320	0	2	551	0	2	26,215	0	39	123,441	0	39	310,200	539,729	223	13,386	381,840	158	157,889	65
March	31	-13.6	50.0	1	1	9	356,942	1	9	2,481	1	9	117,970	0	50	157,629	0	50	397,693	1,032,714	386	23,134	720,071	269	312,643	117
April	30	-4.7	51.0	6	6	70	2,776,215	6	70	19,298	6	70	917,542	1	50	157,647	0	51	405,646	4,276,349	1,650	98,990	2,913,031	1,124	1,363,318	526
May	31	3.5	57.0	42	42	209	8,288,986	42	209	57,619	42	209	2,739,518	8	49	153,982	47	11	83,515	11,323,620	4,228	253,665	7,569,850	2,826	3,753,771	1,401
June	30	10.3	86.0	93	93	25	991,506	93	25	6,892	93	25	327,694	18	68	213,676	101	-15	-115,331	1,424,436	550	32,973	780,164	301	644,272	249
July	31	13.8	111.0	117	117	9	356,942	117	9	2,481	117	9	117,970	23	88	277,701	110	1	7,556	762,650	285	17,084	329,934	123	432,715	162
August	31	12.6	107.0	99	99	10	396,602	99	10	2,757	99	10	131,077	20	87	276,368	96	11	86,697	893,501	334	20,016	444,895	166	448,607	167
September	30	7.2	92.0	54	54	21	832,865	54	21	5,789	54	21	275,263	11	81	257,211	63	29	230,662	1,601,789	618	37,078	982,877	379	618,912	239
October	31	0.4	79.0	15	15	40	1,586,409	15	40	11,028	15	40	524,310	3	76	240,608	20	59	468,084	2,830,438	1,057	63,406	1,900,875	710	929,562	347
November	30	-7.9	71.0	1	1	24	951,845	1	24	6,617	1	24	314,586	0	71	224,097	0	71	564,723	2,061,868	795	47,728	1,424,398	550	637,470	246
December	31	-17.4	57.0	0	0	2	79,320	0	2	551	0	2	26,215	0	57	180,414	0	57	453,369	739,871	276	16,574	525,009	196	214,862	80
Total			***851.0***	***428.0***	***428***	***422***	***16,736,613***	***428***	***422***	***116,341***	***428***	***422***	***5,531,466***	***85***	***766***	***2,424,196***	***436***	***415***	***3,298,462***	***28,107,078***	***10,632***	***637,927***	***18,414,409***	***6,966.3***	***9,692,669***	***3,666***
Average		***-3.2***																			***1,635.7***			***1,071.7***		***564.0***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

Table 18: Molar Lake Water Balance - Post-Closure

	Forest		Wetland		Grass/Shrub/Moss		Open Water	
WHC		300 mm		300 mm		150 mm		Precip.-Lake Evap
Total Area (m^2)		6,066,900		31,270		2,890,210		2,815,180
Infiltration Factor		0.7		0.7		0.60		1.00

Month	Days	Temp	Precipitation	Potential Evapotranspiration	Forest Actual Evapotranspiration	Forest Surplus[1]		Wetland Actual Evapotranspiration	Wetland Surplus[1]		Grass/Shrub/Moss Actual Evapotranspiration	Grass/Shrub/Moss Surplus[1]		Open Water Actual Evapotranspiration[2]	Open Water Surplus[1]		Total Surplus	Total Surplus (Runoff and Infiltration)		Total Infiltration		Total Runoff	
		(°C)	(mm)	(mm)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(mm)	(mm)	(m^3)	(m^3)	(L/s)	(L/min)	(m^3)	(L/s)	(m^3)	(L/s)
January	31	-21.9	51.0	0	0	1	6,067	0	1	31	0	1	2,890	0	51	143,574	152,563	57	3,418	149,577	56	2,986	1
February	28	-20.6	39.0	0	0	2	12,134	0	2	63	0	2	5,780	0	39	109,792	127,769	53	3,169	121,798	50	5,971	2
March	31	-13.6	50.0	1	1	9	54,602	1	9	281	1	9	26,012	0	50	140,759	221,654	83	4,965	194,785	73	26,870	10
April	30	-4.7	51.0	6	6	70	424,683	6	70	2,189	6	70	202,315	0	51	143,574	772,761	298	17,888	563,773	218	208,987	81
May	31	3.5	57.0	42	42	209	1,267,982	42	209	6,535	42	209	604,054	47	11	29,559	1,908,131	712	42,745	1,284,154	479	623,977	233
June	30	10.3	86.0	93	93	25	151,673	93	25	782	93	25	72,255	101	-15	-40,820	183,889	71	4,257	109,251	42	74,638	29
July	31	13.8	111.0	117	117	9	54,602	117	9	281	117	9	26,012	110	1	2,674	83,570	31	1,872	56,700	21	26,870	10
August	31	12.6	107.0	99	99	10	60,669	99	10	313	99	10	28,902	96	11	30,685	120,569	45	2,701	90,714	34	29,855	11
September	30	7.2	92.0	54	54	21	127,405	54	21	657	54	21	60,694	63	29	81,640	270,396	104	6,259	207,700	80	62,696	24
October	31	0.4	79.0	15	15	40	242,676	15	40	1,251	15	40	115,608	20	59	165,673	525,209	196	11,765	405,787	152	119,421	45
November	30	-7.9	71.0	1	1	24	145,606	1	24	750	1	24	69,365	0	71	199,878	415,599	160	9,620	343,946	133	71,653	28
December	31	-17.4	57.0	0	0	2	12,134	0	2	63	0	2	5,780	0	57	160,465	178,442	67	3,997	172,471	64	5,971	2
Total			***851.0***	***428.0***	***428***	***422***	***2,560,232***	***428***	***422***	***13,196***	***428***	***422***	***1,219,669***	***436***	***415***	***1,167,455***	***4,960,552***	***1,878***	***112,657***	***3,700,656***	***1,401.8***	***1,259,896***	***476***
Average		***-3.2***																***288.9***			***215.7***		***73.2***

Notes:

(1) Surplus values (mm) are calculated using rainfall, snowmelt and actual evapotranspiration

(2) Actual evapotranspiration is assumed equal to lake evaporation

Appendix 8B: Time Series of Modelled Predictions of Constituents of Potential Concern for P25, Mean Annual Precipitation, and P75 Model Scenarios at Duley Lake Outlet

Duley Lake Outlet

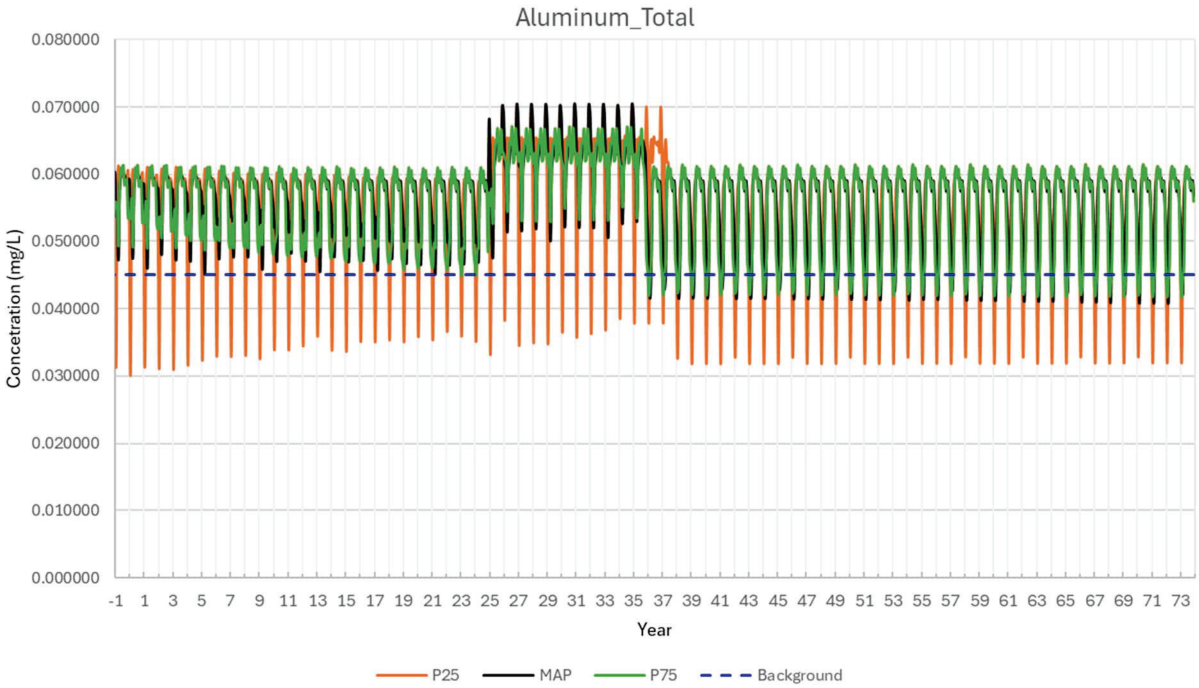

Figure 8D-1: Time series of modelled predictions of total aluminum for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

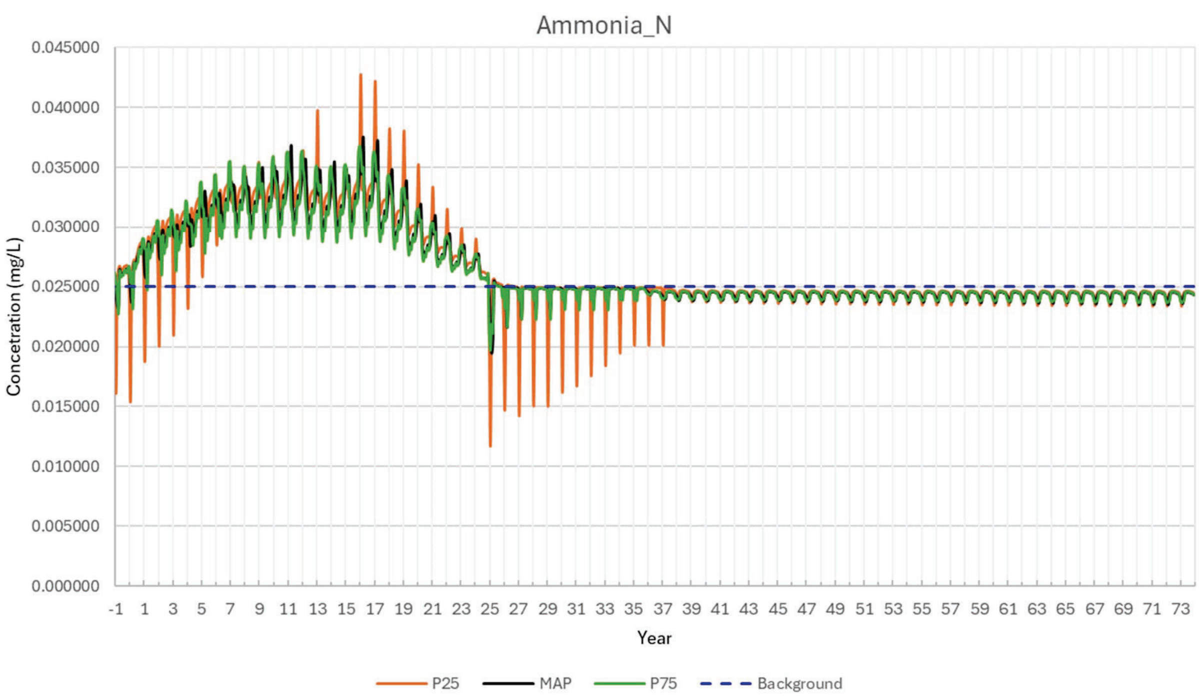

Figure 8D-2: Time series of modelled predictions of Ammonia as N for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

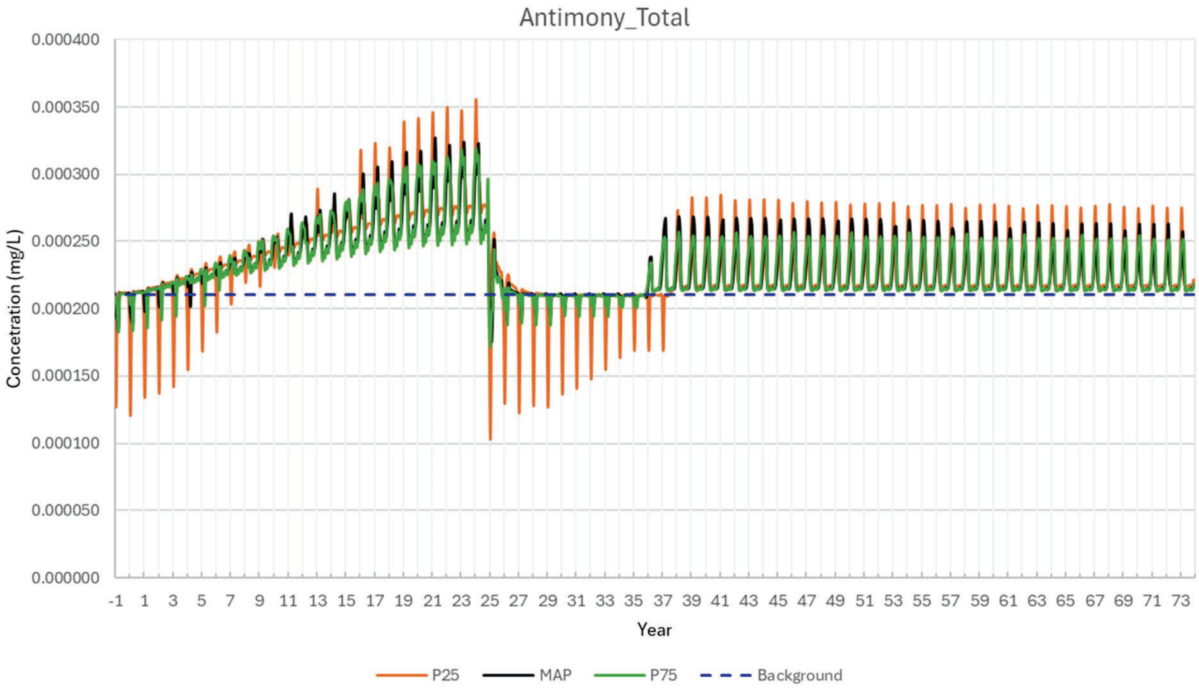

Figure 8D-3: Time series of modelled predictions of total antimony for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

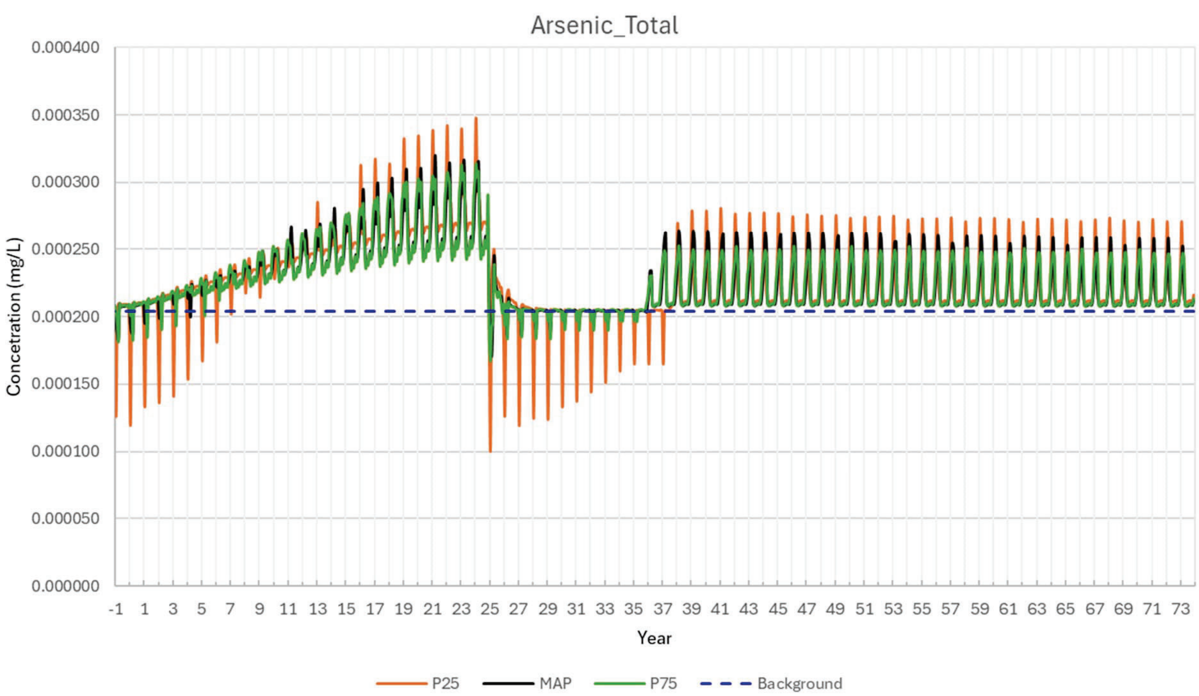

Figure 8D-4: Time series of modelled predictions of total arsenic for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

Figure 8D-5: Time series of modelled predictions of total barium for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

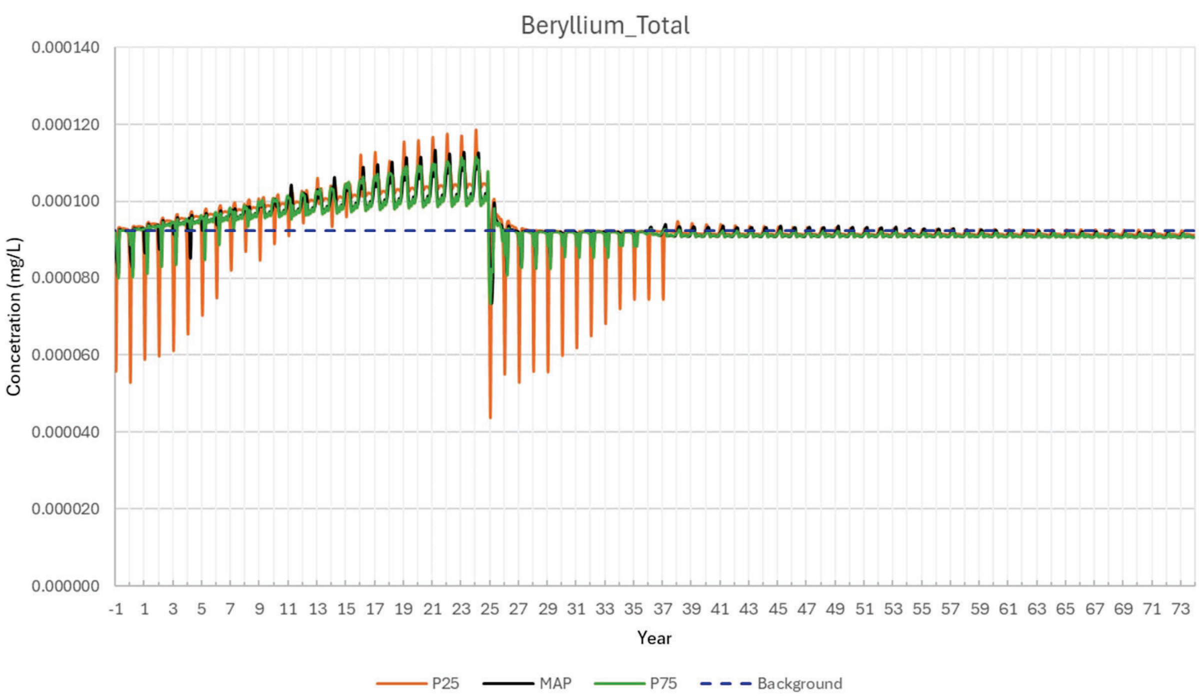

Figure 8D-6: Time series of modelled predictions of total beryllium for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

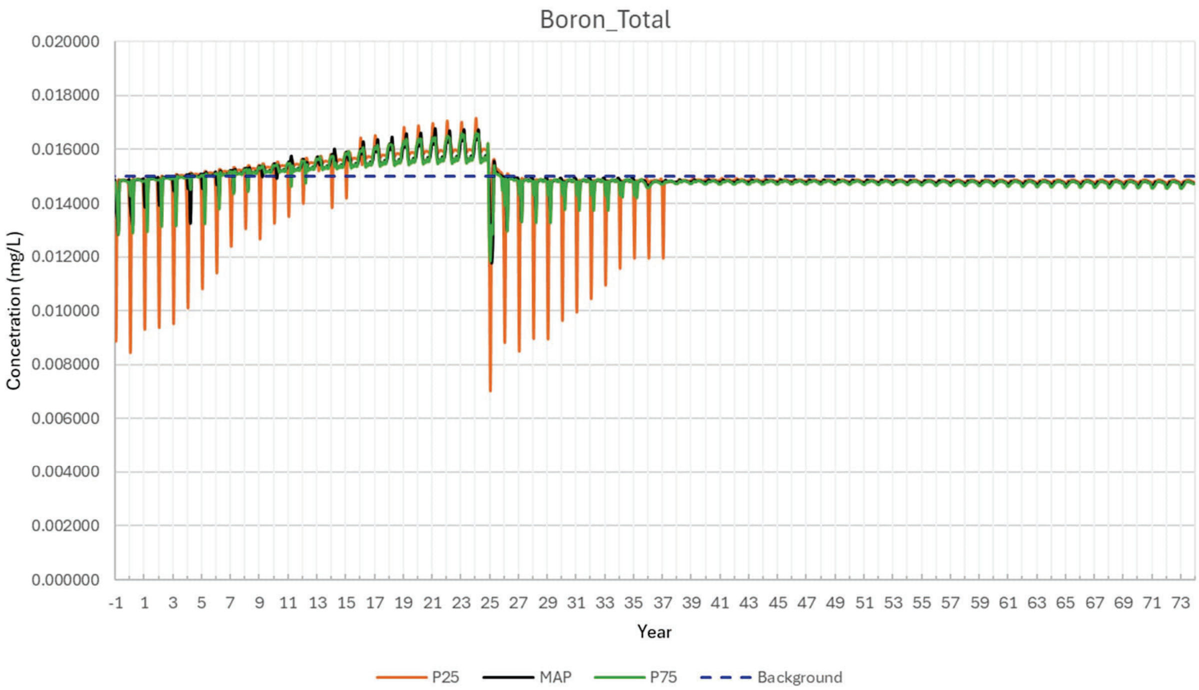

Figure 8D-7: Time series of modelled predictions of total boron for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) scenarios at Duley Lake outlet

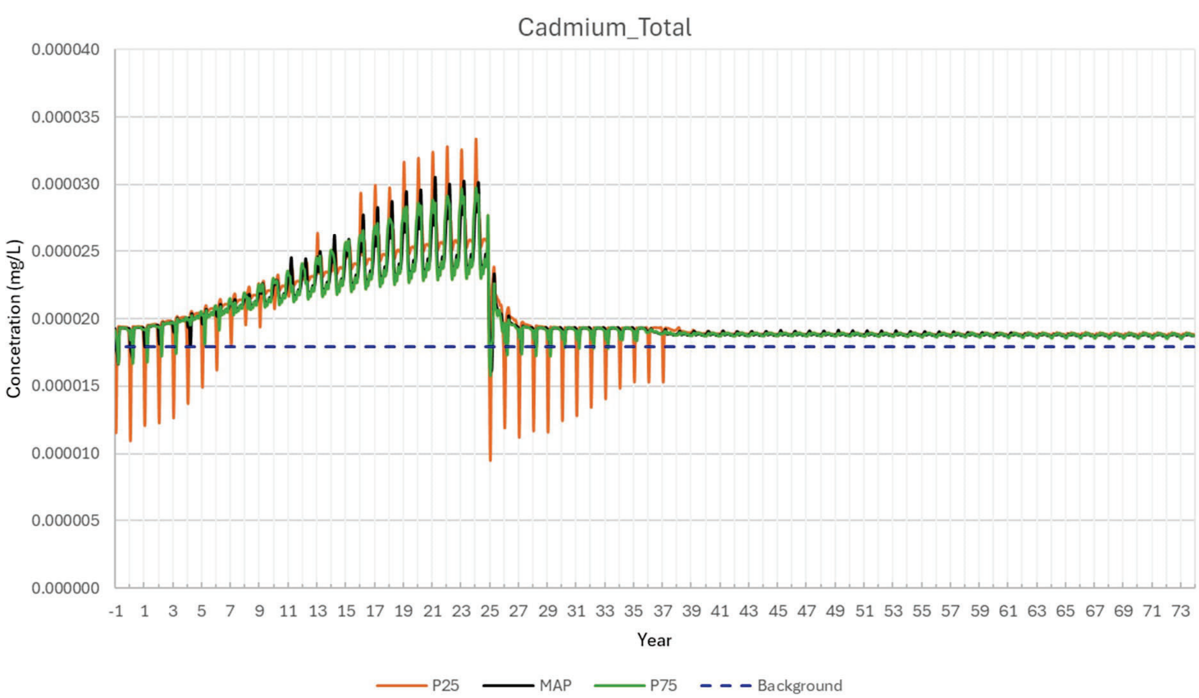

Figure 8D-8: Time series of modelled predictions of total cadmium for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

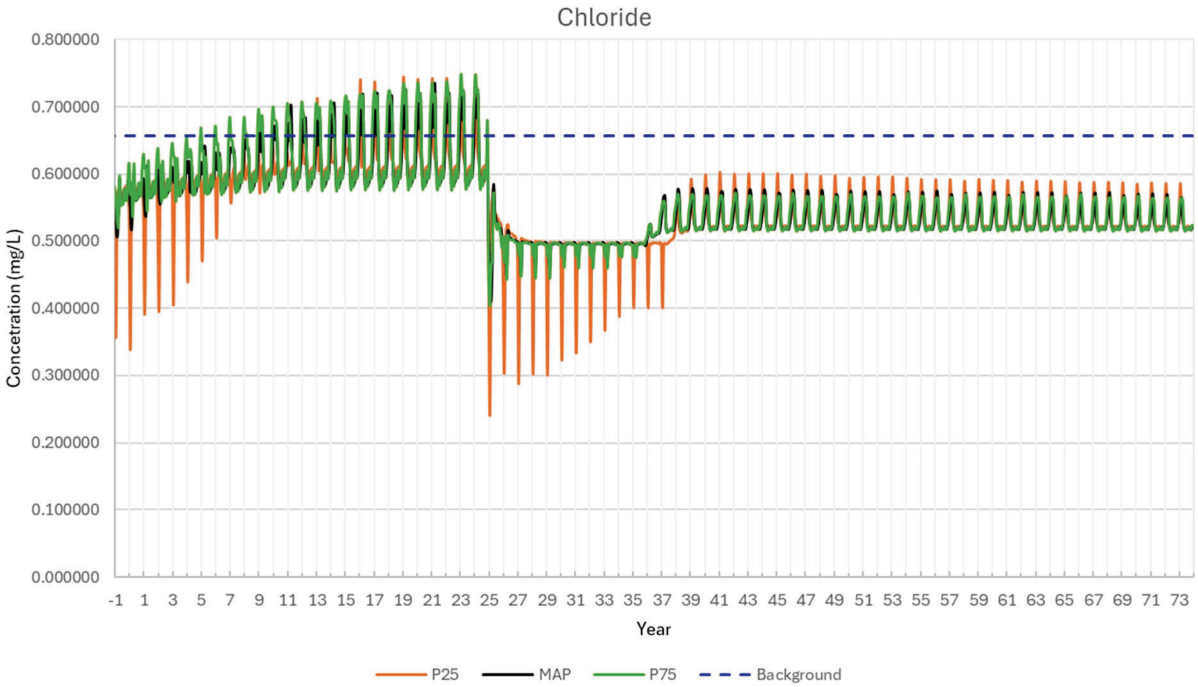

Figure 8D-9: Time series of modelled predictions of chloride for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) scenarios at Duley Lake outlet

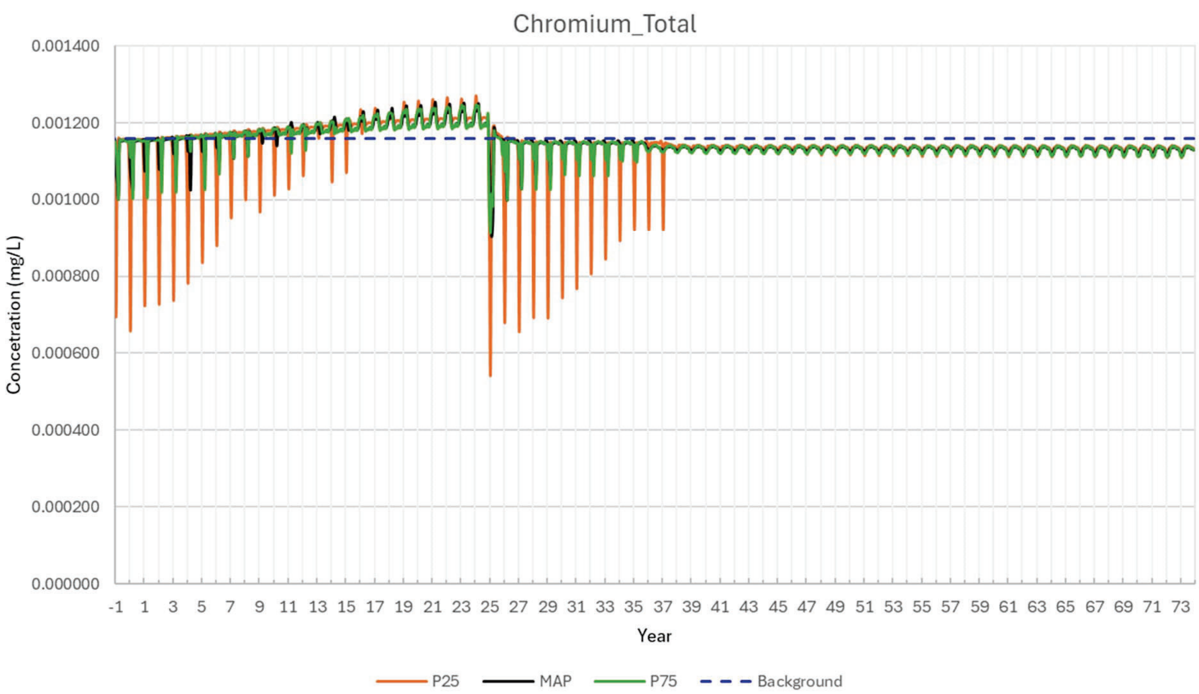

Figure 8D-10: Time series of modelled predictions of total chromium for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) scenarios at Duley Lake outlet

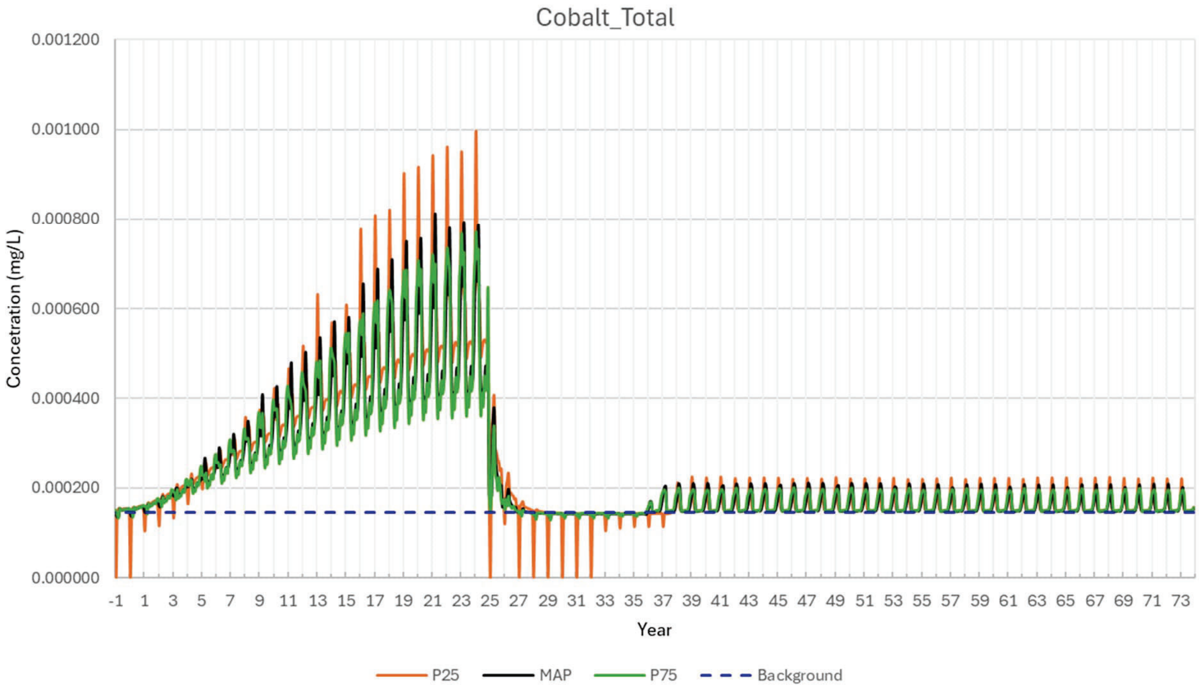

Figure 8D-11: Time series of modelled predictions of total cobalt for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

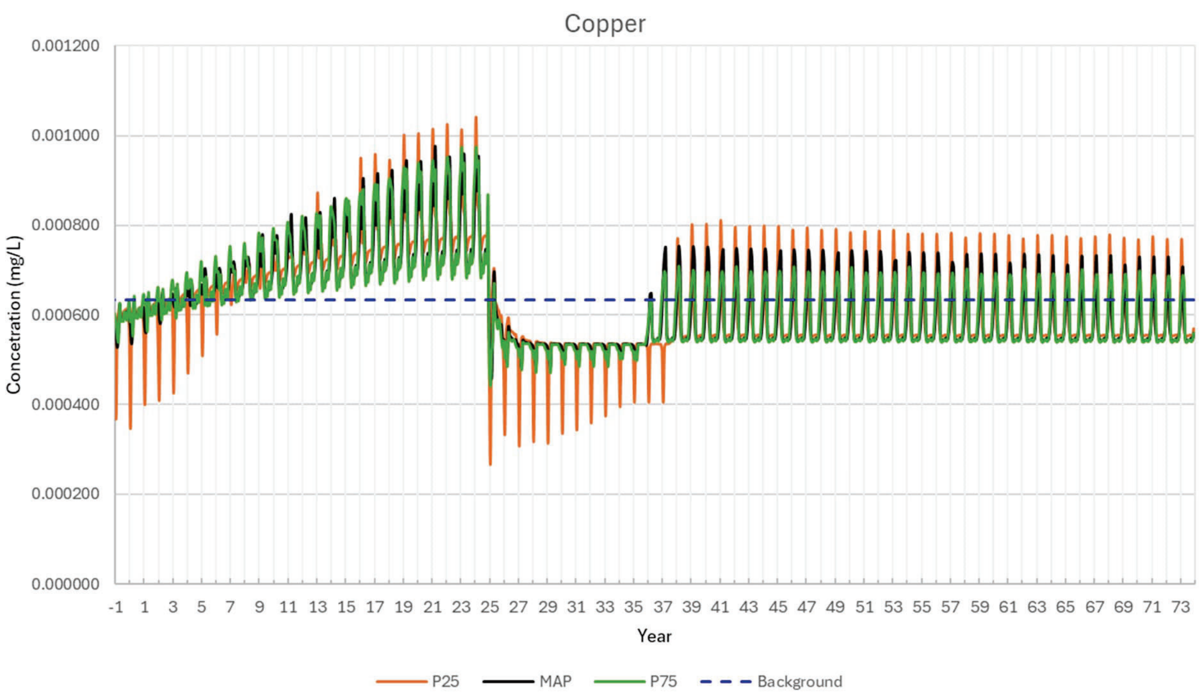

Figure 8D-12: Time series of modelled predictions of copper for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

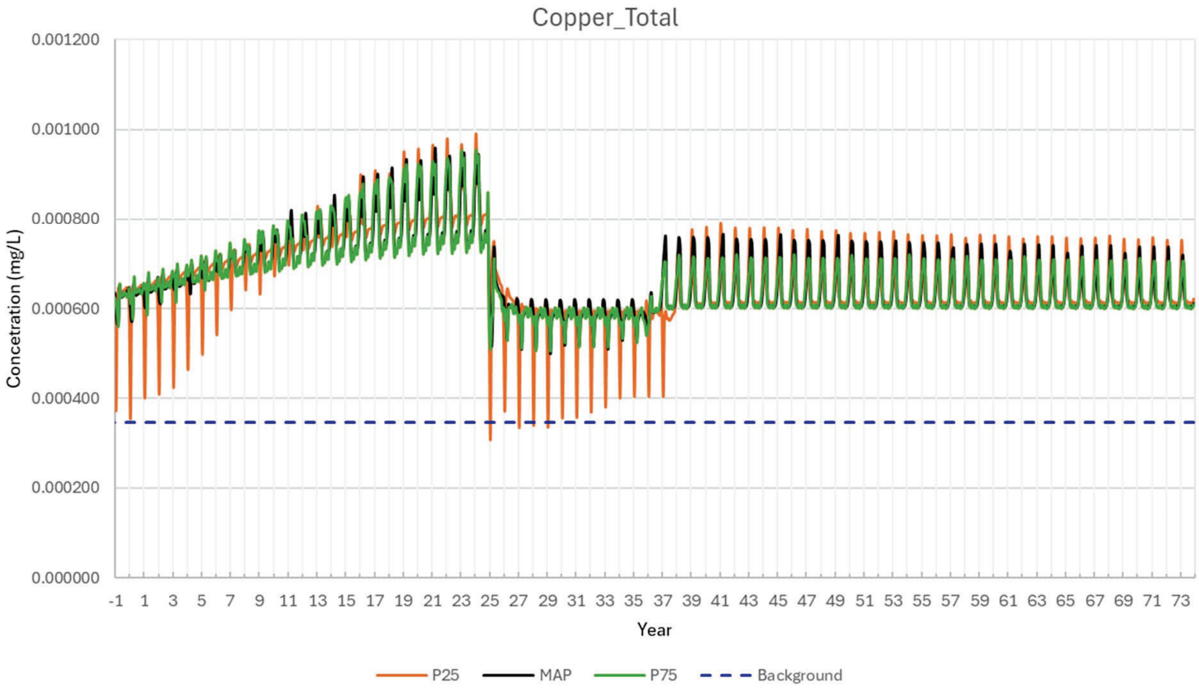

Figure 8D-13: Time series of modelled predictions of total copper for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

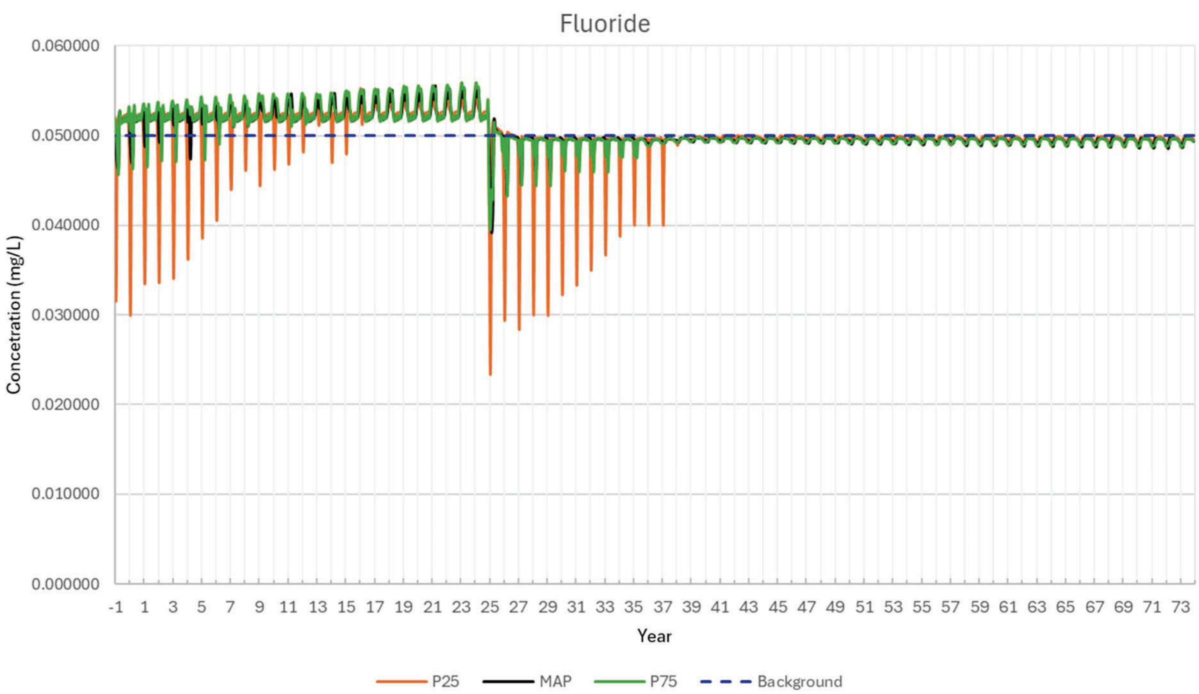

Figure 8D-14: Time series of modelled predictions of fluoride for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

