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6.7 Springpole Lake, North Basin System

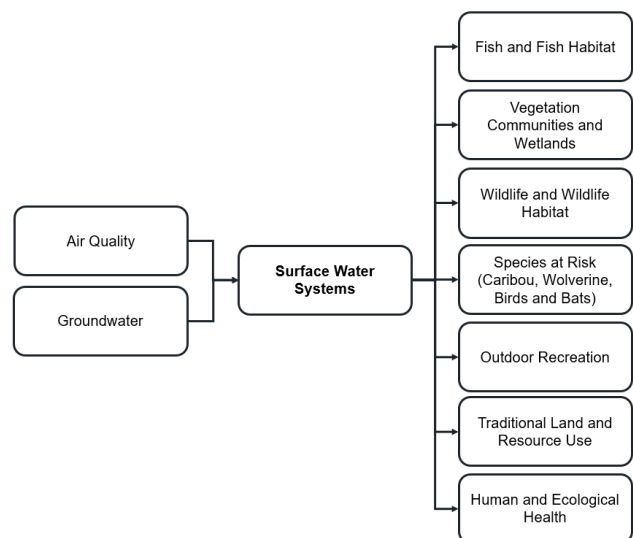
Surface water systems were selected as a valued component (VC) because surface water is critical to the life function of human and non-human biota; supports Indigenous, commercial, and recreational uses; and provides cultural value to humans through various uses including as habitat for aquatic resources and as a medium for travel and recreation. The surface water system VCs encompass aspects related to surface water, including hydrology (surface water volumes and flows) as well as surface water quality.

The mine site is situated between two lakes, Birch Lake and Springpole Lake (Figure 6.6-1). The north basin of Springpole Lake (north basin) is part of the regional Birch Lake watershed. At regional scale, Springpole Lake flows through the Birch River (via the southeast arm of Springpole Lake), towards Lake St. Joseph, approximately 124 kilometres (km) downstream to the south of the mine site. The effects assessment for surface water is divided into the following VCs, shown in Figure 6.6-1, based on the potential for effects:

- Birch Lake System (Section 6.6);
- Springpole Lake, North Basin System (this section);
- Springpole Lake, Southeast Arm System (Section 6.8); and
- Local Inland Waterbody Systems (Section 6.9).

In the absence of mitigation, the assessment of potential changes in surface water systems is directly linked to other VCs, and is informed by the following sections:

- **Air Quality (Section 6.2):** the assessment of the potential effects in air quality includes changes in dust deposition during construction and operation of the Project that may affect surface water quality.
- **Groundwater (Section 6.5):** the assessment of the potential effects in groundwater includes changes in groundwater quantity and quality during construction, operation and closure of the Project that may affect surface water quantity and quality.



In addition, the assessment of potential changes in surface water systems is also directly linked to other VCs, and informs the analysis of the following sections:

- **Fish and Fish Habitat (Section 6.10):** the assessment of the potential effects in fish and fish habitat is informed by the changes in surface water quantity and quality during construction, operation and closure of the Project.
- **Vegetation Communities and Wetlands (Section 6.11):** the assessment of the potential effects in vegetation communities and wetlands is informed by surface water quantity and quality during construction, operation and closure of the Project
- **Wildlife and Wildlife Habitat (Section 6.12):** the assessment of the potential effects in wildlife and wildlife habitat is informed by surface water quantity and quality during construction, operation and closure of the Project.

- **Species At Risk (Section 6.13 to Section 6.16):** the assessment of potential effects in SAR is informed by the potential to change surface water quantity and quality during construction, operation and closure of the Project as this may affect SAR habitat.
- **Outdoor Recreation (Section 6.18):** the assessment of potential effects in outdoor recreation is informed by the potential changes in water quantity during construction and operation of the Project as this may affect navigation.
- **Traditional Land and Resource Use (Section 6.21):** the assessment of potential effects in traditional land and resource use is informed by the potential changes in water quantity during construction and operation of the Project as this may affect the ability to access lands and resources used by Indigenous people.
- **Human and Ecological Health (Section 6.24):** the assessment of potential effects in human and ecological health is informed by the potential changes in water quality during construction and operation of the Project may affect human and ecological health through surface water consumption.

The assessment of the potential changes to surface water systems from the Project are compared to relevant federal and provincial criteria (Section 6.7.1.4) and existing conditions (Section 6.7.2). The assessment is informed by:

- Groundwater technical support documentation, including the Baseline Hydrogeology Report (Appendix L-1) and the Hydrogeological Model Report (Appendix L-2);
- Hydrology technical support documentation, including the Baseline Hydrology Report (Appendix M-1), the Mine Site Water Balance Report (Appendix M-2) and the Receiver Water Balance Report (Appendix M-3); and,
- Surface water quality technical support documentation including the Baseline Surface Water Quality Report (Appendix N-1), the Surface Water Quality Model Report (Appendix N-2), and the Predictive Modelling of Open Pit Basin Water Quality (Appendix N-3).

6.7.1 Assessment Approach

The approach to the assessment of potential changes to surface water systems includes a description of the relevant regulatory and policy setting, a description of the input obtained through consultation specific to this VC, the identification of criteria and indicators along with the associated rationale, a description of the spatial and temporal boundaries used for this VC along with a description of the attributes used to determine the significance of any residual, adverse effects. The assessment of potential effects is supported by a description of the existing conditions for the VC (Section 6.7.2), the identification and description of applicable pathways of potential effects on the VC (Section 6.7.3) and a description of applicable mitigation measures for the VC (Section 6.7.4). An outline of the analytical methodology conducted for the assessment and the key assumptions and/or conservative approach is found in Section 6.7.5. With the application of mitigation measures to the potential effects on the VC, the residual effects are then characterized in Section 6.7.6 and the significance of the residual effects is determined in Section 6.7.7.

6.7.1.1 Regulatory and Policy Setting

The effects assessment for surface water systems has been prepared in accordance with the requirements of the federal Environmental Impact Statement (EIS) Guidelines (Appendix B-1) and the provincial approved Amended Terms of Reference (ToR; Appendix B-3). Concordance tables, indicating where EIS Guidelines and ToR requirements have been addressed, are provided in Appendix B-2 and B-5, respectively.

As the Project is located in the Province of Ontario, it will need to meet applicable federal and provincial legislation and regulatory requirements; further information regarding anticipated approval requirements is provided in Section 11. Government policies, objectives, standards or guidelines most relevant to the VC are summarized below.

Fisheries Act

The responsibility for the management of fisheries resources in Canada under the *Fisheries Act* is administered primarily by Fisheries and Oceans Canada (DFO). The pollution prevention provisions of the *Fisheries Act (Section 36)* are administered by Environment and Climate Change Canada (ECCC).

Metal and Diamond Mining Effluent Regulations

The Metal and Diamond Mining Effluent Regulations (MDMER), developed under Section 36 of the *Fisheries Act* regulates the deposit of mine effluent into natural waters frequented by fish. To remain in compliance with the *Fisheries Act*, Schedule 4 of the regulations provides the maximum allowable concentrations of identified parameters (pH, total suspended solids [TSS], arsenic, copper, lead, nickel, zinc, radium-226, cyanide) in effluents from mining operations. In addition, environmental effects monitoring requirements for mining operations are specified in Schedule 5 of the MDMER.

Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life

The Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life are established by the Canadian Council of Ministers of the Environment (CCME 2017). These guidelines are developed collaboratively among provincial, territorial and federal jurisdictions and regularly updated to reflect current toxicology information and guideline derivation approaches. Water quality guidelines for the protection of aquatic life (WQG PAL) are parameter-specific and are designed to safeguard the most sensitive life stage of the most sensitive aquatic species for periods of indefinite exposure. These guidelines are grounded in rigorous peer-reviewed scientific research and are derived from toxicological data across a range of species and environmental conditions. To account for uncertainties, such as interspecies and environmental variability, most guidelines additionally have conservative safety factors applied, providing a high level of protection for aquatic ecosystems.

Mining Act

The *Mining Act*, as amended by the *Building More Mines Act*, and Ontario Regulation 35/24: Mine Development and Closure under Part VII of the Act (O.Reg. 35/24) sets out standards and criteria for mine closure. Specifically, with respect to surface waters, these statutes and regulations identify surface water quality parameters to be monitored from mines, as well as monitoring and certification requirements for assessing the success of closure activities in protecting surface waters from potential mining effects. Additionally, these statutes and regulations provide guidance regarding progressive rehabilitation to accelerate mine site rehabilitation in advance of close out activities. The monitoring requirements during closure for the Project related to surface water will be developed to meet the requirements under O.Reg. 35/24.

Environmental Protection Act

The *Environmental Protection Act* is the principal pollution control statute in Ontario and is used in conjunction with the *Ontario Water Resources Act* (OWRA) to manage development activity that may affect water quality. The EPA contains general provisions that can be used to protect surface water and groundwater quality.

Ontario Water Resources Act and Related Regulations

The OWRA is the principal statute governing water quality and quantity in Ontario. It is a general management statute that applies to groundwater and surface water. Administered by the Ministry of the Environment, Conservation and Parks (MECP), the OWRA contains several important regulations that protect water resources, including:

- Ontario Regulation 387/04: Water Taking and Transfer Regulation (O.Reg. 387/04), which requires a permit for water takings of more than a total of 50,000 liters per day ([L/d] with some exceptions). Section 34 of the OWRA requires the proponent to obtain a Permit to Take Water and Section 9 of O.Reg. 387/04 requires all permit holders to collect, record and report data on daily volumes of water withdrawals.
- Section 53 of the OWRA requires that an Environmental Compliance Approval (ECA) be obtained for industrial sewage systems that release or discharge, store, or transport contaminants to groundwater or surface water.

Provincial Water Quality Objectives

The Provincial Water Quality Objectives (PWQO) developed by MECP through its responsibilities under the OWRA and EPA, along with management policies and guidelines, were developed for the protection of aquatic life and recreational uses; they are numerical and narrative ambient surface water quality criteria that represent a desirable level of surface water quality. Similar to the Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life, PWQOs for the protection of aquatic life and are intended to be protective of all forms of aquatic life and all aspects of the aquatic life cycle during an indefinite exposure to the water.

MECP Policy B-1-5 describes the procedures to establish receiving-water based effluent requirements for point source discharges to surface waterbodies.

Lakes and Rivers Improvement Act

The *Lakes and Rivers Improvement Act* (R.S.O. 1990, c. L.3), administered by the Ministry of Natural Resources (MNR), governs design, construction, operation, maintenance and safety of dams in any lake or river or any defined portion of a lake or river. MNR approval is required for any work that forwards, holds back or diverts water, such as channelization, pond creation or bypass, dams, weirs, and locks. Thus, a mine cannot construct a dam or a feature acting as a dam in a watercourse or lake without written approval.

6.7.1.2 Influence of Consultation with Indigenous communities, Government and the Public

Consultation has been ongoing for several years, prior to and throughout the environmental assessment process, and will continue with Indigenous communities, government agencies and the public through the life of the Project. Section 2 provides more detail on the consultation process. The Record of Consultation (Appendix D) includes detailed comments received, and responses provided, during the development of the final Environmental Impact Statement / Environmental Assessment (EIS/EA).

Feedback received through consultation has been addressed through direct responses (in writing and follow-up meetings) and incorporated in the final EIS/EA, as appropriate. General comments on water quality and quantity for Birch Lake, Springpole Lake and local inland waterbodies are included in Section 6.6.1.2. The key comments that influenced the assessment for surface water in the north basin between the draft and final EIS/EA are provided below:

Baseline Surface Water Quality for the North Basin of Springpole Lake

MECP requested further information on the adequacy of the sampling in Springpole Lake to characterize baseline conditions. The baseline surface water quality monitoring program has been ongoing since 2011 and is designed to be extensive and appropriate to inform the final EIS/EA, encompassing a comprehensive network of sites strategically selected to capture spatial and temporal variations in water quality. This monitoring program will continue through life of mine and be adjusted as needed over time. To address the comments received, water quality monitoring continued through the submission of the draft EIS/EA resulting in an extensive baseline dataset covering an additional 3 years of data since the draft EIS/EA submission. As part of the baseline program, over 360 water quality samples have been collected for the north basin of Springpole Lake. For representative sampling, the monitoring program includes an extensive number of sites distributed across the lake. These sites are carefully chosen to cover different ecological zones, flow regimes, and potential sources of interaction with the Project. Furthermore, the program accounts for seasonal variations by conducting sampling throughout the year, often monthly, capturing fluctuations in water quality associated with different hydrological conditions and climatic patterns. This approach allows for a comprehensive understanding of baseline conditions to help assess potential impacts associated with the Project. Overall, the monitoring program to characterize water quality spatially and temporally within the area is extensive. The updated baseline water quality results have been included in the Baseline Surface Water Quality Report (Appendix N-1, Section 3) and described further in Section 6.7.2.2.

Baseline Flow Data at the Inlet of Springpole Lake

The Impact Assessment Agency of Canada (IAAC) requested additional information on the streamflow station at the inlet of Springpole Lake and monitored water levels in Springpole Lake to support the estimation of the water available for the refilling of the open pit basin during active closure, and to assess the potential effects on Springpole Lake. A description of the flow monitoring data collected at the inlet and outlet of Springpole Lake is provided in the Baseline Hydrology Report (Appendix M-1, Section 4.4). The description includes both previous flow monitoring data and the more recent stage-discharge measurements that were collected between 2021 and 2023 at the inlet and outlet of Springpole Lake to support the development of a rating curve. The collected data includes two winter monitoring programs in February of 2022 and 2023. Section 4.8 of the Baseline Hydrology Report provides a description of the Springpole Lake level analysis, based on average monthly water levels recorded from 2012, and 2020 to 2022. Based on average annual flows, the active filling rate is determined to be 1.13 cubic metres per second (m^3/s). The water levels in the north basin of Springpole Lake (and therefore the entire Springpole Lake) are anticipated to lower by up to approximately 10 centimetres during the pit refilling phase. The potential effects of these changes on Springpole Lake are further described in Section 6.7.6.1.

Baseline Flows for Smaller Watersheds

MECP requested further information on the baseline flows for smaller watersheds for the Project. Seven Water Survey of Canada (WSC) gauges were considered with watershed areas ranging from 619 to 5,390 square kilometres (km^2). WSC does not typically monitor watersheds with 25 km^2 drainage areas. As described in the Hydrology Baseline Report (Appendix M-1 of the draft EIS/EA), Sturgeon River at McDougall Mills was selected as a reference station after taking into consideration watershed size, period of record, proximity to site, and a comparison to monthly runoff yields from the Project site. Hydrometric baseline data collected from the smaller site watersheds ($\sim 10 \text{ km}^2$) over the 2021 to 2022 monitoring period has demonstrated a reasonable correlation to the WSC station on Sturgeon River. Hydrometric data collected over the 2021 to 2022 monitoring period is considered to be adequate in establishing site-specific

flow data for the Project Site. The results from the ongoing hydrometric baseline program are described in the Baseline Hydrology Report (Appendix M-1, Section 4.5).

Baseline Assessment of Water Level Variation in Springpole Lake

MECP requested further information on water level monitoring for Springpole Lake in order to establish the variation in levels, to support the assessment of potential effects from the dewatering of the open pit basin. The Baseline Hydrology Report (Appendix M-1, Section 4.3.1) provides a description of the water level monitoring for Springpole Lake, and the variation observed. Water level monitoring on Springpole Lake has occurred since 2020 at eight stations. The water levels across the lake have remained relatively consistent. As such, Springpole Lake levels are understood to be outflow controlled, with no difference in hydraulic head across the lake under all observed water levels. Data from several Springpole Lake stations were combined to form a continuous time series for Springpole Lake water levels, which is considered reasonable due to the consistent water levels observed across Springpole Lake. Water levels in Springpole Lake varied by approximately 2.1 metres (m) during the period of record, with a peak water elevation of approximately 392.8 metres above mean sea level (m amsl), and a minimum water level of approximately 390.70 m amsl. Dewatering of the open pit basin is described in Section 5.7.1.2, and the potential effects are assessed in Section 6.7.6.1. It should be noted that monitoring of lake levels in Springpole Lake during dewatering will be used to assess the changes to water levels or flow as a result of construction dewatering and other mining phases.

Rating Curve Development for Springpole Lake

Cat Lake First Nation (CLFN) and Lac Seul First Nation (LSFN) requested clarification on whether a new rating curve would be developed for the Springpole Lake inlet and other level logger stations using more recent data and winter data. Winter flow monitoring was collected in 2022 and 2023 (February) and presented in the Baseline Hydrology Report (Appendix M-1, Section 4.4.2) of the final EIS/EA includes a description of results from the winter monitoring programs, and Section 4.5.2 includes a description of the incorporation of this data into the rating curve.

Site Water Management Infrastructure

MECP requested further information on the design criteria for site water management infrastructure to minimize the potential impacts of storm events. Seepage collection, perimeter ditching and the associated ponds will be designed during the detailed engineering phase in support of environmental approvals. It is anticipated that the mine site runoff collection systems will also be designed to contain a 1:100 year flood event during operation, and a 1 in 25 year event for the construction phase will be the design basis for these features, based on experience with other mining projects in northern Ontario. Section 5.12.1 provides further detail on the design criteria for site water management infrastructure.

Seepage Management Measures

MECP requested clarification of the volume of seepage, and a description of the measures to manage seepage. Further information on the baseline conditions of water quality in the north basin of Springpole Lake was requested. Section 6.5.4 describes mitigation measures for the siting of the co-disposal facility (CDF) which include locating the facility on favourable geologic conditions to support long-term stability and effective seepage management. Further, a geosynthetic clay liner will be installed on the upstream side of the perimeter embankment of the CDF south cell (specifically the south, west, and east sides) to mitigate seepage potential during the operation and closure phases. The volume of seepage predicted during operation and closure is provided in Section 6.7.6.2 for the north basin of Springpole Lake

and used to undertake the assessment of potential effects. Section 6.6.4 and Section 6.7.4 provide a description of the mitigation to address potential effects to water quality. It includes an integrated water management system will be designed to collect and control contact water during the construction and operation phases of the Project from the stockpiles, CDF and plant site areas, and water from the open pit to be recycled and used in processing. The collected contact water not used in processing will be treated at the effluent treatment plant (ETP) and discharged to the southeast arm of Springpole Lake as needed to maintain the site water balance. Similar water management will continue after operations cease until regulatory requirements for passive discharge from the reclaimed site are met. Seepage collection, perimeter ditching and the associated ponds will be designed during the detailed engineering phase in support of environmental approvals. As described in Section 6.6.1.2, and Section 6.7.2, the extensive baseline surface water quality and aquatics program has been implemented over the last 10 years and as it meets / exceeds best industry standards for a Project at this stage.

Assessment of Potential Effects of Dewatering on Springpole Lake

CLFN, LSFN, IAAC and MNR requested further information on the potential effects of flooding on adjacent land/water basins as a result of the construction of the dams to facilitate dewatering be considered. Controlled dewatering of the open pit basin is expected to take approximately six months to complete, based on continuous (24-hour, 7-day per week) pumping at a rate that is able to maintain Springpole Lake water levels within the same order of magnitude and scale as existing conditions. The volume of the proposed open pit basin within Springpole Lake ranges is approximately 18 million cubic metres (Mm³), consistent with the bathymetric survey. Water flows and levels have been monitored over a period of 2.5 years, and have shown an average monthly inflow to Springpole Lake ranging from 21.3 m³/s in June to 5.0 m³/s in March, with an observed annual natural variation in flow of 16.3 m³/s. Further, the average water level of Springpole Lake ranges from 391.78 m amsl in June to 390.79 m amsl in March, showing a maximum natural variation of 2.1 m (Appendix M-1). Controlled dewatering of the open pit basin will be completed in a manner to mitigate potential environmental effects by managing and monitoring flow rates. The six-month timeframe has been determined based on the receiving capacity of Springpole Lake to accept an increase in flow, limited to 10% of the instantaneous natural flow through Springpole Lake. The 10% threshold has been applied as a mitigation measure and is consistent with the DFO guidance document *Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada* (DFO 2013). Within the framework, DFO provides a national technical guidance that cumulative flow alterations of less than 10% in amplitude of the actual (instantaneous) flow relative to a "natural flow regime" have a low probability of detectable impacts to ecosystems. During the dewatering activities, a continuous flow monitoring station at the inlet and outlet of Springpole Lake will be used to provide a running average flow that will be used to inform the actual dewatering rate consistent with anticipated permit conditions. This has been described in Section 5.7.1.2. The potential effects of dewatering are described in Section 6.7.6.1.