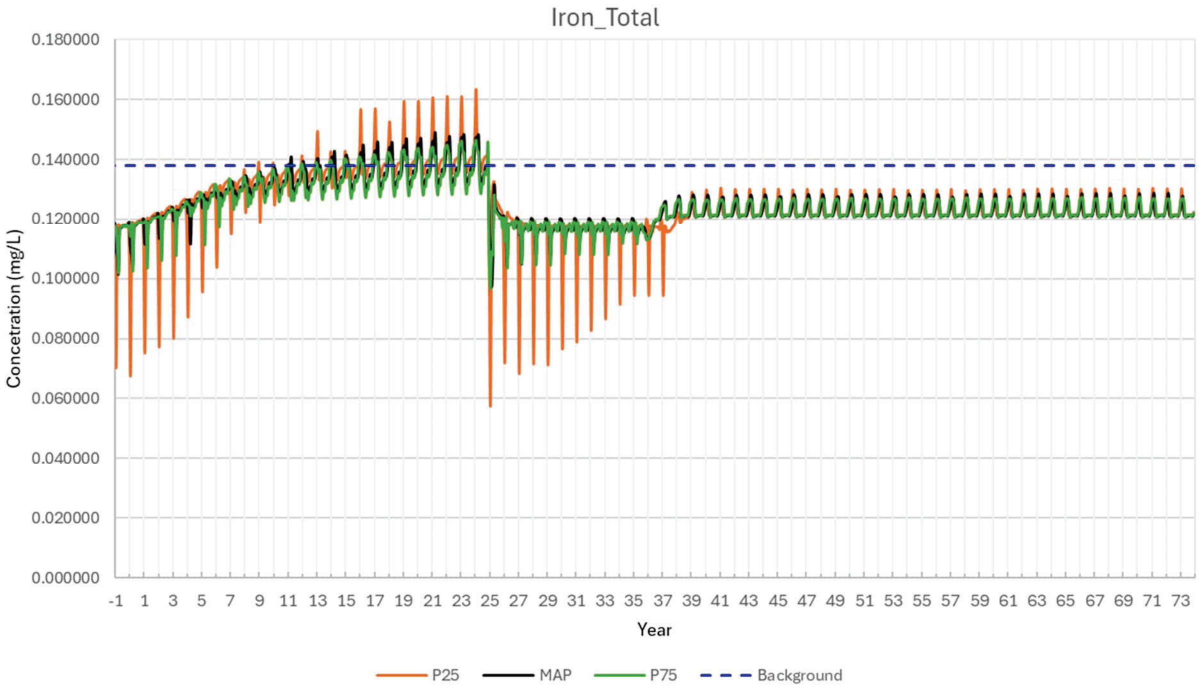

Figure 8D-15: Time series of modelled predictions of total iron for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

Figure 8D-16: Time series of modelled predictions of total lead for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

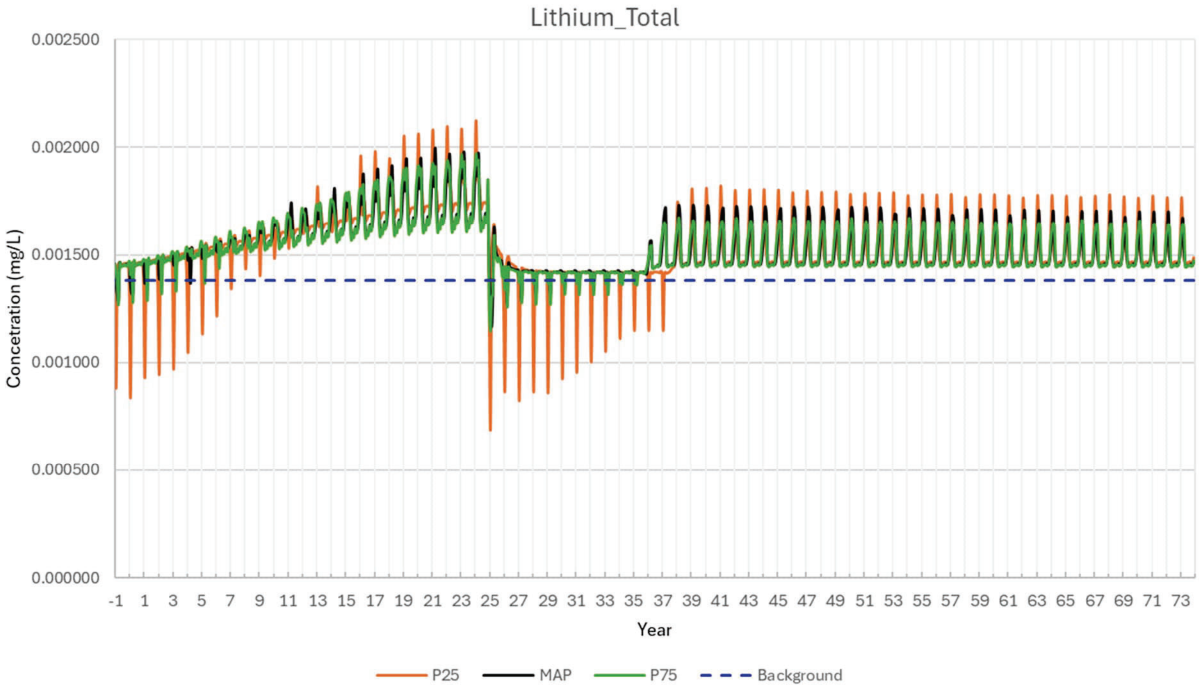

Figure 8D-17: Time series of modelled predictions of total lithium for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

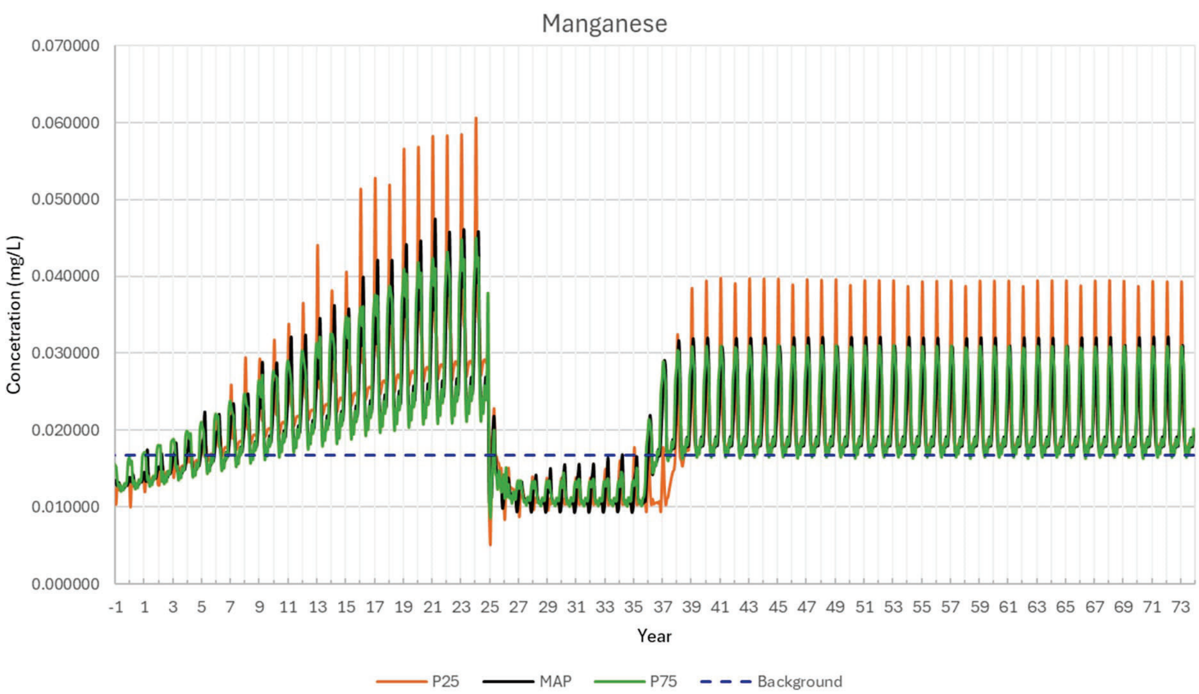

Figure 8D-18: Time series of modelled predictions of manganese for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) scenarios at Duley Lake outlet

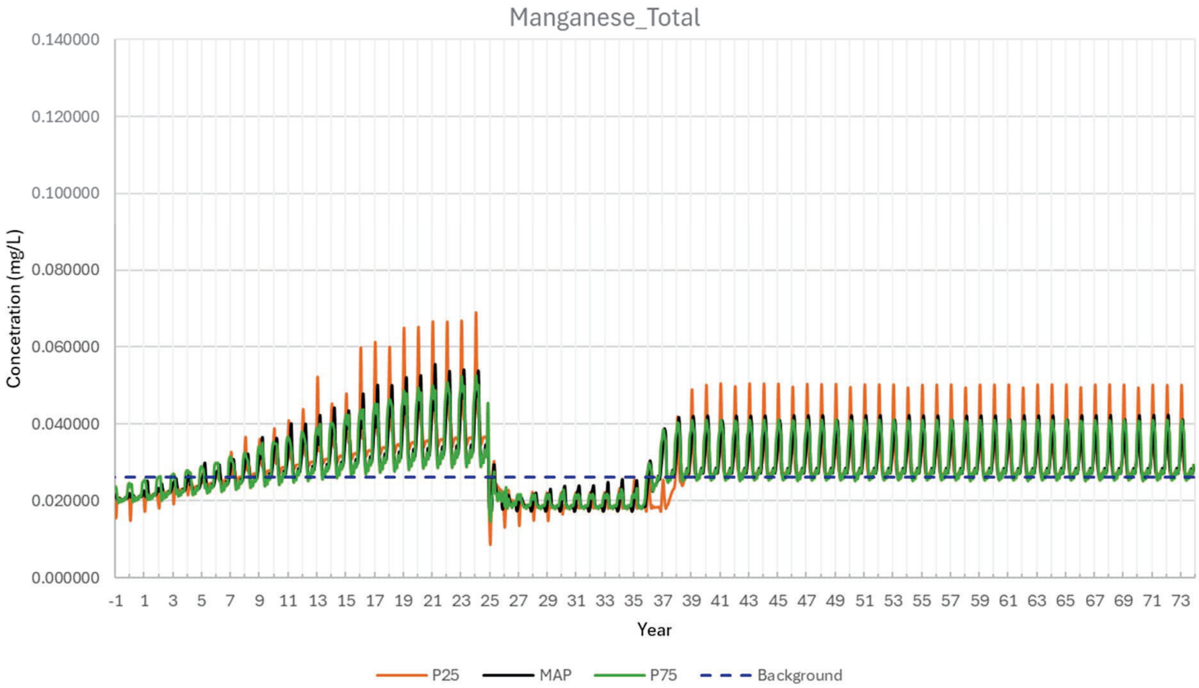

Figure 8D-19: Time series of modelled predictions of total manganese for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

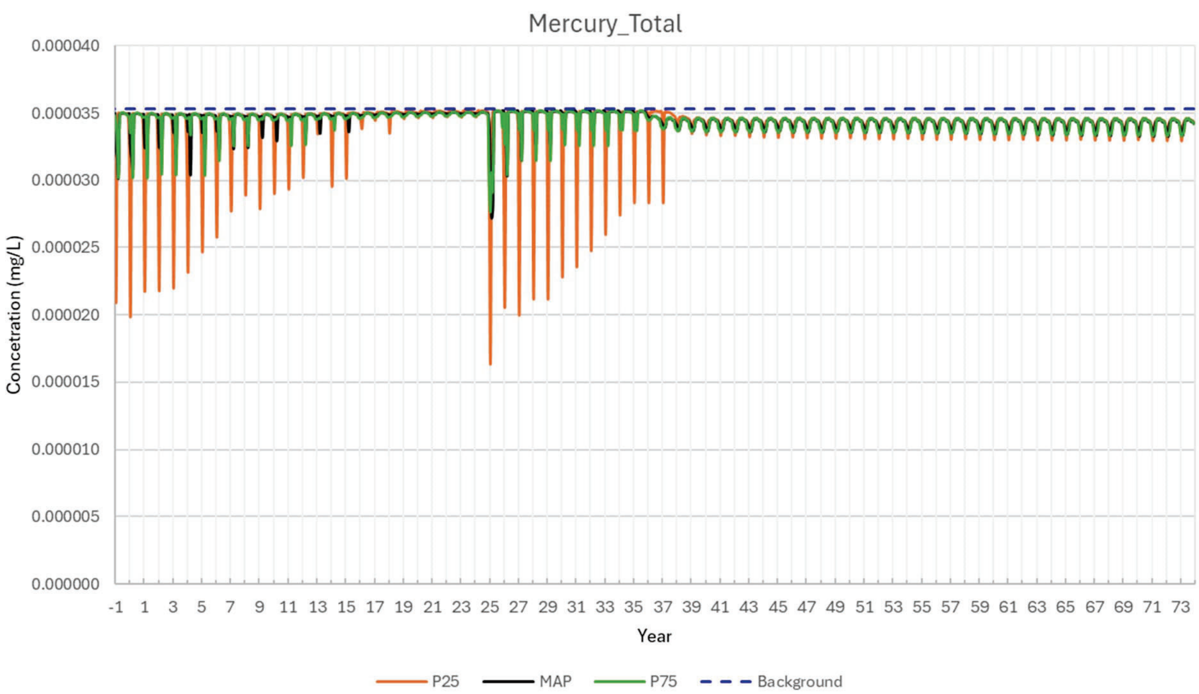

Figure 8D-20: Time series of modelled predictions of total mercury for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

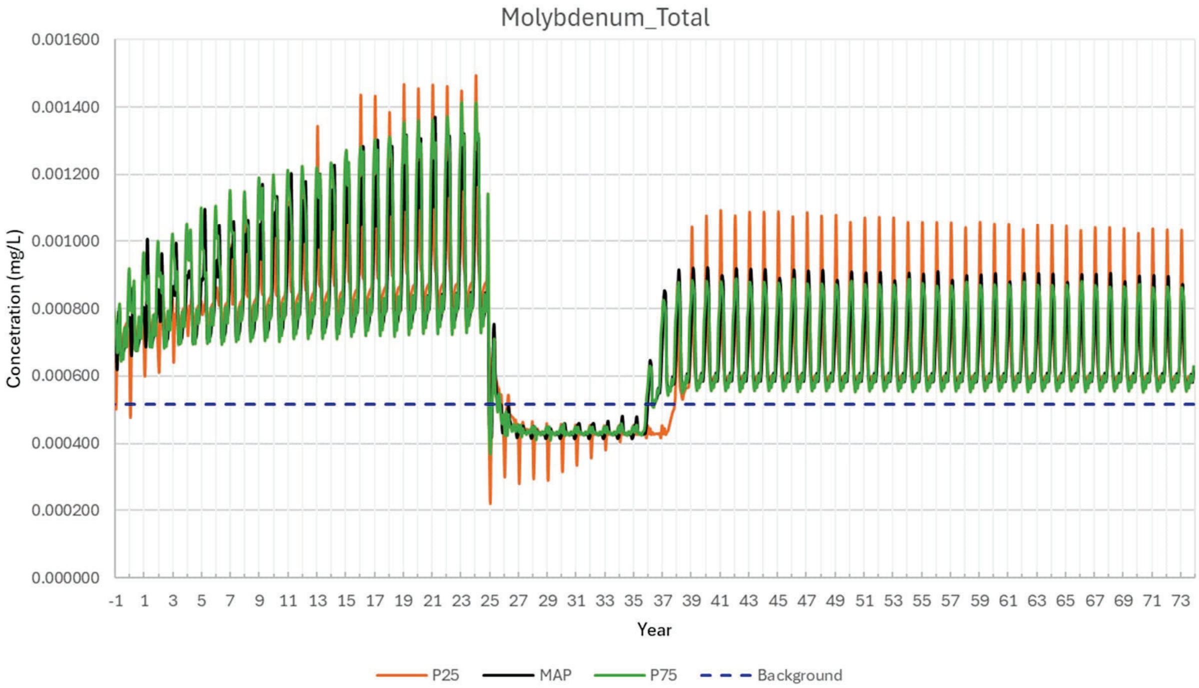

Figure 8D-21: Time series of modelled predictions of total molybdenum for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

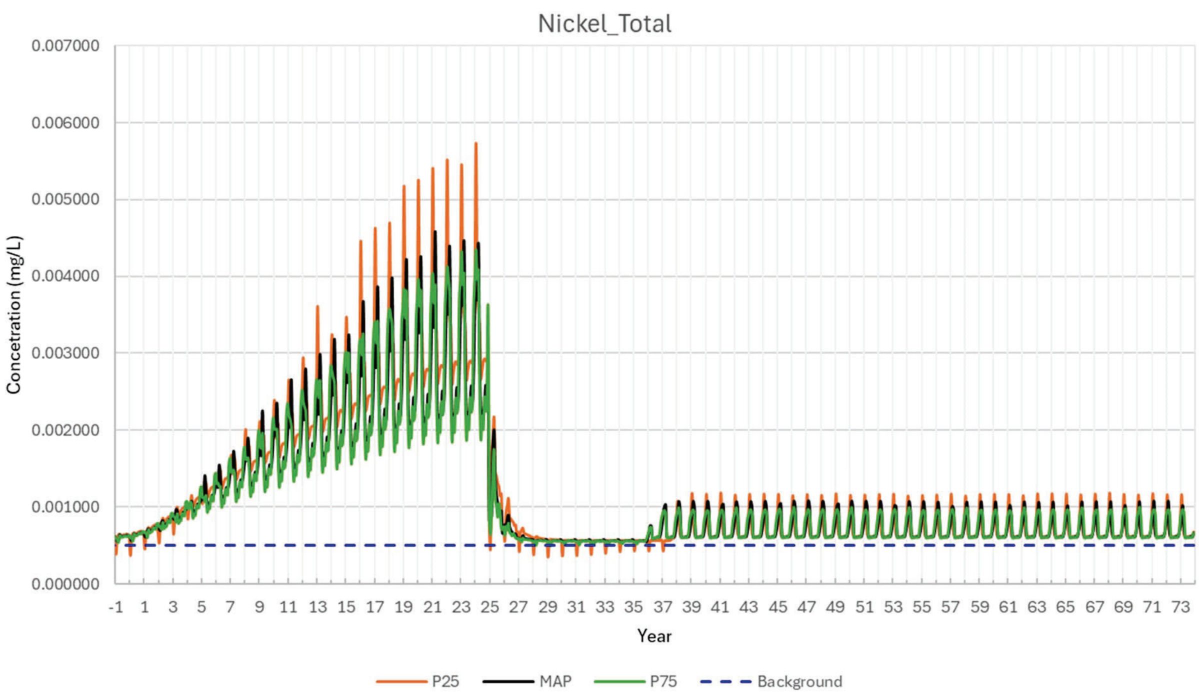

Figure 8D-22: Time series of modelled predictions of total nickel for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

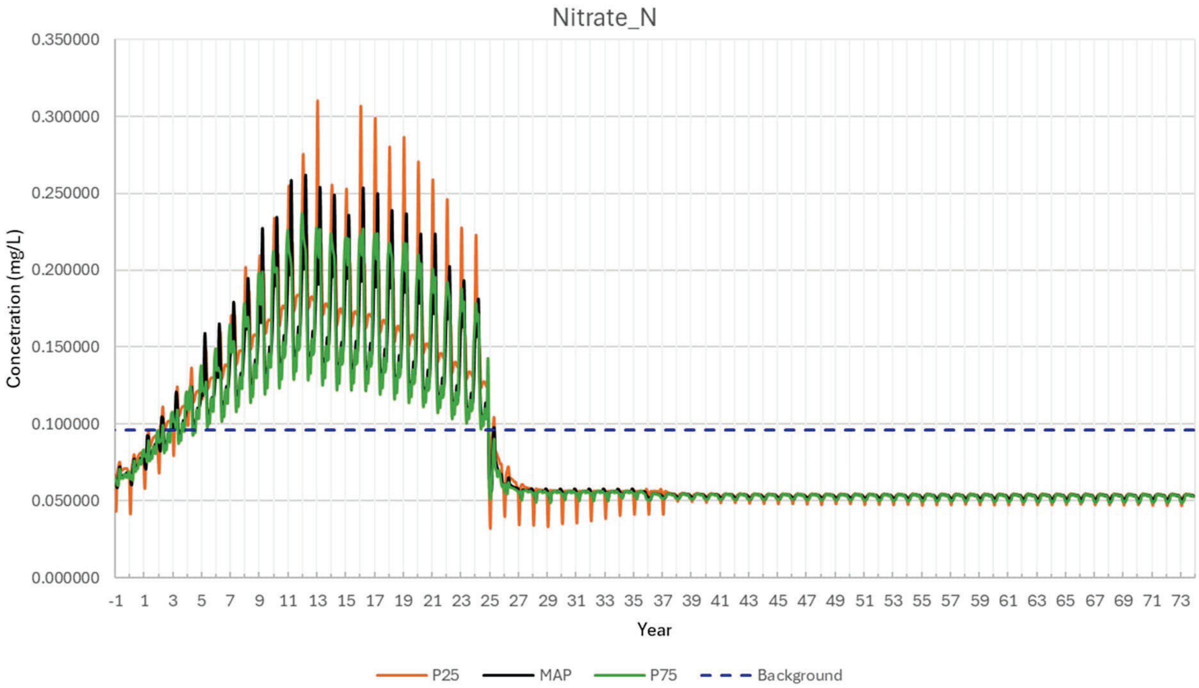

Figure 8D-23: Time series of modelled predictions of nitrate as N for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

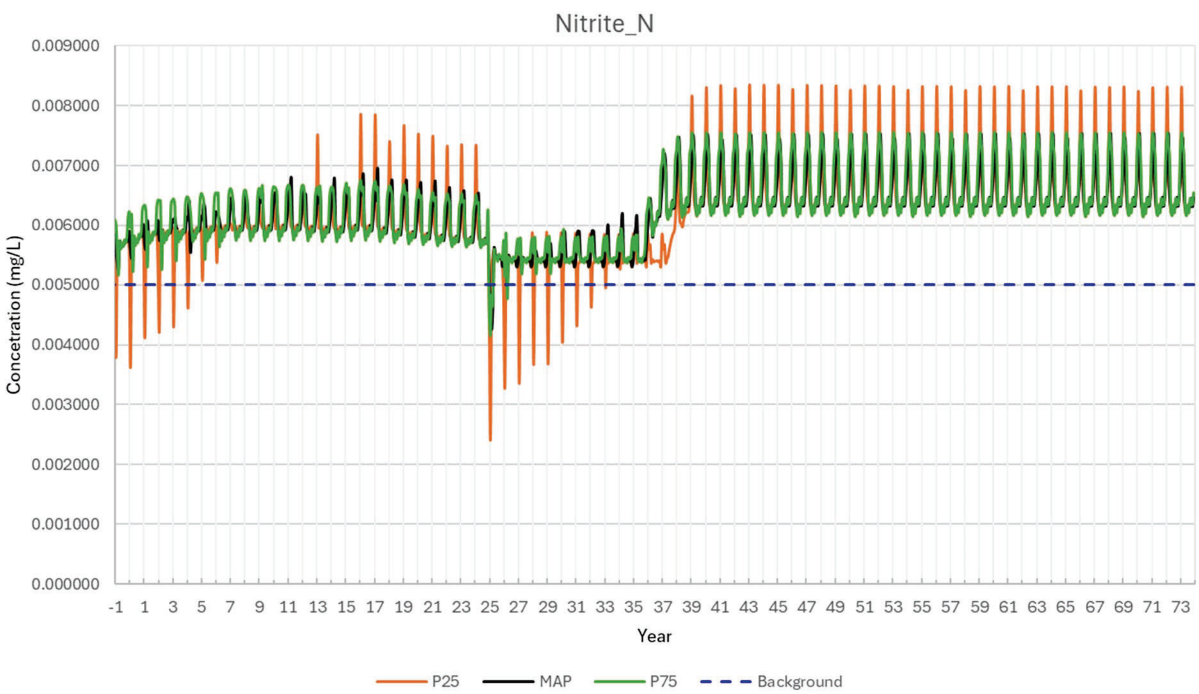

Figure 8D-24: Time series of modelled predictions of nitrite as N for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

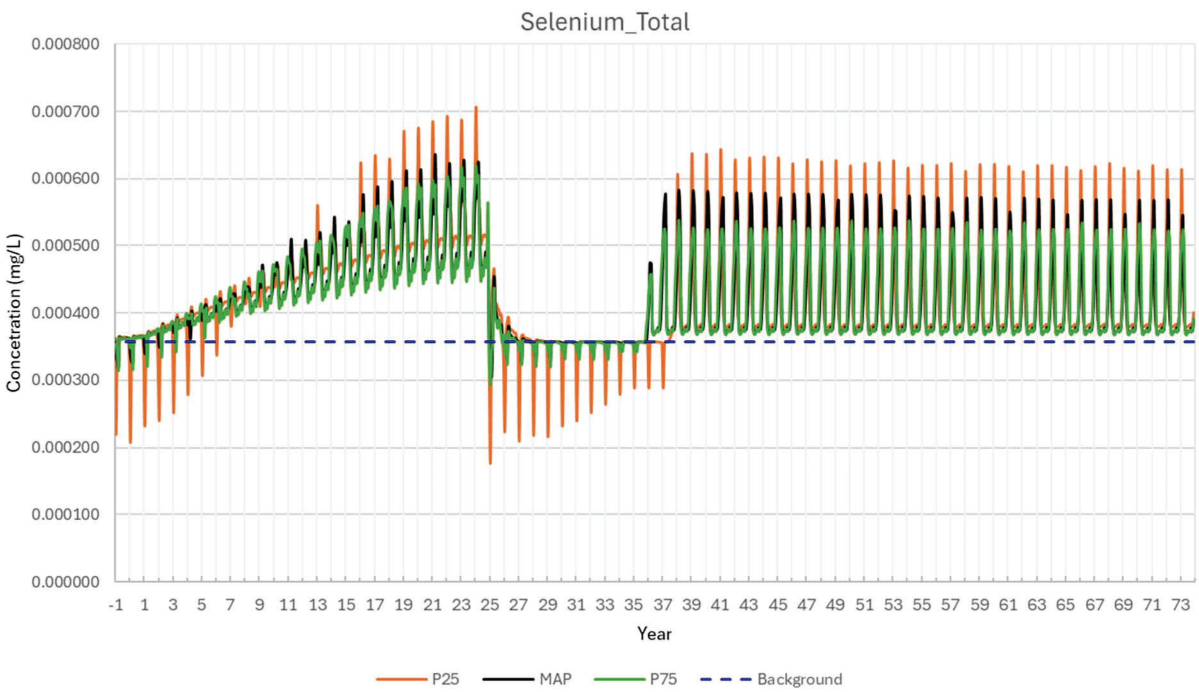

Figure 8D-25: Time series of modelled predictions of total selenium for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

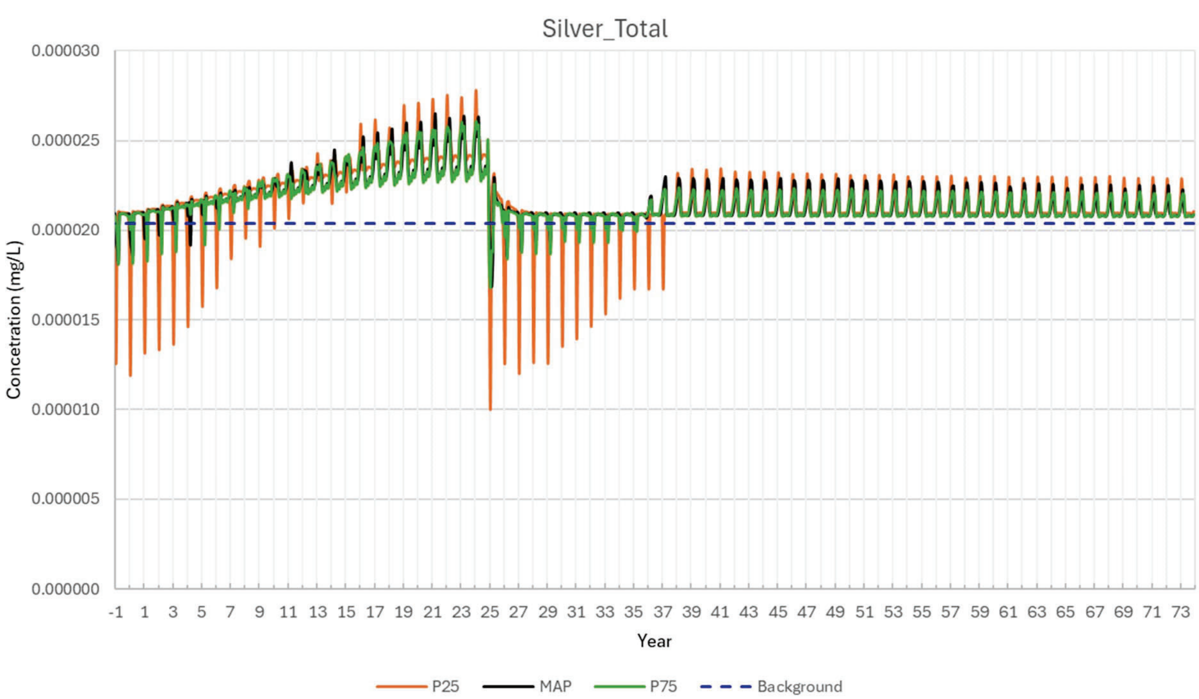

Figure 8D-26: Time series of modelled predictions of total silver for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

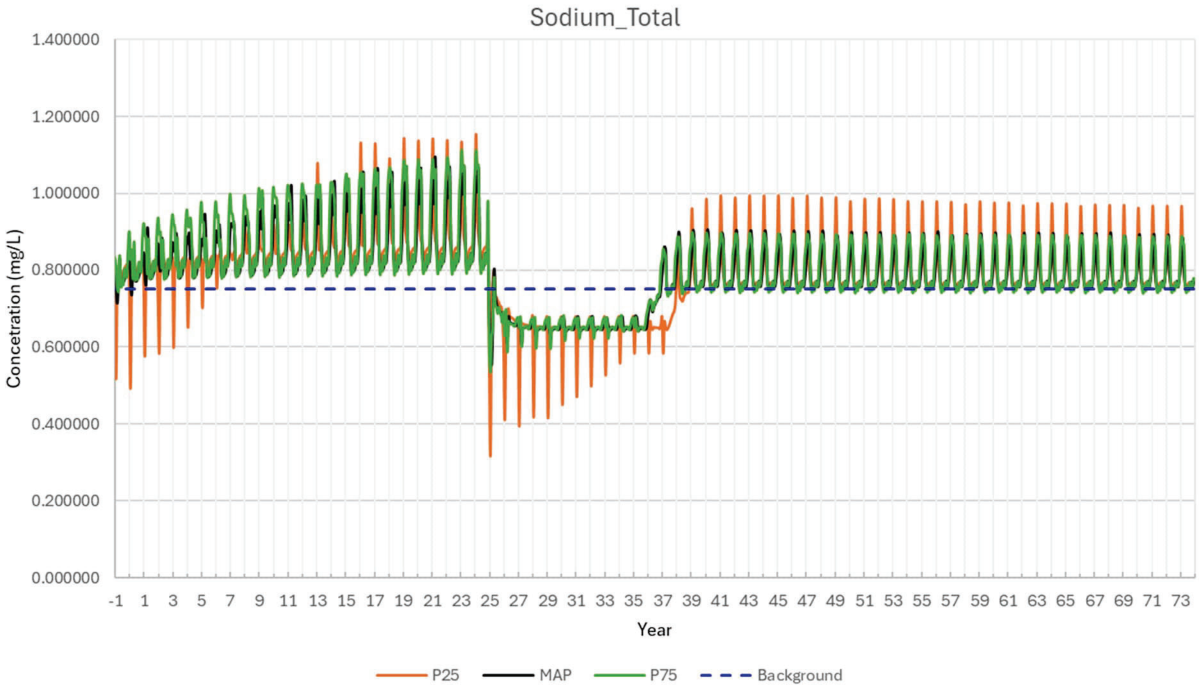

Figure 8D-27: Time series of modelled predictions of total sodium for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

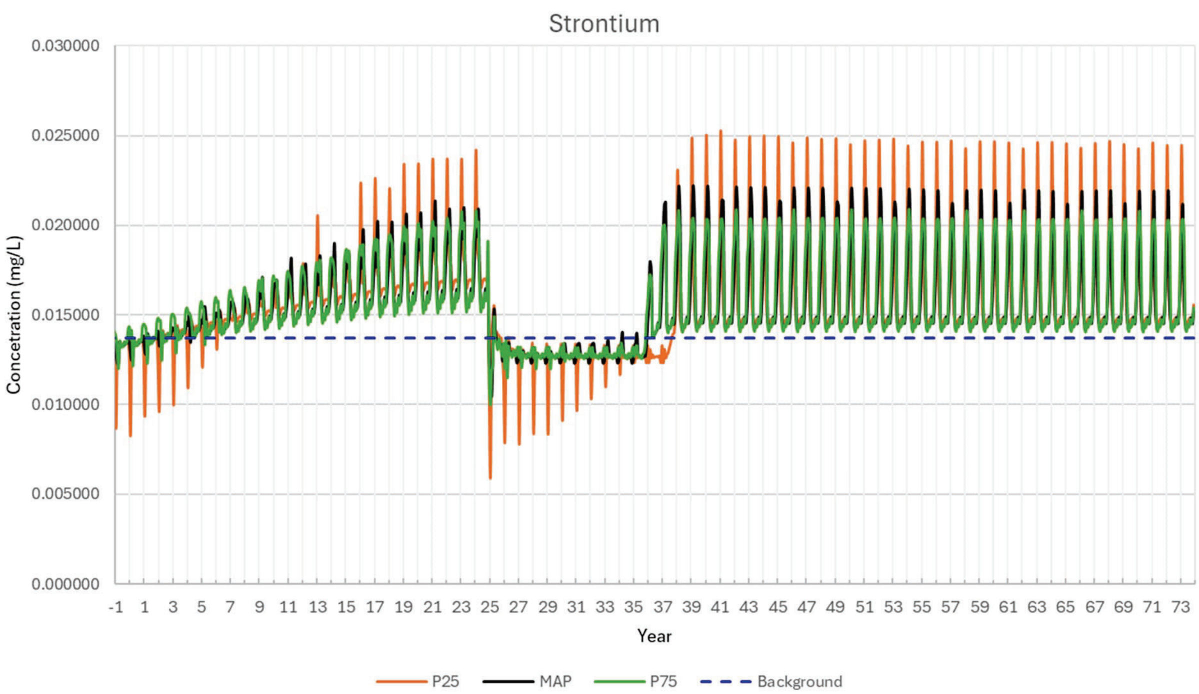

Figure 8D-28: Time series of modelled predictions of strontium for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

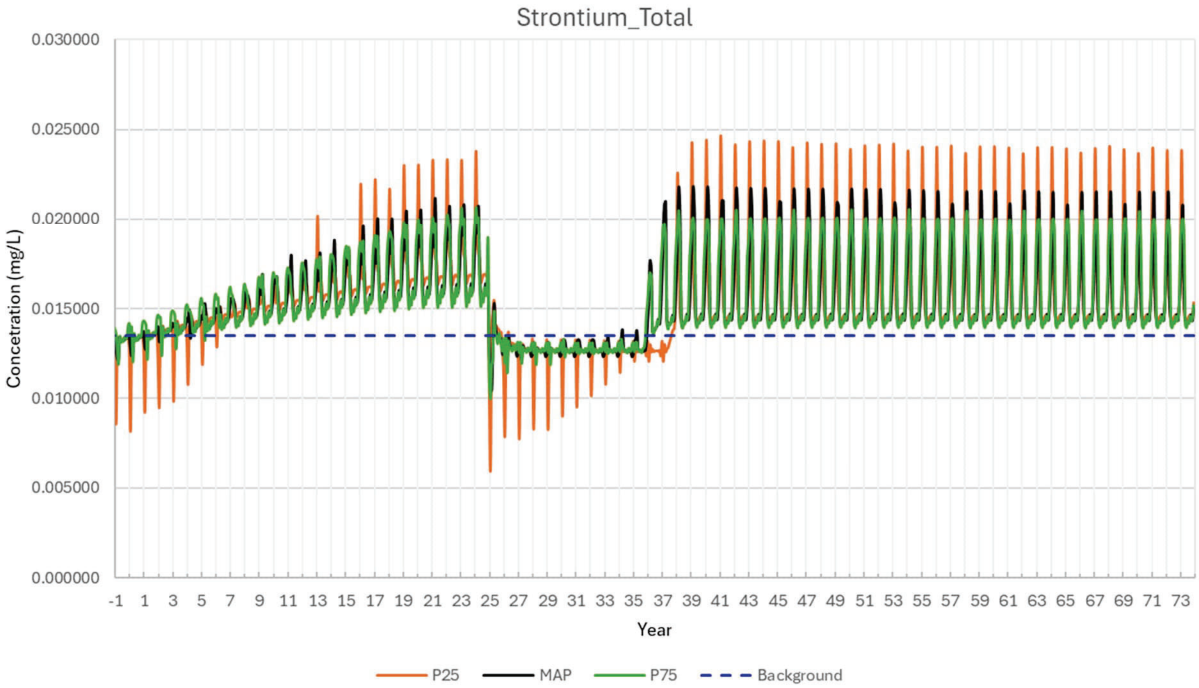

Figure 8D-29: Time series of modelled predictions of total strontium for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

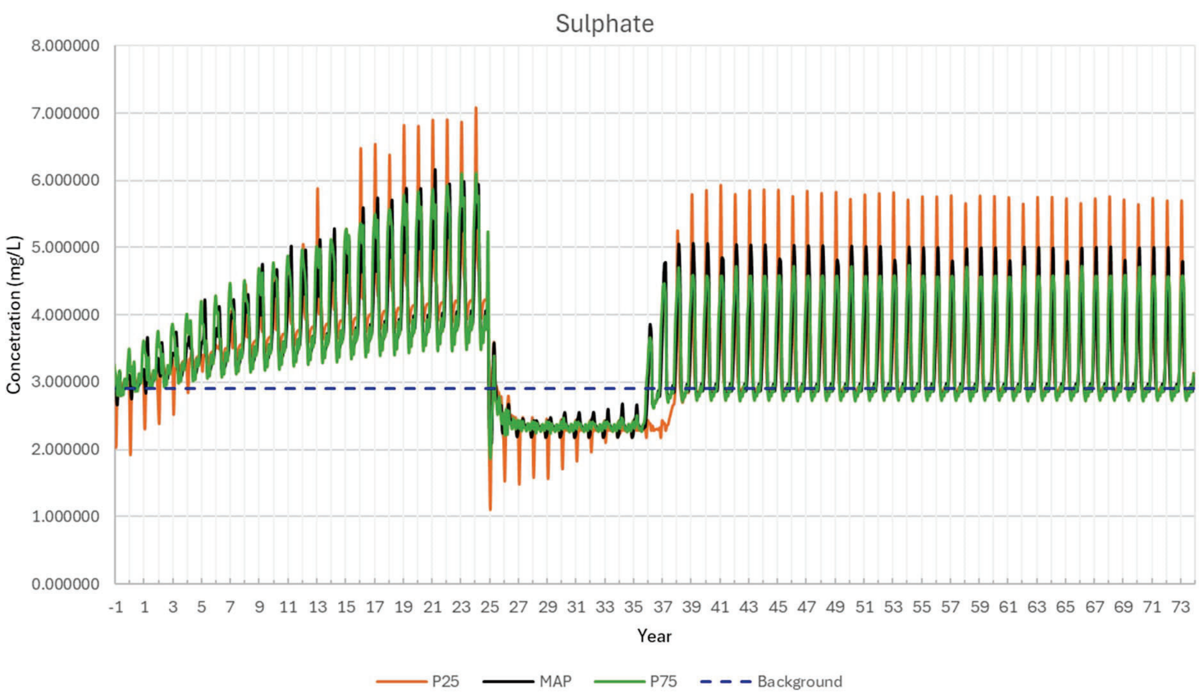

Figure 8D-30: Time series of modelled predictions of sulphate for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

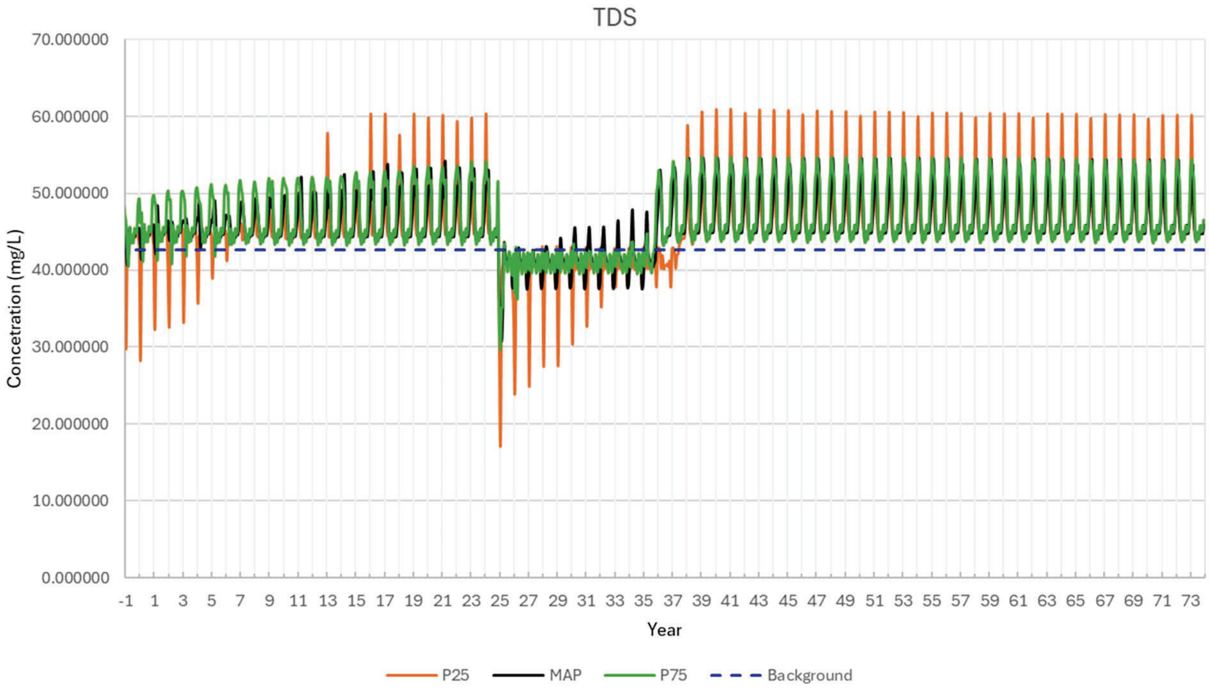

Figure 8D-31: Time series of modelled predictions of total dissolved solids for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

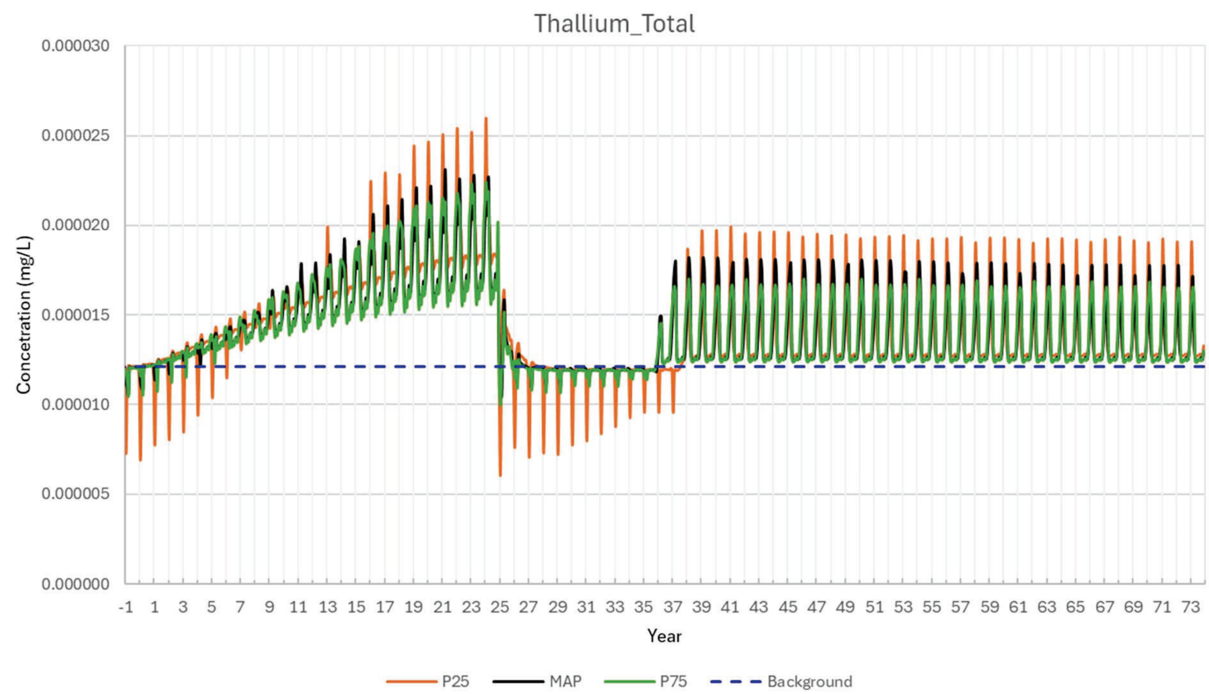

Figure 8D-32: Time series of modelled predictions of total thallium for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

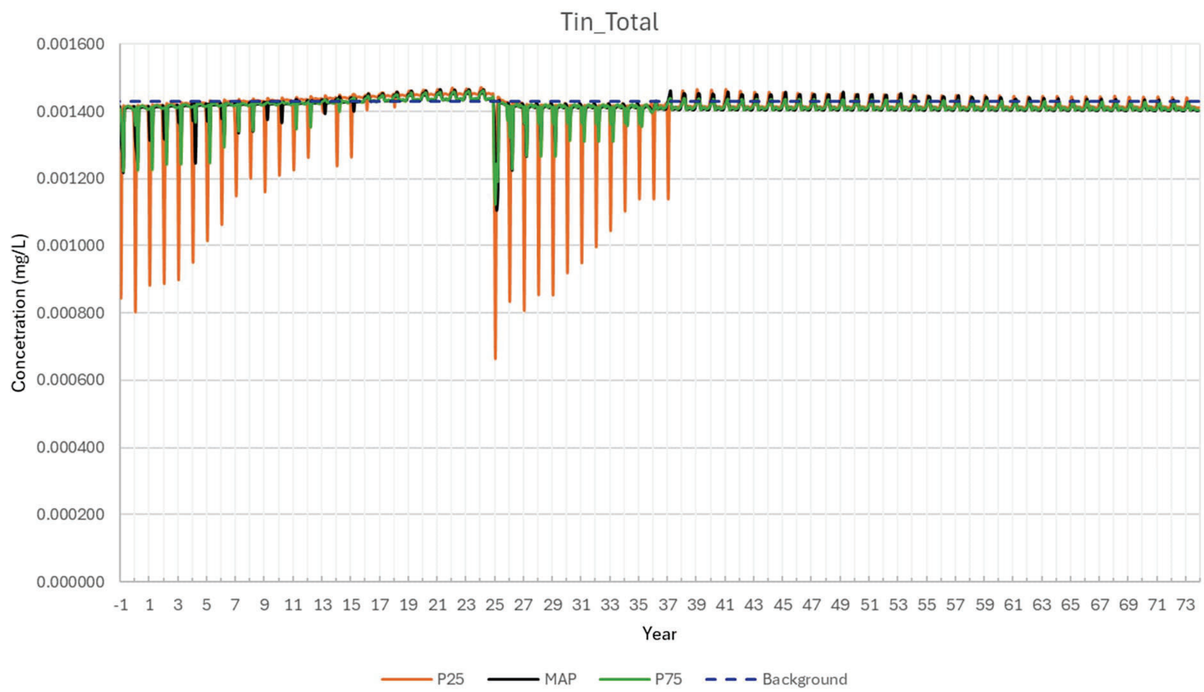

Figure 8D-33: Time series of modelled predictions of total tin for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

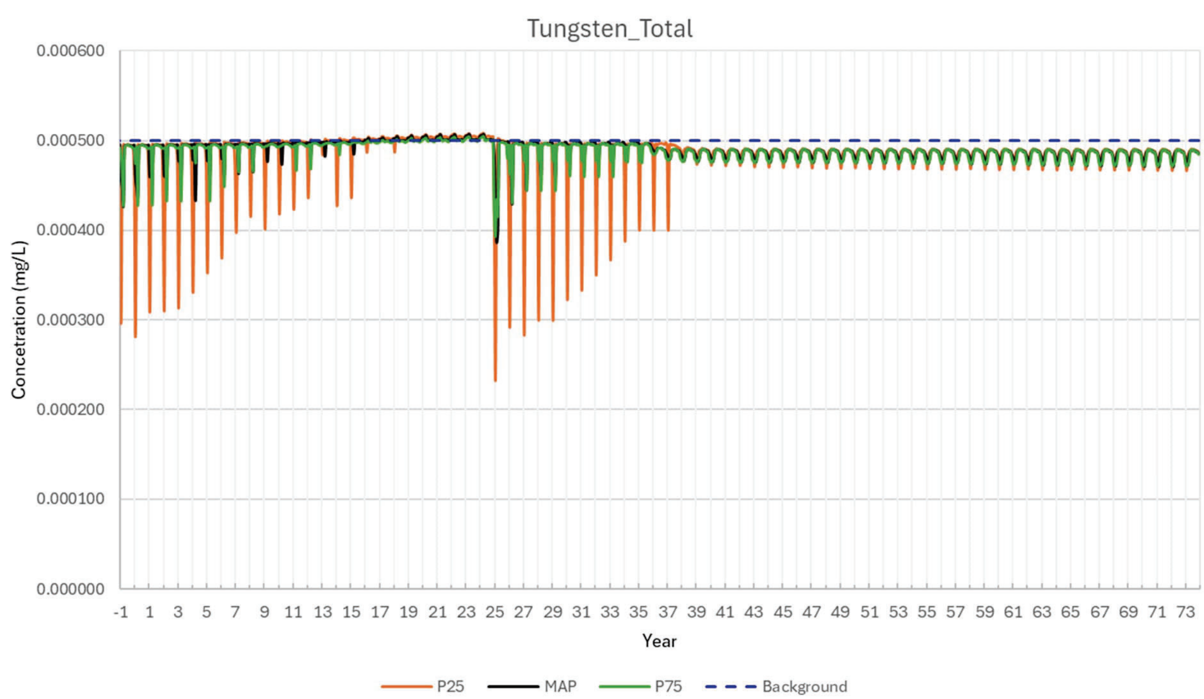

Figure 8D-34: Time series of modelled predictions of total tungsten for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

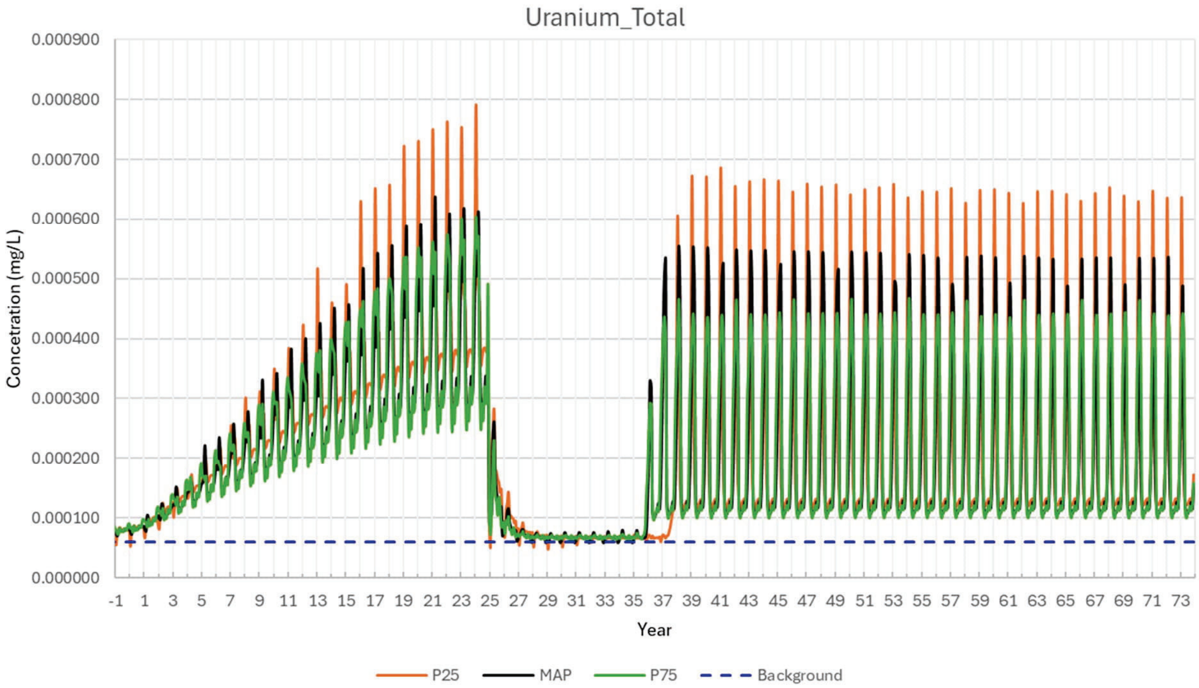

Figure 8D-35: Time series of modelled predictions of total uranium for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

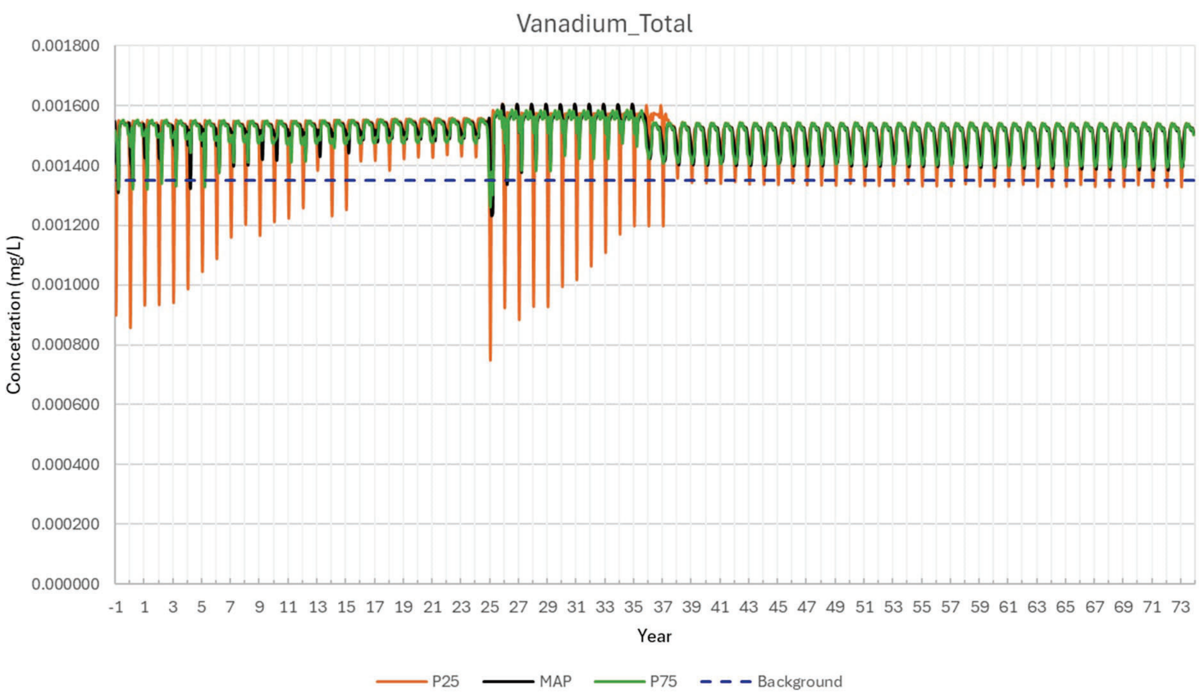

Figure 8D-36: Time series of modelled predictions of total vanadium for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

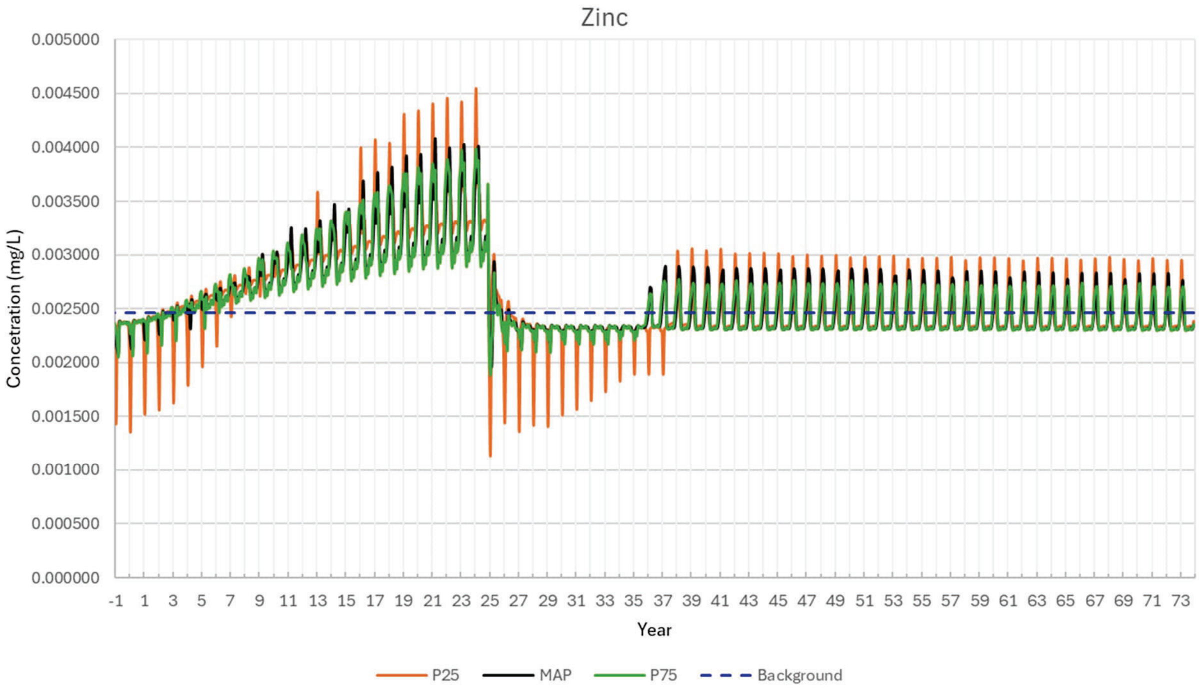

Figure 8D-37: Time series of modelled predictions of zinc for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

Figure 8D-38: Time series of modelled predictions of total zinc for 25th Percentile (P25), Mean Annual Precipitation (MAP) and 75th Percentile (P75) model scenarios at Duley Lake outlet

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9. Fish and Fish Habitat

Chapter 9, Fish and Fish Habitat, of the Environmental Impact Statement characterizes the existing aquatic environment, Project-environment interactions and potential effects, and predicted residual and cumulative effects of the Project on fish and fish habitats. The Project can potentially cause adverse effects on components of the aquatic environment by loss of fish habitat and altering water chemistry in water features near the Project site. The assessment of fish and fish habitat relies on not only the species and habitat information specifically described in this chapter but also the predicted changes in other valued environmental components (VECs) including surface water, groundwater, and noise and vibration. For example, changes in surface water flows or groundwater can affect aquatic and terrestrial ecosystems, as well as those that rely on natural resources or ecosystem services (e.g., fish, plants, and wildlife). Therefore, the fish and fish habitat assessment utilizes information from other chapters to support the assessment where applicable. However, the details of these VECs are provided in their relevant EIS chapter.

9.1 Approach to the Effects Assessment

The methods and assessment presented in this chapter were developed in consideration of the requirements under the provincial Newfoundland and Labrador *Environmental Protection Act* (NL EPA), with specific consideration of the requirements set out in the provincial Environmental Impact Statement Guidelines (EIS Guidelines) for the Project issued by the Minister of Environment and Climate Change (Government of Newfoundland and Labrador 2024a). A table of concordance to the EIS Guidelines is provided in the Executive Summary. The assessment of fish and fish habitat followed the overall effects assessment approach and methods (**Chapter 4, Effect Assessment Methodology**).

Where possible, comparison to the outcomes of the assessment of fish and fish habitat completed within the Alderon EIS has been made to highlight where effects have been reduced through consideration of environmental design features and mitigation or where new adverse effects may be introduced and require additional consideration in Project planning.

9.2 Integrating Engagement from Indigenous Groups and Local Stakeholders

Champion has engaged with potentially affected Indigenous groups and local community stakeholders since acquiring the Project in 2021. The overall approach and methods for incorporating engagement feedback into the EIS are discussed in detail in **Chapter 22, Engagement**.

Issues and concerns related to fish and fish habitat raised by Indigenous groups and local stakeholders, and how these issues and concerns were addressed through the assessment, are summarized in Table 9-1, including cross-references to where comments were considered or addressed in the chapter.

Table 9-1: Summary of Issues and Concerns Related to Fish and Fish Habitat by Indigenous Groups and Local Stakeholders

Comment Theme	How is it addressed in the Assessment	Where was it addressed in the Assessment	Indigenous Group or Local Stakeholder	Raised in Alderon EIS (Yes/No)
Concerns of environmental protection	Mitigation measures are implemented for each predicted effect.	Section 9.5	Innu Nation	Yes
Interest in an environmental evaluation report	EA describes mitigations and follow-up monitoring commitments. The EIS release will likely include monitoring of fish and fish habitat as a condition of release. The *Fisheries Act* authorization will also require detailed monitoring. Monitoring outputs will be made available upon request.	Section 9.7	Innu Takuaikan Uashat mal Mani-Utenam	No

Comment Theme	How is it addressed in the Assessment	Where was it addressed in the Assessment	Indigenous Group or Local Stakeholder	Raised in Alderon EIS (Yes/No)
Concerns of potential dust emissions and impacts on fish and fish habitat.	Dust emissions and their potential effects to fish health, survival, reproduction, and lower trophic organisms was considered as an effect in the EIS.	Section 9.5.2	Newfoundland and Labrador's Department of Environment and Climate Change, Newfoundland and Labrador's Department of Industry, Energy and Technology, and Newfoundland and Labrador's Office of Indigenous Affairs and Reconciliation	No
Concerns regarding the St. Lewis River Enhancement Project: concerns with Atlantic salmon accessing areas they had never reached.	The Fish and Fish Habitat Offsetting Plan (TSD IX) documents the options for offsetting for the Project. Champion will continue to discuss the Offsetting Plan with the NCC.	The Fish and Fish Habitat Offsetting Plan is included in Technical Support Document (TSD) IX of the EIS.	NunatuKavut Community Council	No

9.3 Assessment Scoping

This section identifies key issues for fish and fish habitat, defines and provides a rationale for selecting fish health and fish habitat and productivity, identifies the measurable parameters selected for the assessment, and defines assessment boundaries for fish and fish habitat.

9.3.1 Key Issues

Key issues often relate to the potential environmental, social, economic, and health effects of a proposed project. Key issues identified for the Project reflect the primary concerns of regulatory authorities, Indigenous groups, and local stakeholders, including residents, cabin owners, business owners, and other interested parties.

To identify key issues related to fish and fish habitat, the following sources were reviewed:

- Section 4.1 of the EIS Guidelines that summarizes key issues from regulatory agencies and feedback on the Project Registration and draft EIS Guidelines
- the record of engagement (Chapter 22) that captures engagement input received through meetings, phone calls, letters, and interviews
- past experience with mining projects in Labrador
- key issues identified in the previous Alderon EIS

Key issues related to fish and fish habitat include the following:

- alteration, temporary disruption and/or destruction of fish and fish habitat
- introduction of barriers to fish passage
- sedimentation of water features
- changes in water quality and temperature
- alteration of surface water flow and groundwater
- loss of biodiversity
- introduction of invasive species
- fish disturbance via other VECs, such as noise and vibration

9.3.2 Valued Environmental Components and Measurable Parameters

Fish and fish habitat was selected as a VEC due to its ecological, cultural, economic, and recreational value to Indigenous groups, the public and the government. Fish and fish habitat are defined as follows:

- Fish habitat refers to waters inhabited by fish, either temporarily or permanently, which directly or indirectly support their life processes, including, but not limited to, spawning, nursing, rearing, and migrating (Government of Canada 1985).
- Fish refers to shellfish, crustaceans, and marine animals, including, but not limited to, eggs, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals (Government of Canada 1985).

Project activities such as groundwater changes (**Chapter 7**), surface water changes (**Chapter 8**), and alterations to vegetation, wetlands, and protected areas (**Chapter 10**), noise and vibration (**Chapter 6**) may effect fish and fish habitat. Potential effects include changes or cessation of water flow, introducing discharges or effluents into watercourses, removing riparian vegetation, excavating soils and mine rock, and vibrations during fish egg incubation.

The quality and quantity of freshwater fish and fish habitat are key indicators of the overall health of an aquatic ecosystem. To assess effects to fish and fish habitat, two VECs were identified: fish health and fish habitat and productivity.

Through mitigation and offsetting measures, potential harmful alteration, disruption, or destruction of fish habitat (HADD) will be eliminated or compensated for, as required under the *Fisheries Act.* Project activities and facilities are expected to potentially effect 671,602.7 square metres (m^2) to varying degrees.

Measurable parameters characterize changes to environmental attributes caused by the Project, other human developments, and natural factors. Eight measurable parameters were identified to predict the Project's potential effect on fish health and fish habitat and productivity.

Fish health:

- loss of fish
- loss of species of conservation interest
- alteration of water and/or sediment quality
- reduction in fish health (length/weight ratio)

Fish habitat and productivity:

- area of fish habitat lost or altered
- barriers to fish passage
- reduction or alteration of riparian vegetation
- change in river/stream flow (m^3/sec)

The fish and fish habitat VECs, the rationale for selection, and measurable parameters are summarized in Table 9-2. VEC assessments that are supported by the assessment of the fish and fish habitat VECs is also presented in Table 9-2.

Table 9-2: Valued Environmental Components, Rationale for Selection, and Measurable Parameters

Valued Environmental Component	Rationale for Selection	Measurable Parameters	Linkages to other VECs
Fish health	— Project activities may directly lead to fish mortality — Fish were observed in several rivers and lakes in the Project area — Potential to be altered by changes in surface water flows and quality — Potential to be altered by changes in groundwater upwelling	— Loss of fish — Loss of species of conservation interest — Alteration of water and/or sediment quality — Reduced fish health (length/weight ratio)	— Groundwater — Surface Water — Wildlife — Noise and Vibration — Community Health and Well-Being

Valued Environmental Component	Rationale for Selection	Measurable Parameters	Linkages to other VECs
	— Potential to be altered by changes in surface and groundwater quality — Easily quantifiable via fish surveys and length/weight ratio		
Fish habitat and productivity	— Alteration or destruction of fish habitat could affect the fish species, ecosystem health, and biodiversity — Aquatic habitat provides habitat for various species, including species protected under the *Species at Risk Act* and the *Fisheries Act* — Improperly installed or mitigated crossing structures can cause sedimentation and habitat fragmentation	— Area of fish habitat lost or altered — Barriers to fish passage. — Reduction or alteration of riparian vegetation — Change in river/stream flow (m^3/sec)	— Groundwater — Surface water — Vegetation, Wetlands and Protected Areas — Wildlife

9.3.3 Assessment Boundaries

Assessment boundaries define the spatial and temporal extents of the assessment for each VEC. The spatial boundaries for fish and fish habitat are defined in Table 9-3 and shown in Figure 9-1 and consists of the site study area (SSA), a local study area (LSA), and a larger regional study area (RSA).

The SSA includes the proposed infrastructure for the Project (i.e., the Project footprint) with an additional buffer to account for existing uncertainty in the final design of the Project to conservatively assess potential adverse effects on VECs (i.e., the SSA area is twice the size of the anticipated Project footprint). The SSA is constrained from avoidance of specific features, including major lakes, the Quebec-Labrador provincial border, and sensitive features, such as the Wahnahnish Lake Protected Public Water Supply Area. The SSA represents the smallest scale of assessment and an area where the potential direct effects of the anticipated Project can be accurately and precisely assessed.

The LSA encompasses all areas where potential Project activities may be measurable to some degree of confidence but exceed the SAA footprint, representing the scale to which potential effects on fish and fish habitat from the Project are anticipated. This includes surrounding areas where potential environmental effects could occur, such as lakes downstream of watercourses directly adjacent to Project infrastructure footprints (e.g., Long Lake [referred to hereafter as Duley Lake]). The LSA includes all areas within the SSA. The LSA of the Alderon EIS remains unchanged.

The RSA encompasses all areas that Project activities may effect, providing a broader context for assessing the Project's potential effects on fish and fish habitat. It provides an appropriate scale to evaluate the cumulative effects of the Project, considering existing conditions and reasonably foreseeable projects (RFPs). This includes the furthest extent to which residual effects from Project activities could occur but are not directly measurable with a specific degree of confidence. This generally includes all watersheds surrounding the Project area that drain into and include Wabush Lake. The RSA includes all areas within the LSA. The RSA of the Alderon EIS remains unchanged.

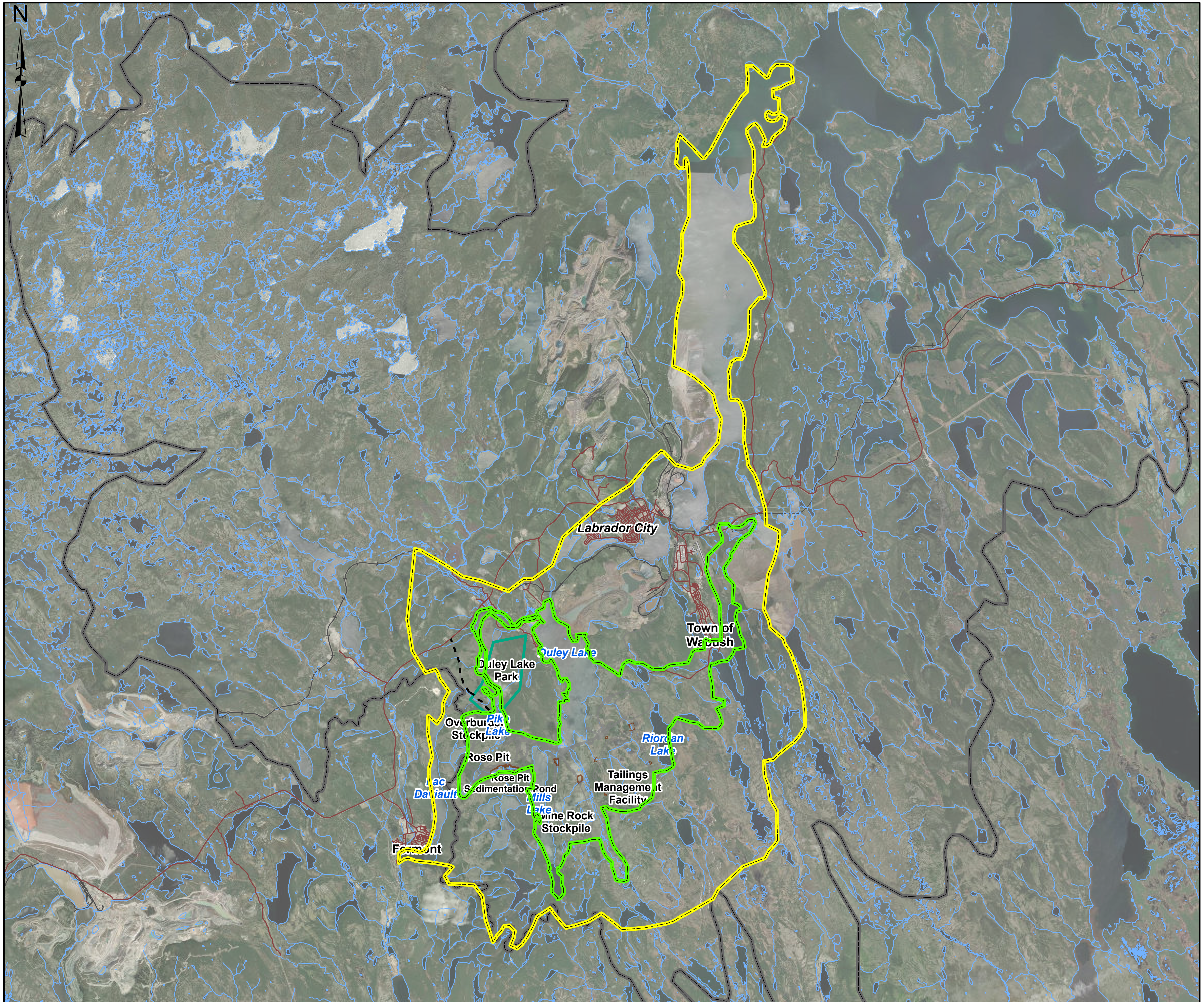
Table 9-3: Spatial Boundaries for Assessment of Fish and Fish Habitat Valued Environmental Components

Study Area	Area (ha)	Description/Rationale
SSA	4,323	The Project footprint includes additional buffered areas to conservatively incorporate a level of uncertainty into the Project design so that potential effects are not underestimated. The site assessment area was defined using bounding points around the outermost components of the Project footprint.
LSA	8,915	This includes the area of the SAA and the areas where Project effects are anticipated to be measurable to some degree of confidence, encompassing many watercourses and waterbodies adjacent to the various Project footprints.
RSA	42,206	Includes the area of the LSA plus the furthest extent to which effects from Project activities could occur but are not anticipated to be directly measurable to a specific degree of confidence, including the watersheds that drain into Wabush Lake.

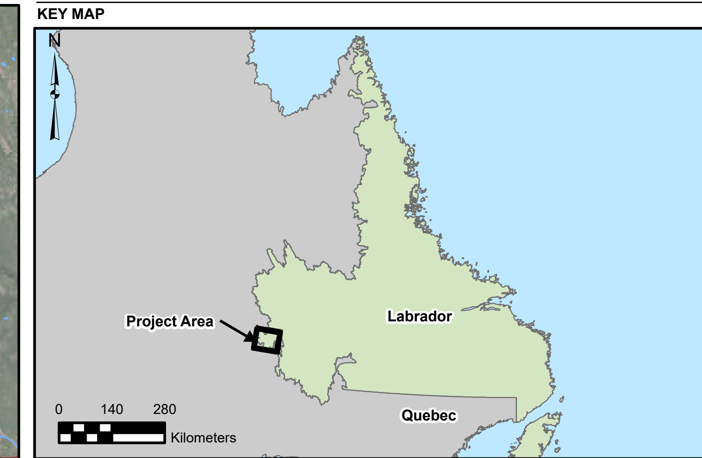
The temporal scope of the assessment focuses on the 40 years from initial construction to the end of decommissioning and rehabilitation (i.e., closure) as defined by the following Project phases:

- **The Construction Phase (Construction):** This phase includes site preparation, mine, process plant, site infrastructure development, and commissioning of the structures, systems, and components. It is expected to last four years.
- **Operations and Maintenance Phase (Operations)**: This phase includes the mining and milling of iron ore, production and shipment of iron ore concentrate, tailings management, management of mine rock, waste management, water management, release of treated effluent, site maintenance, and transportation of staff and materials to and from the site. Operations initiate with one year of pre-development mining (i.e., ramp-up) and conclude when processing is complete, which is expected to be 26 years.
- **Decommissioning and Rehabilitation Phase (Closure)**: This phase includes accelerated flooding of the Rose Pit, re-establishing passive surface water drainage following the pit-flooding period, and recontouring and revegetating disturbed areas. Physical infrastructure not required during post-closure monitoring and for other activities required to achieve the Project's decommissioning criteria and to return the Project site to a safe and stable condition will be removed. Closure is expected to be 10 years.

Seasonality is the most significant factor concerning temporal boundaries affecting fish and fish habitat. Many species discovered via fish surveys (Section 9.4.2) were fall and spring spawners, often emerging following the spring ice melt. The temporal windows in which these species are most vulnerable are September and October for the fall spawners and April to June for the spring spawners. For example, excessive sedimentation of a watercourse during the fall spawning of salmonids could smother the eggs already laid in clean gravel, resulting in the net loss of that year's young.



KEY MAP



SCALE 1:20,000,000

Legend

- Fish Local Study Area (LSA)
- Fish Regional Study Area (RSA)
- Labrador/Quebec Boundary
- Duley Lake Park
- Proposed Sediment Pond
- Proposed Project Infrastructure
- Road
- Potential Access Road
- Watercourse
- Railway

0 2,500 5,000 10,000
1:200,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. IMAGERY CREDITS: WORLD IMAGERY: EARTHSTAR GEOGRAPHICS
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N
4. ELC CLASSIFICATION PROVIDED BY WSP CANADA INC.

CLIENT
CHAMPION IRON MINES LTD.

PROJECT
KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE
2025 FISH HABITAT SUITABILITY STUDY AREA

CONSULTANT
Kami

YYYY-MM-DD	2025-06-30
DESIGNED	----
PREPARED	MS
REVIEWED	BM
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0005	0	9-1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

9.3.4 Administrative Boundaries

Considerations and requirements concerning fish and fish habitat include the federal *Fisheries Act*, the federal *Species at Risk Act* (SARA), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and their supporting regulations. While there were no species found during surveys that are listed under either SARA or COSEWIC, local anglers have reported catching Atlantic salmon (*Salmo salar)*, which are locally referred to as "ouananiche," in the watercourses and waterbodies near the Project site. Atlantic salmon populations are divided into designated units (DUs) because each group or population has unique characteristics (Lehnert et al., 2023). The anglers were referencing the land-locked population, which is not part of any DU, as these DUs only apply to anadromous populations. Thus, the population in question is not listed under SARA or COSEWIC. No other fish species observed through fish surveys or reported by locals are listed under SARA or COSEWIC.

Habitat alteration effects are to be registered under sections 35 and 36 (specifically the Metal and Diamond Mining Effluent Regulations) of the federal *Fisheries Act*. Project effects that will result in HADD of fish habitat will be authorized/permitted under a section 35 authorization submission to Fisheries and Oceans Canada (DFO). Project effects that are likely to pollute the water of fish habitat will be authorized/permitted under a section 36 submission through Environment and Climate Change Canada (ECCC). These authorizations occur outside of the EIS approval process.