Assessment, Mitigation and Management of Changes in Suspended Solids during Dewatering Activities

The Northwestern Ontario Métis Community (NWOMC) requested more information on flocculants that may be used and/or other means of mitigating elevated TSS in discharge. During initial controlled dewatering, a barge is proposed to transfer lake water out of the open pit basin and back into Springpole Lake on the downstream side of the east dike. Dewatering will continue in this manner until the threshold concentration of total suspended solids (TSS) in the discharged water is reached (15 to 30 milligrams per litre [mg/L] according to Schedule 4 of the MDMER and anticipated provincial permit limits). Once the TSS threshold is reached, this water will be directed towards the central water storage pond (CWSP) for

additional settling prior to discharge back to Springpole Lake. The CWSP and related infrastructure will be set up early in the process to be available to receive the TSS-laden water when needed. The CWSP was selected as the preferred location to receive this water for additional settling given its large surface area and depth, which will provide operator flexibility during development of the open pit basin. The CWSP can support a dewatering rate of up to 2.6 m³/s, which will be sufficient for average year hydrologic conditions. The settling pond size assumes that a 5 to 10 micron particle can be settled (the smallest particle size that can be settled by sedimentation alone). Flocculant or other means may be used in the CWSP if needed to help settle suspended sediments. The type of flocculant to be used has not been defined as yet. If a flocculant is expected to be required, it will be provided in the environmental permitting documents submitted to the province for review and approval prior to construction dewatering. This has been described in Section 5.7.1.2.

Potential Effects on Water Quality in the North Basin

NWOMC requested an assessment of the project-related impacts on surface water quality within the north basin of Springpole Lake to allow for sufficient mitigation and monitoring to be identified and undertaken. The potential effects to surface waters of the north basin of Springpole Lake are assessed quantitatively using predictive water balance (Appendix M-3) and water quality modelling (Appendix N-2 and N-3) using industry standard software and include predictions for a number of parameters including mercury. The predictive modelling is used in the assessment of potential effects from the dewatering activities on the surface water of the larger north basin of Springpole Lake (Section 6.7.6.2). That is, while the isolated dewatered area within the north basin of Springpole Lake is not directly assessed in and of itself, the impacts of temporary dewatering activities in this area on surface waters of the remaining in the north basin are assessed. As the isolated portion of the north basin is targeted as a location for fish habitat offsetting / compensation (Appendix F), the specific dewatered area within the north basin is not subject to direct assessment of changes in water quality. It should be noted that the mercury evolution from bottom sediments coincident with planned dewatering activities in the north basin is not expected as existing surface water and sediment concentrations of mercury are very low (less than 0.000026 mg/L and less than 0.0002 micrograms per gram, respectively), as described in detail in the Baseline Surface Water Quality Report (Appendix N-1, Section 3) and the Baseline Aquatic Resources Report (Appendix O).

Changes in Surface Water Quality at the Outlet of the North Basin of Springpole Lake

MECP requested clarification on impact of hydraulically isolating the north basin during open pit refilling and the potential negative impact that site drainage and seepage could have on water quality at the outlet of the basin. The potential effects on surface hydrology in the north basin of Springpole Lake and on downstream watercourses (i.e., the southeast arm of Springpole Lake) during the refilling of the open pit basin are presented in Sections 6.7.6.1. Based on this, surface water quality modelling (Appendix N-2) was completed and included water quality estimates for all these sources, including the outlet of L-16 flows, overland runoff / flow from the catchment reporting to the north basin of Springpole Lake, and in final closure also water from the refilled pit basin once it is reconnected to Springpole Lake. Water quality model results indicate that water quality parameters at the outlet of the north basin are less than the applicable water quality guidelines during operation and in final closure (when the pit basin is connected to the north basin of Springpole Lake). The assessment of these potential effects is described further in Section 6.7.6.2.

Changes in Residence Time in the North Basin of Springpole Lake

MECP and MNR requested that the change in residence time for Springpole Lake due to the isolation of the open pit basin be quantified and the change incorporated into the assessment of changes in surface water

quality. Flow monitoring at the inflow of Springpole Lake via Cromarty Lake has taken place over more than two years, and the estimated change in residence time in Springpole Lake is 20 days resulting from Project-related effects. This is based on an average flow of 12 m³/s (or 1,036,800 m³/day), using a lake volume of 192 Mm³ prior to construction which is estimated to have an existing residence time of 185 days. After construction of the dikes, the lake volume will be 172 Mm³, and the residence time will be 165 days. The change in residence time has been considered in the assessment of changes in water quality in Springpole Lake as described in the Surface Water Quality Modelling Report (Appendix N-2, Section 3).

Changes in Water Levels at the outlet of the North Basin of Springpole Lake

MECP requested further monitoring information at the outlet of the north basin of Springpole Lake and at the outlet of Springpole Lake to support the validation of predict effects of changes in water levels at the outlet of the north basin of Springpole Lake due to refilling of the open pit basin. A description of the water level monitoring for Springpole Lake for both the outlet of the north basin and Springpole lake is provided in the Baseline Hydrology Report (Appendix M-1, Section 4.3.1). Further, an assessment of potential changes in the outlet of the north basin of Springpole Lake due to the refilling of the open pit is provide in the Receiver Water Balance (Appendix M-3, Attachment A). This includes a dynamic wave routing model that describes the existing conditions, as well as the changes at this location during the construction, operation and closure of the Project, including during the pit filling period. During all phases, the changes in velocity and water level at this location are minor as a result of the relatively wide connection channel and are within the same order of magnitude and scale as existing conditions.

Assessment of Potential Effects of Open Pit Basin Refilling on Springpole Lake

CLFN and LSFN requested further information on the time to fill the open pit with water, where the water will come from and how will affect water levels in Springpole Lake and downstream be mitigated. Further, MECP requested further analysis using a worse-case scenario if the initial closure period takes longer than anticipated due to lack of available flow. Springpole Lake is part of a large system with a drainage area of approximately 1,289 km² at its inflow. Once mining concludes in approximately Year 10, the open pit basin will start to fill with water by direct precipitation and groundwater infiltration from the surrounding bedrock. Without enhancement, it would take decades (approximately 30 to 40 years) for the open pit basin to refill to the same level as Springpole Lake. To significantly reduce the filling time, supplemental water from Springpole Lake is planned to be transferred to the pit in a controlled manner while maintaining lake water levels within the same order of magnitude and scale as existing conditions.

To assess the pit filling time under various climate conditions, wet and dry sequences were developed based on pro-rated historical flow records from the Sturgeon River at McDougall Mills WSC station (05QA004). The dry year sequence was developed based on data from 1975 to 1981 and represents a 1st percentile flow sequence over the period. The wet year sequence was developed based on data from 2007 to 2010 and represents a 99th percentile flow sequence over the period. The results indicate that during a 99th percentile wet flow sequence, the pit filling time would be reduced to 3.3 years. During a 1st percentile dry flow sequence, the pit filling time would be increased to 6.3 years. Water taking from Springpole Lake accounts for 95% of the inflows to the open pit basin during the pit filling period (direct runoff and groundwater inflows are quite low in relation to the Springpole Lake water takings. At this proposed active filling rate, the combined open pit basin and fish habitat development area would require three to five years to fill to the average natural elevation of Springpole Lake (elevation 391 m amsl), assuming average flow conditions during those years. Table 5.19-2 provides a range of years to fill for the open pit basin, allowing for average conditions as well as the very dry and very wet flow years.

The proposed active filling rate would be adjustable to reflect up to 10% of the inflows to Springpole Lake. Based on guidance provided by the DFO's (2013) *Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada* and Locke and Paul's (2011) *A Desk-top Method for Establishing Environmental Flows in Alberta Rivers and Streams*, a 10% to 15% reduction in instantaneous flows is unlikely to have detectable ecological effects on downstream habitat. Using the more conservative DFO guidance and a proposed active filling rate of up to 10%, the combined dewatered open pit / fish habitat area basin would require three to five years to fill using the current average elevation of Springpole Lake (elevation 391 m amsl above mean sea level) under average flow conditions during those years. With isolation of the basin occurring in the first year of construction (Year -2) and filling beginning in Year 10, the basin can be filled and ready for reconnection to Springpole Lake in approximately Year 13 to Year 15 of the Project. The description of the final reclamation of the open pit has been updated in Section 5.19.3.1 and further described in Section 6.10.6.1. The assessment of potential effects on water quantity in Springpole Lake are described in Section 6.7.6.1.

Water Quality Predictions in the North Basin of Springpole Lake at Closure

MECP requested further information on a contingency plan in the event that the water quality in the re-filled pit/previously dewatered area does not meet the proposed target. Modelling of open pit basin water quality was conducted to predict the physical and chemical evolution of the water column during closure (Appendix N-3). The results show that all water quality parameter values remain below WQG PAL within approximately 4 to 5 years and is thus considered acceptable to report directly to the environment. The predicted water quality of the open pit basin at the time of reconnection to Springpole Lake is presented in Section 6.7.6.2. In post-closure, discharge from the filled open pit basin, runoff from the reclaimed mine site and seepage/contact water from the CDF also reports to the north basin. The predicted water quality of the north basin is below (i.e., better than) WQG PAL for all modelled parameters. Some parameters are estimated to be greater than baseline concentrations in post-closure, largely as a result of the reconnection of the open pit basin and conservative nature of the mass balance model. The greatest increases relative to baseline were generally estimated for sulphate, nitrate, antimony, and cobalt. Note, predicted concentrations of these parameters remain well below WQG PAL. This is further described in Section 6.7.6.2. A detailed monitoring plan will be developed during the environmental approvals phase and will be implemented during re-filling of the open pit basin. The time for refilling will provide considerable time to validate the model predictions, and identify and implement additional mitigation measures, if warranted. Model predictions supporting this contingency plan can be found in Appendix M-2 (Mine Site Water Balance) and Appendix N-2 (Surface Water Quality Model).

Water Quality Monitoring at Closure

NWOMC requested further information on the monitoring that will be implemented to confirm that WQG PAL will be met after two years of pit filling. The closure monitoring program for the Project will be developed as part of the regulatory Closure Plan. Further, water quality will be regularly monitored throughout the closure phase as water in the open pit basin rises to verify water quality predictions and to ensure that regulatory guidelines are met. Monitoring during re-filling of the open pit basin will provide considerable time to identify and implement additional mitigation measures if needed. Further, the open pit basin will be maintained at a target level below the natural Springpole Lake elevation if needed. Once the water quality in the refilled basin meets, and is predicted to continue to meet, all requirements, the refilled basin will be hydraulically reconnected to Springpole Lake. The approach to monitoring water quality in the refilled open pit is further described in Section 5.19.3.1. It should be noted that Section 12.6 includes a description of the follow-up monitoring program.

6.7.1.3 Spatial and Temporal Boundaries

The Project Development Area (PDA) is defined as the footprint of the Project including the mine site area, mine site access road and the transmission line corridor, as well as a buffer in order to allow for flexibility for design optimizations. The buffer includes approximately 250 m around the mine site area. The buffer for the transmission line is included within the 40 m wide corridor and within the 30 m wide corridor for the mine access road. Where the mine access road and transmission line are aligned together, the buffer is included within a 60 m wide corridor.

The spatial boundaries used for the assessment of surface water systems are shown in Figure 6.6-3 and defined as follows:

- **Local Study Area (LSA):** the LSA for surface water extends from the PDA to include the waterbodies and watercourses potentially affected by changes in hydrology and surface water, which may result in a potential effect on surface water quality and quantity. The area is bounded by:
 - Springpole Lake watershed, from the outflow of Cromarty Lake to 1 km downstream of the Birch River crossing at the Wenasaga Road;
 - Northeastern shoreline of Birch Lake, to the north and northeast of the PDA; and
 - A distance of 3 km downstream of the PDA within Birch Lake, to the west.
- **Regional Study Area (RSA):** the RSA for surface water systems encompasses the LSA, as well as the contributing sources of water in the Birch Lake watershed. This also extends downstream to the confluence of Birch River with Gull Lake, approximately 8 km downstream of the LSA.

From a surface water perspective, the construction of the transmission line is expected to occur during frozen conditions or will occur within a small area for a very short period of time. Therefore, there are no expected effects on the surface water VC due to the construction and operation of the transmission line. As a result, potential for effects to surface water is limited to the mine site and the mine access road area of the PDA.

The temporal boundaries for the assessment of surface water systems are defined as:

- **Construction Phase:** Years -3 to -1, representing the construction period for the Project.
- **Operation Phase:** Years 1 to 10, with the first year potentially representing a partial year as the Project transitions from construction into operation. Mining of the ore from the open pit will end in Year 10, at which time the pit will begin refilling with water; and
- **Decommissioning and Closure Phase:**
 - Active Closure: Years 11 and 15, when final decommissioning and the majority of active reclamation activities are carried out; and
 - Post-Closure: Years 16+, corresponding to the post-closure monitoring period and when the filled open pit basin will be reconnected to Springpole Lake.

Effects on the VC are assessed for each Project phase (i.e., construction, operation and closure).

6.7.1.4 Criteria and Indicators

In undertaking the assessment of surface water effects, the following criteria were used:

- Change in water quantity; and
- Change in water quality.

The specific criteria, measurable indicators and the rationale for the selection of criteria are described in Table 6.7-1.

6.7.1.5 Description of Residual Effect Attributes

The residual effects for surface water systems are characterized in terms of the following attributes:

- Magnitude;
- Geographic Extent;
- Duration;
- Frequency; and
- Reversibility.

These attributes along with the rankings are further described in Table 6.7-2.

In addition, the residual effects for surface water are characterized according to the ecological and/or social context within which the VC is found. This is a qualitative measure of the sensitivity and/or resilience of the VC is to potential change. The following ranking is applicable:

- **Level I:** The VC may or may not be sensitive but is capable of supporting the predicted change with typical mitigation measures.
- **Level II:** The VC is sensitive and requires special measures to support the predicted change.
- **Level III:** The VC is sensitive and unable to support the predicted change even with special measures.

As noted in Section 6.1, a residual effect is defined as significant if both of the following criteria are satisfied:

- A Level II or III rating is attained for all of the attributes involving magnitude, extent, duration, frequency and reversibility; and
- A Level II or III rating is attained for ecological and/or social context.

Conversely, if a Level I rating is achieved for any of the attributes involving magnitude, extent, duration, frequency or reversibility; or, if a Level I rating is achieved for the ecological and/or social context, then the residual effect is considered to be not significant.

In the event there is a significant adverse effect, the likelihood of occurrence is further described.

6.7.2 Existing Conditions

A description of baseline conditions is presented below to characterize the existing conditions for surface water and is based on several years of study that has resulted in a comprehensive surface water dataset for this stage of project planning. The existing conditions are used to support the assessment of potential effects from the Project on surface water and will support long-term monitoring for the Project. Further baseline information on surface water can be found in the technical support documentation including the Baseline Hydrology Report (Appendix M-1) and Baseline Surface Water Quality Report (Appendix N-1).

The surface water quality monitoring stations are shown on Figure 6.6-1 and the hydrometric stations for the Project are shown on Figure 6.6-2. Meteorological data collected from the Project site has been supplemented with regional ECCC data with longer records. Climate data collected at the Project site weather stations were compared to the data from the regional climate stations, and similar trends were observed in precipitation, temperature, and evaporation rates. The results of this analysis indicated that ECCC Ear Falls and Red Lake stations were the most suitable reference stations for Springpole Lake and the Project site. Red Lake station was selected due its location and period of record.

6.7.2.1 Surface Water Quantity

Springpole Lake has a surface area of 25.6 km² at 391.00 m amsl, a predominantly rocky heterogeneous shoreline, and contains numerous islands and rocky shoals. There are a number of small tributary streams flowing into Springpole Lake. Birch River is the largest tributary and enters at the southwest end of Springpole Lake through a short section of rapids below Cromarty Lake. The outflow of Springpole Lake is also through Birch River, at the east end, into Gull Lake where it exits as the Cat River and continues to flow south to Lake St. Joseph. Springpole Lake has a maximum depth of 35.1 m and an average depth of 6.3 m. It is calculated to have a volume of approximately 190 Mm³.

The north basin is a large generally circular basin outflowing to the long, narrow southeast arm of Springpole Lake (southeast arm) by a connecting channel, approximately 160 m wide. Throughout most of the year, water drains from the north basin to the southeast arm through the connecting channel, with flows peaking in July. The average flow through the connecting channel is 0.26 m³/s. Reversal of flow occurs from March to May, as direct inflows to the north basin are too low to rise with water levels in the southeast arm during this time. As a result, water from the southeast arm flows into the north basin. The maximum flow from the southeast arm to the north basin is -2.35 m³/s, occurring in April. Velocities through the connecting channel are extremely low and follow a similar monthly trend, with an average velocity of 0.00046 metres per second (m/s) from the north basin to the southeast arm. In the spring, when the flow in the connecting channel is reversed, the velocity from the southeast arm to the north basin reaches a maximum of -0.0044 m/s. For the remainder of the year, the north basin drains to the southeast arm with a maximum velocity of 0.0024 m/s.

The north basin is 4.5 km wide and 6.5 km long and generally deeper and more open than the southeast arm, with several large areas of water exceeding 30 m in depth. The maximum and average depths of the north basin are 39 m and 6.3 m, respectively. The local catchment area reporting to the north basin is 32 km² and is generally a backwater storage area that feeds into the southeast arm. Flows through Springpole Lake generally enter and exit the system through the southeast arm.

Numerous water level monitoring stations have been established within Springpole Lake, including stations in the north basin, southeast arm, and at the outflow. A comparison of geodetic water level data from these stations demonstrates that the water levels across Springpole Lake remains relatively consistent throughout the entire water body. For almost the entirety of the period of record (2020 to 2023), these water levels are functionally the same. As such, Springpole Lake levels are outlet controlled, with no difference in hydraulic head across the lake under all observed water levels. Water levels in Springpole Lake varied by approximately 2.1 m during the period of record, with a peak water elevation of approximately 392.8 m amsl, and a minimum water level of approximately 390.7 m amsl. Water levels in Springpole Lake are generally highest in June and July and drop approximately 0.4 m to 0.6 m in the late summer or early fall.

Stage storage curves were generated for the north basin and southeast arm, based on the bathymetric survey conducted by Storey Environmental in 2019 (SEI 2020). The upper elevation of each slice and the corresponding area were used to create storage curves for each basin (Figure 6.7-1). The existing north basin has a minimum lake bottom elevation of 353.0 m amsl. At the initial water elevation of 391.0 m amsl, the north basin holds approximately 117 Mm³ of water. The southeast arm has a minimum lake bottom elevation of 363.0 m amsl, with a volume of 73 Mm³ at 391.0 m amsl.

Annualized monthly flow statistics at the Springpole Lake outlet are provided in Table 6.7-3. Flows in Springpole Lake tend to peak in early June, and trend downward over the course of the summer and fall. Flows tend to reach a minimum and remain consistent from January to early April. Flows are highest in May

(22.2 m³/s) and June (22.9 m³/s), following the spring freshet, and lowest during the late winter months (6.2 m³/s to 5.4 m³/s). Average monthly flows were determined by pro-rating flows from long-term flow records of the nearby WSC station Sturgeon River at McDougall Mills (05QA004), selected to act as a basis for the development of flow statistics for the Project site based on its length and completeness of record, as well as good historical data fit with the monitoring baseline data sets (Appendix M-1).

Low flow indices for the are provided in Table 6.7-4. These include the 7Q2, 7Q5, 7Q10 and 7Q20 low flow conditions, defined as the lowest consecutive 7-day average flow that is expected to occur in a 2, 5, 10, or 20-year return period, respectively. Low flow runoff is typically correlated to the watershed size, as smaller watersheds experience lower low flow conditions compared to larger ones. For this reason, a regression analysis was carried out to produce the values in Table 6.7-4.

6.7.2.2 Surface Water Quality

Baseline surface quality monitoring of the north basin has included the analysis of physicochemical parameters (such as temperature, pH, dissolved oxygen, and conductivity), and monitoring of nutrients, anions, cyanide, and total and dissolved metals.

Results indicate that the north basin of Springpole Lake is typical of oligotrophic lakes in northern Ontario, with very low levels of TSS, total dissolved solids and turbidity, and circumneutral pH (ranging pH 6.45 to pH 7.9). Water temperature, dissolved oxygen and pH can vary with depth in a waterbody. These relationships are most pronounced in deep lakes, like the north basin, which become thermally stratified during the summer season in temperate climatic regions, like Ontario. Seasonal lake profiles were conducted at six deep water locations within the north basin during the 2022 and 2023 field campaigns (Figure 6.7-2 to Figure 6.7-6). Thermoclines were shallower than 10 m from June to September at most sampling locations in the north basin and were generally not present in winter and spring, which suggests that the north basin was well mixed at these times of the year. The north basin is well oxygenated and dissolved oxygen levels ranged from approximately 8.0 mg/L to 14.5 mg/L over the period of record. Dissolved oxygen levels generally met or were greater than the PWQO and the Canadian Water Quality Guidelines.

Over 360 water quality samples were collected between as part of the baseline monitoring program for the Project from the north basin (Appendix N-1). Analytical results are compared to a consistent set of Water WQG PAL listed in Table 6.6-6.