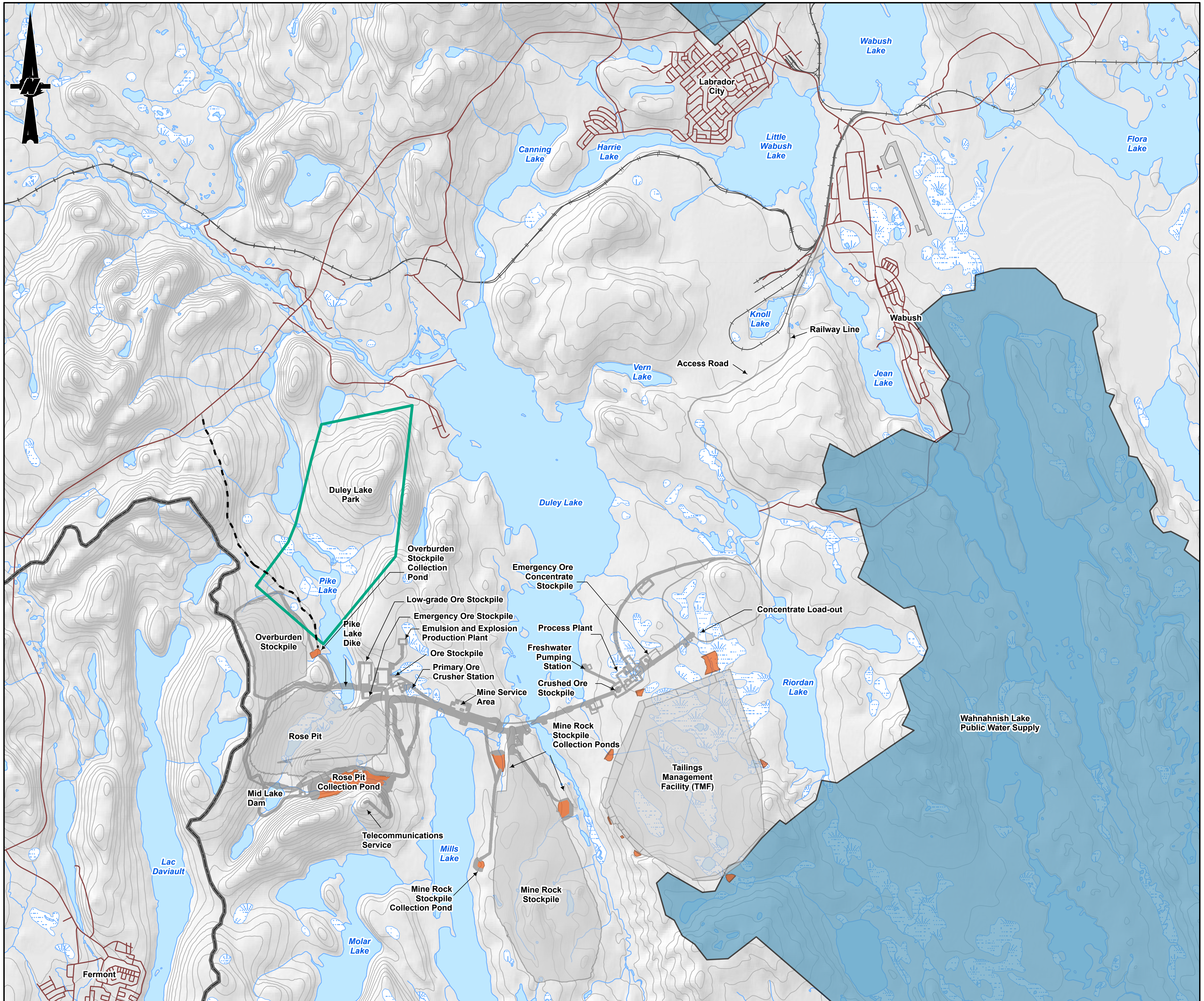
Section 35 of the Federal *Fisheries Act* is the primary driver allowing Project activities that likely effect fish habitats. Following a project review during the post-EIS project permitting stage, which defines the amount of habitat that will undergo HADD, DFO will determine the amount of habitat that must be compensated for elsewhere via a process referred to as offsetting. It is then up to the proponent to complete a restoration project, or projects, that will create the amount of habitat defined by DFO. Once this information is in place, a federal *Fisheries Act Authorization* (FAA) can be submitted to the Department of Fisheries and Oceans (DFO), which, upon acceptance, will enable the Project to proceed under the relevant regulations.

Like the FAA under section 35 of the *Fisheries Act*, an Environmental Compliance Approval (ECA) and an Effluent Discharge Permit under section 36 of the Act must be obtained from the ECCC before the Project begins.

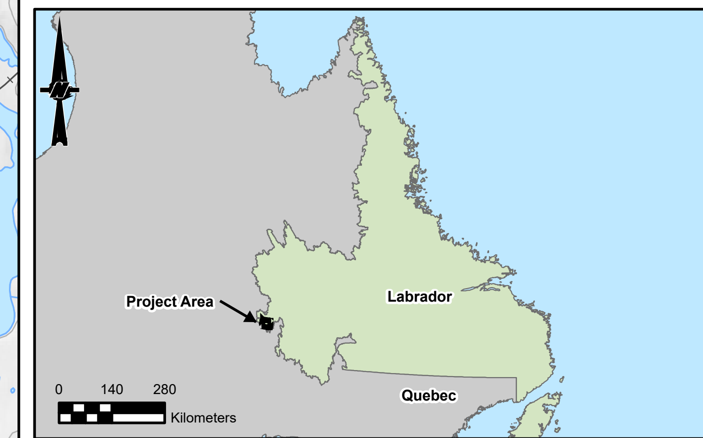
9.4 Existing Environment

The existing environment for fish and fish habitat generally formed the basis against which the potential Project and cumulative effects were assessed. The existing environment also represents the outcome of historical and existing environmental and socio-economic pressures that have shaped the current condition of fish and fish habitat. Environmental and socio-economic pressures or factors resulting in existing conditions of the environment were natural (e.g., weather, wildfires, predation, disease, climate change) or human-related (e.g., industrial development, forestry, changing business models, fishing, hunting).

Since 2011, numerous baseline studies have been conducted to support the characterization of the existing environment of fish and fish habitats. These studies were designed to gather information on the presence and abundance of fish species across the Project area and describe the aquatic habitats.



KEY MAP



SCALE 1:20,000,000

Legend

PROJECT DATA

- Proposed Project Infrastructure
- Proposed Sediment Pond
- Potential Access Road

BASEMAP INFORMATION

- Duley Lake Park
- Railway
- Watercourse
- Contour
- Bog/Wetland
- Waterbody
- Labrador/Quebec Boundary
- Public Water Supply

0 1,000 2,000 4,000

1:71,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE

PROJECT LOCATION AND SITE LAYOUT

CONSULTANT

Kami

YYYY-MM-DD	2025-06-30
DESIGNED	----
PREPARED	GM/MS
REVIEWED	BM
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0005	0	9-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

9.4.1 Methods

Below is a summary of the methodologies employed during the 2011, 2012, 2023, and 2024 field surveys. As the methods used in the 2011 and 2012 surveys are the same as those used in 2023 and 2024, the validity of the earlier data remains to provide consistent data and characterization. Many habitats were previously sampled during the last successful assessment (i.e., Alderon) and *Fisheries Act* Authorization and were re-sampled in recent baseline programs. The focus of the 2023 and 2024 baseline data collection has been to supplement the existing data set by collecting additional information from waterbodies that may be affected by proposed changes from the original Project design.

9.4.1.1 Fisheries Literature Review and Interviews

Literature reviews of available, published information on regional limnology, regional hydrology, fish, and fisheries were completed, and relevant data were consolidated. In addition, interviews were conducted in 2012 with Labrador City/Wabush and Fermont residents to determine the target sport fish species and the areas where locals fished.

9.4.1.2 Riverine Habitat Surveys

Stream surveys (Figure 9-3) were conducted throughout several watercourses within the Project area by AMEC (2012) and WSP. The methods used to classify and quantify the aquatic habitat were based on standardized DFO methodologies such as DFO (2012), Scruton and Gibson (1995), and Sooley et al. (1998). Survey data collection consisted of a series of measurements for each habitat reach, including:

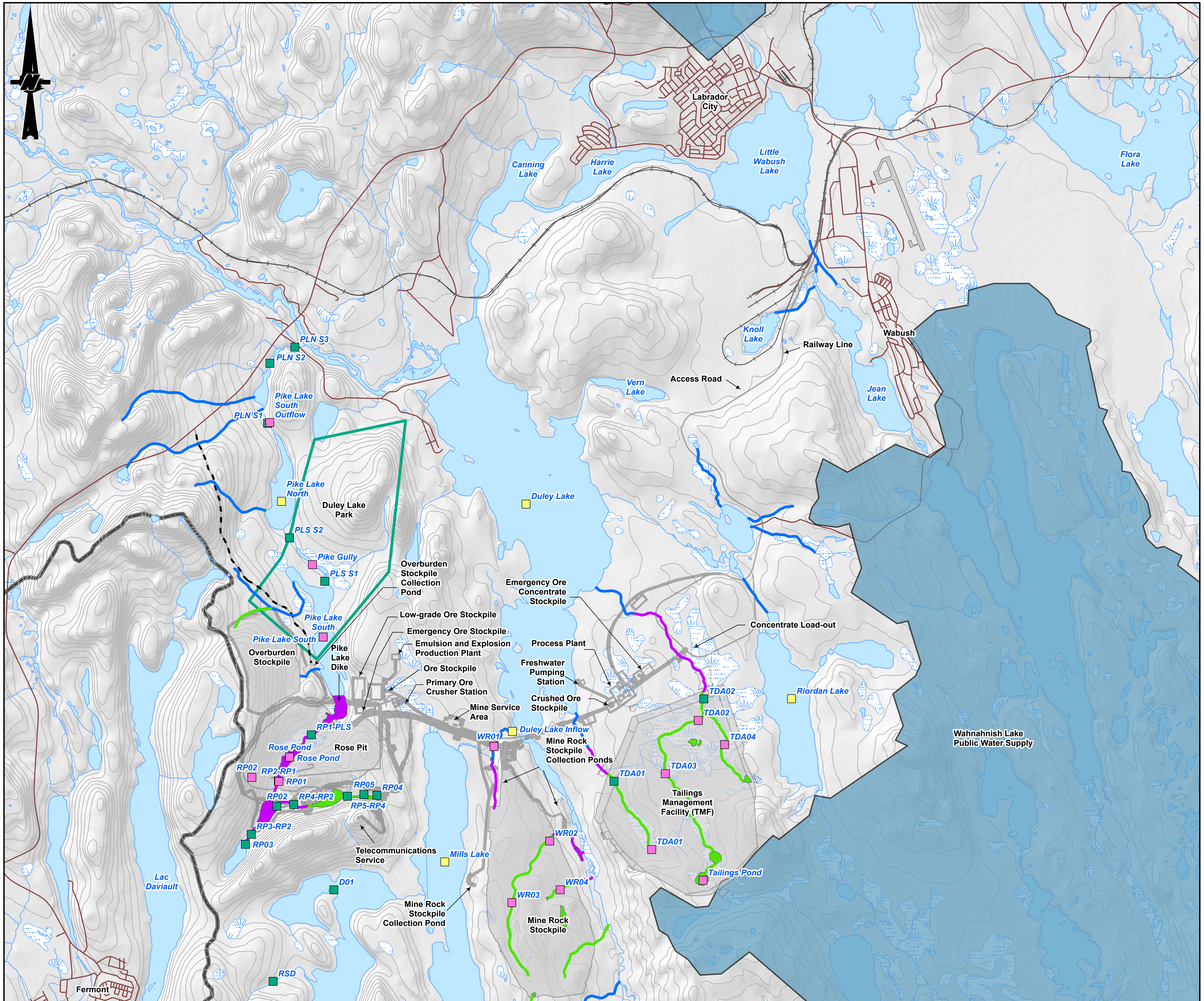
- channel dimensions (channel width, wetted width, ice scour height)
- substrate composition (percentage of each class of substrate found within the stream bed, e.g., cobble, gravel, aquatic vegetation)
- instream features (discharge, water depths and velocity)
- riparian vegetation (dominant species, percent cover, instream woody debris)
- upstream and downstream photos at each transect

A general habitat description was also used to classify each section of the stream with similar habitat features (e.g., pool, riffle, run) and the quantity of each in the surveyed section of the stream.

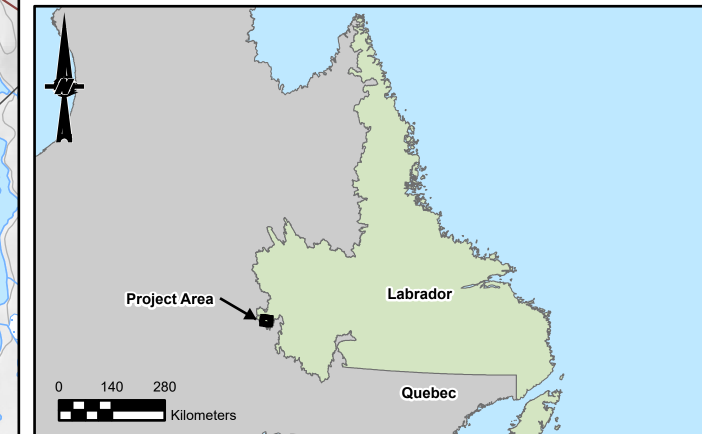
Habitat information was collected in 2024 for potential access road and rail line crossings. Field surveys followed the same procedure as previous riverine habitat surveys. Air photo analysis was also conducted, enabling estimates of slope, wetted width, dominant substrate, flow morphology, and riparian habitat for any crossings inaccessible to the field crew. When assessing the dominant substrate using air photos, it is classified as Fine or Coarse, as this resolution is typically available.

9.4.1.3 Lacustrine Habitat Surveys

Bathymetric surveys (Figure 9-3) were conducted in various waterbodies by Stantec in 2011, AMEC in 2012, and WSP in 2023. The surveys performed in 2012 (AMEC) and 2023 utilized a differential GPS sonar unit mounted on a Zodiac-style inflatable boat. This unit integrates GPS and sonar technology within a digital environment, enabling the precise mapping of depths and locations. The Lowrance sonar/GPS unit was configured to collect combined positional and depth data at one-second intervals. For optimal coverage, the boat generally operated at speeds below 2 meters per second (m/s). The unit's positional accuracy, verified using known survey pin locations, was recorded within one meter. The error margin for sonar depth detection is approximately 1 centimeter (cm), although weather conditions, such as wave height and variable water temperatures, can introduce slight variations. Additionally, shoreline surveys were conducted in select waterbodies to quantify substrate coverage within the littoral zone, allowing for the quantification of lacustrine fish habitat. This information will be incorporated into offsetting measures throughout the DFO authorization permitting process.



KEY MAP



SCALE 1:20,000,000

LEGEND

PROJECT DATA

Sample Location (by year)

- 2011
- 2012
- 2023

FISH HABITAT AUTHORIZATION

- Fish Habitat
- Schedule 2 MDMER HADD
- Section 35 HADD

PROJECT INFRASTRUCTURE

- Proposed Infrastructure Footprint
- Potential Access Road

BASEMAP INFORMATION

- Road
- Railway
- Watercourse
- Contour
- Duley Lake Park
- Bog/Wetland
- Waterbody
- Labrador/Quebec Boundary
- Public Water Supply

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT

CHAMPION IRON MINES LTD.

PROJECT

KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE

FISH HABITAT WITHIN THE KAMI MINES PROJECT AREA

CONSULTANT

Kami

YYYY-MM-DD	2025-06-30
DESIGNED	----
PREPARED	GM
REVIEWED	BM
APPROVED	JM

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0005	0	9-3

9.4.1.4 Riverine Fish Population Surveys

Riverine fish populations were assessed using a combination of quantitative and index electrofishing stations. Quantitative stations were completed in 2012, while index stations were completed in 2011, 2023, and 2024. Both methods collected data on species presence and biometrics, with quantitative stations also providing population and biomass estimates.

9.4.1.4.1 Quantitative Electrofishing

Fish populations in each selected watercourse were assessed with quantitative electrofishing by AMEC (2012). Each electrofishing station was blocked off using barrier nets at the upstream and downstream boundaries. The isolated area was then electrofished with at least four sweeps or until the last sweep had a total catch of less than half of the previous sweep. Abundance and biomass estimates were calculated using the Zippen removal method using the Fisheries Stock Assessment (FSA) package (Ogle 2016) for R (R Core Team 2020). This approach was applied to the combined abundance and biomass of all species, with estimates calculated based on the proportion of the total catch for each species, thereby addressing issues associated with low catch rates for certain species.

9.4.1.4.2 Index Electrofishing

Index electrofishing stations were completed at selected sites in 2012, 2023, and 2024. Electrofishing in 2023 and 2024 was completed using a Smith-Root LR24 backpack electrofisher. A single electrofishing site was completed in Duley Lake inflow on 5 August 2023. Electrofishing in 2024 was completed between 30 July and 5 August 5. Rather than blocking an area of habitat with barrier nets and completing multiple passes, a single pass of at least 400 seconds was completed. All fish collected were identified to species, enumerated, measured, weighed, and live released downstream of further electrofishing. Abundance and biomass catch-per-unit effort (CPUE) were then calculated and standardized to 300 seconds of electrofishing effort. This allows for comparison across years and locations, where applicable.

9.4.1.4.3 Fish Biometrics

Each fish captured during electrofishing was processed following the completion of each sweep. Processing included identifying specimens to the species level, measuring to the nearest millimetre, and weighing to the nearest 0.1 gram. Length (L) and weight (W) data were then used to calculate Fulton's Condition Factor (K; Peterson & Harmon, 2005), which is a length-weight relationship:

$$K = \frac{(W \times 10^5)}{L^3}$$

Smaller fish often have errors associated with the calculation of condition factors. Likewise, instrument error can also affect the data. To account for this, fish smaller than 80mm were removed from estimates of fish condition, as slight errors in the weights of these specimens could skew the estimates. Additionally, ranges were calculated using three standard deviations from the mean for each species. Values outside the calculated range were removed from further analysis, as they likely include length and/or weight errors. This was completed separately for each species to account for varying body types.

9.4.1.5 Lacustrine Fish Population Surveys

Lacustrine fish populations were assessed in several waterbodies between 2011 and 2023, using a combination of fyke nets and gillnets (Table 9-4). For both surveys, fyke nets were installed for at least 16 hours to cover the dawn and dusk periods when fish are most active. Gillnets were primarily used to determine the presence of deep-water species (e.g., lake trout or lake whitefish), with live release being the desired method. Therefore, gillnets were checked regularly to minimize mortalities as much as possible. Regardless of the capture technique, all fish were identified as species, weighed, and measured.

Additionally, in 2012, population estimates were calculated using a mark-recapture study in Pike Lake South and Pike Gully. In each of these waterbodies, all brook trout and northern pike captured were marked with a small clip at the top of the caudal fin to identify recaptures. Regardless of being marked, all fish were then live released near the capture area, and during subsequent net checks, any recaptures were weighed, measured, and noted as such. Population estimates and confidence intervals were calculated using the Schnabel multiple mark-recapture method (Ricker 1977, Ogle 2016).

Table 9-4: Netting Effort Completed throughout Baseline Studies, 2011 through 2023

Year	Waterbody	Fyke Net Effort (net-nights)	Gillnet Effort (hours tended sets)[1]
2011	RP01	2	4.0
	RP02	2	4.0
	RP03	2	4.0
	RP04	2	4.0
	RP05	2	4.0
	D01	2	4.0
	D02	2	4.0
	M01	2	4.0
	M02	2	4.0
	Pike Lake South	5	4.0
2012	Pike Lake South	24	0.0
	Pike Gully	6	0.0
	Rose Pond	25	0.0
	Tailings Pond	10	0.0
2023	Duley Lake	10	0.5
	Riordan Lake	5	0.3
	Mills Lake	10	0.3
	Pike Lake North	10	0.5

Notes:

1. Gillnets were deployed for short durations, approximately 2 hours in 2011 and 15-20 minutes in 2023, as per DFO license requirements.
2. Source: Stantec (2012)
3. Source: AMEC (2012)
4. Sampling completed by WSP

9.4.2 Results

Below is a description of the fish and fish habitat within the Project study area.

9.4.2.1 Regional Fisheries and Species Present

There are no commercial fisheries within the Project area. Therefore, fisheries are focused on recreational fishing within the area. Based on interviews conducted in 2012 with residents of Labrador City, Wabush, and Fermont, the target fish species include lake trout, brook trout, lake whitefish, burbot, northern pike and ouananiche (Atlantic salmon) (AMEC 2012). Fisheries are pursued throughout the region, with activities centered on accessible streams, ponds, and lakes near Labrador City and Wabush, as well as cabins along the highway and rail lines. Specifically, the main areas that are fished include Duley Lake, Shabogamo Lake, Waldorf River, Mills Lake, Ossokmanuan Reservoir, Panchia Lake, Lobstick Lake, Ashuanipi Lake, unnamed lakes, ponds and rivers south of Wabush. Fermont fishers reported the use of Lac Daviault and Lac Carheil.

Numerous water bodies and watercourses have been included throughout the baseline sampling programs, involving different capture techniques and sampling methodologies. Table 9-5 lists the fish species in the Project area and the habitats where they have been observed. None of the identified species fall under DFO's Timing Windows to conduct projects in or around water (DFO 2019) for Newfoundland and Labrador. The four timing windows specified by DFO are specifically for salmon and brown trout (*Salmo trutta*). These include avoiding in-water work:

- in estuaries and main stems of scheduled salmon rivers from May 1 to September 30 (migration)
- in tributaries and headwaters of scheduled salmon rivers on the island of Newfoundland from October 1 to May 31 (spawning, incubating and hatching)

- in tributaries and headwaters of scheduled salmon rivers in Labrador from September to June 15 (spawning, incubating, and hatching)
- in estuaries and the main stems of brown trout rivers from October 1 to November 30 (migration)

As there are no scheduled salmon rivers in the Project area, no brown trout were found during the fish surveys, and locals reported none, these schedules do not apply to the Project.

Table 9-5: Fish species known to be present within the Project area, 2011 through 2024

Common Name	Scientific Name	Present in Riverine Habitat	Present in Lacustrine Habitats
Brook trout	*Salvelinus fontinalis*	•	•
Burbot	*Lota lota*	•	•
Lake chub	*Couesius plumbeus*	•	•
Lake trout	*Salvelinus namaycush*		•
Lake whitefish	*Coregonus clupeaformis*		•
Longnose dace	*Rhinichthys cataractae*	•	•
Longnose sucker	*Catostomus catostomus*	•	•
Ouananiche[1]	*Salmo salar*		
Northern pike	*Esox lucius*	•	•
Pearl dace	*Margariscus nachtriebi*	•	•
Round whitefish	*Prosopium cylindraceum*		•
Sculpin[2]	*Cottis bairdii/C.ognatus*	•	•
White sucker	*Catostomus commersonii*	•	•

Notes:

1.Species were not observed through field surveys but were indicated as present by local anglers.

2. Two species of sculpin are likely present: Mottled and Slimy Sculpin. Identification in the field is complex, and they are recorded as Sculpin (Cottus sp.)

9.4.2.2 Riverine Habitat Surveys

Several watercourses were surveyed in 2011, 2012, and 2024. However, riverine habitat surveys were not completed in 2023. Below is a summary of the habitat classifications in each watercourse surveyed (Table 9-6).

A total of 13 streams were surveyed in 2011. RP01-PLS is the lower portion of the Rose Pit drainage and consists of stream habitat between Pond RP-1 and Pike Lake South (PLS). RP02-RP01 drains from Pod RP02 northeast into Pond RP01. Four ponds are located upstream of this site (RP02, RP03, RP04, and RP05) and their associated interconnecting stream sections. RP03-RP02 is located between Pond RP03 and RP02 and drains from RP03 northeast into RP02. RP05-RP04 drains westward from RP05 into RP04. RP04-RP02 drains from RP04 westward directly into RP02. Stream RSD is upstream of the proposed Kami Mining Project (Pit and Mine Rock Stockpile).

Downstream of the Rose Pit lie five survey sites: PLS-S1, PLS-S2, PLN-S1, PLN-S2, PLN-S3, and PLN-S4. PLS-S1 runs northerly between Pike Lake North and Pike Lake South. PLS-S2 runs north between Pike Lake North and Pike Lake South. PLN-S1 is the central outflow of Pike Lake North, which flows north and empties into the Walsh River. PLN-S2 runs north between two small waterbodies north of Pike Lake North, and PLN-S3 runs north into the Walsh River.

The 2012 surveys focused on four small streams, AD01 through AD04. Stram AD01 drains from the northernmost portion of the Mine Rock Stockpile and empties into Mills Lake's outflow. Streams AD02, AD03, and AD04 drain the remainder of the Mine Rock Stockpile eastwards into the Waldorf River.

A series of potential access roads and rail line crossings were identified based on engineering design, provided to WSP in 2024. In total, 17 potential crossings were identified using air photos before field deployment, 10 of which were visited during the field program for ground truthing. Five of the identified crossings were determined to be ATV trails in the field, while five were identified as watercourses (Table 9-6). In general, crossings surveyed were shallow and relatively slow-moving. All but two of the crossings were riffles, with one pool and one steady.

A total of seven crossings were identified prior to field deployments, which were inaccessible to the field crew at the time of the surveys. Crossings C-11 through C-13 required helicopter access, while crossings C-1, C-2, C-16 and C-17 were all located on private property, owned by Tacora Minerals (Table 9-7). The dominant habitat characteristic identified by air photos was pools, with steady and rapids being less common. All but two crossings were estimated to be dominated by fine substrate.

Table 9-6: Summary of riverine habitat surveyed throughout the Study Area, 2011-2024

Stream Name	Length (m)	Mean Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Mean Slope (%)	Substrate Coverage (%)								Dominant Habitat Type
						Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Fines	Aq. Veg	
RP01-PLS[1]	450	3.3	0.65	0.10	-	0	17	12	5	1	0	64	0	Pool
RP02-RP01[1]	300	2.4	0.54	0.32	-	0	3	11	8	0	0	78	0	Pool
RP03-RP02[1]	300	1.9	0.47	0.19	-	0	9	12	12	11	3	52	0	Riffle/Steady
RP05-RP04[1]	100	2.0	0.46	0.22	-	0	8	10	20	0	0	62	0	Pool/Run
RP04-RP02[1]	550	1.5	0.37	0.21	-	0	0	20	26	10	19	25	0	Riffle
RSD[1]	1,425	1.1	0.27	0.25	-	0	11	18	13	6	24	29	0	Pool
PLS-S1[1]	100	7.4	0.32	0.16	-	0	13	37	27	0	7	17	0	Run
PLS-S2[1]	420	4.3	0.31	0.13	-	0	56	29	11	1	1	4	0	Run
PLN-S1[1]	425	5.2	0.26	0.35	-	0	54	27	3	8	7	3	0	Run
PLN-S2[1]	50	10.2	0.20	0.18	-	0	50	40	0	5	5	0	0	Run
PLN-S3[1]	365	6.7	0.30	0.38	-	0	23	18	26	23	10	0	0	Run
TDA01[1]	2,800	1.0	0.27	0.14	-	1	12	8	1	17	15	45	0	Pool
TDA02[1]	6,650	2.6	0.36	0.09	-	0	20	19	14	20	18	9	0	Riffle
AD01[2]	500	0.7	0.28	0.11	0.8	0	0	0	0	0	0	17	83	Pool
AD02[2]	844	0.5	0.05	0.04	3.1	0	0	0	6	16	40	38	0	Steady
AD03[2]	320	0.5	0.11	0.09	0.0	0	0	0	0	1	37	62	0	Pool
AD04[2]	763	0.6	0.05	0.09	3.6	0	0	4	8	10	49	30	0	Pool
C-6	48[3]	16.2	0.29	0.25	3.3	0	48	25	0	17	10	0	0	Riffle
C-8	20[3]	1.6	0.05	0.02	<1.0	0	0	0	25	0	75	0	0	Pool
C-9	60[3]	0.4	0.06	<0.01	2.7	0	0	0	0	0	0	0	100	Riffle
C-10	40[3]	5	0.15	0.27	3.6	0	87	13	0	0	0	0	0	Riffle
C-14	40[3]	4.8	0.13	0.18	3.6	0	95	0	0	0	5	0	0	Riffle

Notes:

1. Source: Stantec 2012
2. Source: AMEC 2012
3. Total length surveyed

Table 9-7: Summary of riverine habitat characterization of inaccessible crossing locations.

Crossing	Wetted Width (m)	Slope (%)	Dominant Substrate	Habitat Type	Dominant Riparian Habitat
C-1	1.0	<1.0	Fine	Pool	Wetland
C-2	0.9	<1.0	Fine	Pool	Wetland
C-11	2.2	<1.0	Fine	Pool	Conifer Tree
C-12	4.6	<1.0	Coarse	Pool	Conifer Tree
C-13	1.0	6.9	Coarse	Rapids	Conifer Tree
C-16	5.0	2.8	Fine	Steady	Shrub
C-17	21.0	1.5	Fine	Steady	Shrub

9.4.2.3 Lacustrine Habitat Surveys

Since 2011, lacustrine habitat surveys have been conducted in numerous waterbodies throughout the study area, including several small ponds in the Rose Pit, the TMF, and numerous larger lakes downstream of the proposed Project. Below is a summary of the lake habitat surveys that have been completed to date.

Five small waterbodies (<12ha in total surface area per waterbody) within the Rose Pit were surveyed for fish habitat in 2011 (Stantec, 2012). Muck made up most of the substrate coverage in all the waterbodies, except for RP04, where sand was the most dominant (Table 9-8). Mean depths within the ponds ranged from 0.7 m in Rose Pond to 9.0 m in RP04. Bathymetric survey data for each waterbody surveyed in 2011 can be found in the Fish Habitat Baseline Report (Annex 2B).

Field surveys were completed in 2012 to quantify the lacustrine habitat present in Pike Lake South and Pike Gully (Table 9-8). Muck was the most abundant substrate present in each water body. Bathymetric survey data for Pike Lake South in 2023 can be found in the Fish Habitat Baseline Report (Annex 2B), which showed a maximum depth of 10.6 m with a mean depth of 2.2 m. Bathymetric surveys were not completed in Pike Gully due to shallow water depths.

Habitat and bathymetric surveys were completed in Duley Lake, Mills Lake, Pike Lake North, and Riordan Lake in July and August 2023. Table 9-8 presents a summary of the habitat present in each lake surveyed.

Long Lake is a large lake with a surface area of just over 11 km^2, which residents heavily use for boating and recreational fishing. It has several cabins along the shoreline, a public boat launch, and a cordoned-off swimming area. The shoreline was noted to have predominantly coarse material, including boulders and rubble, with an area of bedrock outcrops. There were also sandy beaches, mostly around built-up areas and the boat launch. Aquatic vegetation was noted near the inflow and outflow. Duley Lake had a maximum measured depth of 55 m and a mean depth of 17.6 m.

Mills Lake has a surface area of 4.9 km^2 and drains into Duley Lake from the southwest. The shoreline substrate composition was predominantly boulder and rubble with isolated bedrock outcrops. No substantive areas of aquatic vegetation were noted during the survey. Mills Lake had a maximum measured depth of 26 m and a mean depth of 13.5 m.

Pike Lake North, with a surface area of just over 0.5 km^2, is located downstream of the Project. Water flows from Pike Lake South and Rose Pond. The shoreline substrate was predominantly rubble and boulders. There was aquatic vegetation near the inflow and outflow. Pike Lake North had a maximum measured depth of 10 m, with a mean depth of 8.2 m.

Riordan Lake has a surface area of 1.1 km^2 and is located east of the TMF. The shoreline substrate consisted primarily of boulders. Riordan Lake had a maximum measured depth of 15 m and a mean depth of 4.0 m. At the time of the survey, an apparent algal bloom was present in Riordan Lake, resulting in low visibility within the water column.

Bathymetric maps of each lake can be found in the 2024 baseline report (Annex 2B).

Table 9-8: Summary of Lacustrine habitat surveyed throughout the Study Area, 2011-2024

Waterbody	Surficial Area (m²)	Secchi Depth (m)	Maximum Depth (m)	Mean Depth (m)	Substrate						
					Bedrock	Boulder	Rubble	Cobble	Gravel	Sand	Muck
Rose Pond (RP01)[1]	87,387	1.4	-	0.7	0	1	1	0	0	0	98
RP02[1]	106,825	2.5	-	4.3	0	9	5	4	0	14	68
RP03[1]	117,145	2.1	-	2.2	0	10	1	0	0	1	89
RP04[1]	92,221	4.8	-	9.0	0	13	9	0	0	56	23
RP05[1]	25,296	2.6	-	2.4	0	3	5	6	3	34	50
Pike Lake South[2]	897,755	4.5	2.2	10.6	0	15	16	21	1	8	39
Pike Gully[2]	40,846	-	-	-	0	30	12	0	0	5	53
Duley Lake[3]	11,112,572	5.0	55	17.6	35	25	15	15	5	10	0
Mills Lake[3]	4,907,772	7.2	26	13.5	10	30	20	10	10	5	15
Pike Lake North[3]	530,102	6.6	10	8.2	5	25	35	15	10	5	5
Riordan Lake[3]	1,197,480	4.1	15	4.0	5	30	15	15	5	15	15

Notes:

1. Surveyed in 2011
2. Surveyed in 2012
3. Surveyed in 2023

9.4.2.4 Riverine Fish Surveys

Electrofishing surveys were completed in several watercourses throughout the Project Area during 2011, 2012, and 2023. Throughout the baseline studies, the intended outcomes of electrofishing surveys varied based on the requirements of the *Fisheries Act* for HADD authorization. Surveys in 2011 and 2023 focused on species presence, with population estimates being the focus of the 2012 surveys for select areas. As a result, the electrofishing method and data collection varied between sampling years.

Several electrofishing stations were completed in 2011 (Stantec 2012). Brook trout were the most abundant species observed and were caught at every sampling location except RP1-PLS. Longnose and white suckers were much less abundant in the tributaries (Table 9-9).

Information was not provided to WSP with on effort (time) or sweep-catch patterns. Therefore, standardization for comparison across years or population estimate calculations is not possible. However, these surveys still offer information on species presence in the study area.

Table 9-9: Summary of Total Catches for Each Species in 2011 Electrofishing Stations

Sample Location	Brook trout	Burbot	Lake chub	Longnose dace	Longnose sucker	Pearl dace	Sculpin	White sucker
M01-M02	2	-	-	-	-	-	-	-
M02-ML	22	-	-	4	-	-	-	-
PLN S1	1	4	36	4	-	-	3	4
PLN S2	3	1	1	3	-	-	-	-
PLN S3	13	-	-	22	-	-	3	-
PLS S1	5	6	7	7	-	1	-	1
PLS S2	9	2	1	18	-	26	14	5
RP1-PLS	-	1	12	-	-	-	1	2
RP2-RP1	3	-	7	-	-	-	4	-
RP3-RP2	7	2	5	-	-	1	1	-

Sample Location	Brook trout	Burbot	Lake chub	Longnose dace	Longnose sucker	Pearl dace	Sculpin	White sucker
RP4-RP2	10	-	-	-	-	-	-	1
RP5-RP4	2		1		-	1	-	-
RSD	16	-	-	-	-	-	-	-
SC01	2		1	2	-	-	1	-
SC03	23	1	-	-	-	-	-	-
SC04	7	-	-	-	-	-	1	-
SC05	24	-	-	-	-	-	2	-
SC06	9		1	4	-	4	1	-
SC07	36	-	-	-	-	-	-	-
SC09	3	7	25	4	2	1	5	1
SC10	1	-	-	-	-	1	-	-
TDA01	23	-	-	-	-	-	-	-
TDA02	127	-	-	-	-	2	12	-
Total	**348**	**24**	**97**	**68**	**2**	**37**	**48**	**14**

Source: Stantec (2012)

Several quantitative electrofishing stations were established throughout the study area in 2012, including smaller streams in the Rose Pit, the TMF, and the Mine Rock Stockpile. Throughout all the stations, brook trout were the most abundant species and were found in all areas except for RP02, WR02, and WR04 (Table 9-10). No fish were observed in WR02 and WR04.

Table 9-10: Population and biomass estimates for quantitative electrofishing stations completed in 2012.

Site	Species	Abundance			Biomass (g)		
		Total Catch	Estimate[1]	Confidence Interval[2]	Total Biomass	Estimate[3]	Confidence Interval[2]
RP01	Brook trout	3	2.5	0.8-4.2	126.2	126.2	84.3-105.2
	Lake chub	7	5.8	1.9-9.7	15.2	15.2	10.1-12.7
	Northern pike	2	0.8	0.3-1.4	169.1	169.1	112.9-140.9
RP02	Lake chub	1	1.3	0.7-1.9	9.4	12.1	12.0-12.1
	White sucker	2	2.6	1.4-3.7	65.7	84.2	83.8-84.7
TI01	Brook trout	17	9.4	8.9-10.0	371	206.6	205.7-207.5
	Sculpin	7	3.9	3.7-4.1	19	10.6	10.5-10.6
TI02	Brook trout	14	10.0	9.6-10.4	300.8	214.9	214.2-215.6
TI03	Brook trout	10	7.3	4.6-9.9	370.6	279.1	261.3-296.9
TI04	Brook trout	7	4.7	3.9-5.5	45.6	30.8	30.7-30.9
WR01	Brook trout	4	3.2	1.7-4.7	13.9	11.1	11.0-11.3
WR02	No fish were captured.						
WR03	Brook trout	35	23.6	19.7-27.5	195.3	125.0	121.0-129.0
WR04	No fish were captured.						

Source: AMEC (2012)

1. Fish/habitat unit (100 m^2)

2. 95% Confidence Interval

3. Grams/habitat unit (100 m^2)

Two index electrofishing stations were completed in Duley Lake Outflow on August 4, 2023. White sucker and sculpin were the most abundant species observed within Duley Lake Inflow, while brook trout and white sucker yielded the most biomass (Table 9-11).

Index electrofishing was completed at three crossings (C6, C10, and C14) during 2024. Crossings were selected for electrofishing based on habitat present and accessibility. A total of six species were identified at the various crossings: brook trout, burbot, lake chub, longnose sucker, pearl dace and sculpin (Table 9-11).

Table 9-11: 2023 Electrofishing Catch-Per-Unit-Effort in Duley Lake Inflow (Mill Lake Outflow)

Station Number	Species	Abundance		Biomass (g)	
		Total Catch	CPUE (fish/300 seconds)	Total Catch	CPUE (grams/300 seconds)
LL-01[1]	Brook trout	3	2.24	136.1	101.57
	Lake chub	4	2.99	30.5	22.76
	Longnose dace	2	1.49	8.7	6.49
	Sculpin	10	7.46	25.6	19.10
	White sucker	4	2.99	80.9	60.37
	Total	**23**	**17.17**	**281.8**	**210.29**
LL-02[1]	Brook trout	3	2.12	111.1	78.61
	Burbot	3	2.12	70.8	50.09
	Lake chub	6	4.25	32.5	23.00
	Longnose dace	10	7.08	36	25.47
	Longnose sucker	7	4.95	40.4	28.58
	Sculpin	10	7.08	26.3	18.61
	White sucker	19	13.44	89.4	63.25
	Total	**58**	**41.04**	**406.5**	**287.61**
C-6[2]	Brook trout	1	0.75	3.3	2.48
	Lake chub	1	0.75	6.1	4.76
	Longnose sucker	1	0.75	5.8	4.35
	Sculpin	6	4.50	13.1	9.83
	Total	**9**	**6.75**	**28.3**	**21.42**
C-10[2]	Longnose sucker	1	0.75	2.4	1.80
	Pearl dace	1	0.75	1.9	1.43
	Total	**2**	**1.5**	**4.3**	**3.23**
C-14[2]	Brook trout	3	1.94	25.4	16.42
	Burbot	1	0.65	17.1	11.06
	Lake chub	1	0.65	2.0	1.29
	Total	**5**	**3.24**	**44.5**	**28.77**

Notes:

1. Surveyed in 2023
2. Surveyed in 2024

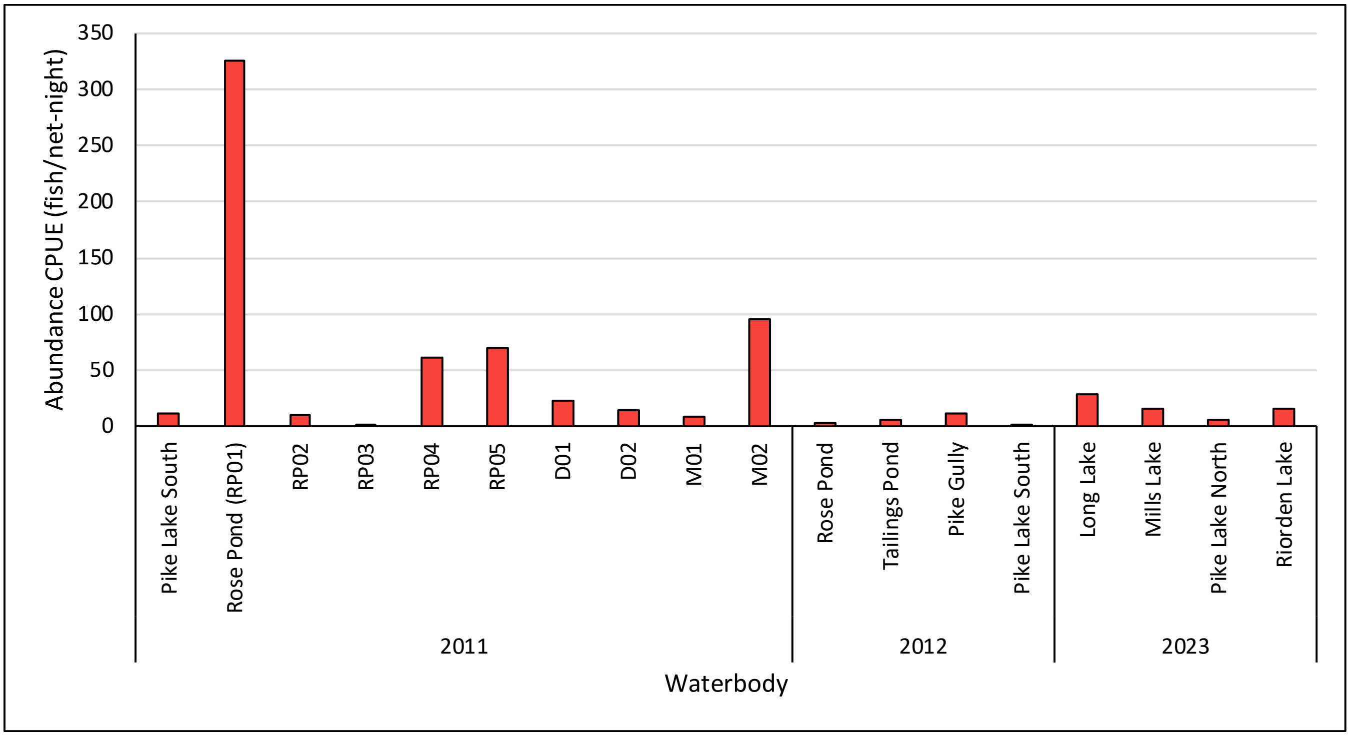
9.4.2.5 Lacustrine Fish Surveys

Fish communities have been sampled in several waterbodies since 2011, utilizing a combination of fyke nets, gillnets, and minnow traps. Similar to the electrofishing surveys discussed in Section 5.4, the intended outcome of lacustrine fish surveys has varied over the years of baseline assessment. Species presence and relative abundance were the focus in 2011 and 2023 and select population estimates were undertaken in 2012.