Surface water quality results for the north basin are presented in Table 6.7-5; results for each monitoring station (SW-01, SW-06, SW-02, SW-25 and SW-15; Figure 6.6-1) are presented in Appendix N-1.

Concentrations of total and dissolved metals in the north basin are low, often at or below analytical detection limits, and are consistently below WQG PAL. Overall, there are few occasions where measured baseline concentrations are outside the range of WQG PAL during the sampling period. These were: pH, phosphorous and copper.

Overall, baseline samples with water quality above WQG PAL in the north basin are of low frequency and are considered representative of the natural heterogeneity of the north basin.

Additional discussion of baseline concentrations of phosphorus, copper and mercury are provided below. These parameters correspond to identified parameters of interest for the north basin based on:

- Exceedance of WQG PAL in baseline conditions (phosphorus and copper). Parameters with a single instance of results above guidelines across the entire sampling period were not considered to be a parameter of interest for the north basin for the purposes of this summary discussion; and
- Parameters identified as important through consultation with stakeholders and local Indigenous communities (mercury).

Phosphorous concentrations range from 0.001 mg/L to 0.44 mg/L in the north basin. Phosphorus concentrations were above the WQG PAL value of 0.02 mg/L in 26 samples over the period of record (approximately 9.5%). However, overall, phosphorous concentrations are characterized as low in the north basin, as average and 75th percentile concentrations are less than WQG PAL, but 95th percentile concentrations are greater than WQG PAL (Table 6.7-5). The highest measured concentrations of phosphorus are associated with lake bottom / hypolimnetic samples collected in 2021 and 2022, with the highest frequency of exceedances at station SW-06. This is likely associated with natural anoxic reduction processes and release of phosphorus from lake bottom sediment, as part of natural phosphorus cycling in the lake system. There are no apparent seasonal trends for phosphorus concentrations.

Baseline copper concentrations range from less than 0.0005 mg/L to 0.012 mg/L in the north basin. Copper concentrations were above the WQG PAL value of 0.005 mg/L in three samples over the period of record (less than 2%). The concentrations of copper greater than WQG PAL were observed at stations SW-02 and SW-01.

Total and dissolved concentrations of mercury have been monitored in the north basin since 2011, with ultra-low detection total mercury and methylmercury analyses added to the baseline monitoring program in 2021. Concentrations of total mercury in the north basin are very low, with 94% of samples below the analytical detection limit of 0.000005 mg/L. Most detectable concentrations of mercury were associated with station SW-02. Overall, total mercury concentrations in the north basin ranged from less than 0.000005 mg/L to 0.000024 mg/L, which are below the WQG PAL limit of 0.000026 mg/L. The highest concentration of detected mercury (0.000024 mg/L) was at station SW-06 in May 2021.

6.7.2.3 Traditional Knowledge

As part of the Project, all eight Indigenous communities were contacted to participate in the EA process, and to provide Traditional Knowledge and Traditional Land and Resource Use information. To date, six Indigenous communities, CLFN, LSFN, Mishkeegogamang Ojibway Nation, Slate Falls Nation, Wabauskang First Nation and NWOMC, have provided Traditional Knowledge and Traditional Land and Resource Use information. Specific Traditional Knowledge and Traditional Land and Resource Use information relevant to surface water in Birch Lake, Springpole Lake and local inland waterbodies is described in Section 6.6.2.3.

6.7.3 Identification of Pathways to Potential Effects

The initial step in the assessment process is to identify interactions between the Project and the VC that can result in pathways to potential effects. These potential effects may be direct, indirect and/or positive effects, where applicable. Table 6.7-6 includes the potential interactions of the Project with the surface water of the north basin, prior to the application of the mitigation measures. The professional judgement of technical experts experienced with mining projects in Ontario and Canada as well as input from Indigenous communities, government agencies and the public informed the identification of those interactions that are likely to result in a pathway to a potential effect due to a measurable change on noise and vibration. These pathways to potential effects are further described below for each phase of the Project, along with the rationale for those interactions excluded from further assessment. Section 6.7.4 and Table 6.7-7 provide a description of the mitigation measures applied to these pathways to potential effects during all phases of

the Project. The residual effects, after the application of the mitigation measures, are then described and further evaluated in Section 6.7.6, using the criteria and indicators identified in Section 6.7.1.4.

Construction Phase

The construction phase of the Project is expected to occur over a three-year period and will include preparation of the site and the construction of mine infrastructure. The following interactions with the Project result in pathways to potential effects on the surface water of the north basin as described below. After mitigation is applied to each pathway, as described in Table 6.7-7, the residual effects are assessed using the criteria identified for each pathway.

- Site preparation activities for the mine site, including clearing, grubbing and bulk earthworks interact with the surface water of the north basin. These activities result in pathways to potential effects on the surface water of the north basin due to the change in catchment areas required to manage contact and non-contact water, which may affect the quantity of surface water contributing to the north basin; ground disturbances that could lead to erosion and sedimentation which may affect surface water quality; and, the operation of equipment that generates dust which may affect surface water quality. The assessment of potential effects on surface water of the north basin includes changes in surface water quantity and quality from these pathways.
- The construction of the mine site water management infrastructure, fish habitat development area and starter embankments for the CDF interacts with the surface water of the north basin. These activities result in a pathway to a potential effect on the surface water of the north basin due to the change in catchment areas for groundwater and runoff contributing to the north basin and the change in water quality from blasting residue on mine rock, and erosion, sedimentation and dust deposition. The assessment of potential effects on surface water from this pathway includes the evaluation of changes in surface water quantity and quality.
- The construction of the mine access road, airstrip, including the development and operation of aggregate resource areas, onsite haul roads and onsite access roads interacts with the surface water of the north basin. These activities result in pathways to potential effects on the surface water of the north basin due to ground disturbances that could lead to erosion and sedimentation which may affect surface water quality and the operation of equipment that generates dust which may affect surface water quality. The assessment of potential effects on surface water includes changes in surface water quality from these pathways.
- The construction of the dikes to isolate the open pit basin interacts with the surface water of the north basin. These activities result in pathways to a potential effect on the surface water of the north basin due to the placement of construction material into the lake may change levels of suspended sediment, which may affect surface water quality; and the disturbance of lake bed sediment from the foundation preparation activities and placement of material could change levels of suspended sediment, which may affect surface water quality. The assessment of potential effects on surface water of the north basin includes changes in surface water quality from these pathways.
- The controlled dewatering of the open pit basin interacts with the surface water of the north basin. These activities result in pathways to potential effects on the surface water of the north basin due to the disturbance of lake bed sediment from the operation of pumps used to dewater the area could change levels of suspended sediment, which may affect surface water quality; and, the pumping of water from the open pit basin will result in changes to water levels in the north basin leading to changes in flows downstream, and may affect surface water quantity. The assessment of



potential effects on surface water of the north basin includes changes in surface water quantity and quality from these pathways.

- The development of the surficial soil stockpile and the initiation of stockpiling of ore interact with the surface water of the north basin. These activities result in pathways to potential effects on the surface water of the north basin due to ground disturbances that could lead to erosion and sedimentation which may affect surface water quality and the operation of equipment that generates dust which may affect surface water quality. The assessment of potential effects on surface water includes changes in surface water quality from these pathways.
- The initiation of pit development in rock interacts with the surface water of the north basin. This activity results in pathways to potential effects on the surface water of the north basin due to the blasting of mine rock in the open pit that may result in mine rock with blasting residues, and mine rock with an increased risk for metal leaching and acid rock drainage generation, which may affect surface water quality and the handling and transportation of mine rock and ore that could lead to increased dust deposition in the watershed and may affect surface water quality. The assessment of potential effects on surface water of the north basin includes changes in surface water quality from these pathways.
- The establishment and operation of the water management and treatment facilities interacts with the surface water of the north basin. These activities result in a pathway to a potential effect on the surface water of the north basin due to the change in catchment areas required to manage contact water, which may affect the quantity of surface water contributing to the north basin. The assessment of potential effects on surface water of the north basin includes changes in surface water quantity and quality from this pathway.

The construction of the transmission line is expected to occur during frozen conditions or will occur within a small area for a very short period of time. Therefore, this activity is unlikely to have potential effects on the surface water of the north basin.

The commissioning of the process plant is unlikely to have potential effects on the surface water of the north basin. There is no plausible interaction between the employment and expenditures activities and the surface water of the north basin during any Project phase.

Operation Phase

The operation phase is anticipated to occur over a 10-year period. The following interactions with the Project result in pathways to potential effects on the surface water of the north basin as described below. After mitigation is applied to each pathway, as described in Table 6.7-7, the residual effects are assessed using the criteria identified for each pathway:

- The operation of the open pit mine interacts with the surface water of the north basin. These activities result in pathways to potential effects on the surface water of the north basin due to the ongoing management of groundwater and surface water in the open pit basin to maintain dry working conditions requires the discharge to the receiving environment, and may affect surface water quality and quantity; the blasting of mine rock in the open pit that may result in mine rock with blasting residues, and mine rock with an increased risk for metal leaching and acid rock drainage generation, which may affect surface water quality; and, the handling and transportation of mine rock and ore that could lead to increased dust deposition in the watershed and may affect surface water quality. The assessment of potential effects on surface water in the north basin includes changes in surface water quantity and quality from these pathways.



- The operation of the CDF and surficial soil stockpile interact with the surface water of the north basin. These activities result in pathways to potential effects on the surface water of the north basin due to the handling and transportation of overburden and mine rock that could lead to increased dust deposition in the watershed and may affect surface water quality; the ongoing management of contact and non-contact water contributing to the north basin with the establishment of diversion ditches and ponds, which may affect surface water quantity; and, the changes in groundwater quality as a result of seepage from the CDF, which may affect the surface water quality. The assessment of potential effects on surface water of the north basin includes changes in surface water quantity and quality from these pathways.
- The operation of the water management facilities within the mine site area (including diversion ditches and ponds) interacts with the surface water of the north basin. These activities result in a pathway to a potential effect on the surface water of the north basin due to the ongoing management of contact and non-contact water contributing to the north basin, which may affect surface water quantity. The assessment of potential effects on surface water of the north basin includes changes in surface water quantity from this pathway.
- The operation and maintenance of mine site infrastructure, specifically the haul roads and mine access road, interacts with the surface water of the north basin. These activities result in a pathway to a potential effect on the surface water of the north basin due to the operation of haul trucks and Project-related vehicles that could lead to increased dust deposition in the watershed and may affect surface water quality. The assessment of potential effects on surface water of the north basin includes changes in surface water quality from this pathway.
- Progressive reclamation activities interact with the surface water of the north basin. These activities result in a pathway to a potential effect on the surface water of the north basin due to changes in water quality from erosion and sedimentation. The assessment of potential effects on surface water of the north basin includes the changes in surface water quality from this pathway.

The operation of the low-grade ore stockpile is not expected to interact with surface water quality of the north basin as it occurs outside the catchment area of the north basin. The operation of the process plant and accommodations complex is not expected to have an interaction with the surface waters of the north basin.

Decommissioning and Closure Phase

Activities occurring during the closure phase, which is expected to occur over a five-year period, are similar to those that occur during the construction phase and use similar mining equipment but generally on a smaller scale. The following interactions with the Project result in pathways to potential effects on the surface water of the north basin as described below. After mitigation is applied to each pathway, as described in Table 6.7-7, the residual effects are assessed using the criteria identified for each pathway:

- The stabilization of disturbed areas during final reclamation, including re-grading, placement of an appropriate cover to facilitate revegetation, if needed, and revegetation (active or passive) interacts with the surface water of the north basin. These activities result in pathways to a potential effect on the surface water of the north basin of Springpole Lake due to ground disturbances that could lead to erosion and sedimentation which may affect surface water quality; and the operation of equipment that generates dust which may affect surface water quality. The assessment of potential effects on surface water in the north basin includes changes in surface water quantity and quality from these pathways.



- Closure and reclamation of the CDF interacts with the surface water of the north basin. This activity results in pathways to potential effect on the surface water of the north basin due to changes in the management of contact and non-contact water contributing to the north basin due to altered catchment areas, which may affect surface water quantity; and, the changes in groundwater quality and quantity as a result of seepage from the CDF once tailings deposition is complete, which may affect the surface water quality and quantity. The assessment of potential effects on surface water of the north basin includes changes in surface water quantity and quality from these pathways.
- The filling of the open pit basin with water during active closure interacts with the surface water of the north basin. This activity results in pathways to a potential effect on the surface water of the north basin due to the discontinuation of ongoing water management in the open pit that will lead to changes in the groundwater levels that may affect surface water quantity; and, the pumping of water from the north basin into the open pit basin that will result in changes to water levels, which may affect surface water quantity. The assessment of potential effects on the surface water of the north basin includes the changes in surface water quantity from these pathways.
- The reconnection of the reclaimed open pit basin to the north basin interacts with the surface water of the north basin. This activity results in pathways to a potential effect on the surface water of the north basin due to the operation of equipment to remove portions of the dike that could lead to changes in suspended sediment which may affect surface water quality; and the introduction of water from the open pit basin to the north basin that may affect surface water quality. The assessment of potential effects on the surface water of the north basin includes the changes in surface water quality from these pathways.

During active closure, the Project's water management system will continue to operate; active closure will continue until site runoff, and excess water from the reclaimed open pit basin is of acceptable quality to report directly to the receiving environment.

During decommissioning and closure, the removal of assets, demolition of remaining materials, disposal of demolition-related wastes and monitoring are unlikely to have potential effects on the surface water of the north basin.

The interaction between the surface water of the north basin and potential spills are not a planned activity that would occur within the normal operating conditions. However, the risk of an unplanned spill is assessed in Section 9 and includes consideration of the design and operational safeguards to avoid a spill, an assessment of the potential risks to the environment as a result of an unplanned spill and the contingency and emergency measures that would be put into place in the event that a spill occurs.

6.7.4 Mitigation Measures

Measures to be implemented to avoid or minimize the effects of the Project on surface water of the north basin include:

- Implementation of relevant mitigation measures for potential effects on air quality particularly for dust (Section 6.2.4) including:
 - During construction, operation and active closure, a dust management plan will be implemented to identify potential sources of fugitive dusts, outline mitigation measures that will be employed to control dust generation and detail the inspection and record keeping required to demonstrate that fugitive dusts are being effectively managed; and,
 - Dust emissions from roads and mineral stockpiles will be controlled through the application of water spray and supplemented by dust suppressants, if required;



- Site roads will be maintained in good condition, with regular inspections and timely maintenance completed to minimize the silt loading on the roads; and,
- Vehicle speeds will be limited.
- Implementation of mitigation measures for potential effects on groundwater relevant to surface water (Section 6.5.4) including:
 - Locating the CDF on favourable geologic conditions at the Project site to support long term stability and effective seepage management; and,
 - During construction, a geosynthetic clay liner will be installed on the upstream side of the perimeter embankment of the CDF south cell (specifically the south, west, and east sides) to mitigate seepage potential during the operation and closure phases.
- Implementation of relevant mitigation measures for potential effects on surface water, as described in Section 6.6.4, including:
 - Development of a compact mine site to limit the areal extent of disturbance, and to limit the overall areas of site contact water that requires management;
 - During construction, operation and active closure, an integrated water management system will be designed to collect and control all contact water from the stockpiles, CDF and plant site areas. Collected contact water that is not recycled in ore processing will be treated at the ETP and discharged to the southeast arm of Springpole Lake in accordance with final permitting requirements, including the MDMER;
 - During construction, operation and active closure phases, water collection ditches will be constructed and operated around the perimeter of infrastructure, including the CDF and stockpiles to collect overland flow and seepage and direct it to the integrated water management system. Non-contact water will be diverted away from Project components using ditches, diversion berms and other suitable measures;
 - During construction, operation and active closure, an erosion and sediment control (ESC) plan will be implemented to manage runoff water around disturbed areas. The ESC plan will be prepared prior to the construction phase with the purpose of minimizing site erosion and protecting surface water from sedimentation. The ESC plan will provide further details on measures to minimize slope length and grade, ditching and diversion berms, contact water management ponds, use of natural vegetation buffers and runoff controls;
 - During construction and operation, best management practices (such as following approved blasting plans, and using appropriate drilling, explosive handling and loading procedures) will be implemented for the use of explosives to reduce the potential presence of blasting residuals in the open pit and on stockpiled mine rock and ore.
 - During construction and operation, co-manage and store potentially acid generating mine rock and thickened non-acid generating tailings in the north cell of the CDF. Potentially acid generating mine rock will be encapsulated with thickened non-acid generating tailings to isolate it from atmospheric oxygen and mitigate potential acid generation and metal leaching;
 - During operation, in-plant destruction of cyanide in tailings using the SO₂/O₂ treatment process to minimize residual cyanide in the CDF; and,
 - During operation and closure phases, revegetation and encouragement of natural revegetation / recolonization of disturbed areas will be undertaken as part of progressive and final reclamation to minimize the length of time disturbed areas are exposed, to reduce erosion.



- Strategic placement of the open pit dikes limits and isolates the open pit basin so that the Project directly affects only 6% of Springpole Lake surface area, while maintaining dam stability;
- During the construction of the dikes, turbidity curtains will be implemented to minimize sedimentation in Springpole Lake, as a proven measure used for in-water works;
- During controlled dewatering of the open pit basin, clean water will be pumped over the dikes at a rate consistent with the natural variability of Springpole Lake while water not suitable for direct discharge will be pumped to the CWSP to manage suspended sediments prior to discharge;
- To reduce the overall volume of water required to refill the open pit basin and support future fish habitat creation, recontouring of a portion of the north end of the open pit basin will be undertaken during operation;
- Passive filling with precipitation and groundwater will be supplemented by water transferred from Springpole Lake in a controlled manner to reduce the fill time while maintaining lake water levels in Springpole Lake within the same order of magnitude and scale as existing conditions; and
- During filling of the open pit basin, efforts will also be made to minimize water takings during natural periods of low flow, to maintain lake levels within the same order of magnitude and scale as existing conditions of Springpole Lake.

The application of mitigation measures for the pathways of potential effects is described in Table 6.7-7. Mitigation measures described in this section are expected to be effective for their intended purposes given their effective implementation at similar projects.

Monitoring programs will be implemented to verify the accuracy of the predicted effects, assess the effectiveness of the implemented mitigation measures and may be further optimized in response to monitoring data. Monitoring programs are in place for the Project with previous data collection completed. Monitoring for the Project going forward is further described in Section 12 and will be further refined during the permitting phase to incorporate conditions of approvals and permits. Consultation on the monitoring programs is expected to continue through all phases of the Project.

6.7.5 Analytical Methodology

The assessment of the surface water effects for the north basin has been completed in accordance with generally and widely accepted assessment methodologies. The prediction and assessment of effects to surface waters involved the following steps:

- Determine baseline surface water conditions in the absence of the Project;
- Identify the key pathways of interaction of the Project on surface water (Section 6.7.3);
- Identify key indicators of changes to surface water, including water quality parameters and compounds potentially released to surface water from the identified sources;
- Identify the relevant regulatory surface water standards and criteria, and establish the appropriate assessment criteria for a site in Ontario, noting that there may be more than one applicable criterion for some of the parameters;
- Predict changes to surface water using appropriate surface water modelling methods and established data sources; and
- Compare surface water quality and hydrology modelling outputs to the assessment criteria

The analytical methodology, including quantitative predictive modelling, used to support the assessment of surface water of the north basin is described in Section 6.6.5. In summary, the key features of the methodology include:



- A quantitative assessment of the change in surface water quality and quantity was completed using predictive water balance and water quality modelling using industry standard software (GoldSim, Microsoft Excel and PitMod) to support the assessment process;
- Water balance and water quality modelling was completed for the construction, operation, pit filling / active closure and post-closure phases, including pit water quality modelling; and
- Water balance and water quality modelling includes appropriately defined sensitivity scenarios to support the assessment of Project effects, including a conservative base case, extreme wet scenario, extreme dry scenario a theoretical upper-case seepage loading sensitivity scenario.

Pit water quality modeling results indicate PWQO and iPWQO for the protection of aquatic life are expected to be achieved within approximately 3 to 5 years. These results have informed the expected duration of the active closure phase (Section 6.7.1.3). Reconnection of the open pit basin to the north basin will only occur once water quality meets the required standards. If water quality in the open pit basin and site contact water is not suitable for passive discharge to the environment at that time, excess water will continue to be directed to the ETP for treatment prior to discharge into the southeast arm of Springpole Lake. Model predictions supporting this contingency plan can be found in Appendix M-2 (Mine Site Water Balance) and Appendix N-2 (Surface Water Quality Model).

Additionally, a dynamic wave routing model of Springpole Lake was developed to assess Project effects on water level and velocity on the Springpole Lake system (Appendix M-3). Almost all the flow of Springpole Lake enters and exits the southeast arm, with the north basin being primarily a backwater storage area, with the entire lake controlled by the outflow from Springpole Lake. In the wave routing model, two storage nodes, representing the north basin and southeast arm were included to represent Springpole Lake. A connecting channel between these two storage nodes was also included (Node 5), to allow water to flow freely between the storage nodes. Flow scenarios for all climate conditions (average, 1:100 dry and 1:100 wet year) were modeled during all phases of the Project. Average monthly flows from the receiver water balance were input to each of the storage nodes, along with the outflow rating curve for Springpole Lake.

To support the effects assessment for the north basin, receiving environment assessment nodes are identified in Figure 6.6-9. Assessment nodes are strategically placed in areas where impacts to flow and water quality may be observed as a result of the Project. For the north basin:

- Directly downstream of outflows of L-16 and dikes (Node 11)
- At the outlet of the north basin, downstream of all Project-influences on the north basin and upstream of the confluence of the north basin with the southeast arm (Node 5)

The assessment of the potential effects on surface water quality compared model results against relevant provincial and federal criteria for surface water quality. Applicable surface water quality criteria for comparing the predicted water quality concentrations are equivalent to protection of aquatic life water quality guidelines; water quality guidelines are as identified in Section 6.6 (Table 6.6-6).

6.7.5.1 Assumptions and the Use of the Conservative Approach

Conservative approaches are defined as those that provide estimates that will tend to be higher than expected, as a means to avoid the underestimation of potential effects from the Project. The assumptions and conservative approach described in Section 6.6.5.4 were used for the effects assessment on surface water of the north basin.

6.7.6 Characterization of Potential Residual Effects

Residual effects of the Project on the surface water of the north basin were assessed using both quantitative water balance and water quality modelling as well as qualitative methods (Section 6.7.5).

Note that the open pit basin is targeted as a location for aquatics offsetting / compensation as described in the revised Fish Habitat Offset / Compensation Plan (Appendix F). As a result, assessment of effects has been focused on surface water quantity and quality outside of the open pit basin which is assessed from a water quality and quantity perspective as part of the pit lake modelling completed for the Project (Appendix N-3). However, the potential residual effects of temporary controlled dewatering activities have also been quantitatively assessed here.

6.7.6.1 Change in Surface Water Quantity

For the north basin VC, residual effects to surface water quantity are assessed by evaluating relative changes to watershed area and using quantitative water balance modelling quantify potential changes in water level and velocity (Section 6.7.5). After implementation of mitigation measures, predicted changes to surface water quantity of the north basin are driven by:

- Changes to local surface water catchment area because of the development of mine site infrastructure and water management facilities;
- Changes to local surface water catchment area because of temporary dewatering, re-filling, and then subsequent reconnection of the open pit basin; and
- Changes in groundwater contributions during open pit dewatering and the operation of the CDF.

During the construction phase, the development of dikes and associated water management infrastructure at the mine site will temporarily remove approximately 6.3 km² of catchment area from the north basin. This accounts for approximately 20% of the existing local catchment area reporting directly to the outlet of the north basin (Node 05) or 0.5% of the overall catchment area the of Springpole Lake system. Once the open pit basin is isolated, the water will be pumped over the dikes back into Springpole Lake, at a rate defined to maintain consistency in lake levels with the natural variability. Maximum monthly average pumping rates used in the assessment were determined based on 10% of the average monthly outflow from Springpole Lake at Station F8-HS7 (Table 6.7-8). The actual pumping rate will be based on a running average of daily or weekly flows established during the environmental approvals process. Controlled dewatering is expected to take approximately six months to complete, based on continuous (24-hour, 7-day per week) pumping.

During construction, model results indicate that the Springpole Lake water level will increase by an average of only approximately 0.032 m (Table 6.7-11), and the velocity will increase by only 0.0010 m/s (Table 6.7-10). These changes are due to the controlled dewatering of the open pit basin, with water being pumped into the north basin. These changes in velocity and water level are very minor and fall within the same magnitude and scale as existing conditions. Similarly, model results indicate that the average flow through the connecting channel will increase to only 0.83 m³/s, up from 0.26 m³/s under baseline conditions. This increase is primarily due to the controlled dewatering of the open pit basin area, which is expected to last for only about six months.

During operation, ongoing water management of the open pit will be required to maintain a safe and dry work environment. Similarly, groundwater contributions to baseflow are also expected to be reduced, as the development of the mine site reduces the area of the lake receiving groundwater discharge. Hydrogeological modelling conducted to support the Project indicates that ongoing water management will result in an overall reduction in groundwater contributions to baseflow for most surrounding surface

water features (Section 6.5, Appendix L-2). The simulated changes in the groundwater-surface water interactions (i.e., water budget) relative to baseline conditions for the north basin are:

Feature	Groundwater Contribution Change from Baseline (m ³ /day) ^(1,2)	
	Operation	Final Closure
Outlet of the North Basin (Node 5)	-1,688	-403

Notes:

m³/day: cubic metres per day

- 1 Groundwater - surface water interactions (i.e., water budget) changes given as [mining phase model] – [baseline model]).
- 2 Includes reduction due to upstream feature overprint.

These results indicate that the north basin will experience a reduction in groundwater contributions to baseflow due to the Project. However, these changes represent less than 10% of the overall water budget to the north basin and are not expected to be measurable or distinguishable from the baseline conditions of the north basin. Model results show a slight reduction in outflow flow rates and velocities at Node 5, with changes of less than 0.0002 m/s in velocity and less than 0.01 m in water level (Table 6.7-9, Table 6.7-10 and Table 6.7-11). These changes are within the same scale and order of magnitude as existing conditions, largely due to the relatively wide connection channel from the north basin to the southeast arm. Ongoing baseline monitoring and quantitative modelling have shown that Node 5 behaves as a lake, not as a riverine lake outlet. Consequently, Springpole Lake levels and the overall water budget of the north basin are sustained by the larger drainage area entering from Cromarty Lake, rather than by the small drainage area and groundwater contributions to Node 5. Therefore, these very minor estimated changes in outflow rates, lake levels, and velocities during operation are not expected to be measurably different from baseline conditions.

After ongoing water management of the open pit ceases, the open pit basin will start to fill with water by direct precipitation and groundwater infiltration from the surrounding bedrock. However, without enhancement, it would take decades (approximately 30 to 40 years) for the open pit basin to refill to the same level as Springpole Lake. To reduce filling time, supplemental water from Springpole Lake is planned to be transferred to the open pit basin in a controlled manner while maintaining lake water levels within the same order of magnitude and scale as existing conditions during active closure (pit filling). A water taking of approximately 10% of the available monthly flow at the inlet of Springpole Lake (outlet of Cromarty Lake on Figure 6.6-1) has been assumed to support the effects assessment, based on DFO guidance (DFO 2013). On an average annual basis, this 10% freshwater taking represents a freshwater taking rate of approximately 1.13 m³/s. The remaining flows (90% of annual average flows) will continue through the Springpole Lake system, and exit at the outlet of Springpole Lake, via the southeast arm. At an active filling rate of 1.13 m³/s, the combined open pit and fish habitat development area would require 3 to 5 years to fill to the average natural elevation of Springpole Lake (391 m amsl), assuming average flow conditions during those years.

During the active closure (pit filling) phase, model results indicate that the changes in velocity and water level in the north basin are within the same order of magnitude and scale of existing conditions, because of the relatively wide connection channel (Table 6.7-9, Table 6.7-10 and Table 6.7-11). Model results show a reversal of flow direction in the connecting channel during the pit filling phase, with water moving from the southeast arm to the north basin. The average annual flow is -0.91 m³/s (from 0.26 m³/s during existing conditions). Like under existing conditions (Section 6.7.2.1), the reversal of flow directions is estimated to peak in April and May.

During pit filling, the water surface of Springpole Lake will be slightly lower, with a maximum difference in elevation of only 0.108 m (June of a 1:100 wet year). Under average conditions, an average annual reduction

of only 0.063 m in the Springpole Lake water level is predicted. These changes are well within the range of natural variation of the Springpole Lake system. For example, the maximum 0.108 m and average 0.063 m differences represent 5% and 3% respectively of the observed natural 2.1 m range in water elevation.

In post-closure, model results show that there will be negligible change in flow conditions at Node 5, less than 0.0001 m/s change in velocity and a negligible 2 mm change in water level (0.09% of the observed natural range). The negligible changes in velocity and water level are within the same order of magnitude and scale of existing conditions, as a result of the relatively wide connection channel and are unlikely to be distinguishable from existing conditions.

In post-closure, the PDA will return to a near-natural state, the collection and treatment of site runoff will cease, and runoff from the site will passively drain to either Springpole Lake or Birch Lake.

Overall, the modelling results from the hydrometric and hydrogeological models indicate that changes to outflow, velocity and lake levels are very minor to negligible and Springpole Lake and the north basin are within the same order of magnitude and scale of existing conditions.

6.7.6.2 Change in Surface Water Quality

The surface water quality effects assessment for the north basin aims to evaluate the potential effects of the proposed Project on concentrations of water quality parameters to support the understanding of how Project activities might alter water quality and to assess whether mitigation measures are appropriately designed. For the north basin VC, residual effects on surface water quality were identified through quantitative water quality modeling (Section 6.7.5), assessing potential changes in monthly water quality. To evaluate the geographic extent of these changes, model simulations were conducted at strategically selected locations (i.e., model nodes) where interactions between the Project and water quality are most likely to occur. These locations are as follows (Figure 6.6-9):

- Directly downstream of outflows of L-16 and dikes (Node 11)
- At the outlet of the north basin, downstream of all Project-influences on the north basin and upstream of the confluence of the north basin with the southeast arm (Node 5)

Surface water quality model results are presented in Table 6.7-12, Table 6.7-13 and Appendix N-2. Water quality for the north basin remains below (i.e., better than) WQG PAL for all parameters during all phases of the Project. Model results for surface water quality of the north basin informs estimates at the downstream assessment nodes in the southeast arm (Section 6.8).

Construction

During construction, there will be no bypass seepages reporting to the north basin. There are no surface water takings or discharge of treated effluent to the north basin during construction; treated effluent is discharged to the southeast arm (see Section 6.8).

During construction, Project interactions with surface water quality of the north basin are largely limited to erosion and sedimentation effects due to soil and lakebed disturbance during dike construction as well as dewatering activities. The implementation of effective erosion and sediment control measures as described in Table 6.7-7 will reduce the potential effects on surface water quality in the north basin of Springpole Lake. As result, the incidences of increased TSS loading to surface waters due to sedimentation will be mitigated and residual effects to surface water quality in the north basin of Springpole Lake due to this pathway is not predicted.

For construction, modeled water quality for the north basin is below (i.e., better than) WQG PAL for all parameters (Table 6.7-12 and Table 6.7-13).

Operation and Active Closure,

During operation and active closure (pit filling), modelling indicates that the Project interacts with north basin water quality through three general pathways:

- Limited seepage from Project components;
- Diverted non-contact water to support pit filling

There are no surface water takings or discharge of treated effluent to the north basin in operation and active closure; treated effluent is discharged to the southeast arm (see Section 6.8).

Hydrogeological modelling conducted for the Project predicts bypass seepage reporting to the north basin as:

Assessment Node	Seepage – Operation (m ³ /day)			Seepage – Post Closure (m ³ /day)	
	Low Grade Ore Stockpile	CDF South Cell	CDF North Cell	CDF South Cell	CDF North Cell
Node 11	0	12	0	24	0
Node 5	0	12	0	24	0
Total	0	24		48	

Over 90% of the seepage is captured by the water collection ditches (Appendix M-2). The above seepage estimates are summarized by Project phase and pathway to the receiver and represent less than 1% of the overall water budget to the north basin. Limited bypass seepage represents deeper groundwater flow that emanates from the source zone (CDF) and discharges along the flow path to the north basin, including any small quantities of seepage potentially bypassing the CDF perimeter collection systems. Geochemical characterization studies for the Project indicate that CDF seepage will be circumneutral to slightly alkaline pH (e.g., pH 7 to 9; Section 6.5).

Surface water quality model results for the north basin, inclusive of CDF seepage loading effects, are presented in Table 6.7-12 and Table 6.7-13; corresponding timeseries graphs for Node 11 (closest to the site) are provided in Figure 6.7-7 and Figure 6.7-8 as well as Appendix N-2.

During operation, the general patterns for water quality model results in the north basin can be attributed to the seasonal water balance and conservative model assumptions related to the mass balance (Section 6.7.5.1). During operation, water quality in north basin within the PDA and LSA is below (i.e., better than) WQG PAL for all modelled parameters. Some parameters are estimated to be greater than baseline concentrations, with concentrations at Node 11 relatively greater than Node 5 (Table 6.7-12 and Table 6.7-13). The increases relative to baseline (at or above 15 % relative change) were identified for sulphate, antimony, cobalt, and uranium concentrations. Note predicted concentrations of these parameters remain well below WQG PAL. Changes to concentrations during operation in the PDA reflect the conservative nature of the mass balance water quality model. As discussed in Section 6.6.5.4, water quality predictions were made based on inflows and did not assume dilution and mixing within the full basin. Further, it was assumed that operation water quality predictions are equivalent to the final year of operation (maximum extent), and that there is no delay or attenuation along seepage flow pathways. In contrast, concentrations of water quality parameters in the CDF and seepage are expected to increase over time to these maximum

values, coincident with mining of the open pit and expansion of corresponding facilities. The conservative approach aims to avoid underestimation of potential residual effects on water quality and although the model identifies a change in concentrations based on the mass balance, it is not expected that these changes will result in a detectable change from baseline water quality conditions for the north basin. Surface water monitoring will be ongoing during construction, operation and closure and will support the validation of the predictions.

In the Upper-case Seepage scenario, while water quality estimates for operations increase relative to Base Case, no exceedances of WQG PAL are predicted.

Closure

During active closure (pit filling) and post-closure, modelling indicates that the Project largely interacts with north basin water quality through:

- In active closure, limited seepage from Project components and diverted non-contact water to support pit filling; and
- In post closure, runoff from reclaimed site (post-closure) and the re-establishment of connection between the open pit basin to the north basin.

During active closure (pit filling) phase, mining and ore processing has ceased, the site is being reclaimed, and the Project's water management system continues to operate. During active closure, the open pit basin will be filled in a controlled manner, supplemented with water from the north basin (Section 6.7.6.1). Predicted water quality during this phase is similar to operation for most parameters; the modeled water quality for Node 11 and Node 5 is below (i.e., better than) WQG PAL for all modelled parameters. Active closure will continue until runoff from the reclaimed mine site, and excess water from the reclaimed open pit basin, achieves regulatory requirements to report directly to the environment.

Modelling of open pit basin water quality was conducted to predict the physical and chemical evolution of the water column (Appendix N-3). Results indicate that all water quality parameter values will meet WQG PAL within approximately 4 to 5 years and is thus considered acceptable to report directly to the environment. Predicted water quality of the open pit basin at the time of reconnection to Springpole Lake is presented in Table 6.7-14. The open pit basin will ultimately reconnect to the north basin via lowering of the dikes.

In post-closure, discharge from the filled open pit basin, runoff from the reclaimed mine site and seepage/contact water from the CDF also reports to the north basin. The predicted water quality of the north basin at Node 5 and Node 11 is below (i.e., better than) WQG PAL for all modelled parameters. Some parameters were estimated greater than baseline concentrations (i.e., at or above 15 % relative change) in post-closure, largely as a result of the reconnection of the open pit basin and conservative nature of the mass balance model (Table 6.7-12 and Table 6.7-13). The greatest increases relative to baseline were generally estimated for sulphate, nitrate, antimony, and cobalt. Note, predicted concentrations of these parameters remain well below WQG PAL.

In the Upper-case Seepage scenario, while water quality estimates for operations increase relative to Base Case, no exceedances of WQG PAL are predicted.

During all phases, Project activities have the potential to result in the generation and airborne transport of fugitive dust. Principal sources of fugitive dust are identified and discussed in Section 6.2 and include vehicles travelling on unpaved site roads and mining activities such as bulldozing, grading, stockpiling, drilling and blasting. Aerial deposition of Project-generated dust on surface water has the potential to affect

surface water quality. With the implementation of the key mitigation measures for dust, the pathway to a potential effect on surface water quality in the north basin of Springpole Lake from dust deposition will be reduced. The effects from atmospheric deposition to water quality are assessed in the Human and Ecological Health Risk Assessment model and determined to be indiscernible from Base Case predictions (Appendix R). As such, potential effects to surface water quality from the dust deposition pathway are not anticipated to result in a residual effect.

Modeled water quality for the north basin is not sensitive to other sensitivity cases specific to surface flows and climatic condition. As a result, no additional elevated results above WQG PAL were identified.

6.7.7 Significance of Residual Effects

The Project is predicted to have a minor residual effect on the north basin. The residual effects on surface water quantity in the north basin are seasonal changes in outflows, velocity and lake levels; however, these changes are predicted to be within the same order of magnitude and scale of existing conditions.

Surface water quality modelling completed to support the Project predicted that the changes in surface water quality would not be measurable in the north basin of Springpole Lake and that the resulting water quality in the receiving environment would meet WQG PAL (Table 6.6-6).

The hydrologic characteristics of the north basin, including its demonstrated stability and capacity to accommodate seasonal fluctuations, indicate that the VC is resilient and not sensitive to the predicted residual effects with the implementation of typical mitigation measures. Given the localized nature of the changes and application of proven mitigation measures, the ecological and social context is therefore low (Level I).

6.7.7.1 Change in Surface Water Quantity

The residual effects on surface water quantity of the north basin are seasonal changes in outflows, velocity and lake levels that are within the same order of magnitude and scale of existing conditions. The magnitude of this residual effect on surface water quantity for the north basin is low (Level I). Measurable changes in surface water quantity relative to baseline are expected to occur seasonally, with intermittent frequency (Level II) during operation (June/July) and pit filling. As the effect is identified to occur over the medium term, in some months during both operation and pit filling, the duration is moderate (Level II). The geographic extent of the residual effects is within the LSA (Level I) and are fully reversible (Level I), returning to the existing condition when the north basin returns to baseline conditions in the final closure phase. As a result, the adverse residual effect on the surface water of the north basin due to a change in surface water quantity is predicted to be not significant.

6.7.7.2 Change in Surface Water Quality

All modelled water quality parameters remained below WQG PAL within the north basin for all Project phases. With the implementation of mitigation measures, including seepage capture and dust mitigation, the residual effect on surface water quality in the north basin is the increase in concentrations above baseline conditions for some parameters and thus is low magnitude (Level I). The geographic extent of the residual effect is low (Level I), and it will be confined to the PDA, proximate to the mine site itself. The duration of the residual effect is generally associated with post-closure and is thus considered to be long-term (Level III) with a continuous frequency (Level III). The residual effect is partially reversible as water quality is not elevated above WQG PAL during any Project phase including post-closure, but concentrations of some modelled water quality parameters remained above baseline concentrations at Node 5 (Level II).

As a result, the adverse residual effect on the surface water of the north basin due to a change in surface water quality is predicted to be not significant.

6.7.8 Confidence Prediction

There is high confidence in the results of these residual effects assessment for surface water effects in the north basin. Input data used in predictive modelling are extensive and of high quality; and the range of existing and projected variability in both the existing regime and the mine influenced regime are well constrained by sensitivity cases applied, including water balance modelling (Appendix M-2), surface water quality modelling (Appendix N-2), and hydrogeological numerical modelling (Section 6.5 and Appendix L-2). The predicted effects were determined using well-established models and the conservative approach of the assessment demonstrates that predicted effects on surface water are not underestimated, and with the application of mitigation measures, there will be reliable environmental protection of surface water. Surface water monitoring will be ongoing during construction, operation and closure and will support the validation of the predictions.

6.7.9 References

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Table 6.7-1: Criteria, Indicators and Rationale for Springpole Lake, North Basin

Indicator	Measurable Parameter	Rationale
Change in water quantity	<ul style="list-style-type: none">• Lake levels, metres (m amsl)• Catchment area, square kilometers (km²)• Velocity, meters per second (m³/s)	The management of contact water can affect the catchment, contributing surface water to local waterbodies. Project activities can result in changes in surface runoff, infiltration and subsequently change the water levels and flows in local waterbodies and watercourses.
Change in water quality	<ul style="list-style-type: none">• Concentration of total and dissolved metals (mg/L)• Concentration of nutrients and anions (mg/L)• Concentration of cyanide (mg/L)	Discharge of treated effluent from the ETP and seepage from the CDF and ore stockpiles can affect receiving water quality.