Rose Pond (RP01) sampled in 2011 had the highest total abundance throughout the baseline sampling program, with 326 fish/net night. This pond was sampled again in 2012, however, catches at this time were significantly lower, with 2.50 fish/net-night (Figure 9-1). Most waterbodies sampled had relatively low CPUEs, typically less than 10 fish/net-night.

Below is a summary of the species' presence and catch-per-unit effort during each sampling year since 2011. Individual catch data since 2011 are presented in Appendix C of Annex 2B, while high-level biometric summaries, including length-weight relationships and length distributions, are presented in Appendix D of Annex 2B.

Table 9-12: Overall Fyke Net Abundance Catch-Per-Unit-Effort in all Waterbodies Sampled Since 2011.



Baseline fish and fish habitat surveys were completed in 2011 (Stantec 2012) in various areas throughout the Project Area, concentrating efforts around the Rose Pit and the Rose Pit Sedimentation Pond. Fish species presence and relative abundance were assessed using a combination of fyke nets and tended gillnets. Lake chub were the most abundant species observed in 2011 (878 total captures; (Table 9-13) northern pike yielded the most biomass (5,126.1 total grams). For the fyke net, Rose Pond (RP01) had the highest abundance CPUE, with 326 fish/net-night, while Pond M02 had the highest biomass CPUE, with 2,312 g/g/net-night.

Tended gill nets were deployed in each pond sampled during 2011. Brook trout, lake trout, northern pike, round whitefish and white sucker were the only species captured with gillnets. Pond RP05 had the highest abundance CPUE (4.5 fish/net hour) and the highest biomass CPUE (1,444.75 grams/net night).

Fish populations were assessed in 2012 (AMEC 2012), with efforts again focused on the proposed Rose Pit. Sampling was completed in Rose Pond, Pike Gully, and Pike Lake South. Additional effort was completed within the Tailings Pond. Throughout 2012, white sucker and northern pike were the most abundant species observed. Pike Gully had the highest abundance CPUE (11.33 fish/net-night) and biomass CPUE (2,291.34 gram/net-night) of any of the waterbodies sampled in 2012, primarily due to high catch rates of White Sucker. Population estimates were also completed for brook trout and northern pike in each waterbody sampled in 2012. Northern pike was more abundant, with 59 caught compared to brook trout in each waterbody, except Tailings Pond. Rose Pond had the highest northern pike abundance estimate, with 128 northern pike.

The 2023 fish survey effort focused on Duley Lake, Mills Lake, Pike Lake North, and Riordan Lake, larger waterbodies downstream of the Project footprint that interest the public. Duley Lake and Mills Lake were identified during the 2012 Regional Fisheries Surveys as waterbodies frequented by local recreational fishers.

Overall, abundance CPUE was highest in Duley Lake, with 28.50 fish/net night, while biomass CPUE was highest in Pike Lake North, with 1,035.85 grams/net night. Lake chub were the most abundant species observed during 2023, with 203 observed, while white sucker yielded the most biomass with 12,408.4g caught. Duley Lake had the highest abundance CPUE (28.5 fish/net-night) of the waterbodies sampled in 2023, while Pike Lake North had the highest biomass CPUE (1,035.85 g/net-night).

Tended gillnets were deployed in each waterbody sampled in 2023 for 15 to 20-minute sets. No fish were captured in Duley Lake or Riordan Lake with tended gillnets. A total of two round whitefish were captured in Mills Lake. Seven lake whitefish and four white suckers were captured in Pike Lake North.

While formal lacustrine fish surveys were not included in the 2024 sampling program, collecting fish samples from Duley Lake was included in the Country Foods assessment. Sample collection was completed using fyke nets and angling. Four net nights were completed along the western portion of Duley Lake, which resulted in no fish being captured. Angling was completed along the eastern side of Duley Lake, based on recommendations of local recreational fishers, which resulted in the collection of Lake Trout and Northern Pike. Neither species had been captured in Duley Lake during previous baseline sampling programs for the Kami Mine.

Table 9-13: Summary of 2011 Fyke Net Abundance Catch-Per-Unit-Effort and Biomass from Various Locations Throughout the Project Area

Waterbody	Species	Abundance		Biomass	
		Total Catch	CPUE (fish/net-night)	Total Catch (g)	CPUE (grams/net-night)
Pike Lake South[1]	Burbot	2	1.00	1.2	0.60
	Lake chub	7	3.50	18.6	9.30
	Northern pike	3	1.50	2,405.5	1,202.75
	Sculpin	10	5.00	11.6	5.80
	Total	**22**	**11.00**	**2,436.9**	**1,218.45**
Rose Pond (RP01)[1]	Burbot	1	0.50	38.0	19.00
	Lake chub	639	319.50	1,919.7	959.85
	Northern pike	1	0.50	126.5	63.25
	White sucker	11	5.50	808.1	404.05
	Total	**652**	**326.00**	**2,892.3**	**1,446.15**
RP02[1]	Lake chub	6	3.00	24.4	12.20
	Northern pike	2	1.00	1,195.0	597.50
	Sculpin	13	6.50	23.0	11.50
	Total	**21**	**10.50**	**1,242.4**	**621.20**
RP03[1]	Northern pike	2	1.00	2,594.1	1,297.07
	Total	2	1.00	2,594.1	1,297.07
RP04[1]	Brook trout	2	1.00	198.7	99.35
	Burbot	9	4.50	606.0	303.00
	Lake chub	40	20.00	386.8	193.38
	Pearl dace	29	14.50	198.3	99.15
	Sculpin	1	0.50	0.5	0.25
	White sucker	41	20.50	1,089.0	544.49
	Total	**122**	**61.00**	**2,479.2**	**1,239.62**
RP05[1]	Burbot	2	1.00	50.3	25.15
	Lake chub	95	47.50	856.7	428.35
	Pearl dace	33	16.50	168.6	84.30
	Sculpin	1	0.50	1.5	0.75
	White sucker	9	4.50	110.4	55.20
	Total	**140**	**70.00**	**1,187.5**	**593.75**

Waterbody	Species	Abundance		Biomass	
		Total Catch	CPUE (fish/net-night)	Total Catch (g)	CPUE (grams/net-night)
D01[1]	Brook trout	2	1.00	46.7	23.35
	Burbot	13	6.50	198.1	99.05
	Lake chub	12	6.00	27.4	13.70
	Longnose sucker	10	5.00	504.2	252.10
	Pearl dace	2	1.00	4.7	2.35
	Round whitefish	2	1.00	59.3	29.65
	Sculpin	3	1.50	2.0	1.00
	White sucker	2	1.00	58.2	29.10
	Total	**46**	**23.00**	**900.6**	**450.30**
D02[1]	Brook trout	1	88.10	46.7	23.35
	Burbot	2	150.80	198.1	99.05
	Lake chub	2	11.00	27.4	13.70
	Longnose dace	1	0.60	504.2	252.10
	Longnose sucker	12	622.70	4.7	2.35
	Pearl dace	9	11.10	59.3	29.65
	Sculpin	1	30.00	2.0	1.00
	Total	**28**	**914.30**	**842.4**	**421.20**
M01[1]	Brook trout	19	9.50	1,271.0	635.50
	Total	**19**	**9.50**	**1,271.0**	**635.50**
M02[1]	Brook trout	20	10.00	755.2	377.59
	Burbot	10	5.00	256.8	128.40
	Lake chub	83	41.50	433.7	216.85
	Lake trout	1	0.50	2,801.5	1,400.77
	Pearl dace	77	38.50	377.6	188.79
	Total	**191**	**95.50**	**4,624.8**	**2,312.39**
Pike Lake South[2]	Burbot	31	1.29	68.3	2.85
	Lake chub	1	0.04	4.6	0.19
	Northern pike	14	0.58	7,090.4	295.43
	Sculpin	3	0.13	12.5	0.52
	Total	**49**	**2.04**	**7,175.8**	**298.99**
Pike Gully[2]	Burbot	2	0.33	16.5	2.75
	Northern pike	3	0.50	202.0	33.67
	White sucker	63	10.50	13,529.5	2,254.92
	Total	**68**	**11.33**	**13,748.0**	**2,291.34**
Rose Pond[2]	Brook trout	6	0.24	1794.4	71.78
	Burbot	3	0.12	32.9	1.32
	Lake chub	2	0.08	11.2	0.45
	Northern pike	42	1.68	7677.6	307.11
	Sculpin	3	0.12	8.0	0.32
	White sucker	7	0.28	1509.1	60.36
	Total	**63**	**2.52**	**11,033.2**	**441.34**
Tailings Pond[2]	Brook trout	7	1.40	253.2	50.64
	Lake chub	49	9.80	314.5	62.89
	Total	**56**	**11.20**	**567.7**	**113.53**

Waterbody	Species	Abundance		Biomass	
		Total Catch	CPUE (fish/net-night)	Total Catch (g)	CPUE (grams/net-night)
Duley Lake[3]	Burbot	4	0.40	41.0	4.10
	Lake chub	36	3.60	246.2	24.62
	Longnose sucker	111	11.10	1,520.6	152.06
	Round whitefish	1	0.10	2.5	0.25
	Sculpin	9	0.90	14.6	1.46
	White sucker	124	12.40	1,688.7	169.87
	Total	285	28.50	3,513.6	351.36
Mills Lake[3]	Brook trout	3	0.3	715.7	71.57
	Burbot	12	1.2	1,095.60	109.56
	Lake chub	35	3.50	155.7	15.57
	Longnose dace	3	0.30	11.3	1.13
	Longnose sucker	81	8.10	1,911.8	191.18
	Sculpin	30	3.00	69.0	6.90
	Total	164	16.4	3,959.1	395.91
Pike Lake North[3]	Burbot	3	0.30	30.8	3.08
	Lake chub	1	0.10	8.3	0.83
	Northern pike	11	1.10	67.9	6.79
	Sculpin	8	0.80	10.8	1.08
	White sucker	31	3.10	10,240.7	1,024.07
	Total	54	5.40	10,358.5	1,035.85
Riordan Lake[3]	Brook trout	1	0.20	2.6	0.52
	Burbot	11	2.20	644.7	128.94
	Lake chub	56	11.20	485.2	97.05
	Longnose dace	6	1.20	34.7	6.94
	Longnose sucker	2	0.40	285.5	57.10
	Sculpin	1	0.20	4.4	0.88
	White sucker	4	0.80	479.0	95.80
	Total	81	16.20	1,936.1	387.23

Notes:

1. Surveyed in 2011
2. Surveyed in 2012
3. Surveyed in 2023

Table 9-14 : Summary of the 2011 Gill Net Abundance Catch-Per-Unit-Effort and Biomass from Various Locations Throughout the Project Area.

Waterbody	Species	Abundance		Biomass	
		Total Catch	CPUE (fish/hour)	Total Catch (g)	CPUE (grams/hour)
Pike Lake South	Northern pike	1	0.25	2,980.7	745.18
	White sucker	1	0.25	17.6	4.40
	Total	**2**	**0.50**	**2,998.3**	**749.58**
Rose Pond (RP01)	**Total**	0	0.00	0.0	0.00
RP02	Northern pike	1	0.25	1,338.4	334.6
	Total	**1**	**0.25**	**1,338.4**	**334.6**
RP03	Northern pike	2	0.50	3,123.0	780.75
	Total	**2**	**0.50**	**3,123.0**	**780.75**
RP04	White sucker	3	0.75	2,394.7	598.68
	Total	**3**	**0.75**	**2,394.7**	**598.68**
RP05	Brook trout	7	1.75	1,790.2	447.55
	White sucker	11	2.75	3,988.8	997.20
	Total	**18**	**4.50**	**5,779.0**	**1,444.75**
D01	Lake trout	2	0.50	1,463.8	365.95
	Round whitefish	5	1.25	1,259.0	314.75
	Total	**7**	**1.75**	**2,722.8**	**680.70**
D02	Brook trout	1	0.25	703.1	175.78
	Total	**1**	**0.25**	**703.1**	**175.78**
M01	Brook trout	2	0.50	104.1	26.03
	Total	**2**	**0.50**	**104.1**	**26.03**
M02	Brook trout	5	1.25	340.4	85.1
	Total	**5**	**1.25**	**340.4**	**85.1**

Source: Stantec (2012)

9.5 Effects Assessment

9.5.1 Methods

9.5.1.1 Effect Pathway Screening

Interactions between Project components or activities, and the corresponding potential changes to the environment that could result in a potential effect to the fish and fish habitat VEC were identified by an effect pathway screening. The effect pathway screening was used to inform the residual Project and cumulative effects analyses for the fish and fish habitat VEC.

Potential pathways from Project activities to the fish and fish habitat VEC were identified using the following:

- review of the Project Description (**Chapter 2**) and scoping of potential effects by the EIS team for the Project
- input from engagement (Chapter 22)
- scientific knowledge; review of EISs for similar mining projects, including the previous Kami EIS (Alderon 2012)
- previous experience with mining projects; and consideration of key issues (Section 9.3.1)

Potential adverse effects of the Project were then identified, and practicable mitigation measures were proposed to minimize and mitigate potential adverse effects on fish and fish habitat. Avoidance and minimization are the most important for biodiversity conservation (BBOP 2016). Avoidance designs and actions integrated into the Project were developed iteratively by the Project's EIS team. The known effectiveness of mitigation measures proposed for each effect pathway was considered to determine whether the mitigation would address the potential Project effect such that the pathway was eliminated, would result in a negligible adverse effect on fish and fish habitat, or if residual adverse effects to fish and fish habitat from the Project remained.

This effect pathway screening was a preliminary assessment intended to focus the analysis on effect pathways that required a more quantitative or comprehensive assessment of effects on VECs. Using scientific knowledge, feedback from consultation, logic, experience with similar developments, and an understanding of the effectiveness of mitigation (i.e., level of certainty that the proposed mitigation would work), each effect pathway was categorized as one of the following:

- **No effect pathway:** The effect pathway could be removed (i.e., the effect would be avoided) by avoidance measures and/or additional mitigation so that the Project would result in no measurable environmental change relative to existing conditions or guideline values (e.g., air, soil, or water quality guidelines), and therefore would have no residual effect on fish and fish habitat.
- **Negligible effect pathway:** With the application of mitigation, the effect pathway could result in a measurable but minor environmental change relative to existing conditions or guideline values, but the change is sufficiently small that it would have a negligible residual effect on fish and fish habitat (e.g., a change in river substrate composition that is negligible compared to the range of existing values and is well within the requirements for salmonid spawning). Therefore, a further detailed assessment of the residual effect is not warranted, as the effect pathway is not expected to result in a substantive residual Project or cumulative effect on fish and fish habitat.
- **Residual effect pathway:** Even with the mitigation application, the effects pathway is still likely to result in a measurable environmental change relative to existing conditions or guideline values, which could cause a greater-than-negligible adverse or positive effect on fish and fish habitat, warranting additional assessment.

Project interactions determined as no effect pathways or negligible effect pathways were not carried forward for further assessment (Section 9.5.3). Residual effect pathways that could result in changes to the environment with one or more associated measurable parameters and have the potential to cause a greater than negligible effect on fish and fish habitat were carried forward to the residual Project effects analysis (Section 9.5.3) and residual cumulative effects analysis (Section 9.5.4).

9.5.1.2 Residual Project Effect Analysis

The residual effects analysis measures and describes the effect of the Project on the fish and fish habitat relative to existing conditions. The residual effects analysis was conducted using the temporal snapshot identified for the assessment (Section 9.3.3). Residual effects are described for each measurement indicator associated with the identified residual effect pathways. During Construction, activities such as land clearing (which includes water features) and excavation of vegetation are likely to have both short-term and long-term effects on fish and their habitats. The effects of each phase are measured to understand both the immediate effect and its long-term effects during operations, allowing for an assessment of the long-term effects on fish and fish habitats. Residual effects are described for each of the measurable parameters for the residual effect pathways identified, including:

- The area of fish habitat lost or altered is quantified by measuring the amount of fish habitat that will be removed as part of various project activities and infrastructure, such as the water features within the Rose Pit footprint. GIS systems are often used to delineate water features and measure the amount of habitat that will be lost due to project activities.
- The number of barriers to fish passage is quantifiable by identifying the number of streams that must be crossed to develop project access roads, rail lines, and other infrastructure. These sites are assessed using a standard habitat assessment protocol that will act as a baseline to which the data of future assessments at the same site will be compared. This data will provide information on whether the crossing structure in question acts as a barrier to fish passage.
- Riparian habitat reduction or alteration is measured in two ways. The first is the measurement of riparian habitat, which activities like excavating the Rose Pit will permanently remove. This is measured using GIS software, similar to the area of fish habitat loss. The second way is to compare the baseline data collected through riverine habitat surveys to the data from replicated surveys in the same areas. Standard riverine habitat assessments include a description of the riparian area abundance, dominant species, and percent coverage.
- Change in river flows is evaluated by comparing the results of velocity readings taken at riverine habitat sites to data from replicated surveys in the same area. Often, this requires multiple measurements, over several years, during different seasons, to accurately capture flow changes. The change in flow velocities at the Pike Lake outlet, which feeds into the Wabush River, was modelled by Lorax Environmental, which predicts the changes in flows based on project activities.
- The loss of fish is directly measured by analyzing changes in water quality and by measuring changes in fish populations or dominant species via continuous fish surveys and comparing results to the baseline surveys.
- The loss of species of conservation interest is analyzed using the same methods described above in the loss of fish.

- Fish health is evaluated using Fulton's condition factor described in Section 9.4.1.4.3, where the length: weight ratio trends are recorded during continuous fish surveys and measured over long periods. Body burden sampling is another method to measure fish health. It is the process by which individual fish are retained during fish surveys under a Scientific Fish Collection Permit issued by the Newfoundland and Labrador Department of Fisheries, Forestry, and Agriculture, and measured for toxic chemicals or accumulation of metals in the organs and tissues.
- Changes in water and sediment quality are measured by collecting regular water and sediment samples over a long period and quantifying the change in parameters measured by the laboratory and in situ results.

The residual effects analysis employed a reasoned narrative to describe the anticipated changes to each measurable parameter resulting from the Project. This narrative description of anticipated residual effects serves as the foundation for classifying residual effects. Residual effects are summarized or classified in tabular form using effects criteria, which is intended to provide structure and comparability across VECs assessed for the Project. The residual effects classification uses nature, magnitude, geographic extent, duration, timing, frequency, reversibility, and probability of occurrence as criteria. The approach to classify each residual effect criterion is provided in Table 9-15. Following the classification of residual Project effects, the analysis also evaluates the significance of residual Project effects using threshold criteria or standards beyond which a residual effect is considered significant. The definition of a significant effect for the fish and fish habitat is provided in Section 9.5.1.4.

Direct and indirect fish and habitat changes are measured using the techniques described in Section 9.4.1. As baseline information on the status of fish and fish habitat has already been compiled, changes in fish and fish habitat can be measured by replicating the same surveys and comparing the results with those of previous surveys, if required.

Table 9-15: Definitions Applied to Effects Criteria Classifications for the Assessment of Fish and Fish Habitat

Criterion	Rating	Definition
Nature	Positive	Change in measurable parameters results in net improvement or benefit to Fish and Fish Habitat
	Neutral	Change in measurable parameters results in no change to Fish and Fish Habitat.
	Adverse	Change in measurable parameters results in net degradation or loss to Fish and Fish Habitat
Magnitude	Qualitative narrative or numeric quantification	Change in measurable parameter is described by effect size (e.g., 10% or less loss of fish habitat or change in fish population is a negligible change, >10% is moderate, and >20% is a significant loss or change).
Geographic extent	Site Assessment Area	Change in measurable parameters is confined to the SSA.
	Local	Change in measurable parameters extends outside the SSA but within the LSA.
	Regional	Changes in measurable parameters extend beyond the LSA but are confined to the RSA.
	Beyond regional	Change in measurable parameters extends beyond the RSA.
Duration	Qualitative narrative or numeric quantification	Short term: Effect is limited to the Construction phase or Closure phase of the Project. Medium term: Effect occurs through the duration of the Project. Long term: Residual effect extends beyond the life of the Project.
Timing	Qualitative narrative or numeric quantification	Change in measurable parameters is described with a focus on seasonality (e.g., as applicable, with a description of how seasonal aspects may affect a VEC or not applicable, where seasonal aspects are unlikely to affect a VEC).
Frequency	Occasional	Change in measurable parameters is expected to occur rarely (e.g., once or a few times).
	Periodic	Changes in measurable parameters are expected to occur consistently at regular intervals or be associated with temporal events (e.g., during hot, dry climatic conditions).
	Continuous	Change in measurable parameters is expected to occur all the time.
Reversibility	Reversible	Change in measurable parameters is reversible within a clearly defined time period.
	Irreversible	Change in measurable parameters is predicted to influence the component indefinitely.
Probability of occurrence	Unlikely	Change in measurable parameters is not expected, but it is not impossible.
	Possible	Change in measurable parameters may occur but is not likely.
	Probable	Change in measurable parameters is likely to occur but is uncertain.
	Certain	Change in measurable parameters will occur.

Criterion	Rating	Definition
Ecological and Socio-economic Context	Qualitative narrative or numeric quantification	Change in measurable parameters is described by the perception of an effect that considers the sensitivity and resilience of VECs (ecological context), the cultural and social significance placed on certain VECs and the unique values, customs or aspirations of local communities or Indigenous groups.

9.5.1.3 Residual Cumulative Effect Analysis

The cumulative effects assessment builds on the residual Project effects assessment results and considers the incremental changes from the Project predicted to have a likely residual adverse effect on fish and fish habitat. This would include the effects of past and existing projects and past climate-related changes (e.g., forest fires), which have contributed to the existing conditions upon which residual Project effects are assessed. For the EIS, the description of the existing environment characterizes the environment already affected by past and existing projects and activities; therefore, the cumulative effects assessment focused on analyzing the effects of other RFDs in combination with the Project. Although positive residual effects are characterized in the residual Project effects analysis, they are not carried forward to the cumulative effects analysis, as the Project benefits from other past, present and RFDs or activities are unlikely to be known or publicly disclosed (e.g., Benefit Agreements with Indigenous groups or local community stakeholders).

The cumulative effects assessment followed a three-step process:

- identify RFDs effects overlapping with residual Project effects in time and space, resulting in cumulative effects
- identify and describe any additional mitigation measures, if applicable
- characterize residual cumulative effects using the same criteria defined for the residual Project effects analysis (Section 9.5.1.2)

Chapter 4 lists known RFDs and physical activities with potential residual effects that could overlap spatially and temporally with the Project's residual environmental effects. Figure 4-4 (Chapter 4) presents the location of all identified RFDs. This list was considered in identifying RFDs with potential effects on fish and fish habitat to assess cumulative effects. After identifying applicable RFDs, residual Project effects on fish and fish habitat were evaluated for temporal and spatial overlap with the effects of RFDs to identify potential cumulative effects. The evaluation was completed qualitatively based on publicly available information (e.g., Project Registrations or EIS reports) describing the environmental effects of RFDs. If effects from these RFDs overlapped spatially and temporally with the residual Project effects on fish and fish habitat, then potential cumulative effects were identified. If no spatial and temporal overlap existed for the residual Project effects and RFDs identified in Chapter 4, then a cumulative effects assessment was not required.

Based on the assessment of potential cumulative effects, an assessment was made regarding whether additional mitigation measures beyond those proposed for the Project were required to address potential cumulative effects. Where applicable, additional mitigation measures were identified under the care and control of Champion to address these cumulative effects.

Residual cumulative effects were characterized using the same criteria assessed for residual Project effects (Section 9.5.1.2). The same measurable parameters were used to assess the cumulative effect of other RFDs on fish and fish habitat. Where applicable, additional mitigation measures were described.

Following the classification of residual cumulative effects, the analysis also evaluated the significance of residual Project effects using threshold criteria or standards beyond which a residual environmental effect was considered significant. The definition of a significant effect on the fish and fish habitat is provided in Section 9.5.1.4.

9.5.1.4 Significance Determination

A significant adverse residual effect on fish habitat and productivity is defined as one that:

- permanently causes a loss of aquatic habitat used by fish for any or all their life stages and is not compensated for under sections 35 and 36 of the *Fisheries Act*.
- reduces the habitat productivity capacity for fish habitat that will remain after mitigation and offsetting measures are implemented.
- alters or reduces the habitat's physical, chemical, and biological characteristics (e.g., water quality parameters, spawning gravel, food webs, etc.) after mitigation and offsetting measures are implemented.

A significant adverse residual effect on fish health/mortality is defined as one that:

- results in the likelihood of fish mortality, after implementing mitigation measures, at a level requiring regulatory bodies to implement specific management plans to recover the affected species
- degrades water quality to levels that harm fish, causing changes below baseline conditions such as increased stress, changes in behaviour, disease or fatalities
- introduces invasive species which can outcompete or negatively interact with native fish, leading to a decline in populations
- introduces harmful chemicals into fish-bearing water features, resulting in toxic effects on fish health and increased fatalities

9.5.2 Effect Pathway Screening

The effect pathway screening predicts potential effect pathways, which are then evaluated, considering proposed mitigation, to predict whether the effect pathway has the potential to cause residual adverse or positive effects. The effectiveness of mitigation measures proposed for each effect pathway was assessed to determine whether the mitigation would address the potential Project effect, such that the effect pathway was eliminated or would result in a negligible adverse effect on a VEC. As described in Section 9.5.1.1, each effect pathway was categorized as one of the following:

- **no effect pathway** (i.e., avoidance measures and/or mitigation results in no residual effect on fish and fish habitat)
- **negligible effect pathway** (i.e., mitigation results in negligible effect on fish and fish habitat)
- **residual effect pathway** (i.e., effect that is greater than negligible and carried forward for further assessment.

The effects pathway screening is summarized in Table 9-16. The subsections following the table provide the rationale for assigning potential effects to the no-effect pathway and negligible-effect pathway categories and listing residual-effect pathways. Each Project component/activity identified as a residual-effect pathway was carried forward for detailed assessment in Section 9.5.3.

Table 9-16: Potential Effects Pathways for fish and fish habitat.

Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening
Project components/activities that imapct fish and fish habitat during Construction, Operation, Maintenance, and closure: **Construction:** — Road development, including culverts and bridge installation — Construction of facilities and infrastructure — Construction of the TMF starter dam — Construction of water management infrastructure — Dewatering activities **Operation and Maintenance:** — None **Closure:** — Removal of infrastructure, restoration and revegetation of facilities and infrastructure	**Instream and in-Lake Construction Activities** Instream and in-lake construction activities can alter fish habitat quality, affecting the survival of fish and their eggs.	— Where possible, instream and in-lake construction in potential spawning habitat areas will occur outside the spawning period for fish VECs. Construction activities will be scheduled to avoid work during DFO's Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat (DFO 2019). If work outside of the timing windows is not possible, the appropriate approvals will be obtained to proceed. Restricted activity periods for fish VECs are as follows: – Lake trout and lake whitefish (September 1 to July 15) – Northern pike (May 1 to July 15) – Ouananiche (October 1 to May 31) — Water crossing structures and intakes will be constructed and installed to protect the banks from erosion and maintain the flow in the water body. This will be done in accordance with permits or authorizations issued for the Project from the appropriate regulatory agencies and DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2025). — If required, instream construction will be completed in isolation from flowing water (i.e., using isolation methods to install culverts and multi-span bridges where surface water is present during construction). — For instream isolations/diversions, 100% downstream flow will be maintained, and, if required, pump intakes should not disturb the bed. Water diversion hoses will be screened as per DFO's Freshwater Intake End-of-Pipe Fish Screen Guidelines (DFO 1995; 2020). — A fish relocation plan will be developed that will follow and adhere to all regulatory requirements. — Implement a Project-specific Environmental Protection Plan. — A Rehabilitation and Closure Plan is being developed in collaboration with government and Indigenous communities. This will be submitted as part of the permitting process.	Negligible Effect Pathway
Construction: — Construction of TMF starter dam — Dewatering activities **Operation and Maintenance:** — Pit dewatering and site water management — Handling, storage and discharge of non-contact water — Handling, storage, treatment and discharge of contact water — Water intake for fresh water and process water **Closure:** — None	**Fish Impingement and Entrainment** Impingement and entrainment of fish in intake pumps can affect the survival of fish	— Intake pumps will be screened to prevent entrainment or impingement of fish. — Pump intake screens will be in accordance with DFO's Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 2015). — Intake screens will be located in areas and depths of water away from high-quality fish habitat. — Screens will be oriented to face in the same direction as the water flow. — Screens will be located above the water body's bottom to prevent the entrainment of sediment and aquatic organisms associated with the bottom area. — A Rehabilitation and Closure Plan is being developed in collaboration with government and Indigenous communities. This will be submitted as part of the permitting process.	Negligible Effect Pathway

Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening
Construction: — Road development, including culverts and bridge installation — Construction of facilities and infrastructure **Operation and Maintenance:** — None **Closure:** — Removal of infrastructure, restoration and revegetation of facilities and infrastructure	**Water Crossing Structures** Water crossing structures for site roads can alter stream hydraulics and geomorphology, which may affect fish habitat quantity and quality, passage at stream crossings, habitat connectivity, and fish distribution.	— Design cross drainage structures to convey the maximum instantaneous flow resulting from a 1:10-year flood event. — Road route alignments will minimize stream crossings and avoid sensitive habitat to the extent possible. — Design crossing structures to limit the area disturbed within waterbodies and watercourses. — Culverts will be designed to allow fish passage where appropriate. Before construction, water flow conditions and fish presence will be assessed to establish a culvert design that allows for fish passage. — Water crossing structures will be constructed and installed in a manner that protects the banks from erosion and maintains the flows in the water body, and follows permits or authorizations issued for the Project from the appropriate regulatory agencies and DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2025). — Culverts will be regularly inspected and maintained to prevent blockages from forming and causing ponding or backwater effects. Where culverts are installed at fish-bearing water bodies, debris removal activities will follow DFO's guidance (i.e., gradual removal such that flooding downstream, extreme flows downstream, release of suspended sediment, and fish stranding can be avoided). — Implement a Project-specific Environmental Protection Plan, Environmental Effects Monitoring Program, Emergency Response Plan, and Erosion and Sedimentation Control Plan. — A Rehabilitation and Closure Plan is being developed in collaboration with government and Indigenous communities. This will be submitted as part of the permitting process.	Negligible Effects Pathway
Construction: — Site preparation, including vegetation clearing and earthworks — Road development, including culverts and bridge installation — Construction of facilities and infrastructure — Construction of TMF starter dam — Handling and storage of mine rock — Construction of water management infrastructure — Dewatering activities **Operation and Maintenance:** — Open pit mining, including blasting and crushing ore and mine rock — Handling and storage of overburden, mine rock and ore — Operation and management of the TMF — Pit dewatering and site water management — Handling, storage and discharge of non-contact water — Handling, storage, treatment and discharge of contact water — Water intake for fresh water and process water — Sewage collection, treatment and surface discharge — Camp, mine services area, and office operation **Closure:** — Accelerated pit flooding — Removal of infrastructure, restoration and revegetation of facilities and infrastructure — Site traffic, transportation of personnel and materials to and from the site	**Water Supply Requirements** The Project's water supply requirements (potable and process) may alter water levels, flows, and channel/bank stability in downstream waterbodies and streams, potentially effecting fish habitat quantity, quality, and distribution.	— Maximize the recycling and reuse of process water to reduce freshwater intake. — Monitor flows before and after construction to quantify the changes in flow and their effects on the aquatic environment and apply adaptive management as necessary. — Adhere to guidance from regulators such as DFO regarding the allowable rate and timing of withdrawals from the point of supply. — Implement a Project-specific Environmental Protection Plan and an Environmental Effects Monitoring Program. — A Rehabilitation and Closure Plan is being developed in collaboration with government and Indigenous communities. This will be submitted as part of the permitting process.	Negligible Effects Pathway

<table>
<tr><th>Project Components/Activities</th><th>Effects Pathway</th><th>Environmental Design Features, Mitigation or Enhancement Measures</th><th>Effect Pathway Screening</th></tr>
<tr><td>Construction:
— Site preparation, including vegetation clearing and earthworks
— Road development, including culverts and bridge installation
— Handling and storage of mine rock
— Operating mobile mining equipment
— Site traffic, including transportation of personnel and materials to and from the site
Operation and Maintenance:
— Open pit mining, including blasting and crushing ore and mine rock
— Handling and storage of overburden, mine rock and ore
— Handling, storage and discharge of non-contact water
— Handling, storage, treatment and discharge of contact water
— Camp, mine services area, and office operation
Closure:
— Removal of infrastructure, restoration and revegetation of facilities and infrastructure
— Site traffic, transportation of personnel and materials to and from the site</td><td>Altered Site Drainage
Altered site drainage, runoff, and discharge from facilities during construction and operations may cause changes to water levels and flows and channel/bank stability and affect fish habitat quantity, quality, and distribution in downstream waterbodies and watercourses.</td><td>— Adequate water storage capacity has been designed to provide a controlled release rate during both routine and non-routine operation scenarios.
— Erosion control measures will be used as required.
— Routine inspection and maintenance of containment and conveyance structures (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment.
— Limit areas of vegetation clearing and soil disturbance.
— Limit the steepness and length of slopes of disturbed areas and stockpiled soils.
— Where possible, avoid placing soil stockpiles on slopes, near water bodies (i.e., maintaining an appropriate buffer from waterbodies), and near natural drainage features.
— Work in sensitive areas will be scheduled to avoid periods (e.g., spring freshet) that may result in high flow volumes and/or increased erosion and sedimentation.
— Where practical and applicable, implement progressive reclamation and revegetation of disturbed areas no longer required.
— Restore and revegetate areas where non-permanent Project features have been removed.
— Alignment of site roads will be designed to minimize stream crossings and avoid sensitive habitat as feasible.
— Apply DFO Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2025).
— Implement an Environmental Effects Monitoring Program that includes monitoring water and sediment quality and applying adaptive management if necessary.
— Implement a Waste Management Plan (Annex 5H) that includes site water management procedures.
— A Rehabilitation and Closure Plan is being developed in collaboration with government and Indigenous communities. This will be submitted as part of the permitting process.</td><td>Negligible Effects Pathway</td></tr>
</table>

Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening
Construction: — Site preparation, including vegetation clearing and earthworks — Handling and storage of overburden — Road development, including culverts and bridge installation — Construction of facilities and infrastructure — Construction of TMF starter dam — Handling and storage of mine rock — Site traffic, including transportation of personnel and materials to and from the site **Operation and Maintenance:** — Handling and storage of overburden, mine rock and ore — Operation and management of the TMF — Handling, storage and discharge of non-contact water — Handling, storage, treatment and discharge of contact water — Progressive reclamation **Closure:** — Removal of infrastructure, restoration and revegetation of facilities and infrastructure — Site traffic, transportation of personnel and materials to and from the site	**Sedimentation** Sediment released during instream Construction and from ground disturbance may alter fish habitat quality in local waterbodies and watercourses.	— For instream isolations/diversions, 100% downstream flow will be maintained, and, if required, pump intakes should not disturb the bed. Water diversion hoses will be screened as per DFO's Freshwater Intake End of Pipe Fish Screen Guidelines (DFO 1995; 2020). — Discharge water to waterbodies and watercourses in a manner that does not cause erosion or other damage to adjacent areas. — Erosion control measures will be used as required. — Routine inspection and maintenance of containment and conveyance structures (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment. — Reduce, where possible, areas of vegetation clearing and soil disturbance. — Reduce, where possible, the steepness and length of slopes of disturbed areas and stockpiled soils. — Avoid placing soil stockpiles on slopes, near water bodies (i.e., maintaining an appropriate buffer from waterbodies), and near natural drainage features. — Where possible, work in sensitive areas will be scheduled to avoid periods (e.g., spring freshet) that may result in high flow volumes and/or increased erosion and sedimentation. — Where possible, instream and in-lake construction in potential spawning habitat areas will occur outside the spawning period for fish VCs. Construction activities will be scheduled to avoid work during Fisheries and Oceans Canada's (DFO) Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat (DFO 2019). If work outside of the timing windows is not possible, the appropriate approvals will be obtained to proceed. Restricted activity periods for fish VCs are as follows: – Lake trout and lake whitefish (September 1 to July 15); – Northern pike (May 1 to July 15); and – Ouananiche (October 1 to May 31). — Instream construction will either be avoided or limited to when watercourses are not flowing, or are frozen to the bottom, where possible. — Where practical and applicable, implement progressive reclamation and revegetation of disturbed areas no longer required. — Restore and revegetate areas where non-permanent Project features have been removed. — Implement a Project-specific Environmental Protection Plan and Erosion and Sediment Control Plan. — Implement a Project-specific Waste Management Plan that includes site contact water management procedures. — Implement Environmental Effects Monitoring Program and surface water monitoring plan, including monitoring water and sediment quality and applying adaptive management if necessary. — A Rehabilitation and Closure Plan is being developed in collaboration with government and Indigenous communities. This will be submitted as part of the permitting process.	Negligible Effect Pathway

Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening
Construction: — Site preparation, including vegetation clearing and earthworks — Handling and storage of overburden — Road development, including culverts and bridge installation — Construction of facilities and infrastructure — Construction of TMF starter dam — Handling and storage of mine rock — Construction of water management infrastructure — Operating mobile mining equipment — Site traffic, including transportation of personnel and materials to and from the site **Operation and Maintenance:** — Open pit mining, including blasting and crushing ore and mine rock — Operating mobile mining equipment — Handling and storage of overburden, mine rock and ore — Processing iron ore concentrate — Site traffic, including transportation of personnel and materials to and from the site **Closure:** — Removal of infrastructure, restoration and revegetation of facilities and infrastructure — Site traffic, transportation of personnel and materials to and from the site	Dust Emissions The deposition of fugitive dust emissions (e.g., metals and radionuclides) can alter water quality, potentially adversely affecting fish health, survival, reproduction, and lower trophic organisms.	— Water and/or suppressants should be applied to site roads and access roads, as necessary. — Establishing and enforcing speed limits on site and access roads will reduce dust production. — Limit vehicle speed on unpaved site roads to reduce fugitive dust during Construction and Operations. — Minimize haul route distances, thereby reducing fuel consumption and fugitive emissions from equipment. — To limit total suspended particulate (TSP) emissions, a reduced speed limit for heavy equipment involved in material movement and earthworks on site will be enforced. This speed limit does not apply to site road traffic or the haul route from the headworks to the mine rock piles. — Implement an Environmental Effects Monitoring Program and surface water monitoring plan that includes monitoring water and sediment quality and applying adaptive management as necessary. — Implement Environmental Effects Monitoring Program, including ambient air monitoring and adaptive management based on ambient air quality standards.	Negligible Effect Pathway
Construction: — Site preparation, including vegetation clearing and earthworks — Road development, including culverts and bridge installation — Construction of facilities and infrastructure — Construction of TMF starter dam — Handling and storage of mine rock — Construction of water management infrastructure — Site traffic, including transportation of personnel and materials to and from the site **Operation and Maintenance:** — Open pit mining, including blasting and crushing ore and mine rock — Handling and storage of overburden, mine rock and ore — Power Generation — Camp, mine services area, and office operation — Site traffic, transportation of personnel and materials to and from the site **Closure:** — Removal of infrastructure, restoration and revegetation of facilities and infrastructure Site traffic, transportation of personnel and materials to and from the site	Deposition of Suspended Solids in Emissions The deposition of suspended solids in criteria air contaminant emissions (e.g., potential acid inputs) can alter water quality, effecting the health, survival, and reproduction of fish and lower trophic organisms. Additionally, fugitive dust containing metals and radionuclides may alter water quality and effect fish habitat quantity, quality, and distribution.	— Use and maintain emissions control devices on motorized equipment. — Maintain and monitor mobile mining equipment and vehicles to validate emissions within engine exhaust systems' designed operating parameters. — Seek to reduce fuel combustion requirements of infrastructure and equipment during detailed design. — Regular maintenance of equipment. — Limit idling of vehicles to the extent practical. — Procurement criteria to ensure that the stationary and mobile engines meet applicable performance standards. — Minimize haul route distances, thereby reducing fuel consumption and fugitive emissions from equipment. — Application of water and/or suppressants should be applied to site roads and access roads as necessary. — Establishing and enforcing speed limits on site and access roads will reduce dust production. — Limit vehicle speed on unpaved site roads to reduce fugitive dust during Construction and Operations. — To limit total suspended particulate emissions, a reduced speed limit for heavy equipment involved in material movement and earthworks on site will be enforced. This speed limit does not apply to site road traffic or the haul route from the headworks to the overburden and mine rock stockpiles. — All crushed iron ore stockpiles would be covered with dust collection technology to minimize fugitive dust and silica from crushed ore stockpiles. — Use dust suppressants that minimize environmental risk and are government approved. — Apply water sprays to stockpiles or areas that have visible dust, as necessary. — Minimize areas of vegetation clearing and soil disturbance to reduce the generation of fugitive dust. — Implement a Project-specific Environmental Protection Plan — Implement Environmental Effects Monitoring Program that includes monitoring ambient air quality, surface water and sediment quality and applying adaptive management if necessary.	Negligible Effect Pathway

Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening
Construction: — Site preparation, including vegetation clearing and earthworks — Handling and storage of overburden — Road development, including culverts and bridge installation — Construction of facilities and infrastructure — Construction of TMF starter dam — Handling and storage of mine rock — Construction of water management infrastructure — Dewatering activities — Site traffic, including transportation of personnel and materials to and from the site **Operation and Maintenance:** — Open pit mining, including blasting and crushing ore and mine rock — Handling and storage of overburden, mine rock and ore — Pit dewatering and site water management — Handling, storage and discharge of non-contact water — Handling, storage, treatment and discharge of contact water — Sewage collection, treatment and surface discharge — Camp, mine services area, and office operation **Closure:** — Removal of infrastructure, restoration and revegetation of facilities and infrastructure — Site traffic, transportation of personnel and materials to and from the site	**Effluent Release** The release of treated effluent into Duley Lake may lead to changes in surface water and sediment quality, and adversely affect the health, survival, and reproduction of fish and lower trophic organisms.	— Design, construct and operate water management infrastructure in accordance with applicable permits, approvals, and best industry practices to minimize impact to surface water in receiving waterbodies. — Recycle and re-use process water to reduce freshwater intake and release to environment including Duley Lake, to the extent practicable. — Design the treated effluent diffuser to provide effective mixing and dilution of the effluent to limit the area of the receiving environment affected by mine discharge. — Develop a site-specific water treatment plant to treat contaminants in effluent to appropriate release limits in accordance with site-specific water quality objectives, federal and provincial standards and regulations, and permit conditions. — Construct and operate a wastewater treatment plant to treat sanitary sewage and wastewater to appropriate release limits in accordance with provincial standards and permit conditions — Design discharge(s) so the discharged flow does not interact with sediment. — Locate proposed treated effluent diffuser away from sensitive or unique habitats to the extent practical. — Collect, store, and routinely monitor contact water to ensure that discharge water meets the water quality criteria appropriate for release. — Monitor the flow and quality of treated effluent and treated sewage. — Implement an Environmental Effects Monitoring Program that includes monitoring water and sediment quality and applying adaptive management as necessary. — Implement a Project-specific Environmental Protection Plan. — Implement a Project-specific Waste Management Plan that includes site contact water management procedures.	Residual Effect Pathway
Construction: — Handling and storage of mine rock **Operation and Maintenance:** — Operation and management of the TMF — Handling and storage of overburden, mine rock and ore **Closure:** — Accelerated put flooding — Handling and storage of mine rock — Removal of infrastructure, restoration and revegetation of facilities and infrastructure	**Runoff and Seepage** Seepage from the Rose pit, overburden stockpile, mine rock stockpile, and tailing management facility during Construction, Operations, Closure, and the post-closure period may affect groundwater and surface water quality in receiving waterbodies and watercourses, as well as farther downstream, and adversely effect the health, survival, and reproduction of fish and lower trophic organisms.	— Blend acid generating material with non-potentially acid generating material to reduce acid-generating potential. — Contain and divert runoff and seepage from the mine rock stockpile, mine rock, and ore to the effluent treatment plant. — Construct runoff and seepage collection ditches around the overburden stockpile, mine rock stockpile, tailing management facility and other Project facilities and divert seepage to collection ponds and effluent treatment plant. — Characterize, identify, and manage potentially acid generating mine rock to prevent localized acid mine drainage and minimize metal leaching. — Develop and implement an Environmental Effects Monitoring Program that includes monitoring groundwater, surface water and sediment quality — Implement a Project-specific Waste Management Plan that includes site contact water management procedures. — Implement a Project-specific Environmental Protection Plan. — A Rehabilitation and Closure Plan is being developed in collaboration with government and Indigenous communities. This will be submitted as part of the permitting process.	Residual Effect Pathway

Project Components/Activities	Effects Pathway	Environmental Design Features, Mitigation or Enhancement Measures	Effect Pathway Screening

Operations and Maintenance:
— Open pit mining, including blasting and crushing ore and mine rock
	Use of Explosives
	Use of explosives during the operation and excavation of Rose Pit.
		— Blasting operations will follow DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2025) and Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky 1998) for setback distances from fish-bearing water bodies.
		— All blasts which might impact effect local structures, disrupt humans or impact effect local fisheries will be monitored for ground and air vibrations.
		— Blasting detonator timing and blast mats will be used, as appropriate, to control vibration as required.
		— The adaptive management plan will include a section related to vibration in which a limit of 80% will be outlined and were different mitigation measures will be considered such as:
		  — Reducing borehole diameter
		  — Introducing additional decked charges within each borehole
		  — Reduce borehole length (depth) by reducing the bench height
		  — Using electronic detonators
		  — These mitigations will be reviewed prior to the operation phase with the support of the blasting contractor.
		— Implement a Project-specific Environmental Protection Plan.
			Negligible Effect Pathway

9.5.2.1 No Effect Pathways

There are no effects related to fish and fish habitat that are expected to follow the no-effect pathway.

9.5.2.2 Negligible Effect Pathways

The following Project interactions are predicted to result in negligible effect pathways to fish and fish habitat and are not carried forward in the assessment:

- instream and in-lake construction activities
- fish impingement and entrainment
- water crossing structures
- water supply requirements
- altered site drainage
- sedimentation
- dust emissions
- deposition of suspended solids from emissions
- use of explosives

Instream and in-Lake Construction Activities (Construction and Closure)

Activities such as road development, including culvert and bridge installations, construction of facilities and infrastructure, the construction of the TMF starter dam, water management infrastructure, and dewatering activities can effect instream and in-lake fish habitats. The infrastructure and mining of Rose Pit are likely to directly remove fish habitat upon which they are planned to be built, which will adversely effect the fish populations within these water features.

These activities are only planned during the Construction and Closure phases and will span an area of 671,602.6 m^2. However, Project design, mitigations, and offsetting under Section 35 of the *Fisheries Act* are expected to limit the potential effect on fish and fish habitat. Mitigations and offsetting measures would include:

- In water works will be limited to outside the spawning period of fish, following DFO's Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat (DFO 2019).
- Water crossings and intakes will be constructed and installed to protect banks from erosion and maintain the watercourse flow.
- Following permits or authorizations issued for the Project from the appropriate regulatory agencies and DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2025).
- In water construction is completed in the dry (isolated from flowing water) using standard isolation methods.
- Maintaining 100% downstream flow during streams requiring diversion/isolation. Pump intakes should not disturb the bed and will be screened as per DFO's Freshwater Intake End-of-Pipe Fish Screen Guidelines (DFO 1995; 2020).
- Fish relocation, using non-lethal methods, in areas where habitat destruction is unavoidable, which will be overseen by a qualified aquatics professional.
- Implementation of a Project-specific Environmental Protection Plan.
- A Rehabilitation and Closure Plan is being developed in collaboration with government and Indigenous communities.

The Fisheries Authorization Habitat Offsetting Plan (TSD IX) will compensate for the destroyed habitat resulting from the Project's construction, per the *Fisheries Act*, Section 35. The proposed remediation method involves creating a pool and weir-type fishway, providing greater accessibility for Atlantic salmon (*Salmo salar*) to a 32 km section of the St. Lewis River. The falls forming the partial obstruction are located approximately 28 km upstream of the river's main stem. In total, the offsetting project is expected to restore 3,440,900 m^2 of fish habitat to not only Atlantic salmon, but also brook trout, American eel, Arctic charr (*Salvelinus alpinus*), rainbow smelt (*Osmerus mordax*), three spine stickleback, and longnose sucker (*Catostomus Catostomus*). Given the offsetting, this pathway is considered negligible; and was not carried forward in the assessment.

Fish Impingement and Entrainment (Construction, Operation and Maintenance)

Activities such as the construction of the TMF starter dam, dewatering activities, pit dewatering and site water management, handling, storage of discharge of non-contact water, treatment and discharge of contact water, and water intake for freshwater and process water have the potential to impinge and entrap fish within the systems used to withdraw water, which is likely to cause fish mortality. If a barrier is not placed at the intake entrance, fish can be expected to become entrapped in this manner.

These activities are expected to occur throughout the Project's Construction, Operations, and Maintenance phases. However, mitigations are expected to minimize the effect on fish and their habitats. Mitigation measures would include:

- Intake pumps will be screened to prevent entrainment or impingement of fish.
- Pump intake screens will be following DFO's Freshwater Intake End-of-pipe Screen Guidelines (DFO 1995, 2020).
- Intake screens will be in areas and depths of water away from high-quality fish habitat.
- Screens will be oriented to face the same direction as the flow of water.
- Screens will be above the bottom of the water body to prevent the entrainment of aquatic organisms.
- A Rehabilitation and Closure Plan is being developed in collaboration with government and Indigenous communities.

The anticipated potential effects of water intake on fish and fish habitat are negligible if the above-mentioned mitigation measures are implemented; therefore, this effect pathway is not carried forward for further assessment. These measures will prevent fish impingement and entrainment, as screens with small openings limit the approach velocity of water and minimize or eliminate the risk of fish being drawn into the intake system or becoming trapped against the screens. Water withdrawal can be planned during periods outside of spawning seasons, and intake structures can be placed where fish are unlikely to congregate or migrate. The effects of this activity can be measured by comparing the results from the baseline surveys in the watercourses from which water will be drawn with those from new surveys completed in the same areas. The results of the baseline report can also be used to inform the relative number and species that can be expected to be found in the watercourses from which the water will be drawn.

Water Crossing Structures (Construction and Closure)

Activities such as road development, the construction and removal of facilities and infrastructure, and maintenance are expected to create potential barriers to fish passage, as roads and infrastructure are likely to intersect with streams throughout the RSA. If crossing structures are not installed with the proper mitigation measures, fish habitat may become fragmented, resulting in restricted access for fish. Structures that are installed and maintained in accordance with the mitigation measures outlined below will result in negligible effects to fish and their habitats.

These activities are expected to occur through Construction and Closure. The following mitigation measures will reduce the effect that constructing structures has on fish and fish habitat:

- Implementation of a Project-specific Environmental Protection Plan and Erosion and Sediment Control Plan, including:
  - structure designs that best facilitate fish passage, such as open-bottom culverts
  - when possible, reduce construction near watercourses around sensitive periods for fish
  - sediment control measures
  - restoration plans for effected habitat, including riparian areas
  - maintenance plans
- Implementation of monitoring programs to assess the efficacy of the crossing structure and its effect on fish habitat.
- Design cross drainage structures to convey the maximum instantaneous flow resulting from a 1:10-year flood event.
- Align roads to minimize stream crossings and avoid sensitive habitat where possible.
- Design crossing structures to limit the area disturbed within the water features, protect banks from erosion, maintain flows in the watercourse, and follow relevant permits and authorizations.
- Culverts will be designed to allow fish passage where appropriate. Before construction, water flow conditions and fish presence will be assessed to establish a culvert design that allows for fish passage.
- Regularly inspect and maintain crossing structures to prevent blockages from forming.
- Development of a Rehabilitation and Closure Plan in collaboration with the government and indigenous communities.

The anticipated potential effects of water crossing structures on fish and fish habitat are negligible if the above-mentioned mitigation measures are implemented; therefore, this effect pathway is not carried forward for further assessment. The effectiveness of mitigations can be measured via fish surveys above and below the crossing structure. If many fish of various species are found downstream of a crossing structure but not upstream, this suggests that the structure acts as a barrier to fish passage and should be further investigated and modified to allow for more effective fish passage if necessary.

Water Supply Requirements (Construction, Operation and Maintenance, and Closure)

Project activities that are expecting to withdraw water (potable and process) include site preparation, road development, construction and removal of facilities and infrastructure, handling and storage of mine rock, overburden, and ore, operations of the TMF, dewatering activities, open pit mining, dewatering and site water management, handling, storage, treatment, and discharge of contact and non-contact water, sewage collection treatment and discharge, water intake, camp, mine service area, and office operation, site traffic and transportation of personnel and materials, and accelerated pit flooding. These activities have the potential to alter water levels, flows, and channel/bank stability in water features, which may effect fish and fish habitat.

To avoid potential effects to fish and fish habitat, the effects of water supply requirements will be mitigated through the following methods:

- Maximize the recycling and reuse of process water to reduce freshwater intake.
- Monitor flows before and after construction to quantify the changes in flow and their effects on the aquatic environment and apply adaptive management as necessary.
- Adhere to guidance from regulators, such as DFO, regarding the allowable rate and timing of withdrawals from the point of supply.
- Implement a Project-specific Environmental Protection Plan, including measures to address tailings management, mine rock management, site water management and surface water management.
- Implement an Environmental Effects Monitoring Program that includes surface water and fish and fish habitat monitoring.

These mitigation and management plans are expected to minimize the Project's water supply requirements' potential effects on fish and fish habitat. These mitigations will be paired with water withdrawal mitigations to prevent effects on fish and fish habitat. The effect that water supply requirements will have on fish and fish habitat is expected to be negligible, and therefore, this pathway was not carried forward in the assessment.

The above potential effects of water supply requirements on fish and fish habitat are measurable, as the results of the previous baseline surveys can be compared to future surveys.

Altered Site Drainage (Construction, and Operation and Maintenance)

Altered site draining, runoff, and discharge from facilities and infrastructure during Construction and Operations can cause changes in water level, flows, watercourse channel, and bank stability, effecting fish habitat. Activities which may alter site drainage include site preparation, road development, handling and storage of mine rock, overburden, and ore, site traffic, including the transportation of personnel and material, open pit mining, handling, storage, treatment, and discharge of contact and non-contact water, and camp, mine service area, and office operations. See section 8.5.2 (Chapter 8), SW-06, for details of the watershed alterations in the SAA.

Additionally, residual changes from site drainage during Closure may cause changes in water level, flows, watercourse channels, and bank stability. Activities that may effect fish and fish habitat during this time include the removal of infrastructure, restoration and revegetation of facilities and infrastructure, and site traffic, including the transportation of personnel and materials.

Project designs and mitigations that will minimize the effect of site drainage, runoff and discharge from facilities and infrastructure, during all three Project phases, on fish and fish habitat include:

- Adequate water storage capacity has been designed to provide a controlled release rate during routine and non-routine operation scenarios.
- Erosion control measures will be used as required.
- Routine inspection and maintenance of containment and conveyance structures (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment.
- Limit areas of vegetation clearing and soil disturbance.
- Reduce, where possible, the steepness and length of slopes of disturbed areas and stockpiled soils.

- Avoid, when possible, placing soil stockpiles on slopes, near water bodies (i.e., maintaining an appropriate buffer from waterbodies), and near natural drainage features.
- When possible, work in sensitive areas will be scheduled to avoid periods (e.g., spring freshet) that may result in high flow volumes and/or increased erosion and sedimentation.
- Where practical and applicable, implement progressive reclamation and revegetation of disturbed areas no longer required.
- Restore and revegetate areas where non-permanent Project features have been removed.
- Adhere to guidance from regulators, such as DFO, regarding the allowable rate and timing of withdrawals from the point of supply.
- Alignment of site roads will be designed to minimize stream crossings and avoid sensitive habitat as feasible.
- Apply DFO Measures to Avoid Causing Harm to Fish and Fish Habitat.
- Implement a Project-specific Environmental Effects Monitoring Program that includes monitoring water and sediment quality and applying adaptive management if necessary.
- Implement site water management plan, as included in the Project-specific Environmental Protection Plan and Waste Management Plan.
- A Rehabilitation and Closure Plan is being developed in collaboration with government and Indigenous communities.

Champion has modelled water balances, and the predicted changes in flow rates from Pike Lake to Walsh River and onto Duley (Long) Lake were found to be insignificant and therefore are considered negligible (TSD VI). The effects that removing the water features in the Project footprint will have on site drainage will be offset under the St. Lewis River Connectivity project and are therefore considered negligible. Therefore, this pathway has not been carried forward in the assessment.

Sedimentation (Construction, Operation and Maintenance, and Closure)

Activities such as site preparation, handling and storage of overburden and mine rock, road development, the construction of infrastructure and facilities, construction, operation, and management of the TMF starter dam, site traffic, handlings, storage, treatment, and discharge of non-contact and contact water, progressive reclamation, and the removal of infrastructure are likely to result in sedimentation in water features within the LSA. If sedimentation is not mitigated, fish and fish habitat can be significantly effected. Sedimentation can degrade the quality of watercourse sediment, smother fish eggs, alter the flow of streams, reduce water quality and alter fish behaviour.

Sedimentation is expected to occur during Construction, Operation and Maintenance, and Closure. The following mitigation measures are expected to minimize potential effects on fish and fish habitat.

- For instream isolations/diversions, 100% downstream flow will be maintained, and, if required, pump intakes should not disturb the bed. Water diversion hoses will be screened as per DFO's Freshwater Intake End of Pipe Fish Screen Guidelines (DFO 1995; 2020).
- Discharge of water to water features so as not to cause erosion or damage to adjacent areas.
- Implement erosion control measures, as presented in the Erosion and Sediment Control Plan.
- Routine inspection and maintenance of containment and conveyance structures to limit the risk of road washouts.
- Limit areas of vegetation clearing and soil disturbance.
- Limit the steepness and length of slopes of disturbed areas and stockpiled soils.
- Avoid placing soil stockpiles on slopes, near water bodies (i.e., maintaining an appropriate buffer from waterbodies), and near natural drainage features.
- Where possible, work in sensitive areas will be scheduled to avoid periods (e.g., spring freshet) that may result in high flow volumes and/or increased erosion and sedimentation.
- Where possible, instream and in-lake construction in potential spawning habitat areas will occur outside the spawning period for fish VCs. Construction activities will be scheduled to avoid work during Fisheries and Oceans Canada's (DFO) Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat (DFO 2019). If work outside of the timing windows is not possible, the appropriate approvals will be obtained to proceed. Restricted activity periods for fish VCs are as follows:
  - Lake trout and lake whitefish (September 1 to July 15);
  - Northern pike (May 1 to July 15); and
  - Ouananiche (October 1 to May 31).
- Instream construction will either be avoided or limited to when watercourses are not flowing, or are frozen to the bottom, where possible.

- Where practical and applicable, implement progressive reclamation and revegetation of disturbed areas no longer required.
- Restore and revegetate areas where non-permanent Project features have been removed.
- Implement site water management plan, as included in the Environmental Protection Plan and Waste Management Plan.
- Implement Environmental Effects Monitoring Program and surface water monitoring plan, including monitoring water and sediment quality and applying adaptive management if necessary.
- A Rehabilitation and Closure Plan is being developed in collaboration with government and Indigenous communities

Mitigation measures for preventing sedimentation are widely practiced, well established, and well known to be effective. As a result, the effects of sedimentation are expected to be negligible; therefore, this effect pathway is not carried forward for further assessment. Sediment and erosion mitigation measures should be inspected following extreme weather events such as floods, which may cause mitigation measures to fail. If there is evidence of failure, the effect of sedimentation on fish and their habitats can be measured through fish habitat surveys (substrate surveys) and fish surveys (health assessments via length-to-weight ratio). Any effects are unlikely to occur, but if they are observed, they are expected to be infrequent and restricted to the LSA. Mitigation and measures presented in the Erosion and Sediment Control Plan (Annex 5F) will be implemented.

Dust Emissions (Construction, Operation and Maintenance, and Closure)

Activities such as site preparation, handling and storage of overburden and mine rock, road development, construction and removal of facilities and infrastructure, operation of mobile mining equipment, site traffic, open pit mining, and iron ore processing are likely to produce fugitive dust. This dust can be directly deposited into water features and/or vegetation in riparian areas, potentially adversely affecting surface water and sediment quality, which could effect fish and fish habitat. This dust is expected to be mobilized primarily in the summer, as snow and ice provide a natural mitigation to the spread of fugitive dust.

However, mitigation measures and Project design are anticipated to limit the spread of fugitive dust generated by Project activities, particularly in the summer months. These mitigation measures and project designs include:

- Application of water and/or suppressants to site roads, access roads, and airstrip as necessary.
- Establishing and enforcing speed limits on site and access roads will reduce dust production.
- Limit vehicle speed on unpaved site roads to reduce fugitive dust during Construction and Operations.
- Minimize haul route distances, thereby reducing fuel consumption and fugitive emissions from equipment.
- To limit total suspended particulate emissions, a reduced speed limit for heavy equipment involved in material movement and earthworks on site will be enforced. This speed limit does not apply to site road traffic or the haul route from the headworks to the mine rock piles
- Application of water and/or suppressants should be applied to site roads and access roads as necessary.
- All crushed iron ore stockpiles would be covered with dust collection technology to minimize fugitive dust and silica from crushed ore stockpiles.
- Use dust suppressants that minimize environmental risk and are government approved.
- Apply water sprays to stockpiles or areas that have visible dust, as necessary.
- Minimize areas of vegetation clearing and soil disturbance to reduce the generation of fugitive dust.
- Implement an Environmental Effects Monitoring Program that includes monitoring ambient air quality and water and sediment quality and applying adaptive management as necessary.

Road watering during summer months has been found to suppress dust emission generation by approximately 80% and maintain its efficacy for four to six hours after watering (Golder 2012).

These mitigation measures are expected to limit fugitive dust generation and limit deposition into water features, which could effect fish and fish habitat. Therefore, a measurable residual effect on fish and fish habitat is not expected; as a result, this pathway has not been carried forward in the assessment.

Deposition of Suspended Solids from Emissions (Construction, Operation and Maintenance, and Closure)

Deposition of suspended solids from emissions into water features and terrestrial areas from emissions associated with Project activities such as site preparation, road development, construction and removal of infrastructure and facilities, handling and storage of mine roc and overburden, site traffic, open pit mining, power generation, and camp, office, and mine service area operations. Unlike fugitive dust emission, which experiences natural mitigation during the winter months, emissions from the above sources can be generated year-round. Thus, they require more robust mitigation measures to limit their potential effect on fish and fish habitat. Air contaminants can accumulate within the snowpack surrounding the Project site during the winter, as they are not dispersed by runoff. The spring melt may carry an increased load of emission contaminants to regional water features.

Project design and mitigation measures, which will minimize the effect of suspended solid deposition from emissions on fish and fish habitat, include:

- Use and maintain emissions control devices on motorized equipment.
- Maintain and monitor mobile mining equipment and vehicles to validate emissions within engine exhaust systems' designed operating parameters.
- Seek to reduce fuel combustion requirements of infrastructure and equipment during detailed design.
- Regular maintenance of equipment.
- Limit idling of vehicles to the extent practical.
- Procurement criteria to ensure that the stationary and mobile engines meet applicable performance standards.
- Minimize haul route distances, thereby reducing fuel consumption and fugitive emissions from equipment.
- Application of water and/or suppressants should be applied to site roads and access roads as necessary.
- Use dust suppressants that minimize environmental risk and are government approved.
- Apply water sprays to stockpiles or areas that have visible dust, as necessary.
- Establishing and enforcing speed limits on unpaved site and access roads will reduce dust production.
- All crushed iron ore stockpiles would be covered with dust collection technology to minimize fugitive dust and silica from crushed ore stockpiles.
- Minimize areas of vegetation clearing and soil disturbance to reduce the generation of fugitive dust.
- Implement a Project-specific Environmental Protection Plan
- Implement Environmental Effects Monitoring Program that includes monitoring ambient air quality, surface water and sediment quality and applying adaptive management if necessary.

These designs, mitigation, and monitoring measures are expected to minimize the generation and deposition of suspended solids from Project emissions. The largest effect is expected from this pathway through the aforementioned snow accumulation and subsequent melt, which could mobilize emission contaminants that may have accumulated on it. This could potentially result in minor, localized changes in surface water and sediment quality, leading to temporary, minor effects on fish and fish habitats. However, any effects are expected to dissipate quickly, given the large amount of water released during snowmelt, resulting in negligible residual effects on fish and fish habitat. Therefore, this pathway was not carried forward in the assessment.

Use of Explosives and Vibrations (Operation and Maintenance)

It is expected that aggregates used for construction will come from blasting used to develop Rose Pit. Construction blasting will be used for site preparation and carried out by the contractor using typical construction blasting techniques and parameters.

Assuming a single hole per delay, the DFO limit of 13.0 mm/s is anticipated to be complied with for all blasting beyond the estimated standoff distances of 99 m from an active spawning bed during egg incubation. The DFO limit of 50 kPa is also anticipated to be with for all blasting beyond the estimated standoff distances of 51 m from the nearest fisheries habitat.

Assuming a single hole per delay, the DFO limit of 13.0 mm/s is anticipated to be complied with for all blasting beyond the estimated standoff distances of 353 m from an active spawning bed during egg incubation. The DFO limit of 50 kPa is also anticipated to be complied with for all blasting beyond the estimated standoff distances of 182 m from the nearest fisheries habitat.

Blasting will be completed following DFO's Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky 1998). No effects to fish habitat are expected outside of the SSA. As this area will be offset under the *Fisheries Act*, the effects of this pathway are considered negligible and are not carried forward in this assessment.

9.5.2.3 Residual Effect Pathways

The following Project interaction was predicted to be a residual effect pathway to fish and fish habitat, and was advanced for further assessment of residual effects (Section 9.5.3):

- effluent release and seepage

Effluent Release, Run-off and Seepage (Construction, Operation and Maintenance, and Closure)

Project activities, including site preparation, handling and storage of overburden and mine rock, road development, construction and removal of infrastructure and facilities, dewatering, open pit mining, handling, storage, and discharge of contact and non-contact water, sewage collection, treatment and discharge, and camp, office and mine service area operations can cause adverse effects to the water quality of the receiving water features. However, effluent discharges must be monitored for compliance with federal and provincial criteria. Discharge will adhere to *Fisheries Act* section 36 MDMER requirements.

Mitigation measures and project designs are expected to minimize the potential effect of effluent release on fish and fish habitat. The mitigation measures and project designs include:

- Design, construct and operation water management facilities and infrastructure.
- Recycle and reuse process water to minimize freshwater intake and reduce discharge to Duley Lake, to the extent practicable.
- Design the treated effluent diffuser and treated sewage outfall to provide adequate mixing and dilution of the effluent to limit the area of the receiving environment affected by mine discharge.
- Develop a site-specific water treatment plant to treat contaminants in effluent to appropriate release limits in accordance with site-specific water quality objectives, federal and provincial standards and regulations, and permit conditions.
- Construct and operate a wastewater treatment plant to treat sanitary sewage and wastewater to appropriate release limits in accordance with provincial standards and permit conditions
- Design discharge(s) so the discharged flow does not interact with sediment.
- Locate proposed treated effluent diffuser away from sensitive or unique habitats to the extent practical.
- Collect, store, and routinely monitor contact water to ensure that discharge water meets the water quality criteria appropriate for release.
- Monitor the flow and quality of treated effluent and treated sewage.
- Blend acid generating material with non-potentially acid generating material to reduce acid-generating potential.
- Contain and divert runoff and seepage from the mine rock stockpile, mine rock, and ore to the effluent treatment plant.
- Construct runoff and seepage collection ditches around the overburden stockpile, mine rock stockpile, tailing management facility and other Project facilities and divert seepage to collection ponds and effluent treatment plant.
- Characterize, identify, and manage potentially acid generating mine rock to prevent localized acid mine drainage and minimize metal leaching.
- Implement an Environmental Effects Monitoring Program that includes monitoring water and sediment quality and applying adaptive management as necessary.
- Implement a Project-specific Environmental Protection Plan.
- Implement a Project-specific Waste Management Plan that includes site contact water management procedures.
- A Rehabilitation and Closure Plan is being developed in collaboration with government and Indigenous communities.

To predict risks of effluent release and seepage under future development scenarios for the Project, both the predicted increases of contaminants of potential concern (COPCs) and the consequences of those increases on the health of aquatic life were investigated. Discharge effluent and seepage remained below the MDMER discharge limits throughout all phases and modelled flow scenarios. Mercury and thallium were excluded from the modelled results due to elevated background surface water quality measurements, which reflect a method detection limit higher than the guidelines. The mercury and thallium levels are not driven by Project effects associated with effluent discharge. The model produced three different flow scenarios:

- Mean annual precipitation (MAP), which corresponds to the climate year closest to the MAP value of 890 mm (2016).
- P25, which corresponds to the climate year closest to the 25th percentile of the precipitation record of 790 mm in 1994.
- P75, which corresponds to the climate year closest to the 75th percentile of the precipitation record of 960 mm in 2014.

However, as presented in Chapter 8 (Section 8.5.3.1.2) and Table 9-17, there were still several exceedances of the CCME guidelines for total cobalt and total selenium in Duley Lake, Pike Lake and Walsh River. Simulations for Duley Lake show ambient conditions due to Project effluent discharge. Model results show that:

- Total cobalt concentrations exceed CCME guideline during the Operations phase starting around year 9, but the Project effects are reversible and do not persist beyond Operations phase.

- Total selenium concentrations exceed CCME guideline during the Operations phase starting around year 16. Project effects are seasonal, reversible, and do not persist beyond Operations

Project effects on Pike Lake differ between the Operations and Post-Closure phases. During Operations Phase, Project effects are linked to water transfers from Duley Lake and its ambient water quality due to Project effluent discharges, whereas during Post-Closure Phase, these are due to passive seepage from the overburden stockpile. Model results show that:

- Total cobalt concentrations exceed CCME guideline starting around year 11, but these Project effects are reversible and do not persist beyond Operations phase.
- Total selenium concentrations seasonally exceed CCME guideline from approximately year 19 to year 24. These effects do not persist above the guideline during Closure when the Rose pit is being flooded. However, starting in year 36, total selenium concentrations consistently exceed CCME guideline.

Like Pike Lake, Project effects in the Walsh River are also divided into the Operations and Post-Closure phases. During Operations, Project effects are limited to total cobalt due to water transfers from Duley Lake, whereas during the Post-Closure phase Project effects are associated with passive discharge from the overburden stockpile. Model results show that:

- Project effects on total cobalt occur late in Operations (around year 19), are seasonally limited to P25 flow events, are reversible, and do not persist beyond operations.
- Project effects on total selenium occur around year 39 and are associated with passive discharge from the overburden stockpile. Project effects on total selenium are seasonally limited to P25 flow events, are reversible, and infrequent (Figure 9-13).

Due to the exceedances of these CCME guidelines listed above, the effects of effluent release and seepage can result in a residual effect on fish health. As such, these effect pathways were carried forward to the residual Project effects analysis.

Table 9-17: Canadian Council of Ministers of the Environment and Human Health Exceedance Summary Table for Receiving Environment Model Nodes (TSD VI)

Station	Phase	Construction			Operations			Closure			Post-closure		
	Model Scenario	P25	MAP	P75	P25	MAP	P75	P25	MAP	P75	P25	MAP	P75
Duley Lake IDZ	Cobalt_Total	-	-	-	CCME	CCME	CCME	-	-	-	-	-	-
	Selenium_Total	-	-	-	CCME	CCME	CCME	-	-	-	-	-	-
Duley Lake	Cobalt_Total	-	-	-	CCME	CCME	CCME	CCME	CCME	CCME	-	-	-
	Selenium_Total	-	-	-	CCME	CCME	CCME	CCME	-	-	-	-	-
Duley Lake Outlet	Cobalt_Total	-	-	-	CCME	CCME	CCME		-	-	-	-	-
Pike Lake	Cobalt_Total	-	-	-	CCME	CCME	CCME	CCME	CCME	CCME	-	-	-
	Selenium_Total	-	-	-	CCME	-	CCME	CCME	CCME	CCME	CCME	CCME	CCME
Walsh River	Cobalt_Total	-	-	-	CCME	-	-	-	-	-	-	-	-
	Selenium_Total	-	-	-		-	-	-	-	-	CCME	-	-

IDZ = initial dilution zone; MAP = mean annual precipitation (MAP), which corresponds to the climate year closest to the MAP value of 890 mm (2016), P25= the climate year closest to the 25th percentile of the precipitation record of 790 mm in 1994; P75 = the climate year closest to the 75th percentile of the precipitation record of 960 mm in 2014.

9.5.3 Residual Project Effect Analysis

This section provides results of the Project effects analysis for fish and fish habitat based on the residual effects pathways identified in Section 9.5.2.3.

Methods for completing the residual Project effects analysis for fish and fish habitat are presented in Section 9.5.1.2.

9.5.3.1 Residual Project Effects Characterization

This section assesses the predicted changes to fish and fish habitat from the residual effect pathways identified in Section 9.5.2.3, Residual Effects Pathways. From the effluent pathway screening (Section 9.5.2), two residual effect pathways were identified: effluent release and run-off and seepage during all Project phases. The residual effects associated with effluent releases and seepage into the receiving environment include possible changes in surface water and sediment quality and subsequent effects on fish health, survival, reproduction, and lower trophic organisms.

The assessment of effluent release and seepage has been measured against both fish health and fish habitat and productivity VECs. Measurable habitat parameters include the area of fish habitat lost or altered, barriers to fish passage, alterations in water and/or sediment quality, reductions or alterations in riparian vegetation, and changes in watercourse flows. Fish health measurable parameters include loss of fish, loss of species of conservation interest, and reduction in fish health, as indicated by the length-to-weight ratio.

The above residual Project effects are compared against these measurable parameters to understand the overall effect in terms of the effect criteria described in Table 9-15. Permanent change to fish habitat and productivity and fish health requires quantification, authorization, and offsetting under the federal *Fisheries Act*. Effects are characterized as either direct or indirect. Direct effects are immediate and occur at the development site, including physical alterations to the habitat, the construction of water crossing structures, water diversion, and the discharge of pollutants. Indirect effects occur later or further away from the site, including habitat fragmentation, and population changes.

9.5.3.1.1 Fish Habitat and Productivity

Residual effects from effluent and release and seepage are characterized below for each of the measurable parameters for fish habitat and productivity. A summary of the characterization of residual effects to fish habitat and productivity is presented in Table 9-20.

Area of Fish Habitat Lost or Altered

While the Project activities are predicted to result in the loss and alteration of fish habitat areas, the effects will be offset by the St. Lewis River Habitat Connectivity offsetting project, as presented in Section 9.5.2.2. Effluent release and seepage are not anticipated to result in additional habitat lost or alternation that is not already considered by the offsetting project. To this end, residual effects to fish habitat and productivity from the loss or alternation of fish habitat from effluent discharge and seepage are not anticipated and were not characterized.

Barriers to Fish Passage

In total, 17 water crossings were identified throughout the Project site, and crossing structures will be required to facilitate access roads and a rail line, presented in Section 9.5.2.2. Effluent release and seepage are not anticipated to result in additional barriers to fish passage. To this end, residual effects to fish habitat and productivity from barriers to fish passage due to effluent discharge and seepage are not anticipated and were not characterized.

Reduction or Alteration of Riparian Habitat

While the Project activities are predicted to result in the loss and alteration of riparian habitat, the effects will be offset by the St. Lewis River Habitat Connectivity offsetting project, as presented in Section 9.5.2.2. Effluent release and seepage are not anticipated to result in reduction or alternation of riparian habitat that is not already considered by the offsetting project. To this end, residual effects to fish habitat and productivity from the reduction or alternation of riparian habitat from effluent discharge and seepage are not anticipated and were not characterized.

Change in River/Stream Flow

To predict the changes to surface water flows and water levels in receiving waterbodies (Duley Lake and Pike Lake), a Water Balance and Water Quality Model (TSD VI) was developed that accounted for the changes to drainage pattern (including headwater areas upstream) and runoff to the receiving waterbodies, water takings, effluent discharges, seepage flows and water transfers between the Duley Lake and Pike Lake, and fugitive loadings from explosive spills. For this chapter, only information on Duley and Pike Lake will be considered, as Rose Pit and the collection ponds will not hold any fish or be considered fish habitat and will require authorization for habitat loss under the *Fisheries Act*. The model was run using the MAP scenario. Water transfers from the pit collection pond to Duley Lake increase over time as the stockpile footprint grows and the open pit develops. By the end of Operations, the model predicted an annual discharge from the collection pond to Duley Lake to reach 24 million cubic meters (Mm^3). The discharge rate of Duley Lake was modelled to include the current, baseline flow average, compared to the expected mine operation flow rate, during the End of Mine (Year 24), and Closure (years 25 through 36).

The end-of-mine years showed a discharge change from Duley Lake ranging from -2% to 18%, flow during winter due to effects from pit dewatering, which are conservative. Overall, the annual average discharge at Duley Lake outlet at the end of Operations is projected to be 1% lower than the pre-mine conditions (Table 9-18).

During the closure phase, monthly discharge reductions are expected to range from -5% to -16%, with the largest flow reduction occurring during the winter due to effects from water transfers to accelerate pit flooding. Overall, the annual average discharge at Duley Lake outlet during Closure is projected to be 7% lower than the pre-mine conditions (Table 9-19).

Table 9-18: Predicted Monthly Duley Lake Average Discharge Under Pre-mine vs Mine Conditions for the Mean Annual Precipitation (MAP) Scenario for the End of Mine (Year 24) (TSD VI).

Month	Pre-mine Conditions (m^3/s)	Mine Conditions (m^3/s)	Project Effect (%)
January	1.8	2.1	12%
February	3.3	3.4	5%
March	0.9	1.0	18%
April	10.5	10.5	0%
May	68.5	67.3	-2%
June	40.0	39.4	-1%
July	21.0	20.9	0%
August	19.6	19.5	0%
September	17.3	17.2	0%
October	18.8	18.7	0%
November	21.2	21.1	-1%
December	4.0	4.2	6%
Average	18.9	18.8	-1%

Table 9-19: Predicted Monthly Duley Lake Average Discharge under Pre-Mine vs Mine Conditions for the Mean Annual Precipitation (MAP) Scenario during Closure phase (Years 25-36) (TSD VI)

Month	Pre-mine Conditions (m^3/s)	Mine Conditions (m^3/s)	Project Effect (%)
January	2.0	1.7	-16%
February	3.3	2.9	-12%
March	0.9	0.8	-14%
April	11.3	10.3	-9%
May	65.0	62.2	-4%
June	39.4	37.2	-5%
July	21.1	19.5	-8%
August	19.9	18.3	-8%
September	17.5	16.1	-8%
October	19.2	17.9	-7%
November	21.5	19.9	-8%
December	4.1	3.5	-14%
Total	18.8	17.5	-7%

To mitigate the potential effects of removing the contributing catchment area within the proposed mine site and groundwater seepage from Pike Lake into the open pit lake discharges, water will be transferred from Duley Lake to Pike Lake during both the Operations and Closure phases. Under the MAP scenario, Pike Lake discharge is expected to remain above the seasonal minimum discharge threshold rates (0.003 m^3/s for Dec-April and 0.25 m^3/s for May-Nov) for environmental maintenance flows.