Table 6.7-2: Significance Determination Attributes and Rankings for Springpole Lake, North Basin

Attribute	Description	Category
Magnitude	A qualitative or quantitative measure to describe the size or degree of the residual effects relative to baseline conditions	<p>Level I: Project-related change of surface water quality in receiving waters is consistent with assessment criteria / water quality guidelines; or Project-related change in surface water quantity less than or equal to 15% of seasonal norms.</p> <p>Level II: Project-related change in surface water quality in receiving waters is inconsistent with assessment criteria/water quality guidelines but there is no realistic potential to adversely affect aquatic life beyond any defined mixing zone; Project-related change in surface water quantity is greater than 15% of seasonal norms excluding provisions for offsetting and compensation.</p> <p>Level III: Project-related change in surface water quality in receiving waters is inconsistent with assessment criteria / water quality guidelines and there is likely to result in an unacceptable adverse effect to aquatic life beyond any defined mixing zones; Project-related change in surface water quantity greater than 15% of seasonal norms is likely to result in an unacceptable adverse effect to aquatic life, excluding provisions for offsetting and compensation.</p>
Geographic Extent	The spatial extent over which the residual effect will take place	<p>Level I: Effect is restricted to the LSA.</p> <p>Level II: Effect extends beyond the LSA.</p> <p>Level III: Effect extends beyond the RSA.</p>
Duration	The time period over which the residual effect will or is expected to occur	<p>Level I: Effect occurs over the short term: less than or equal to 3 years.</p> <p>Level II: Effect occurs over the medium term: more than three years but less than 20 years.</p> <p>Level III: Effect occurs over the long term: greater than 20 years.</p>
Frequency	The rate of occurrence of the residual effect	<p>Level I: Effect occurs once, infrequently or not at all.</p> <p>Level II: Effect occurs intermittently or with a certain degree of regularity.</p> <p>Level III: Effect occurs frequently or continuously.</p>
Reversibility	The extent to which the residual effect can be reversed	<p>Level I: Effect is fully reversible.</p> <p>Level II: Effect is partially reversible or potentially reversible with difficulty.</p> <p>Level III: Effect is not reversible.</p>

Table 6.7-3: Annualized Monthly and Annual Flow Statistics for Springpole Lake Outlet

Pro-Rated Monthly Flows (m³/s) at F8-HS7

Watershed Area = 1,372 km²

	Flow (m ³ /s)													Mean Annual Runoff (mm)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	
Mean	7.3	6.1	5.4	7.8	22.4	22.9	16.9	12.3	11.7	12.0	11.7	9.1	12.2	280.1
1st Percentile*	3.3	2.8	2.5	3.6	10.4	10.6	7.8	5.7	5.4	5.5	5.4	4.2	5.6	155.0
99th Percentile*	12.6	10.6	9.3	13.5	39.0	39.9	29.4	21.3	20.4	20.9	20.3	15.9	21.2	457.7

Notes:

* The 1st and 99th percentile monthly values are annualized monthly values, pro-rated using annual flow statistics, not 1st and 99th percentile values calculated from individual monthly data. For example, the mean monthly F7-HS1 runoff values were multiplied by a factor of (23.5/39.4) where 23.5 m³/s is the 1st percentile annual flow and 39.4 m³/s is the mean annual flow, as summarized in Table 4-4.

Table 6.7-4: Estimated Springpole Lake Outlet Low Flow Indices

Station	Distribution ⁽³⁾	F8-HS7	
Catchment Area (km ²)		1,372	
7-Day Low Flow ^(1,2)		m ³ /s	m ³ /day
7Q20	Log-Pearson Type III	1.35	116,831
7Q10	Log-Pearson Type III	1.69	145,672
7Q5	Lognormal	2.05	177,359
7Q2	Lognormal	3.00	259,103

Note:

(1) Defined as the lowest consecutive 7-day average flow that is expected to occur in a 2-year (7Q2), 5-year (7Q5), 10-year (7Q10), or 20-year (7Q20) return periods.

(2) Springpole Lake levels and the overall water budget of the North Basin are sustained by the larger drainage area entering from Cromarty Lake, rather than by the small drainage area and groundwater contributions to Node 05; these prorated flows consider the total watershed area to Springpole Lake, at its outlet.

(3) Results presented for the most conservative distribution selected from Gumbel, Lognormal, and Log-Pearson Type III.

Table 6.7-5: Springpole Lake, North Basin Baseline Surface Water Quality

Parameter	WQG PAL	Count	Minimum	25 th	Average	75 th	95 th
Hardness (as CaCO ₃)	-	271	23.7	29.4	31	32	35.3
pH	6.5 to 8.5	270	6.4	7.3	7.4	7.6	7.7
Total Suspended Solids	-	271	0.5	1.25	7.62	1.5	50.5
Total Dissolved Solids	-	272	1.5	40	42.5	51	67
Acidity (as CaCO ₃)	-	162	1	1	2.04	2.7	3.49
Alkalinity, Total (as CaCO ₃)	-	272	23	29.7	31.2	32	34.9
Ammonia, Total (as N)	2.22	266	0.0025	0.0189	0.411	0.231	2.08
Ammonia, Un-ionized (as N)	0.02	3	0.005	0.005	0.005	0.005	0.005
Chloride	128	116	0.05	0.24	0.385	0.5	0.523
Nitrate (as N)	3	234	0.01	0.01	0.0374	0.05	0.116
Nitrite (as N)	0.06	234	0.005	0.005	0.00513	0.005	0.005
Nitrate + Nitrite	-	47	0.05	0.05	0.0536	0.05	0.085
Phosphorus, Total	0.02	272	0.001	0.00778	0.0136	0.0138	0.0251
Phosphorus, Dissolved	-	132	0.001	0.005	0.0128	0.015	0.025
Sulfate	-	220	1	1.47	1.74	1.89	2.39
Dissolved Inorganic Carbon	-	213	6.4	7.8	8.83	9.06	11.2
Dissolved Organic Carbon	-	266	6.3	7.86	9.15	9.43	15.3
Aluminum (Al)	0.75	272	0.0015	0.008	0.0159	0.016	0.0396
Antimony (Sb)	0.02	272	0.00005	0.00005	0.000111	0.00005	0.00025
Arsenic (As)	0.005	272	0.00033	0.0005	0.000583	0.00059	0.000894
Beryllium (Be)	0.011	272	0.00001	0.00001	0.0000708	0.00005	0.00025
Cadmium (Cd)	0.0001	272	0.0000025	0.0000025	0.0000137	5.93E-06	0.00005
Cobalt (Co)	0.00078	272	0.00005	0.00005	0.0001	0.00005	0.00025
Copper (Cu)	0.005	272	0.00025	0.00067	0.000915	0.00089	0.00145
Iron (Fe)	1	272	0.005	0.024	0.0505	0.05	0.131
Lead (Pb)	0.009	272	0.000025	0.000025	0.0000889	0.0000718	0.00025
Mercury (Hg)	0.000026	224	0.0000025	0.0000025	3.65E-06	0.0000025	6.29E-06
Molybdenum (Mo)	0.073	264	0.000025	0.0000978	0.000156	0.00015	0.00025
Nickel (Ni)	0.025	272	0.00025	0.00025	0.000336	0.00025	0.0005
Selenium (Se)	0.002	272	0.000025	0.00008	0.000285	0.000113	0.001
Silver (Ag)	0.0001	272	0.000005	0.000005	0.0000156	0.000025	0.00005
Thallium (Tl)	0.00025	272	0.000005	0.000005	0.0000105	0.000005	0.000025
Uranium (U)	0.005	272	0.000005	0.000011	0.0000381	0.0000165	0.00005
Vanadium (V)	0.006	272	0.00025	0.00025	0.000277	0.00025	0.0005
Zinc (Zn)	0.02	272	0.0015	0.0015	0.00214	0.0025	0.005
Zirconium (Zr)	0.004	272	0.00003	0.0001	0.000181	0.0001	0.0005

Notes:

WQG PAL: Water Quality Guideline for the Protection of Aquatic Life (long-term exposure),

- indicates value is not available

All units are mg/L (unless indicated otherwise)

All results are reported as total concentrations (e.g., total metals), unless indicated otherwise

Results less than the analytical detection limit (DL) were incorporated into summary statistics as half DL (0.5*DL)

- indicates value is not available

Grey shaded values are greater than identified WQG PAL



Table 6.7-6: Potential Interactions of Project Components on Springpole Lake, North Basin

Project Component / Activity	Springpole Lake, North Basin
Construction Phase	
Site preparation activities including clearing, grubbing and bulk earthworks	Yes
Construction of the mine access road and airstrip, including the development and operation of aggregate resource areas	Yes
Development of temporary construction camp and staging areas	-
Construction of the fish habitat development area	Yes
Construction of the transmission line to the Project site	-
Construction of the onsite haul and access roads	Yes
Construction of dikes in the north basin of Springpole Lake	Yes
Construction of buildings and onsite infrastructure	-
Construction of the central water storage pond	Yes
Controlled dewatering of the open pit basin	Yes
Construction of the starter embankments for the CDF	Yes
Stripping of lake bed sediment and overburden at the open pit	-
Development of the surficial soil stockpile	Yes
Initiation of pit development in rock	Yes
Initiation of stockpiling of ore	-
Establishment and operation of water management and treatment facilities	Yes
Commissioning of the process plant	-
Employment and expenditures	-
Operation Phase	
Operation of the process plant	-
Operation of open pit mine	Yes
Management of overburden, mine rock, tailings and ore in designated facilities	Yes
Operation of water management and treatment facilities	Yes
Accommodations complex operations	-
Operation and maintenance of mine site infrastructure	Yes
Progressive reclamation activities	Yes
Employment and expenditures	-
Decommissioning and Closure Phase	
Removal of assets that can be salvaged	-
Demolition and recycling and/or disposal of remaining materials	-
Removal and disposal of demolition-related wastes in approved facilities	-
Reclamation of impacted areas, such as by regrading, placement of cover and revegetation	Yes
Filling the open pit basin with water	Yes
Monitoring and maintenance	-
Employment and expenditures	-

Note:

(-) The interaction is not expected, and no further assessment is warranted.

Table 6.7-7: Proposed Mitigation Measures for Potential Springpole Lake, North Basin Effects

Pathways to Potential Effect / Criteria	Phase			Proposed Mitigation Measure
	Con.	Op.	Cl.	
Change in water quantity	•	•	•	Implementation of relevant mitigation measures for potential effects on surface water, as described in Section 6.6.4, including: <ul style="list-style-type: none"> • Development of a compact mine site to limit the areal extent of disturbance, and to limit the overall areas of site contact water that requires management; • During construction, operation and active closure, an integrated water management system will be designed to collect and control all contact water from the stockpiles, CDF and plant site areas. Collected contact water that is not recycled in ore processing will be treated at the ETP and discharged to the southeast arm of Springpole Lake in accordance with final permitting requirements, including the MDMER; • During construction, operation and active closure phases, water collection ditches will be constructed and operated around the perimeter of infrastructure, including the CDF and stockpiles to collect overland flow and seepage and direct it to the integrated water management system. Non-contact water will be diverted away from Project components using ditches, diversion berms and other suitable measures.
	•	•	–	Strategic placement of the open pit dikes limits and isolates the open pit basin so that the Project directly affects only 6% of Springpole Lake surface area, while maintaining dam stability.
	•	–	–	During controlled dewatering of the open pit basin, clean water will be pumped over the dikes at a rate consistent with the natural variability of Springpole Lake while water not suitable for direct discharge will be pumped to the CWSP to manage suspended sediments prior to discharge.
	–	•	–	To reduce the overall volume of water required to refill the open pit basin and support future fish habitat creation, recontouring of a portion of the north end of the open pit basin will be undertaken during operations.
	–	–	•	Passive filling with precipitation and groundwater will be supplemented by water transferred from Springpole Lake in a controlled manner to reduce the fill time while maintaining lake water levels in Springpole Lake within the same order of magnitude and scale as existing conditions.
	–	–	•	During filling of the open pit basin, efforts will also be made to minimize water takings during natural periods of low flow, to maintain lake levels within the same order of magnitude and scale as existing conditions of Springpole Lake.

Table 6.7-7: Proposed Mitigation Measures for Potential Springpole Lake, North Basin Effects

Pathways to Potential Effect / Criteria	Phase			Proposed Mitigation Measure
	Con.	Op.	Cl.	
Change in water quality	•	•	•	Implementation of relevant mitigation measures for potential effects on air quality particularly for dust (Section 6.2.4) including: <ul style="list-style-type: none"> • During construction, operations and active closure, a dust management plan will be implemented to identify potential sources of fugitive dusts, outline mitigation measures that will be employed to control dust generation and detail the inspection and record keeping required to demonstrate that fugitive dusts are being effectively managed; and, • Dust emissions from roads and mineral stockpiles will be controlled through the application of water spray and supplemented by dust suppressants, if required; • Site roads will be maintained in good condition, with regular inspections and timely maintenance completed to minimize the silt loading on the roads; and, • Vehicle speeds will be limited.
	•	-	-	Implementation of mitigation measures for potential effects on groundwater relevant to surface water (Section 6.5.4) including: <ul style="list-style-type: none"> • Locating the CDF on favourable geologic conditions at the Project site to support long term stability and effective seepage management; and, • During construction, a geosynthetic clay liner will be installed on the upstream side of the perimeter embankment of the CDF south cell (specifically the south, west, and east sides) to mitigate seepage potential during the operation and closure phases.
	•	•	•	Implementation of relevant mitigation measures for potential effects on surface water, as described in Section 6.6.4, including: <ul style="list-style-type: none"> • Development of a compact mine site to limit the areal extent of disturbance, and to limit the overall areas of site contact water that requires management; • During construction, operation and active closure, an integrated water management system will be designed to collect and control all contact water from the stockpiles, CDF and plant site areas. Collected contact water that is not recycled in ore processing will be treated at the ETP and discharged to the southeast arm of Springpole Lake in accordance with final permitting requirements, including the MDMER; • During construction, operation and active closure phases, water collection ditches will be constructed and operated around the perimeter of infrastructure, including the CDF and stockpiles to collect overland flow and seepage and direct it to the integrated water management system. Non-contact water will be diverted away from Project components using ditches, diversion berms and other suitable measures.

Table 6.7-7: Proposed Mitigation Measures for Potential Springpole Lake, North Basin Effects

Pathways to Potential Effect / Criteria	Phase			Proposed Mitigation Measure
	Con.	Op.	Cl.	
				<ul style="list-style-type: none"> During construction, operation and active closure, an ESC plan will be implemented to manage runoff water around disturbed areas. The ESC plan will be prepared prior to the construction phase with the purpose of minimizing site erosion and protecting surface water from sedimentation. The ESC plan will provide further details on measures to minimize slope length and grade, ditching and diversion berms, contact water management ponds, use of natural vegetation buffers and runoff controls. During construction and operation, best management practices (such as following approved blasting plans, and using appropriate drilling, explosive handling and loading procedures) will be implemented for the use of explosives use to reduce the potential presence of blasting residuals in the open pit and on stockpiled mine rock and ore. During construction and operation, co-manage and store potentially acid generating mine rock and thickened non-acid generating tailings in the north cell of the CDF. Potentially acid generating mine rock will be encapsulated with thickened non-acid generating tailings to isolate it from atmospheric oxygen and mitigate potential acid generation and metal leaching. During operations, in-plant destruction of cyanide in tailings using the SO₂/O₂ treatment process to minimize residual cyanide in the CDF. During operation and closure phases, revegetation and encouragement of natural revegetation / recolonization of disturbed areas will be undertaken as part of progressive and final reclamation to minimize the length of time disturbed areas are exposed, to reduce erosion.
	•	–	–	During the construction of the dikes, turbidity curtains will be implemented to minimize sedimentation in Springpole Lake, as a proven measure used for in-water works.
	•	–	–	During controlled dewatering of the open pit basin, clean water will be pumped over the dikes at a rate consistent with the natural variability of Springpole Lake while water not suitable for direct discharge will be pumped to the CWSP to manage suspended sediments prior to discharge.

Notes:

Con. = construction; Op. = operations; Cl. = closure; • = mitigation is applicable; – = mitigation is not applicable.

Table 6.7-8: Controlled Dewatering Rates for the Open Pit Basin

Springpole Lake outflow (m³/s) Station F8-HS1 and Estimate Allowable Rate of Taking												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	7.3	6.2	5.4	7.8	22.2	22.9	17	12.4	11.9	12.1	11.8	9.2
5th Percentile*	4	3.4	3	4.3	12.2	12.7	9.4	6.8	6.6	6.7	6.5	5.1
95th Percentile*	11.7	9.9	8.7	12.5	35.5	36.7	27.3	19.8	19.1	19.4	18.9	14.8
Derived Values for Controlled Dewatering Rates of Open Pit Basin												
10% Mean Value Daily flow (m³/s)	0.73	0.62	0.54	0.78	2.22	2.29	1.7	1.24	1.19	1.21	1.18	0.92
Monthly Volume (m³)	1,955,232	1,499,904	1,446,336	2,021,760	5,946,048	5,935,680	4,553,280	3,321,216	3,084,480	3,240,864	3,058,560	2,464,128
Cumulative Volume January Start (m³)	1,955,232	3,455,136	4,901,472	6,923,232	12,869,280	18,804,960	23,358,240	26,679,456	29,763,936	33,004,800	36,063,360	38,527,488
Cumulative Volume June Start (m³)						5,935,680	10,488,960	13,810,176	16,894,656	20,135,520	23,194,080	25,658,208

Notes:

Open pit basin has a current water level at 391 metres above mean sea level and a volume within the dike area of 18,000,000m³.

Station F8-HS1 is located at the outflow of Springpole Lake.

Cumulative flow alterations <10% in amplitude of the actual (instantaneous) flow in the river relative to a natural flow are expected to be acceptable to DFO based on current guidance

Fisheries timing constraints for Springpole Lake allow impacts and in-water works to occur from June 15 through September 1, unless an exemption is obtained.

Source of tables and figure are Hydrology Baseline Report Springpole Gold Project First Mining Gold Corp. Wood May 2021

* The 5th and 95th percentile monthly values are annualized monthly values, pro-rated using annual flow statistics, not 5th and 9th percentile values calculated from individual monthly data. For example, the mean monthly F7-HS1 runoff values were multiplied by a factor of (21.9/39.7) where 21.9 m³/s is the 5th percentile annual flow and 39.7 m³/s is the mean annual flow.