As presented in Figure 9-4 the model predicts that discharge rates for the P25 flow scenario would fall below the minimum threshold during the winter months in the early years of the Closure phase, coincident with pit filling. To reduce the length of the Closure phase, the model currently assumes that flooding of the pit is maximized. The flooding sequence that will be implemented for the Project will be finalized based on site conditions, and will be driven by minimizing environmental effects to surrounding waterbodies, including Pike Lake. Champion is committed to maintaining the minimum discharge threshold in Pike Lake to minimize effects to fish and fish habitat.

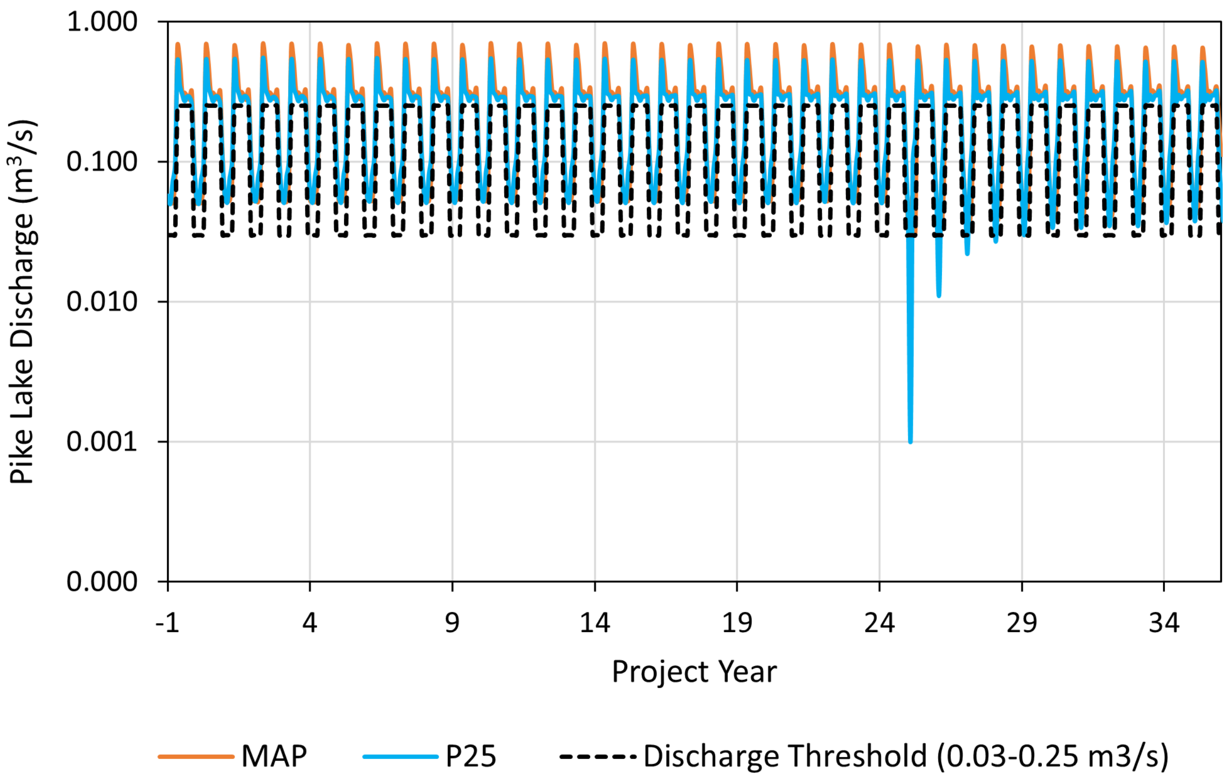


Figure 9-4 : Predicted Monthly Pike Lake discharge for MAP and P25 Scenarios during the Construction, Operations, and Closure Phases, Compared to Seasonal Minimum Threshold Discharge Rates

In addition to this model, flow measurements were taken at 16 watercourse stations during 2023 and 2024, and five stream stations in 2011. While it is expected that the largest changes in flow will result in the areas described in the model above, there are stream reaches immediately downstream of the Project footprint (e.g., Mine Rock Stockpile and Tailings Management Facility) that will receive limited upstream flow input and will therefore have limited aquatic habitat available. These areas have been included in the estimation of total habitat loss and will require a *Fisheries Act* authorization and offsetting. Data collected in subsequent surveys will be compared to the baseline information, thereby providing a quantifiable measure of effect.

Overall, the magnitude of effluent release and seepage on stream and river flows is expected to be negligible. The effect will be long term, but reversible following the completion of pit flooding during the closure phase. Table 9-20 summarizes the classification of the residual effects to fish habitat and productivity.

Table 9-20: Classification of Residual Effects on Fish Habitat and Productivity Measurable Parameters

Residual Effect	Criterion	Rating/Effect Size
Change in River/Stream Flow	Nature	Adverse
	Magnitude	Negligible
	Geographic Extent	Local
	Duration	Long term
	Timing	Spring, Summer and Fall.
	Reversibility	Reversible
	Frequency	Continuous
	Probability of occurrence	Probable
	Ecological and Socio-economic context	Alteration of flows may result in habitat fragmentation, alteration of water quality, and species which may inhabit an area, which can effect ecological processes.

9.5.3.1.2 Fish Health

Residual effects from effluent release and seepage are characterized below for each of the measurable parameters for fish health. A summary of the classification of residual effects to fish health is presented in Table 9-21.

Alteration of Water and/or Sediment Quality

As mentioned in ection 9.5.2.3, a water quality model was completed, which simulated the water quality of the Project's receiving waterbodies (TSD VI). While the model simulations of the Project effluent fall below the MDMER discharge limits for all phases and flow periods, total cobalt and total selenium exceeded the CCME guidelines. Each are further assessed and described below.

Cobalt

Elevated levels of cobalt can be toxic to fish, affecting their growth, reproduction, and survival. Long-term exposure can lead to bioaccumulation in fish, potentially causing long-term health issues within a population. Cobalt toxicity can result in changes in fish behaviour, such as reduced activity and feeding. Water hardness is the parameter that modifies the toxicity of cobalt, influencing metal uptake. As presented in Table 9-17, cobalt is predicted to exceed the CCME guideline (1 µg/L for a hardness of 100 mg/L; 0.83 µg/L for maximum predicted hardness at the edge of the mixing zone in Duley Lake under discharge conditions) at five waterbody stations (Duley Lake initial dilution zone, Duley Lake, Duley Lake Outlet, Walsh River and Pike Lake) within Duley Lake, Walsh River and Pike Lake.

To understand site-specific conditions, a desktop assessment was conducted to define a site-specific water quality objective (SSWQO) for cobalt (TSD VIII), following federal guidance for developing site-specific objectives. Site-specific water quality objectives are scientifically derived benchmarks tailored to the unique environmental conditions of a particular location. They are designed to protect aquatic life by accounting for local ecological, chemical, and physical characteristics that influence how aquatic organisms respond to contaminants.

The cobalt SSWQO study (TSD VIII) considered the factors known to influence the toxicity of cobalt in freshwater (e.g., water hardness) and applied curve fitting to reliable and site-relevant aquatic toxicity data. The model fit utilized toxicity data standardized to a common water hardness, employing a species sensitivity distribution. The approach assumes that total predicted cobalt comprises mainly dissolved forms of cobalt, a conservative assumption used for screening evaluation.

Using the above approach, the long-term hardness-dependent cobalt SSWQO equation is:

$$SSWQO\ (\mu g/L) = e^{\{0.414[\ln(hardness)] - 0.57417\}}$$

Based on the hardness-dependent SSWQO equation, site-specific values for total cobalt ranged between 2.7 and 3.2 µg/L for the affected water bodies (Duley Lake and Pike Lake).

Modelled predictions of total cobalt concentrations that exceed CCME guidelines over the course of the Project at the five waterbody stations (Duley Lake initial dilution zone, Duley Lake, Duley Lake Outlet, Walsh River and Pike Lake) within Duley Lake, Walsh River and Pike Lake are presented in Figures 9-5 to 9-9 and summarized below.

- Total cobalt concentrations at the Duley Lake IDZ (Figure 9-5) are expected to exceed the CCME guidelines during Operations, starting in year 9 for all scenarios. These levels are reversible and will return to the baseline following Operations. These concentrations do not exceed the cobalt SSWQO.
- Total cobalt concentrations at Duley Lake (Figure 9-6) are expected to exceed the CCME guidelines during the Operations phase beginning in approximately year 10 for all scenarios. As in the Duley Lake IDZ, results are reversible and will return to baseline following Operations. These concentrations are near, but do not exceed the cobalt SSWQO.
- Total cobalt concentrations at Duley Lake Outlet (Figure 9-7) are expected to exceed the CCME guidelines during the Operations phase beginning in approximately year 16 for the P25 scenario. As in the Duley Lake IDZ and Duley Lake, results are reversible and will return to baseline following Operations. These concentrations do not exceed the cobalt SSWQO.
- Total cobalt concentrations at Walsh River (Figure 9-8) are expected to exceed the CCME guidelines during the Operations phase beginning in approximately year 16 during the P25 scenario before returning to background during active closure (i.e., Pit flooding). Cobalt concentrations are predicted to increase again following closure due to passive discharge from the overburden stockpile, but do not exceed CCME. These levels do not exceed the cobalt SSWQO.
- Total cobalt concentrations in Pike Lake (Figure 9-9) are expected to exceed CCME guidelines during Operations, beginning in approximately years 11 through 24. Following the flooding of Rose Pit, seepage from the overburden stockpile is expected to affect total cobalt concentrations, raising them above background but below the CCME. These levels do exceed the cobalt SSWQO.

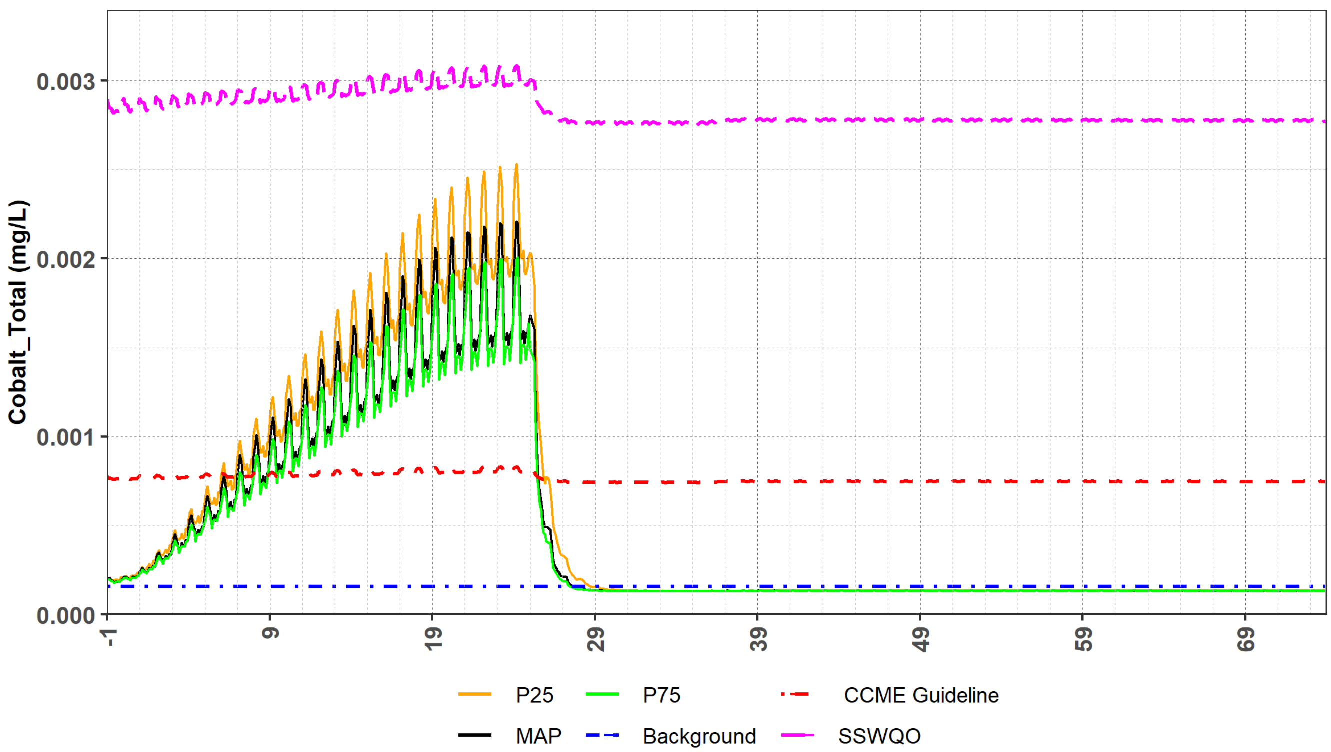


Figure 9-5 : Modelled Predictions of Total Cobalt Concentration for Duley Lake Initial Dilution Zone

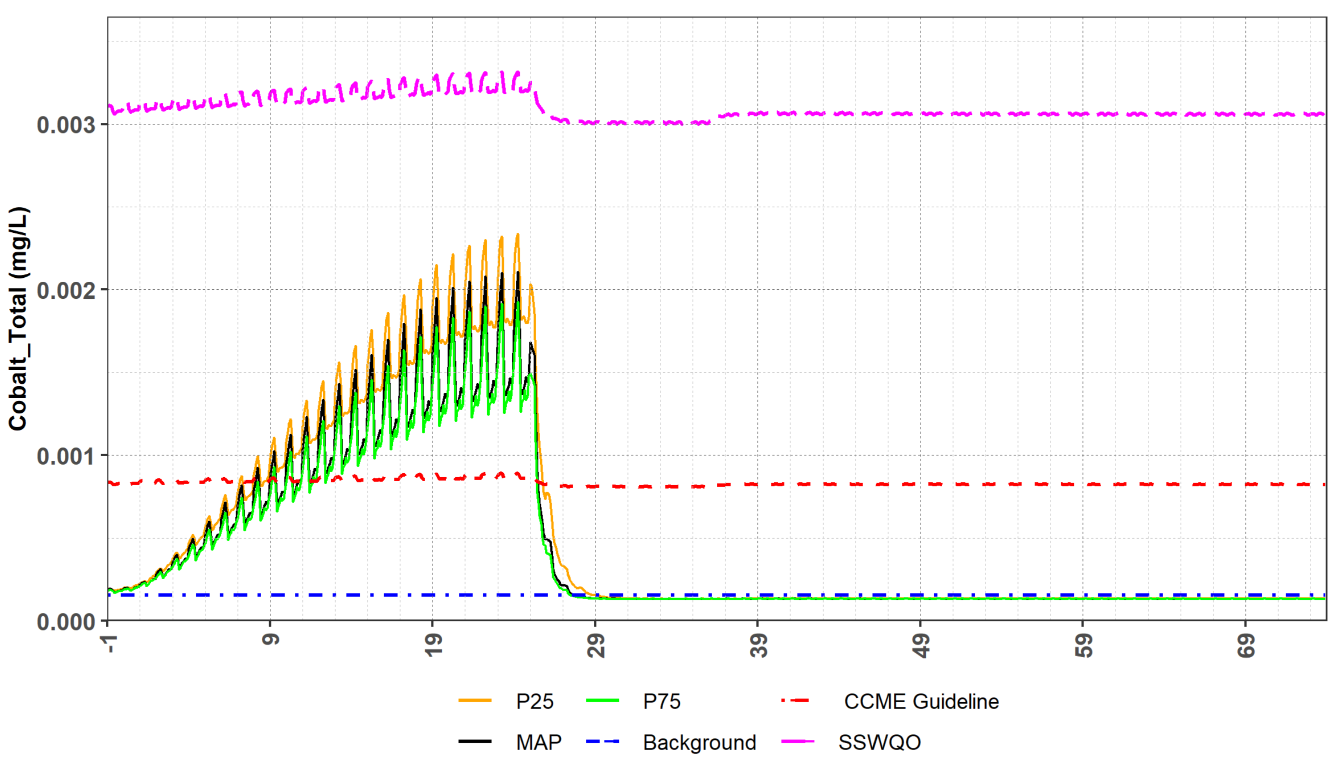


Figure 9-6 : Modelled Predictions of Total Cobalt Concentrations at Duley Lake

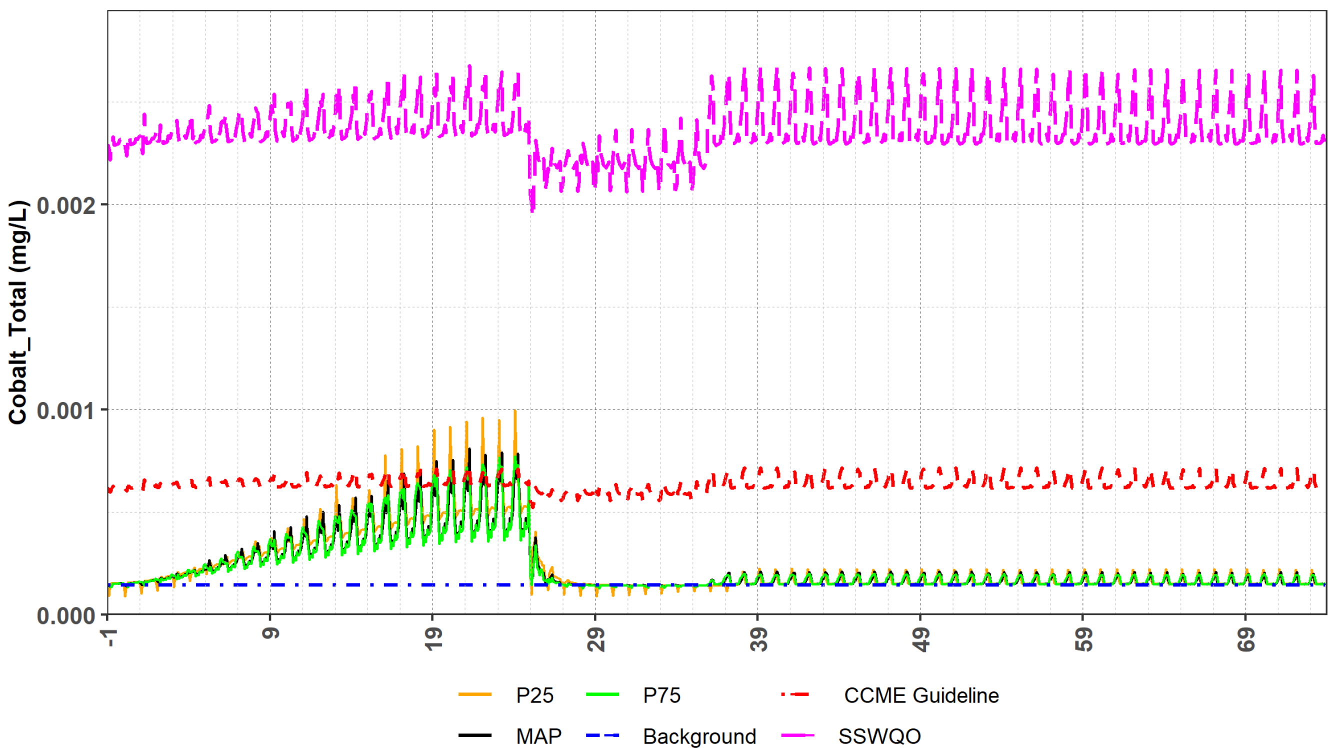


Figure 9-7: Modelled Predictions of Total Cobalt Concentrations at the Duley Lake Outlet

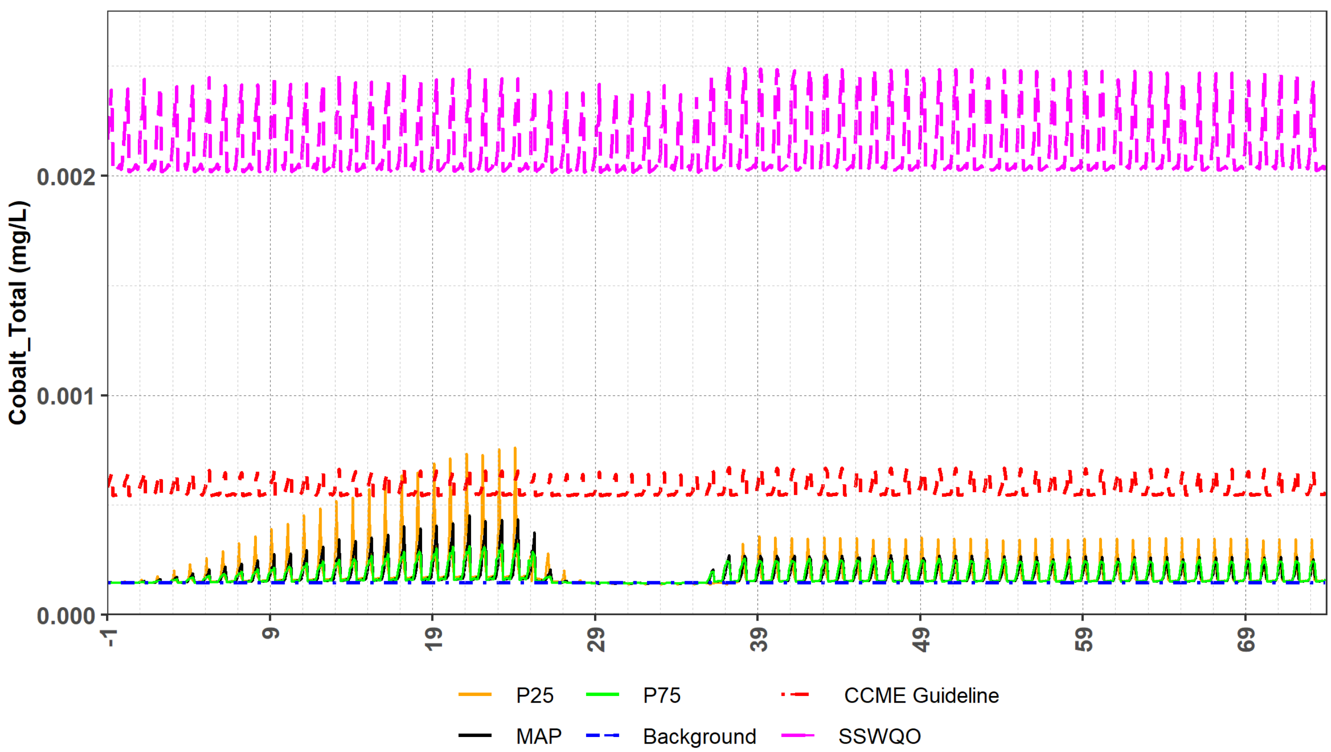


Figure 9-8 : Modelled Predictions of Total Cobalt Concentrations at the Walsh River

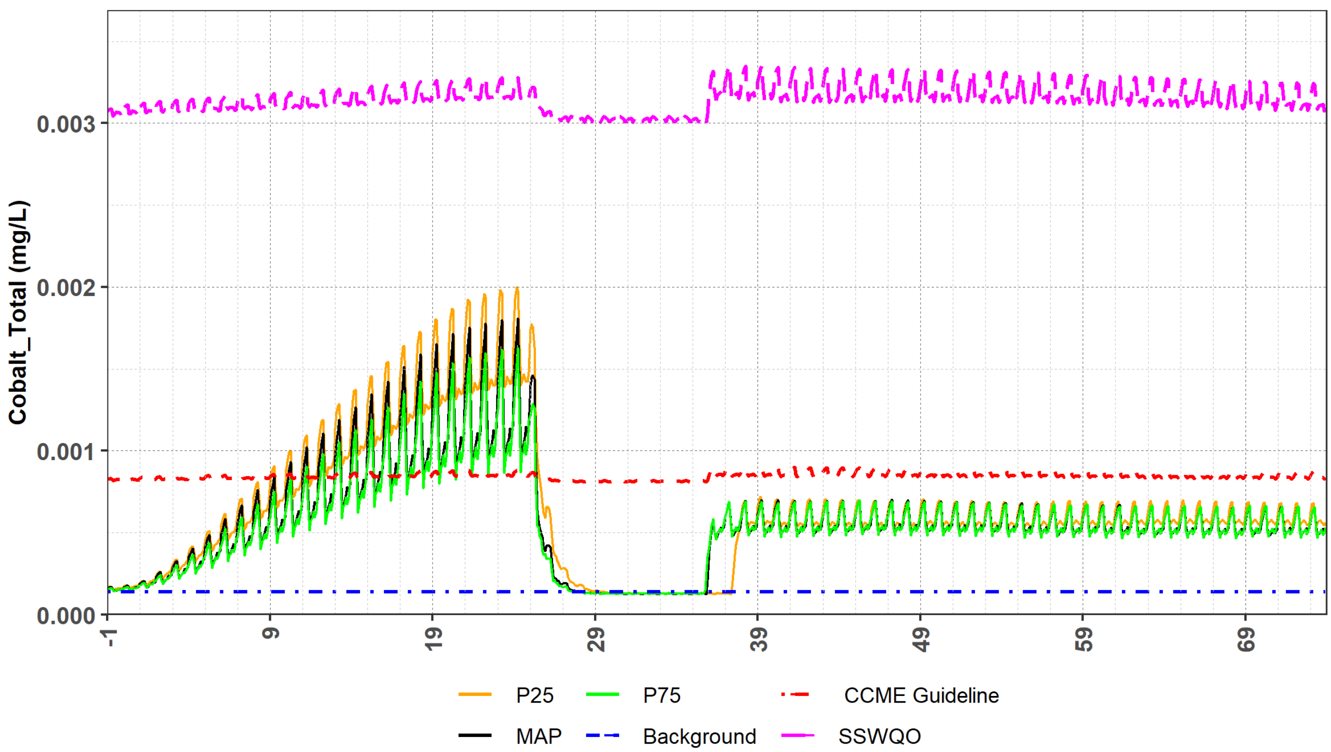


Figure 9-9 : Modelled Predictions of Total Cobalt Concentrations at Pike Lake

Predicted concentrations for total cobalt at each of the five waterbody stations fall below the cobalt SSWQO, and therefore, residual effects of effluent discharge and seepage are anticipated to be negligible in magnitude. Following Operations, total cobalt concentrations are predicted to return to background levels within Duley Lake and Walsh River, but slightly above background concentrations in Pike Lake, resulting in short-term reversible and long-term irreversible effects.

Selenium

High selenium concentrations can adversely effect fish reproductive success by causing deformities in offspring and reducing egg hatch rates. It can accumulate in fish, particularly their reproductive organs, reducing their survival rates. Selenium distribution throughout the aquatic food web has been shown to bioaccumulate in the tissues of species that depend on aquatic organisms for food, which can cause reproductive impairments. The life cycle stage in which fish are most susceptible to selenium is during the egg and larval stages. Selenium is passed from mother to egg via the yolk sac, reducing hatch rates and can result in deformations in early life stages (ECCC 2022).

The CCME guidelines for selenium conclude that 1 µg/L is protective for most sensitive environments and a recommended alert concentration. They also proposed a water column guideline for the protection of aquatic life of 2 µg/L in British Columbia (BC), Alberta, and across Canada. The review of toxicological data that followed the proposal resulted in the provincial-specific guideline in BC of 2 µg/L, or lower for sensitive environments/species. The federal selenium guidelines state that the BC water quality guideline can be used for other Canadian sites (ECCC 2022).

Similar to cobalt described above, a desktop assessment was conducted to define an SSWQO for selenium (TSD VIII), following federal guidance for developing site-specific objectives. The selenium SSWQO was developed for Duley Lake, which drew data from the surrounding lakes to build the model. Due to the differences in the characteristics of Pike Lake and Duley Lake, the SSWQO is not an applicable guideline to determine Project effects to Pike Lake. As the Walsh River represents a waterbody connecting Pike Lake and Duley Lake, selenium concentrations were also compared to the selenium SSWQO for Duley Lake.

The selenium SSWQO study (TSD VII) analyzed uncertainties and results from estimated selenium fish tissue concentrations using region-specific bioaccumulation factors (BAFs) and demonstrated that under a scenario of chronic exposure to selenium at the federal guideline value of 1 µg/L in surface waters, estimated tissue concentrations are below tissue benchmarks (negligible risk). Under selenium concentrations at or above 2 µg/L (BC MOE 2014), estimated concentrations in fish tissue slightly exceeded these protective tissue benchmark values. Considering this result and acknowledging the screening level of the analysis (i.e., conservative assumptions used in the face of uncertainty), the generic water quality guideline value of 1.5 µg/L from the USEPA (2016) was selected as an interim site-specific water quality objective to protect against the long-term effects of selenium. The 1.5 µg/L value is based on average selenium concentrations in surface waters over a 30-day period, and the recommended frequency of exceedance is once every three years on average. Because the SSWQO was derived from a robust empirical dataset spanning multiple lentic ecosystems in North America, it is considered protective of fish species across different trophic levels. Furthermore, the generic chronic selenium guideline value of 1.5 µg/L is higher than the current maximum water quality projections for total dissolved selenium in Duley Lake (1.2 µg/L). Minor changes to the selenium bioaccumulation potential in Duley Lake may occur over time due to future biogeochemical changes, including water quality factors that influence selenium uptake. However, given the modest total selenium concentrations predicted for all Project phases, and the lack of likelihood for qualitative changes in receiving conditions (i.e., substantially higher biological activity, higher proportion of selenite, or predominance of reduced aqueous selenium species and organo-Se forms), the SSWQO will remain protective under these modified conditions.

Modelled predictions of total selenium concentrations that exceed CCME guidelines over the course of the Project at the four waterbody stations (Duley Lake initial dilution zone, Duley Lake, Walsh River and Pike Lake) within Duley Lake, Walsh River and Pike Lake are presented in Figures 9-10 to 9-13 and summarized below.

- Total selenium concentrations at the Duley Lake IDZ (Figure 9-10) are expected to exceed the CCME guidelines during Operations, starting in year 13. These concentrations are reversible and will return to the baseline following Operations. These concentrations do not exceed the selenium SSWQO.
- Total selenium concentrations at Duley Lake (Figure 9-11) are expected to exceed the CCME guidelines during the Operations phase beginning in approximately year 16. As in the Duley Lake IDZ, results are reversible and will return to baseline following Operations. These concentrations do not exceed the selenium SSWQO.
- Total selenium concentrations in Pike Lake (Figure 9-12) are expected to exceed CCME guidelines during Operations, beginning in approximately years 19 through 24. Following the flooding of Rose Pit, seepage from the Overburden Stockpile is expected to affect total selenium concentrations, raising them above the CCME guidelines and the BC water quality guideline. The SSWQO is not applicable to Pike Lake.
- Total selenium concentrations at Walsh River (Figure 9-13) are not expected to exceed CCME guidelines until after Closure (year 39+) and only in the P25 model scenario due to passive discharge from the overburden stockpile. These concentrations do not exceed the selenium SSWQO.

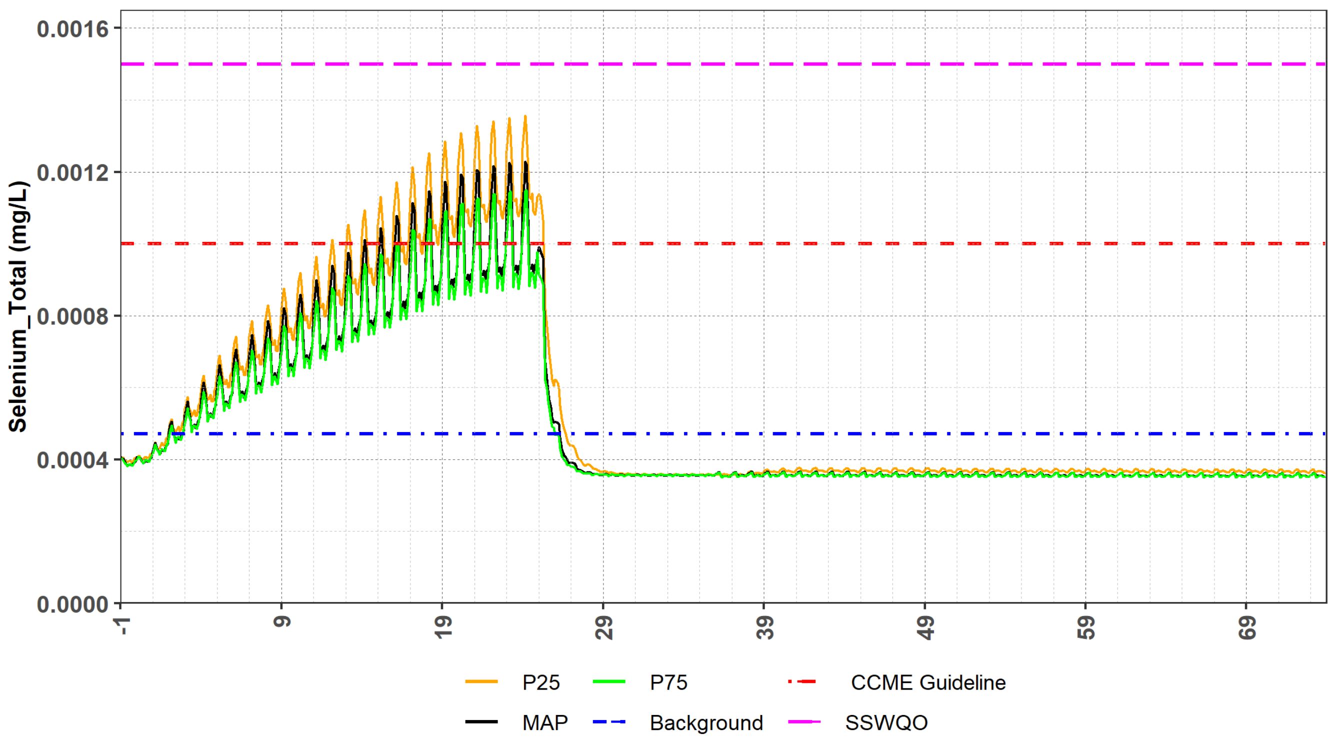


Figure 9-10 : Modelled Predictions of Total Selenium at the Duley Lake Initial Dilution Zone

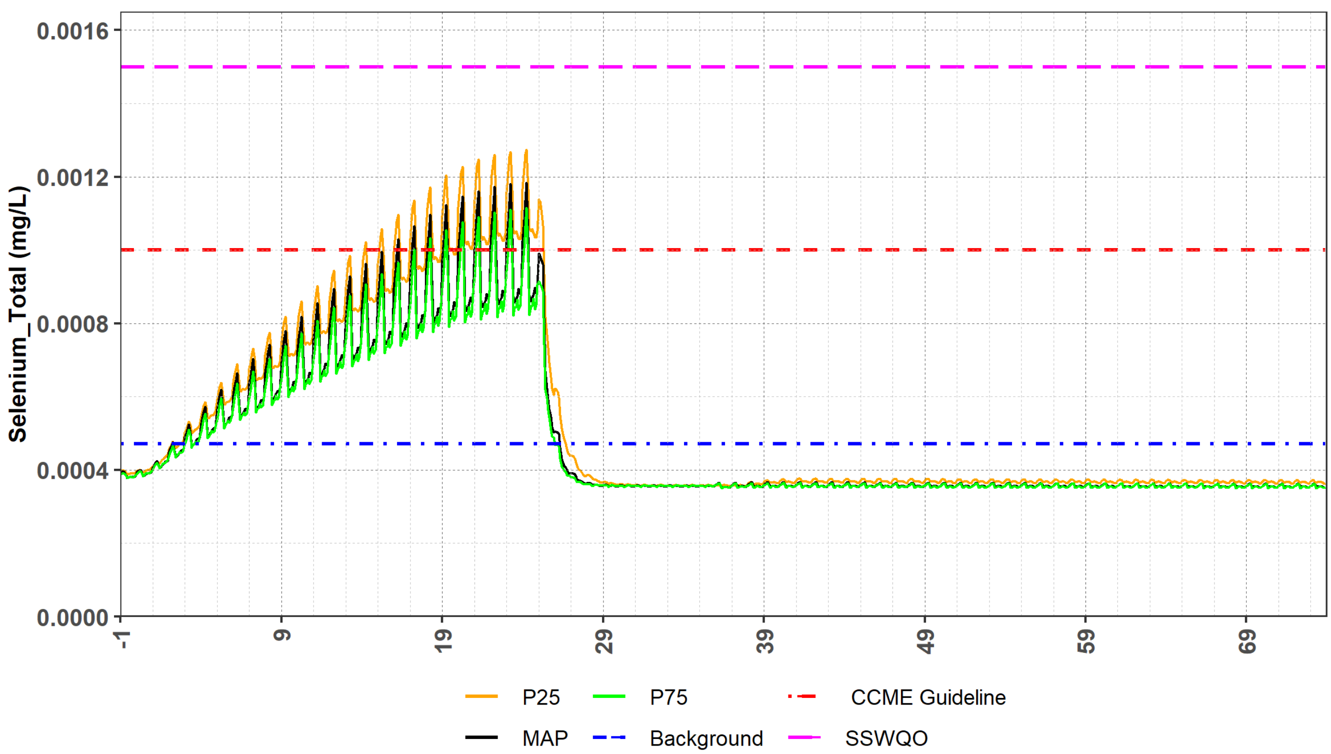


Figure 9-11 : Modelled Predictions of Total Selenium at Duley Lake

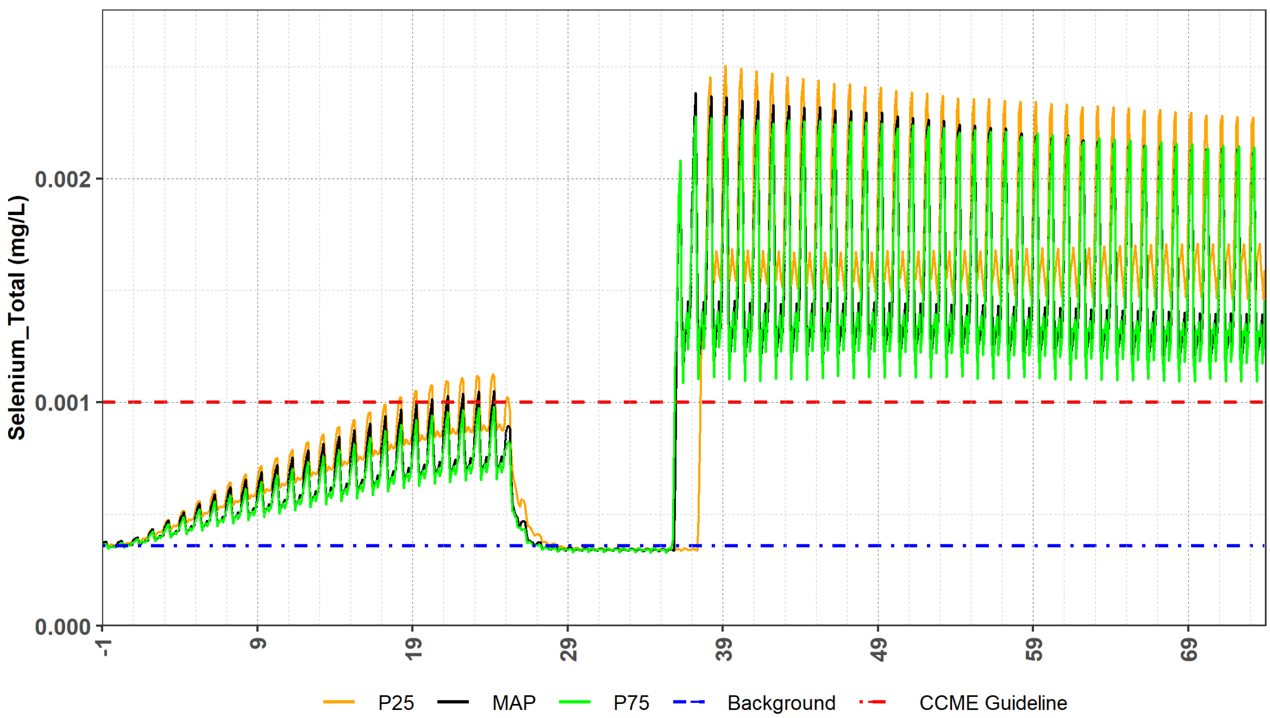


Figure 9-12 : Modelled Predictions of Total Selenium at Pike Lake

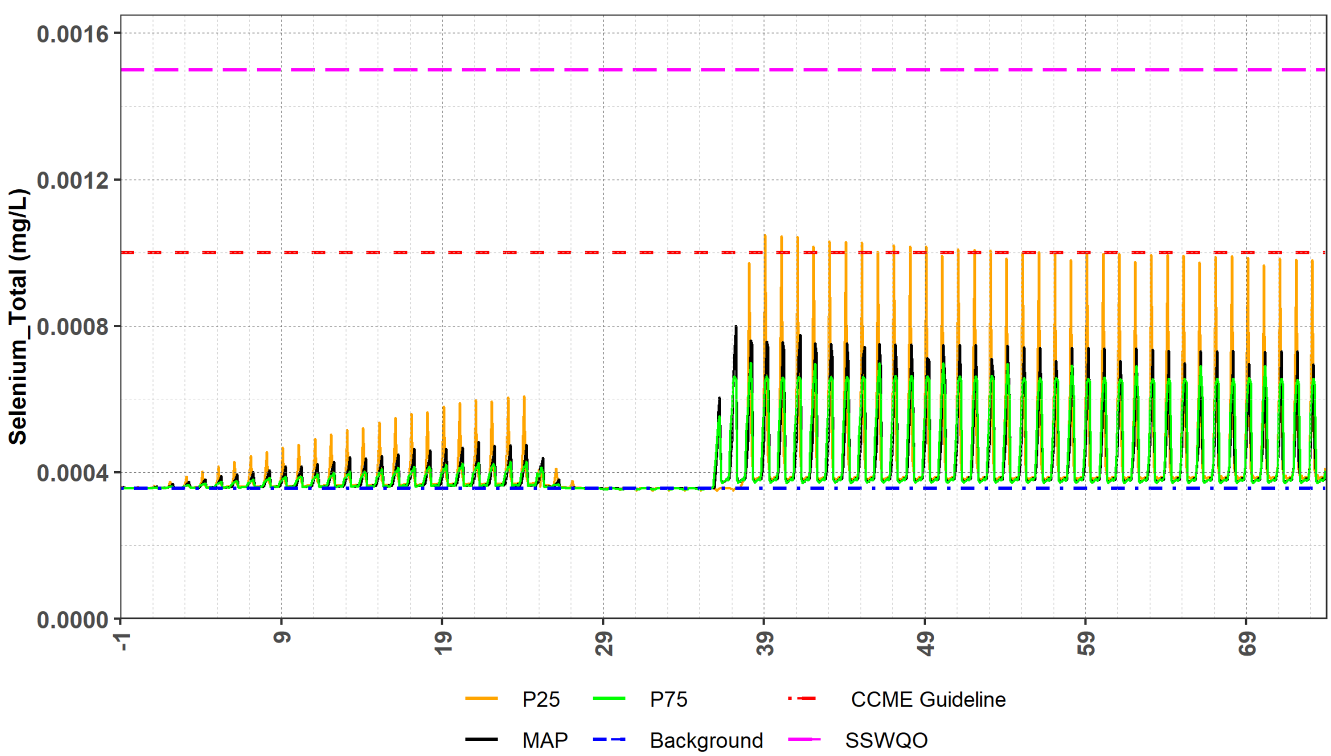


Figure 9-13 : Modelled Predictions of Total Selenium at Walsh River

Predicted concentrations for total selenium at Duley Lake fall below the selenium SSWQO. The P25 scenario just exceed the CCME guideline for selenium but are below the SSWQO developed for Duley Lake. A selenium SSWQO has yet to be developed for Pike Lake; however, total selenium is continually above the CCME guideline following the Closure phase. Therefore, without an SSWQO for selenium in Pike Lake, the residual effects of effluent discharge and seepage is conservatively predicted to be high in magnitude. Following Operations, total selenium concentrations are predicted to return to background levels within Duley Lake, remain at or below CCME guidelines and below the SSWQO in Walsh River but remain above CCME guidelines in Pike Lake, resulting in short-term reversible and long-term irreversible effects. Effects to the receiving environment are anticipated to be local, as described in Chapter 8

Although the cumulative selenium concentrations in Pike Lake are predicted to exceed the CCME guidelines following the flooding of Rose Pit, selenium concentrations in the discharge water generated from the Project are predicted to remain below the MDMER guidelines and will be in compliance with the *Fisheries Act*.