Table 6.7-9: Predicted Changes to Springpole Lake, North Basin Outflow Flowrate

Watershed ID	Flow Condition	Scenario	Connecting Channel Flowrate (m ³ /s)													Average	Change in Flowrate (m ³ /s)
			January	February	March	April	May	June	July	August	September	October	November	December			
Node 5	Average Year	Existing	0.51	0.50	-0.074	-2.35	-0.99	1.1	1.4	0.85	0.37	0.32	0.68	0.80	0.26	-	
		Construction	0.94	0.93	0.46	-0.93	1.2	2.5	1.8	0.81	0.35	0.30	0.61	0.94	0.83	0.57	
		Operations	0.49	0.42	-0.13	-2.2	-0.91	0.92	1.2	0.69	0.28	0.25	0.57	0.69	0.19	-0.069	
		Active Closure (Pit Filling)	-0.0030	-0.088	-0.70	-3.4	-3.0	-0.96	-0.17	-0.43	-0.82	-0.84	-0.41	-0.10	-0.91	-1.2	
		Post-Closure	0.50	0.48	-0.067	-2.3	-0.95	1.1	1.4	0.87	0.41	0.34	0.66	0.78	0.27	0.012	
	1:100 Dry Year	Existing	1.4	0.68	0.17	-1.2	-0.96	0.37	0.81	0.56	0.26	0.18	0.36	0.48	0.26	-	
		Construction	1.5	0.81	0.36	-0.64	0.068	1.2	1.37	1.0	0.71	0.65	0.77	0.78	0.72	0.46	
		Operations	1.4	0.60	0.10	-1.2	-0.90	0.32	0.71	0.47	0.20	0.14	0.31	0.41	0.21	-0.050	
		Active Closure (Pit Filling)	1.1	0.36	-0.15	-1.7	-1.8	-0.55	0.045	-0.058	-0.31	-0.37	-0.15	0.038	-0.30	-0.56	
		Post-Closure	1.4	0.68	0.17	-1.2	-0.96	0.36	0.81	0.56	0.26	0.17	0.35	0.46	0.25	-0.0030	
	1:100 Wet Year	Existing	-0.60	0.44	-0.23	-3.4	-0.67	1.9	2.1	1.1	0.53	0.53	1.1	1.2	0.32	-	
		Construction	0.27	1.3	0.75	-1.1	1.2	1.8	1.8	1.0	0.50	0.50	0.95	1.4	0.88	0.55	
		Operations	-0.55	0.38	-0.27	-3.1	-0.62	1.6	1.7	0.91	0.40	0.43	0.90	0.98	0.23	-0.097	
		Active Closure (Pit Filling)	-1.4	-0.53	-1.3	-5.4	-4.3	-1.7	-0.66	-1.0	-1.5	-1.5	-0.80	-0.37	-1.7	-2.0	
		Post-Closure	-0.62	0.41	-0.22	-3.3	-0.59	1.9	2.1	1.2	0.60	0.55	1.0	1.1	0.35	0.026	

Table 6.7-10: Predicted Changes to Springpole Lake, North Basin Outflow Velocity

Watershed ID	Flow Condition	Scenario	Connecting Channel Velocity (m/s)													Average	Change in Velocity (m/s)
			January	February	March	April	May	June	July	August	September	October	November	December			
Node 5	Average Year	Existing	0.0010	0.0010	-0.00015	-0.0044	-0.0017	0.0018	0.0024	0.0015	0.00067	0.00058	0.0013	0.0015	0.00046	-	
		Construction	0.0019	0.0019	0.00093	-0.0017	0.0019	0.0040	0.0030	0.0014	0.00064	0.00056	0.0011	0.0018	0.0015	0.0010	
		Operations	0.0010	0.00087	-0.00026	-0.0042	-0.0015	0.0015	0.0021	0.0012	0.00051	0.00046	0.0011	0.0013	0.00034	-0.00012	
		Active Closure (Pit Filling)	0.00	-0.00019	-0.0015	-0.0066	-0.0050	-0.0016	-0.00029	-0.00079	-0.0015	-0.0016	-0.00076	-0.00020	-0.0017	-0.0021	
		Post-Closure	0.0010	0.0010	-0.00013	-0.0043	-0.0016	0.0018	0.0025	0.0016	0.00074	0.00060	0.0012	0.0015	0.00048	0.000023	
	1:100 Dry Year	Existing	0.0030	0.0015	0.00038	-0.0027	-0.0019	0.00071	0.0016	0.0012	0.00054	0.00040	0.00077	0.0010	0.00054	-	
		Construction	0.0032	0.0018	0.00081	-0.0014	0.00012	0.0023	0.0027	0.0020	0.0015	0.0014	0.0016	0.0017	0.0015	0.00093	
		Operations	0.0028	0.0014	0.00024	-0.0026	-0.0018	0.00060	0.0014	0.0010	0.00042	0.00030	0.00066	0.00090	0.00044	-0.00010	
		Active Closure (Pit Filling)	0.0023	0.00081	-0.00035	-0.0038	-0.0036	-0.0011	0.000090	-0.00013	-0.00065	-0.00080	-0.00032	0.000083	-0.00062	-0.0012	
		Post-Closure	0.0030	0.0015	0.00038	-0.0027	-0.0019	0.00068	0.0016	0.0012	0.00054	0.00040	0.00074	0.00100	0.00053	-0.0000028	
	1:100 Wet Year	Existing	-0.0012	0.00083	-0.00042	-0.0056	-0.0010	0.0028	0.0031	0.0018	0.00085	0.00085	0.0018	0.0020	0.00049	-	
		Construction	0.00047	0.0024	0.0014	-0.0017	0.0019	0.0027	0.0028	0.0016	0.00081	0.00080	0.0016	0.0025	0.0014	0.00095	
		Operations	-0.0011	0.00071	-0.00051	-0.0052	-0.00094	0.0024	0.0026	0.0015	0.00065	0.00070	0.0015	0.0017	0.00033	-0.00015	
		Active Closure (Pit Filling)	-0.0028	-0.0010	-0.0025	-0.0091	-0.0064	-0.0025	-0.0010	-0.0017	-0.0025	-0.0025	-0.0014	-0.00064	-0.0028	-0.0033	
		Post-Closure	-0.0012	0.00078	-0.00041	-0.0054	-0.00089	0.0029	0.0032	0.0019	0.0010	0.00088	0.0017	0.0019	0.00052	0.000040	

Table 6.7-11: Predicted Changes to Springpole Lake Elevation

Watershed ID	Flow Condition	Scenario	Springpole Lake Elevation (m amsl)													
			January	February	March	April	May	June	July	August	September	October	November	December	Average	Change in Elevation (m)
Node 5	Average Year	Existing	390.96	390.89	390.86	391.13	391.65	391.71	391.52	391.33	391.27	391.26	391.22	391.11	391.24	-
		Construction	390.98	390.92	390.90	391.20	391.75	391.78	391.55	391.34	391.28	391.27	391.22	391.11	391.27	0.032
		Operations	390.95	390.87	390.84	391.12	391.65	391.71	391.51	391.32	391.27	391.26	391.21	391.09	391.23	-0.0089
		Active Closure (Pit Filling)	390.93	390.84	390.81	391.07	391.57	391.63	391.44	391.26	391.21	391.20	391.15	391.04	391.18	-0.063
		Post-Closure	390.96	390.89	390.86	391.13	391.65	391.71	391.52	391.34	391.28	391.27	391.22	391.11	391.24	0.000009
	1:100 Dry Year	Existing	390.83	390.64	390.56	390.68	391.01	391.11	391.01	390.88	390.83	390.81	390.78	390.71	390.82	-
		Construction	390.83	390.65	390.58	390.72	391.08	391.17	391.06	390.92	390.87	390.85	390.82	390.75	390.86	0.039
		Operations	390.81	390.61	390.53	390.66	391.01	391.10	390.99	390.87	390.81	390.79	390.76	390.69	390.80	-0.018
		Active Closure (Pit Filling)	390.81	390.61	390.53	390.64	390.95	391.05	390.95	390.83	390.78	390.76	390.73	390.66	390.77	-0.046
		Post-Closure	390.83	390.64	390.56	390.68	391.01	391.11	391.01	390.88	390.83	390.81	390.78	390.71	390.82	-0.00028
	1:100 Wet Year	Existing	391.14	391.17	391.18	391.58	392.25	392.26	391.99	391.76	391.70	391.70	391.64	391.48	391.65	-
		Construction	391.17	391.22	391.23	391.68	392.33	392.27	391.98	391.76	391.70	391.70	391.63	391.48	391.68	0.028
		Operations	391.13	391.16	391.16	391.59	392.25	392.26	391.98	391.75	391.70	391.69	391.63	391.46	391.65	-0.0053
		Active Closure (Pit Filling)	391.10	391.11	391.11	391.51	392.14	392.15	391.89	391.67	391.62	391.61	391.55	391.40	391.57	-0.081
		Post-Closure	391.13	391.17	391.17	391.58	392.25	392.26	391.99	391.76	391.70	391.70	391.63	391.47	391.65	-0.000025

Table 6.7-12: Base Case Water Quality Results, Node 11

Project Phase	Month	Parameter	Ammonia-N	Nitrate-N	Nitrite-N	Phosphorus	Total Cyanide	Aluminum	Antimony	Arsenic	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Tungsten	Uranium	Vanadium	Zinc
		WQG PAL	1.8	3	0.06	0.02	0.005	0.83	0.020	0.005	0.011	1.50	0.0001	0.0089	0.00078	0.005	0.3	0.00906	0.000026	0.073	0.025	0.1	0.00025	0.0008	0.030	0.005	0.12	0.011
Existing Condition	January	0.025	0.057	0.005	0.014	0.001	0.007	0.00015	0.0005	0.000050	0.0050	0.000006	0.00020	0.00008	0.00076	0.032	0.00003	0.000002	0.00019	0.00038	0.00055	0.000038	0.000015	0.00005	0.00003	0.00025	0.0015	
	February	0.025	0.057	0.005	0.014	0.001	0.007	0.00015	0.0005	0.000050	0.0050	0.000006	0.00020	0.00008	0.00076	0.032	0.00003	0.000002	0.00019	0.00038	0.00055	0.000038	0.000015	0.00005	0.00003	0.00025	0.0015	
	March	0.025	0.057	0.005	0.014	0.001	0.007	0.00015	0.0005	0.000050	0.0050	0.000006	0.00020	0.00008	0.00076	0.032	0.00003	0.000002	0.00019	0.00038	0.00055	0.000038	0.000015	0.00005	0.00003	0.00025	0.0015	
	April	0.054	0.019	0.005	0.011	0.001	0.012	0.00005	0.0005	0.000010	0.0050	0.000004	0.00018	0.00005	0.00087	0.034	0.00003	0.000002	0.00010	0.00025	0.00010	0.00005	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015
	May	0.054	0.019	0.005	0.011	0.001	0.012	0.00005	0.0005	0.000010	0.0050	0.000004	0.00018	0.00005	0.00087	0.034	0.00003	0.000002	0.00010	0.00025	0.00010	0.00005	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015
	June	0.054	0.019	0.005	0.011	0.001	0.012	0.00005	0.0005	0.000010	0.0050	0.000004	0.00018	0.00005	0.00087	0.034	0.00003	0.000002	0.00010	0.00025	0.00010	0.00005	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015
	July	0.020	0.045	0.005	0.010	0.001	0.014	0.00005	0.0005	0.000010	0.0050	0.000002	0.00019	0.00005	0.00075	0.026	0.00003	0.000002	0.00011	0.00025	0.00009	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
	August	0.020	0.045	0.005	0.010	0.001	0.014	0.00005	0.0005	0.000010	0.0050	0.000002	0.00019	0.00005	0.00075	0.026	0.00003	0.000002	0.00011	0.00025	0.00009	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
	September	0.020	0.045	0.005	0.010	0.001	0.014	0.00005	0.0005	0.000010	0.0050	0.000002	0.00019	0.00005	0.00075	0.026	0.00003	0.000002	0.00011	0.00025	0.00009	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
	October	0.208	0.010	0.005	0.008	0.001	0.007	0.00005	0.0006	0.000010	0.0050	0.000002	0.00016	0.00005	0.00067	0.024	0.00003	0.000002	0.00012	0.00025	0.00009	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
	November	0.208	0.010	0.005	0.008	0.001	0.007	0.00005	0.0006	0.000010	0.0050	0.000002	0.00016	0.00005	0.00067	0.024	0.00003	0.000002	0.00012	0.00025	0.00009	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
	December	0.208	0.010	0.005	0.008	0.001	0.007	0.00005	0.0006	0.000010	0.0050	0.000002	0.00016	0.00005	0.00067	0.024	0.00003	0.000002	0.00012	0.00025	0.00009	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
Construction	January	0.044	0.053	0.005	0.014	0.001	0.008	0.00013	0.0005	0.000050	0.0050	0.000005	0.00021	0.00007	0.00076	0.032	0.00003	0.000002	0.00018	0.00035	0.00047	0.000033	0.000013	0.00005	0.00003	0.00025	0.0015	
	February	0.136	0.028	0.005	0.013	0.001	0.014	0.00006	0.0006	0.000050	0.0050	0.000003	0.00025	0.00005	0.00079	0.035	0.00003	0.000002	0.00013	0.00026	0.00014	0.000012	0.000006	0.00005	0.00002	0.00025	0.0015	
	March	0.136	0.028	0.005	0.013	0.001	0.014	0.00006	0.0006	0.000050	0.0050	0.000003	0.00025	0.00005	0.00079	0.035	0.00003	0.000002	0.00013	0.00026	0.00014	0.000012	0.000006	0.00005	0.00002	0.00025	0.0015	
	April	0.139	0.024	0.005	0.012	0.001	0.014	0.00005	0.0006	0.000046	0.0050	0.000003	0.00024	0.00005	0.00080	0.035	0.00003	0.000002	0.00012	0.00025	0.00010	0.000010	0.000005	0.00005	0.00001	0.00025	0.0015	
	May	0.138	0.024	0.005	0.012	0.001	0.014	0.00005	0.0006	0.000046	0.0050	0.000003	0.00024	0.00005	0.00080	0.035	0.00003	0.000002	0.00012	0.00025	0.00010	0.000010	0.000005	0.00005	0.00001	0.00025	0.0015	
	June	0.138	0.024	0.005	0.012	0.001	0.014	0.00005	0.0006	0.000046	0.0050	0.000003	0.00024	0.00005	0.00080	0.035	0.00003	0.000002	0.00012	0.00025	0.00010	0.000010	0.000005	0.00005	0.00001	0.00025	0.0015	
	July	0.135	0.027	0.005	0.012	0.001	0.014	0.00005	0.0006	0.000046	0.0050	0.000002	0.00024	0.00005	0.00079	0.034	0.00003	0.000002	0.00012	0.00025	0.00010	0.000010	0.000005	0.00005	0.00001	0.00025	0.0015	
	August	0.125	0.028	0.005	0.012	0.001	0.014	0.00005	0.0006	0.000043	0.0050	0.000002	0.00024	0.00005	0.00079	0.034	0.00003	0.000002	0.00012	0.00025	0.00010	0.000009	0.000005	0.00005	0.00001	0.00025	0.0015	
	September	0.060	0.038	0.005	0.011	0.001	0.014	0.00005	0.0005	0.000023	0.0050	0.000002	0.00021	0.00005	0.00076	0.029	0.00003	0.000002	0.00011	0.00025	0.00010	0.000007	0.000005	0.00005	0.00001	0.00025	0.0015	
	October	0.197	0.015	0.005	0.010	0.001	0.010	0.00005	0.0006	0.000024	0.0050	0.000002	0.00019	0.00005	0.00071	0.028	0.00003	0.000002	0.00012	0.00025	0.00009	0.000007	0.000005	0.00005	0.00001	0.00025	0.0015	
	November	0.201	0.014	0.005	0.009	0.001	0.009	0.00005	0.0006	0.000022	0.0050	0.000002	0.00019	0.00005	0.00071	0.027	0.00003	0.000002	0.00012	0.00025	0.00009	0.000006	0.000005	0.00005	0.00001	0.00025	0.0015	
	December	0.208	0.013	0.005	0.009	0.001	0.009	0.00005	0.0006	0.000019	0.0050	0.000002	0.00018	0.00005	0.00070	0.027	0.00003	0.000002	0.00012	0.00025	0.00009	0.000006	0.000005	0.00005	0.00001	0.00025	0.0015	
Operations	January	0.027	0.091	0.005	0.014	0.001	0.007	0.00086	0.0005	0.000050	0.0054	0.000006	0.00020	0.00015	0.00076	0.031	0.00002	0.000003	0.00022	0.00038	0.00058	0.000038	0.000020	0.00009	0.00015	0.00025	0.0015	
	February	0.028	0.100	0.005	0.014	0.001	0.008	0.00105	0.0005	0.000050	0.0055	0.000006	0.00021	0.00017	0.00076	0.031	0.00002	0.000003	0.00023	0.00038	0.00059	0.000038	0.000022	0.00010	0.00018	0.00025	0.0015	
	March	0.028	0.107	0.005	0.014	0.001	0.008	0.00122	0.0005	0.000050	0.0056	0.000006	0.00021	0.00019	0.00076	0.031	0.00002	0.000003	0.00024	0.00038	0.00060	0.000038	0.000023	0.00011	0.00021	0.00025	0.0015	
	April	0.055	0.075	0.005	0.011	0.001	0.014	0.00125	0.0005	0.000010	0.0057	0.000004	0.00019	0.00017	0.00087	0.034	0.00002	0.000003	0.00016	0.00026	0.00017	0.000006	0.000015	0.00012	0.00021	0.00025	0.0015	
	May	0.054	0.058	0.005	0.011	0.001	0.013	0.00088	0.0005	0.000010	0.0055	0.000004	0.00019	0.00013	0.00087	0.034	0.00002	0.000003	0.00014	0.00026	0.00015	0.000006	0.000012	0.00009	0.00015	0.00025	0.0015	
	June	0.054	0.061	0.005	0.011	0.001	0.013	0.00094	0.0005	0.000010	0.0055	0.000004	0.00019	0.00014	0.00087	0.034	0.00002	0.000003	0.00015	0.00026	0.00015	0.000006	0.000012	0.00010	0.00016	0.00025	0.0015	
	July	0.022	0.085	0.005	0.010	0.001	0.015	0.00092	0.0005	0.000010	0.0055	0.000003	0.00020	0.00014	0.00075	0.026	0.00002	0.000003	0.00016	0.00026	0.00015	0.000006	0.000012	0.00010	0.00016	0.00025	0.0015	
	August	0.023	0.099	0.005	0.010	0.001	0.015	0.00122	0.0005	0.000010	0.0057	0.000003	0.00020	0.00017	0.00075	0.026	0.00002	0.000003	0.00017	0.00026	0.00017	0.000006	0.000014	0.00011	0.00021	0.00025	0.0015	
	September	0.023	0.094	0.005	0.010	0.001	0.015	0.00112	0.0005	0.000010	0.0056	0.000003	0.00020	0.00016	0.00075	0.026	0.00002	0.000003	0.00017	0.00026	0.00016	0.000006	0.000014	0.00011	0.00019	0.00025	0.0015	
	October	0.226	0.062	0.005	0.008	0.001	0.008	0.00116	0.0006	0.000010	0.0056	0.000003	0.00017	0.00016	0.00067	0.024	0.00002	0.000003	0.00018	0.00026	0.00016	0.000006	0.000014	0.00011	0.00020	0.00025		

Table 6.7-12: Base Case Water Quality Results, Node 11

Project Phase	Month	Parameter	Ammonia-N	Nitrate-N	Nitrite-N	Phosphorus	Total Cyanide	Aluminum	Antimony	Arsenic	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Tungsten	Uranium	Vanadium	Zinc
		WQG PAL	1.8	3	0.06	0.02	0.005	0.83	0.020	0.005	0.011	1.50	0.0001	0.0089	0.00078	0.005	0.3	0.00906	0.000026	0.073	0.025	0.1	0.00025	0.0008	0.030	0.005	0.12	0.011
Post Closure	January	0.262	0.62	0.015	0.020	0.002	0.032	0.00087	0.0011	0.000084	0.0066	0.000015	0.00051	0.00019	0.00087	0.033	0.00007	0.000005	0.00056	0.00183	0.00119	0.000039	0.000023	0.00019	0.00062	0.00066	0.0021	
	February	0.261	0.58	0.015	0.020	0.002	0.039	0.00100	0.0012	0.000080	0.0070	0.000014	0.00056	0.00019	0.00089	0.032	0.00007	0.000006	0.00060	0.00174	0.00114	0.000040	0.000024	0.00022	0.00060	0.00077	0.0022	
	March	0.312	0.71	0.017	0.020	0.002	0.042	0.00111	0.0013	0.000089	0.0072	0.000016	0.00061	0.00021	0.00091	0.033	0.00008	0.000006	0.00067	0.00209	0.00129	0.000041	0.000025	0.00024	0.00073	0.00082	0.0023	
	April	0.422	0.98	0.023	0.020	0.002	0.046	0.00114	0.0013	0.000085	0.0072	0.000020	0.00064	0.00023	0.00098	0.036	0.00011	0.000006	0.00071	0.00274	0.00137	0.000021	0.000020	0.00025	0.00098	0.00081	0.0023	
	May	0.579	1.57	0.034	0.016	0.001	0.029	0.00101	0.0010	0.000134	0.0064	0.000028	0.00060	0.00031	0.00094	0.041	0.00015	0.000005	0.00080	0.00418	0.00214	0.000022	0.000019	0.00022	0.00146	0.00053	0.0023	
	June	0.510	1.33	0.029	0.017	0.002	0.033	0.00100	0.0010	0.000114	0.0066	0.000025	0.00059	0.00027	0.00095	0.039	0.00013	0.000005	0.00074	0.00359	0.00183	0.000021	0.000019	0.00022	0.00126	0.00059	0.0023	
	July	0.379	0.97	0.022	0.018	0.002	0.038	0.00094	0.0011	0.000084	0.0067	0.000018	0.00057	0.00022	0.00088	0.032	0.00010	0.000005	0.00064	0.00266	0.00134	0.000019	0.000018	0.00021	0.00094	0.00066	0.0022	
	August	0.424	1.07	0.024	0.019	0.002	0.044	0.00110	0.0012	0.000092	0.0071	0.000020	0.00063	0.00024	0.00091	0.032	0.00011	0.000006	0.00072	0.00294	0.00148	0.000021	0.000020	0.00024	0.00105	0.00076	0.0023	
	September	0.455	1.19	0.026	0.018	0.002	0.040	0.00107	0.0012	0.000101	0.0069	0.000022	0.00062	0.00026	0.00090	0.033	0.00012	0.000006	0.00073	0.00322	0.00163	0.000021	0.000019	0.00023	0.00114	0.00069	0.0023	
	October	0.623	1.41	0.031	0.020	0.002	0.032	0.00110	0.0012	0.000120	0.0068	0.000025	0.00062	0.00029	0.00087	0.035	0.00014	0.000006	0.00080	0.00380	0.00193	0.000023	0.000020	0.00024	0.00134	0.00065	0.0023	
	November	0.573	1.20	0.027	0.020	0.002	0.035	0.00108	0.0012	0.000103	0.0069	0.000022	0.00061	0.00026	0.00086	0.033	0.00012	0.000006	0.00075	0.00328	0.00166	0.000021	0.000020	0.00023	0.00116	0.00069	0.0023	
	December	0.478	0.89	0.021	0.016	0.001	0.025	0.00076	0.0010	0.000079	0.0063	0.000017	0.00047	0.00020	0.00080	0.031	0.00010	0.000005	0.00056	0.00248	0.00125	0.000016	0.000015	0.00018	0.00085	0.00054	0.0021	

Notes:

All units are mg/L

Water quality model results summarized in this table are Base Case (Expected Case); results of model sensitivity cases are presented in Appendix N-2

WQG PAL: Water Quality Guideline for the Protection of Aquatic Life (long-term exposure) identified in Table 6.6-6.

As applicable, numerical guideline values were calculated using the most conservative approach (i.e., 25th percentile baseline values for ameliorating factors, save for zinc, which uses 75th percentile pH for the FEQG calculation). For the north basin, these data were as follows:

	25 th	75 th
pH	7.4	7.6
Hardness (mg/L)	28	
DOC (mg/L)	8.1	
Chloride (mg/L)	0.25	
Alkalinity (mg/L)	28	

Only model results for parameters with WQG PAL are summarized here; results for all modelled parameters are presented in Appendix N-2

Grey shaded values are greater than water quality guidelines (none).

Bolded purple values are estimated to be measurably different than existing conditions (15% or greater change relative to baseline conditions)

Table 6.7-13: Base Case Water Quality Results, Node 05

Project Phase	Month	Parameter	Ammonia-N	Nitrate-N	Nitrite-N	Phosphorus	Total Cyanide	Aluminum	Antimony	Arsenic	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Tungsten	Uranium	Vanadium	Zinc
		WQG PAL	1.8	3	0.06	0.02	0.005	0.83	0.020	0.005	0.01100	1.50	0.0001	0.0089	0.00078	0.005	0.3	0.00906	0.000026	0.073	0.025	0.1	0.00025	0.0008	0.03000	0.005	0.12	0.011
Existing Condition	January	0.025	0.057	0.005	0.014	0.001	0.007	0.00015	0.0005	0.00010	0.0050	0.000006	0.00020	0.00008	0.00076	0.032	0.00003	0.000002	0.00019	0.00038	0.00055	0.000038	0.000015	0.00005	0.00003	0.00025	0.0015	
	February	0.025	0.057	0.005	0.014	0.001	0.007	0.00015	0.0005	0.00010	0.0050	0.000006	0.00020	0.00008	0.00076	0.032	0.00003	0.000002	0.00019	0.00038	0.00055	0.000038	0.000015	0.00005	0.00003	0.00025	0.0015	
	March	0.025	0.057	0.005	0.014	0.001	0.007	0.00015	0.0005	0.00010	0.0050	0.000006	0.00020	0.00008	0.00076	0.032	0.00003	0.000002	0.00019	0.00038	0.00055	0.000038	0.000015	0.00005	0.00003	0.00025	0.0015	
	April	0.054	0.019	0.005	0.011	0.001	0.012	0.00005	0.0005	0.00010	0.0050	0.000004	0.00018	0.00005	0.00087	0.034	0.00003	0.000002	0.00010	0.00025	0.00010	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
	May	0.054	0.019	0.005	0.011	0.001	0.012	0.00005	0.0005	0.00010	0.0050	0.000004	0.00018	0.00005	0.00087	0.034	0.00003	0.000002	0.00010	0.00025	0.00010	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
	June	0.054	0.019	0.005	0.011	0.001	0.012	0.00005	0.0005	0.00010	0.0050	0.000004	0.00018	0.00005	0.00087	0.034	0.00003	0.000002	0.00010	0.00025	0.00010	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
	July	0.020	0.045	0.005	0.010	0.001	0.014	0.00005	0.0005	0.00010	0.0050	0.000002	0.00019	0.00005	0.00075	0.026	0.00003	0.000002	0.00011	0.00025	0.00009	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
	August	0.020	0.045	0.005	0.010	0.001	0.014	0.00005	0.0005	0.00010	0.0050	0.000002	0.00019	0.00005	0.00075	0.026	0.00003	0.000002	0.00011	0.00025	0.00009	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
	September	0.020	0.045	0.005	0.010	0.001	0.014	0.00005	0.0005	0.00010	0.0050	0.000002	0.00019	0.00005	0.00075	0.026	0.00003	0.000002	0.00011	0.00025	0.00009	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
	October	0.208	0.010	0.005	0.008	0.001	0.007	0.00005	0.0006	0.00010	0.0050	0.000002	0.00016	0.00005	0.00067	0.024	0.00003	0.000002	0.00012	0.00025	0.00009	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
	November	0.208	0.010	0.005	0.008	0.001	0.007	0.00005	0.0006	0.00010	0.0050	0.000002	0.00016	0.00005	0.00067	0.024	0.00003	0.000002	0.00012	0.00025	0.00009	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
	December	0.208	0.010	0.005	0.008	0.001	0.007	0.00005	0.0006	0.00010	0.0050	0.000002	0.00016	0.00005	0.00067	0.024	0.00003	0.000002	0.00012	0.00025	0.00009	0.000005	0.000005	0.00005	0.00001	0.00025	0.0015	
Construction	January	0.044	0.052	0.005	0.014	0.001	0.008	0.00013	0.0005	0.00010	0.0050	0.000005	0.00021	0.00008	0.00076	0.032	0.00003	0.000002	0.00018	0.00035	0.00048	0.000033	0.000013	0.00005	0.00003	0.00025	0.0015	
	February	0.136	0.028	0.005	0.013	0.001	0.014	0.00006	0.0006	0.00010	0.0050	0.000003	0.00025	0.00005	0.00079	0.035	0.00003	0.000002	0.00013	0.00026	0.00014	0.000012	0.000006	0.00005	0.00002	0.00025	0.0015	
	March	0.136	0.028	0.005	0.013	0.001	0.014	0.00006	0.0006	0.00010	0.0050	0.000003	0.00025	0.00005	0.00079	0.035	0.00003	0.000002	0.00013	0.00026	0.00014	0.000012	0.000006	0.00005	0.00002	0.00025	0.0015	
	April	0.138	0.024	0.005	0.012	0.001	0.014	0.00005	0.0006	0.00010	0.0050	0.000003	0.00024	0.00005	0.00080	0.035	0.00003	0.000002	0.00012	0.00025	0.00010	0.000010	0.000005	0.00005	0.00001	0.00025	0.0015	
	May	0.138	0.024	0.005	0.012	0.001	0.014	0.00005	0.0006	0.00010	0.0050	0.000003	0.00024	0.00005	0.00080	0.035	0.00003	0.000002	0.00012	0.00025	0.00010	0.000010	0.000005	0.00005	0.00001	0.00025	0.0015	
	June	0.138	0.024	0.005	0.012	0.001	0.014	0.00005	0.0006	0.00010	0.0050	0.000003	0.00024	0.00005	0.00080	0.035	0.00003	0.000002	0.00012	0.00025	0.00010	0.000010	0.000005	0.00005	0.00001	0.00025	0.0015	
	July	0.135	0.027	0.005	0.012	0.001	0.014	0.00005	0.0006	0.00010	0.0050	0.000002	0.00024	0.00005	0.00079	0.034	0.00003	0.000002	0.00012	0.00025	0.00010	0.000010	0.000005	0.00005	0.00001	0.00025	0.0015	
	August	0.125	0.028	0.005	0.012	0.001	0.014	0.00005	0.0006	0.00004	0.0050	0.000002	0.00024	0.00005	0.00079	0.034	0.00003	0.000002	0.00012	0.00025	0.00010	0.000009	0.000005	0.00005	0.00001	0.00025	0.0015	
	September	0.060	0.038	0.005	0.011	0.001	0.014	0.00005	0.0005	0.00002	0.0050	0.000002	0.00021	0.00005	0.00076	0.029	0.00003	0.000002	0.00011	0.00025	0.00010	0.000007	0.000005	0.00005	0.00001	0.00025	0.0015	
	October	0.192	0.015	0.005	0.010	0.001	0.010	0.00005	0.0006	0.00002	0.0050	0.000002	0.00019	0.00005	0.00071	0.028	0.00003	0.000002	0.00012	0.00025	0.00009	0.000007	0.000005	0.00005	0.00001	0.00025	0.0015	
	November	0.196	0.015	0.005	0.009	0.001	0.009	0.00005	0.0006	0.00002	0.0050	0.000002	0.00019	0.00005	0.00071	0.027	0.00003	0.000002	0.00012	0.00025	0.00009	0.000007	0.000005	0.00005	0.00001	0.00025	0.0015	
	December	0.202	0.013	0.005	0.009	0.001	0.009	0.00005	0.0006	0.00002	0.0050	0.000002	0.00018	0.00005	0.00070	0.027	0.00003	0.000002	0.00012	0.00025	0.00009	0.000006	0.000005	0.00005	0.00001	0.00025	0.0015	
Operations	January	0.026	0.074	0.005	0.014	0.001	0.007	0.00052	0.0005	0.00005	0.0052	0.000006	0.00020	0.00012	0.00076	0.032	0.00002	0.000003	0.00021	0.00038	0.00057	0.000038	0.000018	0.00007	0.00009	0.00025	0.0015	
	February	0.026	0.079	0.005	0.014	0.001	0.007	0.00060	0.0005	0.00005	0.0053	0.000006	0.00020	0.00013	0.00076	0.032	0.00002	0.000003	0.00021	0.00038	0.00057	0.000038	0.000018	0.00007	0.00011	0.00025	0.0015	
	March	0.027	0.082	0.005	0.014	0.001	0.007	0.00068	0.0005	0.00005	0.0053	0.000006	0.00020	0.00013	0.00076	0.032	0.00002	0.000003	0.00021	0.00038	0.00058	0.000038	0.000019	0.00008	0.00012	0.00025	0.0015	
	April	0.054	0.047	0.005	0.011	0.001	0.013	0.00065	0.0005	0.00001	0.0053	0.000004	0.00018	0.00011	0.00087	0.034	0.00002	0.000003	0.00013	0.00025	0.00013	0.000006	0.000010	0.00008	0.00011	0.00025	0.0015	
	May	0.054	0.039	0.005	0.011	0.001	0.013	0.00048	0.0005	0.00001	0.0052	0.000004	0.00018	0.00009	0.00087	0.034	0.00002	0.000003	0.00012	0.00025	0.00012	0.000005	0.000008	0.00007	0.00008	0.00025	0.0015	
	June	0.054	0.041	0.005	0.011	0.001	0.013	0.00051	0.0005	0.00001	0.0053	0.000004	0.00018	0.00010	0.00087	0.034	0.00002	0.000003	0.00012	0.00025	0.00013	0.000005	0.000009	0.00007	0.00009	0.00025	0.0015	
	July	0.021	0.066	0.005	0.010	0.001	0.014	0.00050	0.0005	0.00001	0.0053	0.000003	0.00019	0.00010	0.00075	0.026	0.00002	0.000003	0.00013	0.00025	0.00012	0.000005	0.000009	0.00007	0.00009	0.00025	0.0015	
	August	0.021	0.073	0.005	0.010	0.001	0.015	0.00066	0.0005	0.00001	0.0054	0.000003	0.00019	0.00011	0.00075	0.026	0.00002	0.000003	0.00014	0.00025	0.00013	0.000006	0.000010	0.00008	0.00012	0.00025	0.0015	
	September	0.021	0.070	0.005	0.010	0.001	0.015	0.00060	0.0005	0.00001	0.0053	0.000003	0.00019	0.00011	0.00075	0.026	0.00002	0.000003	0.00014	0.00025	0.00013	0.000006	0.000009	0.00008	0.00011	0.00025	0.0015	
	October	0.218	0.037	0.005	0.008	0.001	0.008	0.00063	0.0006	0.00001	0.0053	0.000003	0.00017	0.00011	0.00067	0.024	0.00002	0.000003	0.00015	0.00025	0.00013	0.000006	0.000010	0.00008	0.00011	0.00025	0.0015	
	November	0.218	0.037	0.005	0.008	0.001	0.008	0.00061	0.0006	0.00001	0.0053	0.000003	0.00017	0.00011	0.00067	0.024	0.00002	0.000003	0.00015	0.00025	0.00012	0.000006	0.000010	0.00008	0.00011	0.00025	0.0015	
	December	0.217	0.024	0.005	0.008	0.001	0.007	0.00034	0.0006	0.00001	0.0052	0.000003	0.00016	0.00008	0.00067	0.024	0.00002	0.000003	0.00013	0.00025	0.00011	0.000005	0.000007	0.00007	0.00006	0.00025	0.0015	
Active Closure	January	0.026	0.057	0.005	0.014	0.001	0.007	0.00049	0.0005	0.00005	0.0052	0.000006	0.00020	0.00011	0.00076	0.032	0.00002	0.000003	0.00020	0.00038	0.00056	0.000038	0.000018	0.00007	0.00009	0.00025	0.0015	
	February	0.026	0.057	0.005	0.014	0.001	0.007	0.00057	0.0005	0.00005																		

Table 6.7-13: Base Case Water Quality Results, Node 05

Project Phase	Month	Parameter	Ammonia-N	Nitrate-N	Nitrite-N	Phosphorus	Total Cyanide	Aluminum	Antimony	Arsenic	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Thallium	Tungsten	Uranium	Vanadium	Zinc
		WQG PAL	1.8	3	0.06	0.02	0.005	0.83	0.020	0.005	0.01100	1.50	0.0001	0.0089	0.00078	0.005	0.3	0.00906	0.000026	0.073	0.025	0.1	0.00025	0.0008	0.03000	0.005	0.12	0.011
Post Closure	January	0.165	0.388	0.011	0.018	0.001	0.022	0.00057	0.0008	0.00007	0.0059	0.000011	0.00038	0.00014	0.00082	0.033	0.00005	0.000004	0.00041	0.00123	0.00093	0.000039	0.000019	0.00013	0.00038	0.00049	0.0018	
	February	0.161	0.356	0.011	0.019	0.001	0.025	0.00064	0.0009	0.00007	0.0061	0.000011	0.00041	0.00014	0.00083	0.032	0.00005	0.000004	0.00042	0.00116	0.00089	0.000039	0.000020	0.00015	0.00036	0.00055	0.0019	
	March	0.195	0.443	0.012	0.020	0.002	0.028	0.00072	0.0010	0.00007	0.0063	0.000012	0.00044	0.00016	0.00085	0.032	0.00006	0.000005	0.00047	0.00139	0.00099	0.000039	0.000021	0.00016	0.00045	0.00059	0.0019	
	April	0.286	0.623	0.016	0.017	0.002	0.034	0.00073	0.0010	0.00006	0.0064	0.000014	0.00047	0.00017	0.00094	0.036	0.00008	0.000005	0.00048	0.00182	0.00090	0.000015	0.000015	0.00018	0.00062	0.00060	0.0020	
	May	0.427	1.122	0.025	0.014	0.001	0.024	0.00073	0.0008	0.00010	0.0060	0.000021	0.00048	0.00023	0.00092	0.039	0.00011	0.000004	0.00060	0.00304	0.00155	0.000017	0.000015	0.00017	0.00104	0.00045	0.0021	
	June	0.363	0.910	0.021	0.015	0.001	0.026	0.00069	0.0009	0.00008	0.0061	0.000018	0.00046	0.00020	0.00093	0.038	0.00010	0.000004	0.00053	0.00252	0.00127	0.000016	0.000014	0.00016	0.00086	0.00048	0.0020	
	July	0.247	0.632	0.016	0.015	0.001	0.029	0.00061	0.0009	0.00006	0.0061	0.000012	0.00043	0.00016	0.00083	0.030	0.00007	0.000004	0.00044	0.00178	0.00088	0.000014	0.000013	0.00015	0.00060	0.00051	0.0019	
	August	0.283	0.716	0.017	0.016	0.002	0.034	0.00074	0.0010	0.00006	0.0064	0.000014	0.00048	0.00018	0.00085	0.030	0.00008	0.000005	0.00051	0.00200	0.00100	0.000015	0.000015	0.00018	0.00069	0.00058	0.0020	
	September	0.308	0.806	0.019	0.015	0.001	0.031	0.00072	0.0009	0.00007	0.0062	0.000015	0.00048	0.00019	0.00085	0.031	0.00009	0.000005	0.00052	0.00222	0.00111	0.000016	0.000015	0.00017	0.00076	0.00054	0.0020	
	October	0.496	0.980	0.023	0.016	0.001	0.024	0.00078	0.0010	0.00009	0.0063	0.000018	0.00048	0.00022	0.00081	0.031	0.00010	0.000005	0.00059	0.00271	0.00137	0.000017	0.000016	0.00018	0.00094	0.00053	0.0021	
	November	0.452	0.803	0.020	0.016	0.001	0.026	0.00074	0.0010	0.00007	0.0063	0.000016	0.00046	0.00019	0.00080	0.030	0.00009	0.000005	0.00054	0.00227	0.00114	0.000016	0.000015	0.00017	0.00078	0.00055	0.0020	
	December	0.375	0.552	0.015	0.013	0.001	0.018	0.00049	0.0009	0.00005	0.0058	0.000011	0.00035	0.00014	0.00075	0.028	0.00007	0.000004	0.00039	0.00163	0.00080	0.000012	0.000011	0.00013	0.00053	0.00043	0.0018	

Notes:

All units are mg/L

Water quality model results summarized in this table are Base Case (Expected Case); results of model sensitivity cases are presented in Appendix N-2

WQG PAL: Water Quality Guideline for the Protection of Aquatic Life (long-term exposure) identified in Table 6.6-6.

As applicable, numerical guideline values were calculated using the most conservative approach (i.e., 25th percentile baseline values for ameliorating factors, save for zinc, which uses 75th percentile pH for the FEQG calculation). For the north basin, these data were as follows:

	25 th	75 th
pH	7.4	7.6
Hardness (mg/L)	28	
DOC (mg/L)	8.1	
Chloride (mg/L)	0.25	
Alkalinity (mg/L)	28	

Only model results for parameters with WQG PAL are summarized here; results for all modelled parameters are presented in Appendix N-2

Grey shaded values are greater than water quality guidelines (none).

Bolded purple values are estimated to be measurably different than existing conditions (15% or greater change relative to baseline conditions)

Table 6.7-14: Water Quality of Filled Open Pit Basin

Parameter	Expected Case ¹	Conservative Case ¹	Springpole Lake 75 th Percentile Water Quality	Water Quality Criteria ²	
				Value	Source ³
Units	mg/L				
Major Ions					
Ca	11	12	10	-	-
Mg	1.8	2.0	1.5	-	-
Na	0.90	1.1	0.74	-	-
K	0.77	0.84	0.70	-	-
Sulfate	19	21	2.0	-	-
Trace Elements and Phosphorus					
Al	0.0050*	0.0050*	0.0050	0.83	FEQG
Sb	0.0012	0.0019	0.00025	0.02	PWQO
As	0.00072	0.0043	0.00052	0.005	iPWQO
Be	0.00025*	0.00025*	0.00025	0.011	PWQO
B	0.0059	0.0070	0.0050	1.5	CCME
Cd	0.000050*	0.000050*	0.000050	0.00053	CCME
Cr	0.00070	0.00072	0.0025	0.0089	CCME
Co	0.00051	0.0009	0.00025	0.00078	FEQG
Cu	0.00092*	0.0019	0.00092	0.005	iPWQO
Fe	0.05*	0.05*	0.050	0.3	PWQO
Pb	0.00025*	0.00025*	0.00025	0.009	FEQG
Hg	0.0000050*	0.0000050*	0.0000050	0.000026	CCME
Mo	0.0012	0.0026	0.00025	0.073	CCME
Ni	0.0077	0.0093	0.0050	0.025	PWQO
P	0.010	0.012	0.014	0.02	iPWQO
Se	0.020	0.020	0.0010	0.1	PWQO
Ag	0.000031	0.000033	0.000050	0.00025	CCME
Tl	0.000023	0.000027	0.000025	-	-
W	0.00023	0.00032	0.00050	-	-
U	0.0027	0.0028	0.000050	0.015	CCME
V	0.00025*	0.00025*	0.00025	0.12	FEQG
Zn	0.0025*	0.0034	0.0025	0.0254	CCME

Notes:

1. Predictions are maximum monthly concentrations in final year of pit filling.

2. Equivalent to water quality guidelines for the protection of aquatic life (long-term exposure). Water quality guidelines represent generic criteria that are inherently conservative as they are developed by governments or international organizations to identify the concentrations of parameters in the receiving environment that are protective of the most sensitive aquatic species for periods of indefinite exposure. As applicable, numerical guideline values summarized here were calculated using the most conservative approach (*i.e.*, 25th percentile Birch Lake baseline values for ameliorating factors, save for zinc, which uses 75th percentile pH for the FEQG calculation).

3. PWQO: Provincial Water Quality Objectives. iPWQO: Interim Provincial Water Quality Objectives. CCME: Canadian Council of Ministers of the Environment water quality guideline for the Protection of Aquatic Life. FEQG: Federal Environmental Quality Guideline for the Protection of Aquatic Life.