Loss of Fish

Fish loss due to effluent release and seepage will be measured by replicating fish surveys performed in Pike Lake, Walsh River, and Duley Lake. The most likely effect associated with effluent release and seepage to cause loss of fish is the modelled elevated concentrations of selenium and cobalt. Water quality concentrations and guideline exceedances are described in the section above: Alteration of Water and/or Sediment Quality.

Selenium and cobalt are both toxic to fish at higher concentrations and can be measured through the levels found in fish tissue. While the effect on the loss of fish is difficult to quantify, factors such as the amount of time fish spend in waters with elevated selenium and cobalt and the concentration in the tissue of their prey can effect the amount of cobalt and selenium found in the fish population. A SSWQO was created for both cobalt and selenium (excluding Pike Lake), which builds on regional data collections and provides sufficient conservatism for water management without requiring a supplemental program of site-specific testing. The SSWQO is not exceeded for cobalt or selenium.

Regular fish surveys will be conducted as part of the ongoing Environmental Effects Monitoring Program (Annex 5E). Body burden samples will be collected, and the dry weight (dw) levels of cobalt and selenium in select samples will be measured to monitor the effects of effluent discharge on the fish populations, and to observe if the levels are approaching toxicity levels in the fish population. The direct effect of effluent discharge on fish loss will need to be measured over the coming years and decades. Champion will continue to refine the water quality modelling to reduce the predicted loading of selenium and cobalt to the receiving environment and refine the SSWQOs for cobalt and selenium as new water quality model predictions and site-specific baseline data become available.

The collected monitoring and updated modelling results will inform adaptive management measures to future mitigate the toxicological effects of cobalt and selenium to fish populations. To this end, it is currently predicted that fish loss that exceeds 10% of existing populations is not anticipated, and the residual effect of treated effluent discharge to loss of fish is of negligible magnitude. Effects are predicted to be long-term and reversible, except for Pike Lake, where elevated selenium concentrations are currently predicted to remain following the Closure phase.

Reduction in Fish Health

As mentioned in Section 9.4.1.4.3, fish health will be quantified using Fulton's Condition Factor (Peterson & Harmon 2005), which is a length-weight relationship. Fish surveys will be replicated at the previously surveyed site to monitor the overall health of the fish population. The results of these surveys will be compared to the results of the baseline surveys to obtain a quantifiable description of changes in fish health. It is anticipated that some effects may be observed in Pike Lake, following the flooding of Rose Pit, as selenium concentrations are expected to exceed 2 µg/L within the Lake, above the defined SSWQO. All other changes in water quality, as a result of the discharge of treated effluent, are expected to return to background or below CCME guideline levels. As mentioned above, excessive selenium concentrations can adversely affect fish reproduction. Both fish egg-ovary and whole-body tissue selenium dry weight (dw) levels are used to measure selenium toxicity. Federal environmental quality guidelines for selenium are 6.7 µg/g dw in whole body tissue, and 14.7 µg/g dw in egg and ovary. Effects of selenium toxicity vary from species to species (ECCC 2022).

Fish health will be primarily measured throughout the Project's lifespan. Body burden samples taken during fish surveys will be analyzed for cobalt and selenium concentrations in the fish tissue. Additionally, reductions in length: weight ratios would indicate that the fish within the RSA are adversely affected by Project activities, and further mitigation measures must be implemented to halt the effects. Reduction in the number of species caught within the RSA may also indicate that Project activities are adversely affecting the overall populations. These effects are expected to be adverse if they occur, and the effects may be measured for decades. The effects are expected to be continuous, with some (selenium in Pike Lake) being irreversible and others reversible. These occurrences are probable given the available resources, which describe the effluent's effects on fish health. As is the case with the loss of fish measurable parameter, the effects of effluent release and seepage on fish health will be measured over the coming years and decades. Champion will continue monitor and refine the water quality modelling to reduce the predicted loading of selenium and cobalt to the receiving environment. The collected monitoring and updated modelling results will inform adaptive management measures to future mitigate the toxicological effects of cobalt and selenium to fish health. To this end, it is currently predicted that effects to fish health that would result in reductions of the existing population to exceed 10% is not anticipated, and the residual effect of treated effluent discharge to reduction in fish health is of negligible magnitude. Effects are predicted to be long-term and reversible, except for Pike Lake, where elevated selenium concentrations are currently predicted to remain following the Closure phase.

Loss of Species of Conservation Interest

During the fish surveys and interviews with locals, no species of conservation interest or concern was identified within the Project area. Therefore, effluent release and seepage are not anticipated to result in loss of species of conservation interest, and residual effects are not anticipated and were not characterized.

Table 9-21: Characterization of Residual Effects on Fish Health Measurable Parameters

Residual Effect	Criterion	Rating/Effect Size
Alteration of Water and/or Sediment Quality	Nature	Adverse
	Magnitude	High
	Geographic Extent	Local
	Duration	Long term
	Timing	All seasons
	Reversibility	Reversible and Irreversible (Pike Lake)
	Frequency	Periodic
	Probability of occurrence	Possible
	Ecological and Socio-economic context	Water quality and sediment changes may affect long-term fish health and the ecological processes of water features.
Loss of fish	Nature	Adverse
	Magnitude	Negligible
	Geographic Extent	Local
	Duration	Long term
	Timing	All seasons
	Reversibility	Reversible and Irreversible (Pike Lake)
	Frequency	Occasional
	Probability of occurrence	Possible
	Ecological and Socio-economic context	Loss of fish on a large scale, especially during sensitive periods such as spawning, could effect ecological processes and fisheries.
Reduction in Fish Health	Nature	Adverse
	Magnitude	Negligible
	Geographic Extent	Local
	Duration	Long term
	Timing	All seasons
	Reversibility	Reversible and Irreversible (Pike Lake)
	Frequency	Occasional
	Probability of occurrence	Possible
	Ecological and Socio-economic context	Reduction in fish health could affect ecological processes and fisheries.

9.5.3.2 Significance Determination

Fish Habitat and Productivity

Barriers to fish passage are most likely to occur due to improperly installed water crossing structures, such as culverts. However, as culverts will be installed following all approvals and permits issued by DFO, and the mitigation measures mentioned in Table 9-16, the effects of these crossing structures is expected to be negligible.

Reduction of riparian habitat is directly tied to the loss of fish habitat. While the riparian area is not considered when calculating the amount of fish habitat lost due to project activities, it is expected to be removed in the areas where fish habitat will be destroyed. Riparian habitat may be destroyed or altered in areas where the aquatic habitat will not be removed, such as during culvert installation. Mitigation measures will be implemented to reduce the effect on riparian areas, and destroyed areas will be replanted. As a result, the effect is expected to be negligible. Loss of fish habitat will be mitigated under section 35 of the *Fisheries* Act through the St. Lewis Offsetting plan. Despite the amount of habitat expected to be destroyed due to Project activities (e.g. Rose Pit excavation), the planned restoration measures on the St. Lewis River are expected to restore a substantial amount of fish habitat.

A river/stream flow change is expected at Pike Lake and Duley Lake outflows. The Duley Lake discharge rates are expected to drop by an annual amount of 1% at the end of the Operations phase, and a further 7% during the Closure phase. The discharge rate at Pike Lake is expected to remain above the minimum discharge threshold, except during the early phases of the Closure phase. There is expected to be a sharp reduction in the first year, with subsequently smaller reductions occurring each year, eventually returning the threshold in year 29. Champion will continue baseline data collection, update the water balance model and monitor the water levels in Pike Lake through the Construction and Operation phases to inform additional mitigation and adaptive management measures to mitigate any exceedances of the discharge threshold, so that this seasonal reduction is expected to be short-lived and reversible.

In consideration of the mitigation and compensation measures proposed, the residual effects to fish habitat and productivity will be **not significant.**

Fish Health

Fish loss due to direct effects such as the excavation of Rose Pit will be mitigated through various means, including fish rescues. Fish rescue methodology is well established and has been proven to be effective. Despite the potential for some fish to be missed or injured/killed during handling, the number of fish lost this way is expected to be negligible for the overall population.

As mentioned above, no species of conservation interest has been identified within the RSA. While the loss of individual species of conservation interest could be considered significant, depending on the species in question, none are known to exist within the Project area.

Fish health is most likely affected by the changes in water chemistry that the effluent release and seepage will have on the receiving environment and fish populations. With the exception of Pike Lake for selenium, SSWQOs for cobalt and selenium were developed for waterbodies/watercourses where CCME guidelines are currently predicted to be exceed. Concentrations of total cobalt and selenium are predicted to be below the SSWQOs developed for these waterbodies.

While cobalt and selenium concentrations are expected to return to baseline levels after various Project phases in each model, the modelled selenium concentrations, across each of the three flow scenarios in Pike Lake are currently expected to exceed CCME guidelines. These elevated selenium concentrations are primarily a result of seepage from the overburden stockpile. The seasonality of the exceedances and the toxicological effect that this will have on fish health and fish populations are uncertain.

Champion has proposed to manage uncertainty through adaptive management. The objective of adaptive management is to identify risks and uncertainties that may result in adverse effects to the environment and develop a management plan that allows for continual improvement through review and analysis of uncertainties and risks for a project.

The model results identify a risk posed by the Project seepage to water quality and in turn, fish health. This risk will be adaptively managed so that such significant effects to fish health and mortality are avoided. This will be carried out via the systematic process of assessing potential effect drivers, design and implementation of an action plan to address the problem, monitoring effectiveness of action plans, and evaluation of outcomes and adjustment of the plan. The entire process is iterative with the main objective of Champion to continuously improve management practices during the Project lifecycle. Examples of action plans Champion will assess include:

- Update geochemical source terms from the overburden stockpile and water quality predictions in Pike Lake with addition test results from the ongoing geochemical characterization and surface water monitoring programs during the Operation phase.
- Evaluate water management alternatives to reduce selenium loadings to Pike Lake during Operations Closure and the post-closure period, including water diversions from Mills Lake instead of Duley Lake.
- Determine a SSWQO for selenium in Pike Lake

Following the adaptive management approach and implementation of additional measures, effects to fish health as a result of the Project are expected to be **not significant.**

9.5.4 Residual Cumulative Effects Analysis

9.5.4.1 Reasonably Foreseeable Developments and Potential Cumulative Effects

Following the assessment of Project effects discussed in the sections above, an assessment of potential cumulative effects was conducted for other projects and activities (RFDs) (Table 9-22) that have the potential to interact with the Project's residual effects. Six other projects were identified that had the potential to contribute to the cumulative effects, five of which are mines and one road improvement project. These projects range from 6 to 30 km from the Project, and are presented in Figure 9-14.

The Scully Mine Tailings Impoundment Area Expansion Project is expected to destroy a large section of fish habitat in a series of small lakes that flow north into Flora Lake. The expansion of the mine's tailing impoundment area will affect this area. The lost habitat will be offset under section 35 of the *Fisheries Act,* and all effluent discharges will meet the MDMER guidelines. Annual sub-lethal toxicity testing occurs annually for the Flora Lake final discharge point. The Environmental Assessment Registration for this project concluded that the project is not expected to cause any changes to water quality at the Flora Lake final discharge point, which would negatively affect receiving waterbodies. While this project footprint is outside the fish and fish habitat LSA, the flow from Flora Lake ends in Wabush Lake, within the Project's RSA. The effects of this project have been assessed as negligible.

The Rio Tinto IOC Western Hillside Tailings Pipeline project will destroy fish habitat within Wabush Lake to create a new tailing impoundment area within the fish and fish habitat RSA. However, this effect will be offset under section 35 of the *Fisheries Act*. The effluent released by the project will be monitored to ensure it meets the federal (MDMER and CCME guidelines) and provincial Certificate of Approval (CoA) criteria. The Environmental Assessment Registration for this project concludes that water management activities associated with the project's operation are not anticipated to have significant adverse effects on the natural environment. Therefore, the effects of this project have been assessed as negligible.

The Rio Tinto IOC Smallwood North Extension project will not interact with fish habitat within the RSA and thus has not been assessed. Project activities can potentially effect Wabush Lake via runoff from Loraine Lake. However, project controls and mitigation measures are expected to eliminate runoff into nearby waterbodies. Therefore, the effects of this project have been assessed as negligible.

The Humphrey South Extension Project will not interact with fish habitat within the RSA and thus has not been assessed. Project activities can effect Wabush Lake as White Lake flows into Loraine Lake and onto Wabush Lake. However, project controls and mitigation measures are expected to eliminate runoff into White Lake. Therefore, the effects of this project have been assessed as negligible.

The Bloom Lake Iron Mine will not interact with fish habitat or health within the RSA and thus has not been assessed.

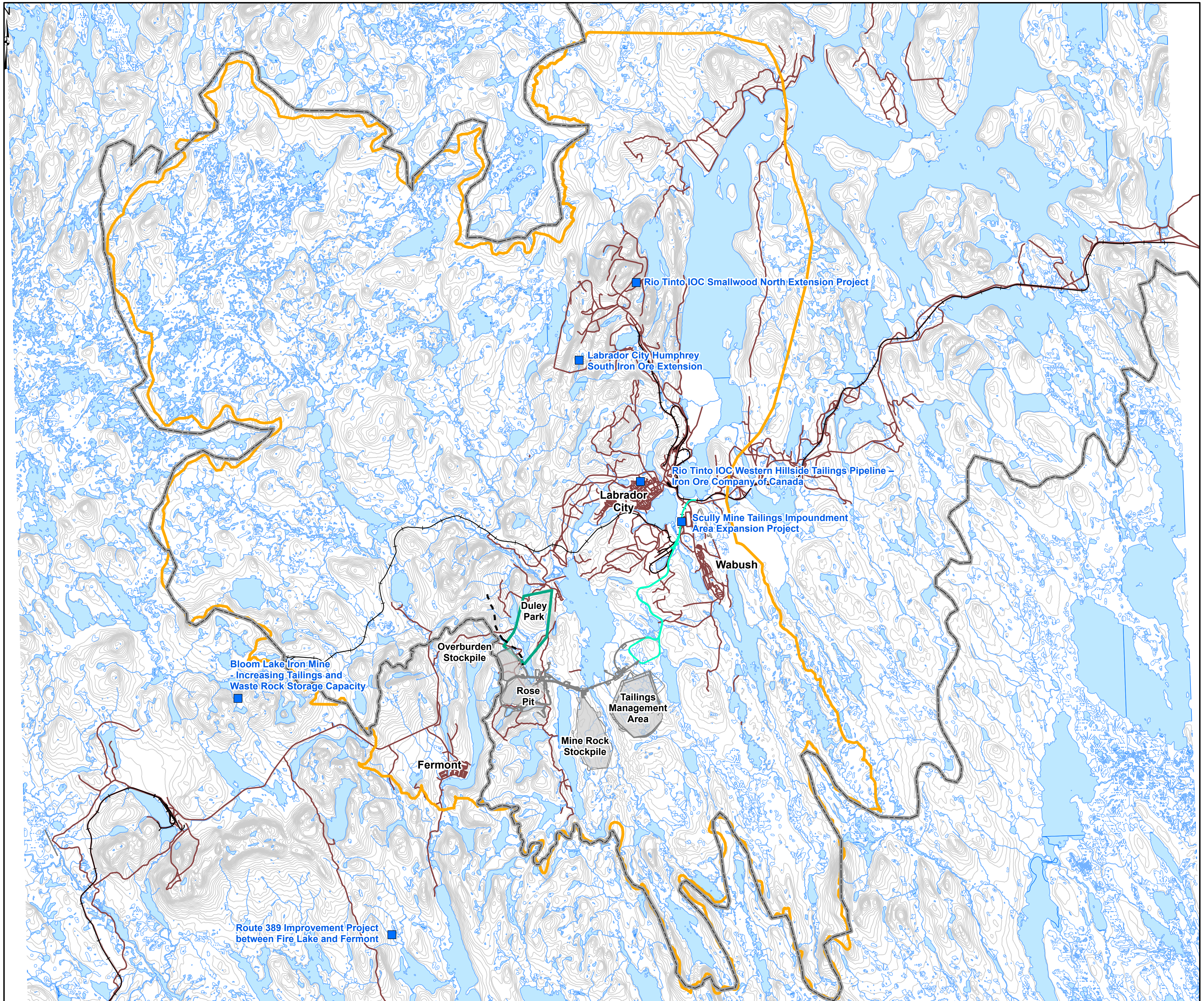
The Route 389 improvement project will not interact with fish habitat or influence fish health within the RSA and thus has not been assessed.

Alteration of fish habitat is the only expected effect from other RFDs within the RSA. However, it is considered negligible as all effects will be offset under section 35 of the *Fisheries Act* from the respective projects. The assessment conclusion is that potential cumulative effects with identified RFDs are unlikely to result in greater than negligible incremental contributions to the Project's residual effects.

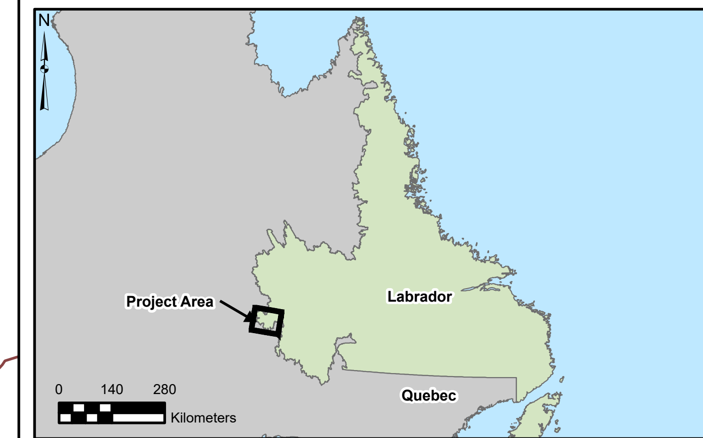
Table 9-22: Other Projects and Activities Considered in the Cumulative Effects Assessment

Project name or Physical Activity	Description of Project Effects	Approximate Direct Distance to Kami Project Site	Status/Timing	Interaction with Residual Effects to Fish and Fish Habitat from Kami Project
Scully Mine Tailings Impoundment Area Expansion Project	TACORA Resources Inc. proposes expanding the tailings impoundment area of the Scully Mine, an iron ore mine located in Wabush, Newfoundland and Labrador. As proposed, the Scully Mine Tailings Impoundment Area Expansion Project would expand the existing tailings impoundment area by up to 1,411 hectares, allowing for the full use of the mine's ore reserves and for operations to continue until 2047. The existing tailings impoundment area is expected to reach full capacity around 2025.	13 km	Anticipated start in 2025 and expand operations by 22 years	The affected water features will be offset under section 35 of the *Fisheries Act.* Effluent Release will meet the MDMER guidelines. **No cumulative effects predicted.**
Rio Tinto IOC Western Hillside Tailings Pipeline – Iron Ore Company of Canada	A new tailings management plan that would include optimizing the available space of the existing Wabush Lake tailings storage facility and utilizing the Western Hillside. The Project would consist of developing an access road and pipeline alignment, transmission lines, pumps and pumphouses, and a modified strategy for tailings deposition into Wabush Lake.	15 km	The Minister announced that the project was released from an Environmental Assessment on May 17, 2024	The affected water features will be offset under section 35 of the *Fisheries Act.* Effluent discharge will meet MDMER guidelines. **No cumulative effects predicted**
Rio Tinto IOC Smallwood North Extension Project	Expansion to the boundaries of the existing Smallwood Pit to support ongoing operations in Labrador City. The proposed extension of Smallwood Pit is located within Rio Tinto IOC's existing mining leases and encompasses approximately 160 hectares. The proposed project includes extending the Smallwood North pit to the north, development of a new waste dump, construction of new power lines, construction of new pit dewatering wells and the development of surface water handling systems.	25 km	The Minister announced that the project was released from an Environmental Assessment on July 21, 2021	Lorraine Lake borders the project, which sits above Wabush Lake on its western edge and drains into it. There is no predicted interaction with fish and fish habitat. **No cumulative effects predicted.**

Project name or Physical Activity	Description of Project Effects	Approximate Direct Distance to Kami Project Site	Status/Timing	Interaction with Residual Effects to Fish and Fish Habitat from Kami Project
Labrador City Humphrey South Iron Ore Extension	A 370-hectare extension to the Humphrey South Pit iron ore deposit that will include development into the White Lake area to support its existing operations in Labrador City. The project consists of an extension of the Humphrey South Pit to the east and south, development of a waste dump south of White Lake, extension of the Carol waste dump, power lines, dewatering wells, and surface water-handling systems.	20 km	Condition of release from Environmental Assessment met on December 11, 2024	There is no predicted interaction with fish and fish habitat that Kami Mines would affect. **No cumulative effects predicted**
Bloom Lake Iron Mine - Increasing Tailings and Waste Rock Storage Capacity	Increasing Tailings and Waste Rock Storage Capacity for Bloom Lake Iron Mine. The project's objective is to increase the capacity of the accumulation areas to allow annual production of 7.5 Mt of concentrate/year from 2019 to 2021 and 16 Mt of concentrate/year from 2022 to 2040, i.e. for an estimated operating life of 21 years.	17 km	*Fisheries Act* Authorization provided in 2024	No connection to watercourses near the Kami Mine Project. **No cumulative effects predicted.**
Route 389 Improvement Project between Fire Lake and Fermont	Improving Route 389 between Fire Lake and Fermont (kilometres 478 to 564) to increase the flow and safety of the road and, in addition, improve the link with Newfoundland and Labrador and facilitate access to natural resources. The work includes building 55.8 kilometres of new right-of-way road and improving existing road, for a total length of 69.5 kilometres.	6 to 93 km	Environmental Assessment approved in 2019	Road construction will not approach water features that Kami Mines would affect. **No cumulative effects predicted**



KEY MAP



SCALE 1:20,000,000

LEGEND

PROJECT INFRASTRUCTURE

- Proposed Project Infrastructure
- Fish and Fish Habitat Regional Study Area (RSA)
- Proposed Project Infrastructure (Linear)
- Proposed Access Road and Railway Corridor
- Potential Access Road
- Reasonably Foreseeable Developments

BASEMAP INFORMATION

- Duley Lake Park
- Labrador/Quebec Boundary
- Bog/Wetland
- Waterbody
- River/Stream
- Existing Railway
- Existing Road

0 2,000 4,000 8,000

1:230,000 METRES

NOTE(S)
1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - NEWFOUNDLAND AND LABRADOR
2. IMAGERY CREDITS:
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 19N

CLIENT
CHAMPION IRON MINES LTD.

PROJECT
KAMI IRON ORE MINE PROJECT (KAMI PROJECT)
WABUSH, NL

TITLE
OTHER PROJECT AND ACTIVITIES CONSIDERED IN THE CUMULATIVE EFFECTS ASSESSMENT

CONSULTANT

YYYY-MM-DD	2025-07-04
DESIGNED	----
PREPARED	MS
REVIEWED	MS
APPROVED	CD

PROJECT NO.	CONTROL	REV.	FIGURE
CA0038713.5261	0025	0	9-14

9.5.4.2 Climate Change

In addition to human activities, climate change and related effects (e.g., extreme weather, increased frequency and intensity of extreme weather events, wildfires, and insect infestations) may contribute cumulatively to fish and fish habitat loss and alteration,. Current climate change projections under a high greenhouse gas emissions model (Shared Socioeconomic Pathway 5-8.5) predict summer temperatures to rise by +1.9°C and winter temperatures to rise by +6.0°C by 2060 in Happy Valley-Goose Bay (roughly 530 km east of the Project area) (Neilsen 2023). A Climate Projections Study (Finnis and Daraio 2018) projects similar changes by mid-century in Wabush where daily mean temperatures are predicted to rise by +2.8°C in the summer and as much as 5.8°C in the winter (Finnis and Daraio 2018). These increases would result in noticeable changes in precipitation, rising ambient temperatures, shorter winters, and permafrost thaw (Neilsen 2023). Higher average temperatures could affect the fish health and reproduction of cold-water species, affect fish habitat and potentially disrupt predator-prey dynamics and ecosystem function (Bush and Lemmen 2019).

Changes to climate could also result in an increase in frequency and intensity of extreme weather events. Labrador is subject to severe weather events like heavy rainfall, blizzards, and hurricanes, all of which could result in habitat loss and alteration. The northwestern Atlantic Ocean, the Labrador Sea, and the Gulf of St. Lawrence are some of the stormiest areas in North America (Savard et al. 2016). Climate projections suggest that substantial changes in wind speed are unlikely to be impacted by climate change but there is likely to be a northward shift in storm tracks that will affect storm frequency and intensity in the East Coast region (Loder et al. 2013). Storms, like hurricanes, can result in substantial habitat loss and alteration. Storms moving up the eastern seaboard or across the continent impact precipitation events in Labrador (Lemmen and Warren 2016). Thus, more frequent and intense storms, together with increased precipitation due to ocean warming, is expected to increase the risk of floods (US EPA 2022). Flooding events can affect fish habitat.

Changes to climate could also result in an increase in frequency and intensity of wildfires. Labrador is prone to wildfires, with the most recent fire occuring in 2024, covering an area of 19,059 ha. An increase in the frequency and intensity of wildfires could alter reduce the size of wetlands on the landscape, which could reduce suitable fish habitat. An increase in the frequency and intensity of wildfires could reduce natural sediment and erosion controls such as trees and vegetation, resulting in additional sedimentation events during extreme weather events that result in high intensity precipitation, impacting fish habitat.

Labrador is prone to wildfires, with the most recent fire occuring in 2024, covering an area of 19,059 ha. An increase in the frequency and intensity of wildfires could alter reduce the size of wetlands on the landscape, which could reduce suitable fish habitat. An increase in the frequency and intensity of wildfires could reduce natural sediment and erosion controls such as trees and vegetation, resulting in additional sedimentation events during extreme weather events that result in high intensity precipitation, impacting fish habitat.

Because of the uncertainty in direction and magnitude, it was conservatively assumed that climate change would have an adverse cumulative effect on wildlife habitat distribution.

9.6 Prediction Confidence and Uncertainty

A key element of a comprehensive EA is predicting future environmental conditions resulting from the Project from previous and existing projects, activities, and RFDs. Given that environments change naturally and continually through time and across space, assessments of effects and predictions about future conditions embody some degree of uncertainty (CEA Agency 2018a).

The purpose of the Prediction Confidence and Uncertainty section is to identify the key sources of uncertainty and qualitatively describe how uncertainty was addressed for fish and fish habitat to increase the level of confidence that effects would not be larger than predicted, including the potential need for monitoring and adaptive management that can reduce uncertainty over time (Section 4.10).

Confidence in effects analyses can be related to many elements for Fish and Fish Habitat, including the following:

- adequacy of the baseline data to characterize existing conditions
- the nature, magnitude, and spatial extent of future fluctuations in ecological, cultural, and socio-economic variables, independent of effects from the Project and other developments (e.g., climate change, fire, flood)
- assumptions, conditions, and constraints of quantitative model inputs
- understanding of Project-related effects on complex social-ecological systems that contain interactions across different scales of time and space (e.g., how and why the Project would influence wildlife and Indigenous land and resource use)
- knowledge and experience with the type of effect in the system

- knowledge of the effectiveness of proposed Project environmental design features or mitigation for avoiding or minimizing effects
- uncertainties associated with the exact location, physical footprint, activity level, and the timing and rate of future developments
- Uncertainty was managed by:
- reviewing historical data and relevant studies completed in the LSA and RSA
- conducting regional analysis of hydroclimate baseline data
- performing quality assurance and quality control on baseline data
- incorporating conservative estimates, inputs, and assumptions
- using known constituent concentrations for similar site analogues when the information was unavailable
- developing robust water management infrastructure and mitigation measures to address potential uncertainties (e.g., capture and routing of contact water to a central discharge location)
- calibrating the prediction models to measured data
- conducting sensitivity analysis on key parameters
- assessing a larger Project footprint (site study area) and overall imprint of the Project on fish habitat to manage uncertainty in Project design and provide confidence that future design changes would not result in additional adverse effects.

Baseline data collected during previous surveys, while robust, may not capture the full extent of what the surveys were intended to capture. Fish surveys may never capture every species in the target water features, which may lead to uncertainty about the species present, as illustrated by the absence of ouananiche captured during surveys, while the local residents claim is that it can be found within the local water features.

The assessment of fish habitat and productivity is based the understanding of effects from the Project and existing fish and fish habitat conditions likely to be affected by the Project. The effects from the Project are well-understood through the completion of baseline studies and assessment in the Alderon EIS and through this current assessment. Effects to fish habitat will be compensated in accordance with section 35 of the *Fisheries Act,* and the efficacy of offsetting plans of a similar nature are well understood. Overall, the confidence level of residual Project effects assessment to fish habitat and productivity was considered to be high.

Regarding fish health, the factor most likely to effect fish health are the elevated concentrations of cobalt and selenium, particularly in Pike Lake, where selenium concentrations are currently predicted to be irreversible and above the CCME guideline following Project closure, driven by seepage from the overburden stockpile. Compared to the Alderon EIS, Champion has increased confidence in the assessment and understanding of effects to fish health through completion of additional surface water modelling, which was identified as a condition of the release of the Alderon EIS. Chapter 8, Surface Water, Section 8.6 provides additional detail as to how uncertainty was managed in the water quality model.

However, selenium concentrations within Pike Lake pose a source of uncertainty, based on the conservatism that exists in the model and uncertainties surrounding the source terms developed for the overburden stockpile (TSD VI). Uncertainty also exists regarding how these elevated concentrations will affect fish and fish health. Selenium concentrations may be higher at the point of entry into the lake and dilute to a lower level as they spread across the lake, but the model conservatively applies a uniform level across the lake. Selenium uptake in fish is another area of uncertainty, as some fish may be more susceptible to higher selenium uptake through predation. Some species may prey on others that have a higher level of bioaccumulated selenium in their body than others. Additionally, fish may travel through areas of the lake that experience varying levels of selenium and may exit the lake entirely, altering their exposure to the increased selenium concentrations. Additional geochemical analysis, surface water quality modelling and monitoring in Pike Lake is needed to better understand the potential effects of selenium to fish health, and what adaptive management measures may be required to reduce Project effects. Based on the known uncertainties and conservative assumptions that have been applied to manage this uncertainty, the confidence in the assessment of this residual effect is moderate.

Mitigation measures proposed for each expected potential effect resulting from Project activities are well studied and standardized across similar activities, which provides a high level of confidence about their efficacy. However, mitigation measures can fail under extreme conditions, negligence, or human error. Therefore, an ongoing monitoring program will confirm the prediction of this chapter, as required. The required monitoring program will include replicating previous completed surveys and new baseline studies in areas where Project effects are expected to occur but have not yet been surveyed.

9.7 Monitoring, Follow-Up, and Adaptive Management

This section presents a summary of the identified monitoring and follow-up required to confirm the effects predictions and address the uncertainty identified in Section 9.5.4.2.

Specifically, follow-up and monitoring programs will be used to:

- evaluate the effectiveness of reclamation and other mitigation actions and modify or enhance as necessary through monitoring and developing updated mitigation measures (if needed)
- monitor concentrations of contaminants and flows to compare to the modelled results to determine if additional adaptive management measures are required to mitigate effects to fish health and fish habitat
- identify unanticipated adverse effects, including possible accidents and malfunctions
- contribute to the overall continual improvement of the Project

Following the approval and initiation of the Project, a monitoring program will begin to monitor the mine operation's compliance with the *Fisheries Act* and other relevant legislation. The program will include:

- Environmental Effect and Compliance Monitoring
- Any monitoring, testing, and/or reporting required under Section 36, MDMER, such as
  - Effluent monitoring
  - Environmental Effects Monitoring
  - Reporting
  - Any biological studies required under section 36, MDMER
  - Any monitoring, testing, and/or reporting required under the DOEC Certificate of Approval, such as:
    - Fish population sampling
    - Water quality testing
    - Habitat assessments
- Fish offsetting Monitoring
  - As part of the offsetting plan, compliance monitoring for project effectiveness will begin
  - Any EEM required under the section 35 authorization, such as:
    - Fish population surveys
    - Water quality testing
    - Habitat assessments
    - Sediment testing and analysis
    - Biological monitoring, such as benthic invertebrate surveys
  - Monitoring of offsetting project efficacy, including:
    - Hydrology survey
    - Habitat surveys
    - Fish population estimates
    - Redd surveys
- Before Construction begins, the Fish and Fish Habitat offsetting plan will require approval by DFO. An Environmental Protection Plan (EPP) and Environmental Effects Monitoring Program (EEMP) will also be developed. Mitigation measures for the protection of freshwater fish and fish habitat will be incorporated into the EPP, and monitoring requirements will be implemented into the EEMP. An annotated table of contents for the construction EPP is provided in Annex 5D, and a preliminary framework for the EEMP is provided in Annex 5E.

9.8 Predicted Future Conditions Should the Project Not Proceed

If the Project does not proceed, the predicted environmental conditions for fish and fish habitat are unlikely to experience substantive changes due to climate change in the next 40 years. The most likely effect the area will experience is the results of other mining projects and logging activities. Given the number of mines already in the area, mine development could increase as economic pressures boost mining interest. Forestry activity is difficult to predict, but any logging in the area could adversely effect fish and fish habitat. Recreational fisheries could also start up within the project area, but under federal and provincial regulations, there are unlikely to be significant effects on fish and fish habitat. If the Kami mine project does not proceed, it is unlikely that any significant changes to fish and fish habitat will occur.

9.9 Key Findings and Conclusions

Potential effects on fish and fish habitat will be compensated for through the Offsetting Plan (TSD IX: Fish and Fish Habitat Offsetting Plan), including designed mitigation measures, controls, and treatment of surface water contaminants, and a water quality monitoring program for surface and subsurface water, which will adhere to the MDMER standards for water discharge. While the predicted effect footprint is large, significant adverse effects on fish and fish habitats are unlikely if the above plans and procedures are followed, including a formal and robust fish relocation plan. Despite the amount of habitat expected to be destroyed due to Project activities (e.g. Rose Pit excavation), the planned restoration measures on the St. Lewis River are expected to restore a substantial amount of fish habitat. As such, the effects of losing fish habitat will be not significant.

Compared to the Alderon EIS, Champion has increased confidence in the assessment and understanding of effects to fish health through completion of additional surface water modelling, which was identified as a condition of the release of the Alderon EIS. The surface water quality model predicted concentrations of cobalt and selenium to exceed CCME guidelines but fall below the SSWQOs developed for the Project, with the exception of Pike Lake, where an applicable SSWQO has yet to be developed. Concentration of selenium in Pike Lake are predicted to remain above the CCME guidelines following Project closure, which is primarily driven by seepage from the overburden stockpile. The model results identify a risk posed by the Project to water quality and in turn, fish health and mortality. This risk will be adaptively managed so that such significant effects to fish health and mortality are avoided. This will be carried out via the systematic process of assessing potential effect drivers, design and implementation of an action plan to address the problem, monitoring effectiveness of action plans, and evaluation of outcomes and adjustment of the plan. The entire process is iterative with the main objective of Champion to continuously improve management practices during the Project lifecycle. Examples of action plans Champion will assess include:

- Update geochemical source terms from the overburden stockpile and water quality predictions in Pike Lake with addition test results from the ongoing geochemical characterization program
- Collect additional baseline data to determine a SSWQO for selenium in Pike Lake
- Complete monitoring through the operation phase to understand selenium loading and effects to Pike Lake

Following the adaptive management approach and implementation of additional measures, effects to fish health as a result of the Project are expected to be not significant.

The Alderon EIS completed had similar findings; however, a notable missing piece from the Alderon EIS was the water balance and water quality modelling, which depicts the predicted increase in metals that could effect fish health. The inclusion of the model is crucial for understanding the long-term effects that fish may experience as a result of Project activities, and that additional adaptive management measures will be required to mitigate effects to fish health. In absence of this modelling, the findings from the Alderon EIS in regard to water quality and hydrology and their effects to fish habitat and fish health are not comparable to the outcomes of the updated assessment for potential residual effects to fish and fish habitat.

Kami | Kamistiatusset Mining Project