Bold italicized values: Prediction exceeds Water Quality Criteria.

Predictions for shaded parameters based on geochemical modelling.

* Predicted value from geochemical modelling was less than Springpole Lake 75th percentile water quality. Therefore, predicted value substituted with 75th percentile Springpole Lake background water quality concentration.

Figure 6.7-1: Stage-Storage Curve, Springpole Lake

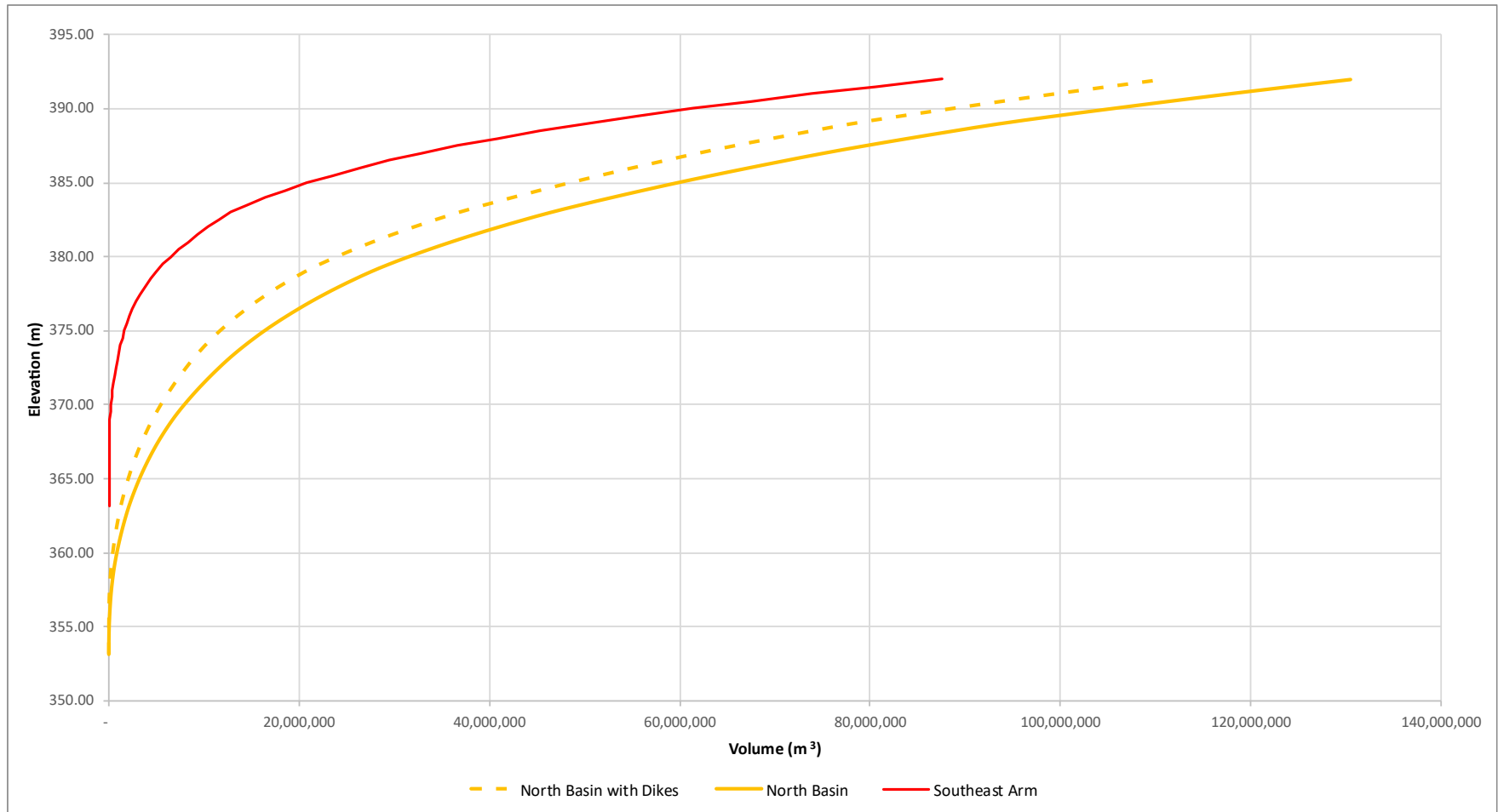


Figure 6.7-2: Temperature and Dissolved Oxygen Profiles – Springpole Lake, North Basin (L-15-B1)

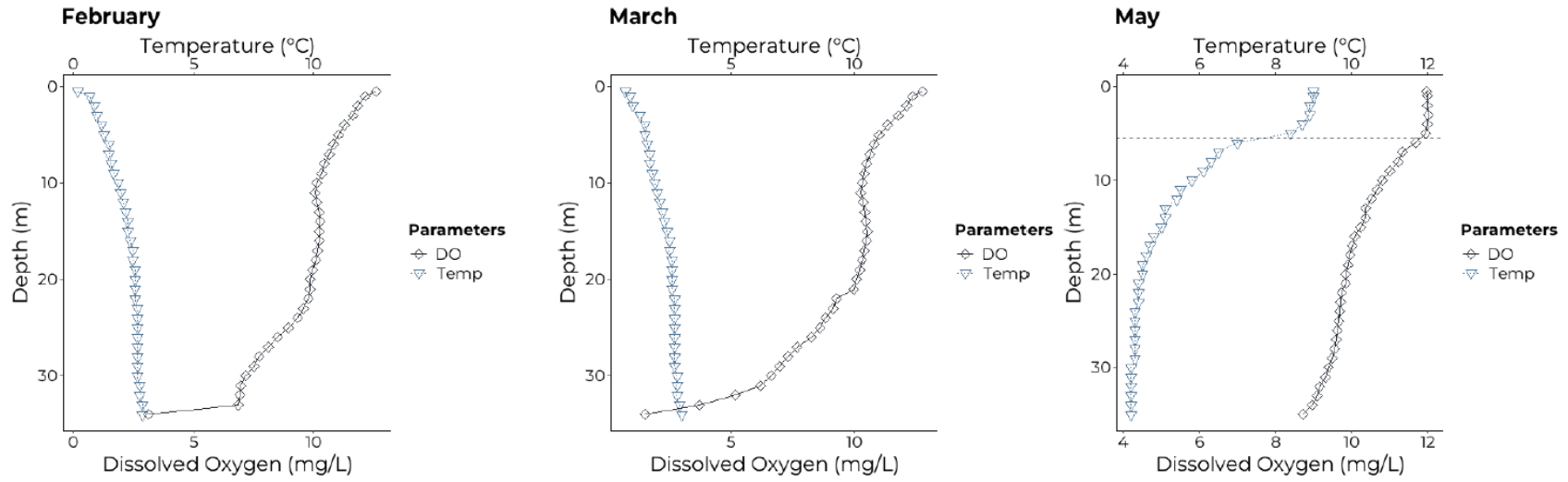


Figure 6.7-3: Temperature and Dissolved Oxygen Profiles – Springpole Lake, North Basin (L-15-B2)

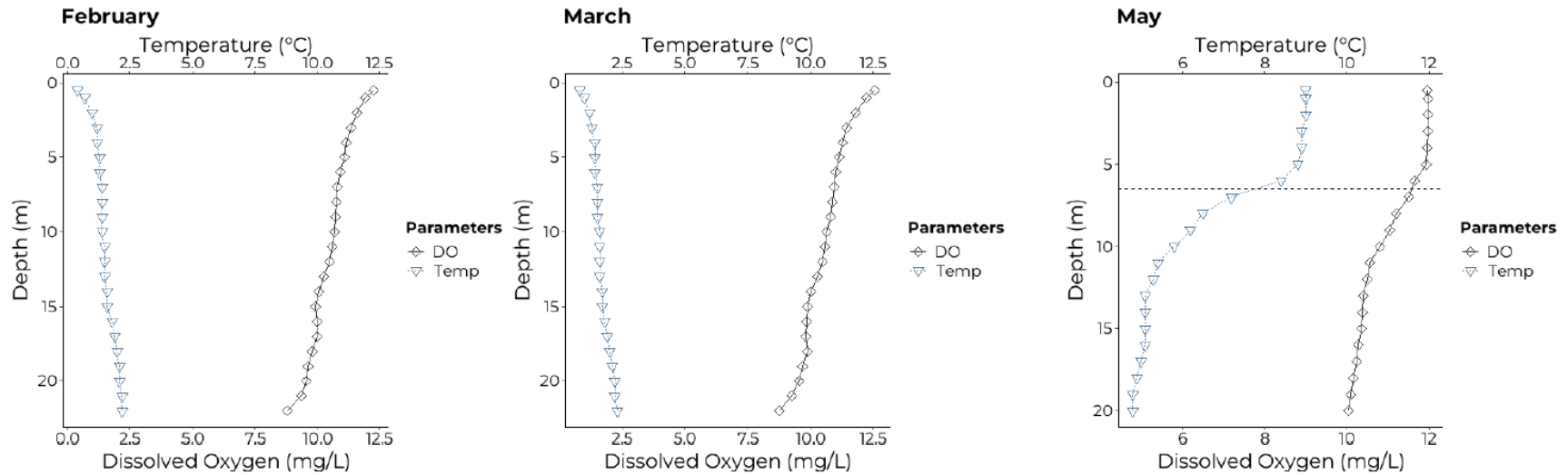


Figure 6.7-4: Temperature and Dissolved Oxygen Profiles – Springpole Lake, North Basin (L-15-B3)

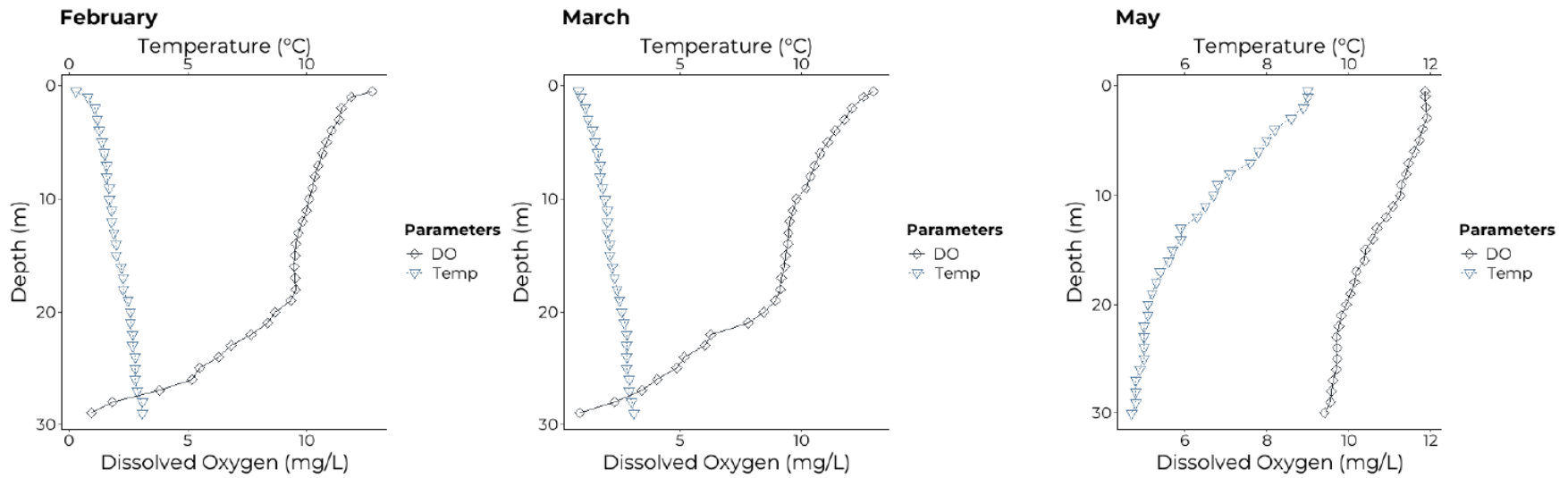


Figure 6.7-5: Temperature and Dissolved Oxygen Profiles – Springpole Lake, North Basin (L-15-B4)

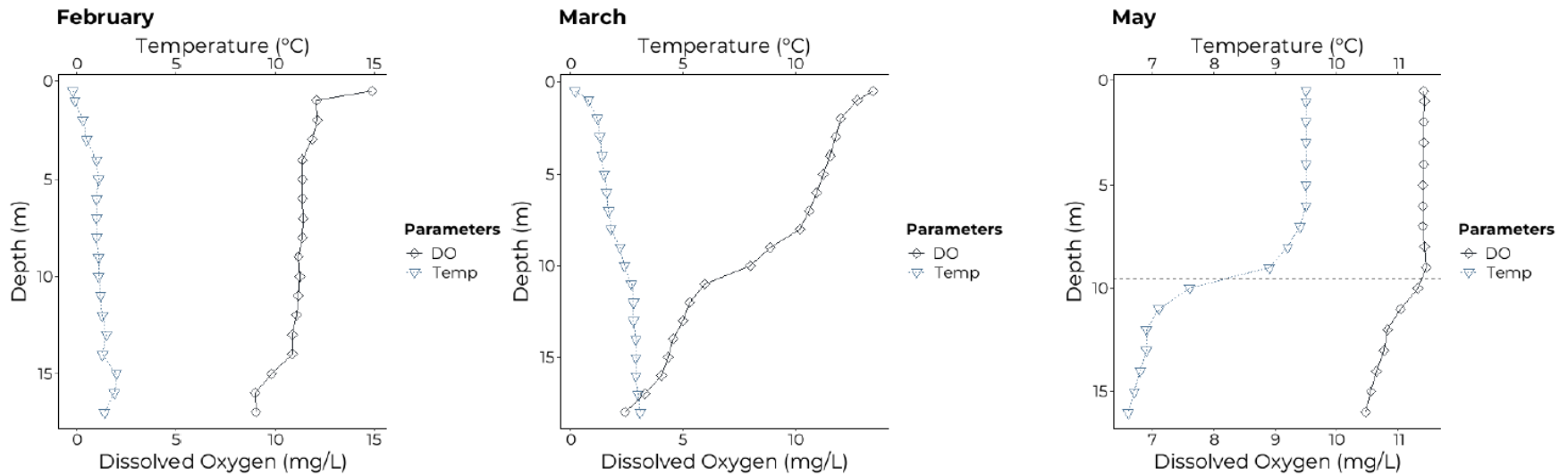


Figure 6.7-6: Temperature and Dissolved Oxygen Profiles – Springpole Lake, North Basin (L-15-B6)

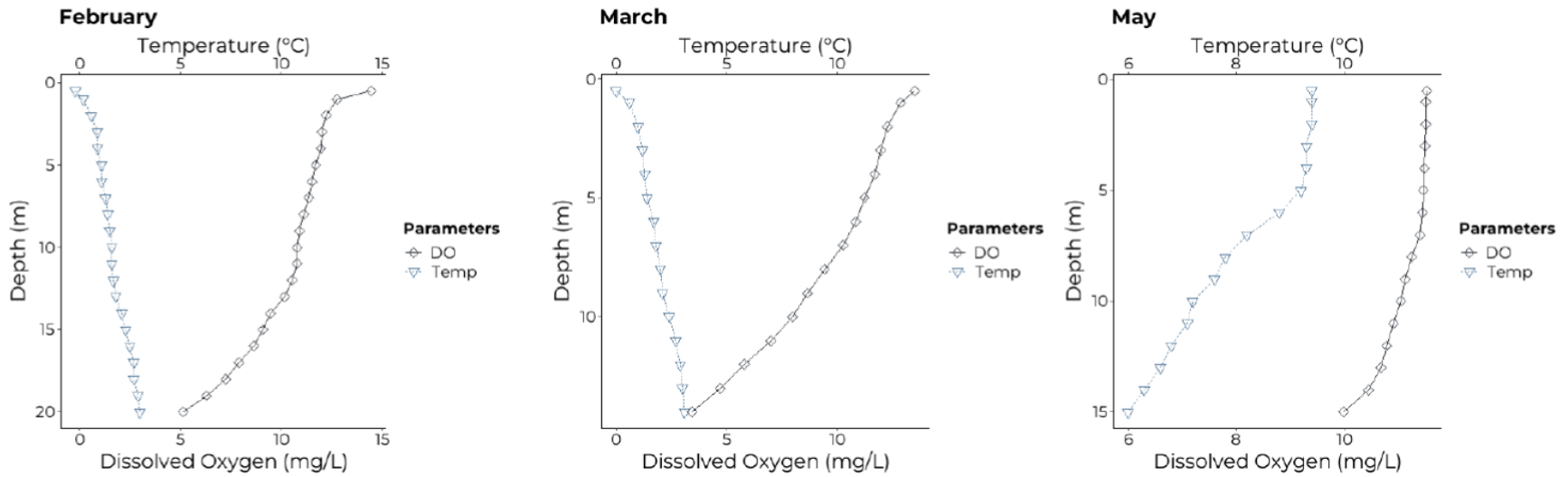


Figure 6.7-7: Operations Water Quality Model Results, North Basin (Node 11)

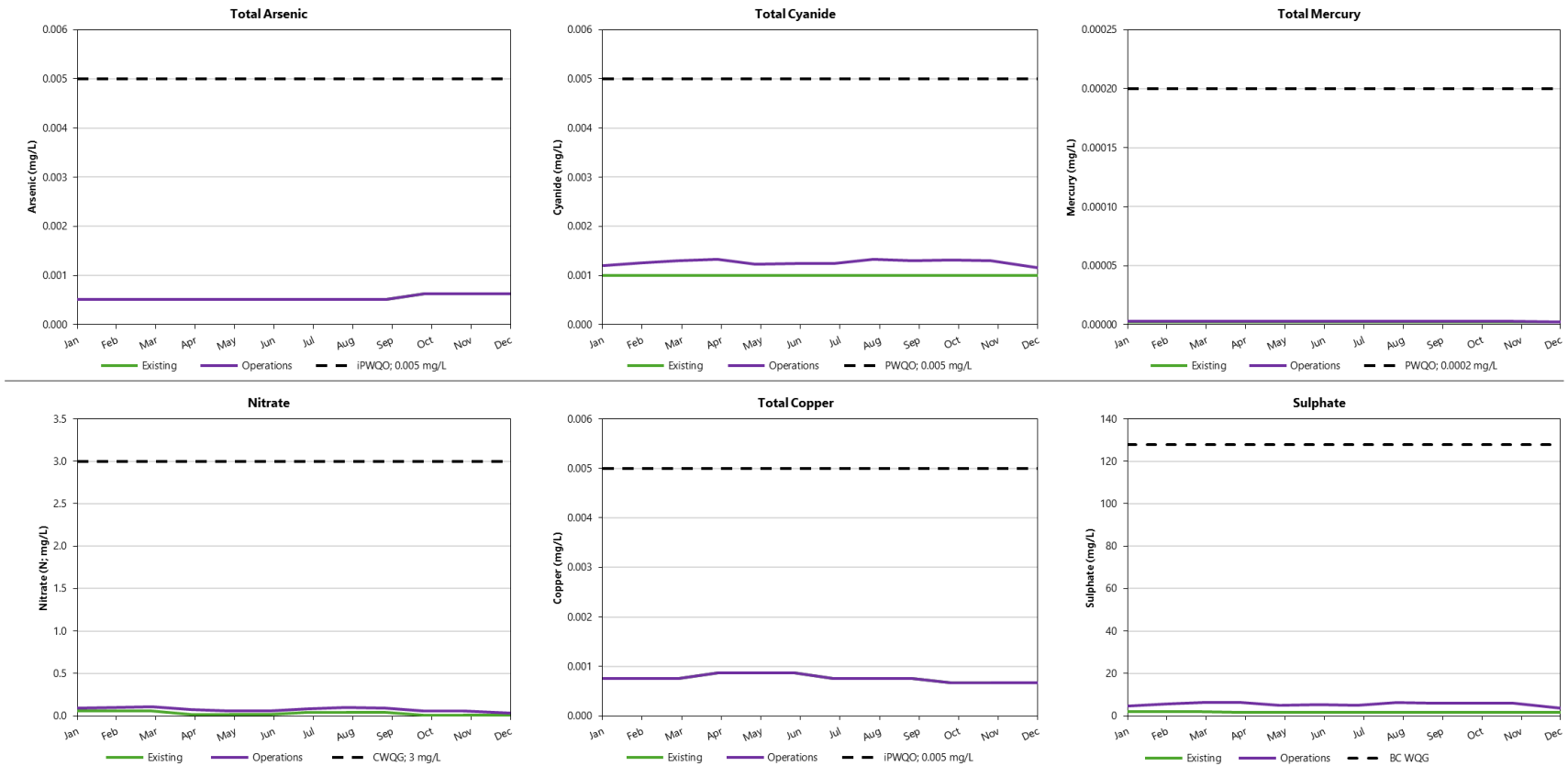


Figure 6.7-8: Post-Closure Water Quality Model Results, North Basin (Node 11)

