
# Appendix I.6

Touquoy Integrated Water & Tailings Management Plan
Fifteen Mile Stream Gold Project,
Stantec Consulting Ltd.

# TOUQUOY INTEGRATED WATER AND TAILINGS MANAGEMENT PLAN – FIFTEEN MILE STREAM GOLD PROJECT

FINAL REPORT

February 8, 2021

Prepared for:

Atlantic Mining NS Inc.
409 Billybell Way, Mooseland
Middle Musquodoboit, NS B0N 1X0

Prepared by:

Stantec Consulting Ltd.
845 Prospect Street
Fredericton, NB  E3B 2T7

Job No.: 121619250

# Sign-off Sheet

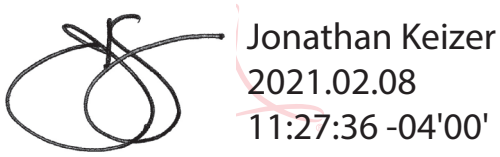
This document entitled TOUQUOY INTEGRATED WATER AND TAILINGS MANAGEMENT PLAN – FIFTEEN MILE STREAM GOLD PROJECT was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Atlantic Mining NS Corp, a wholly owned subsidiary of St. Barbara Ltd. (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

This report was prepared by Rachel Jones, Water Resources Engineer and reviewed by Jonathan Keizer, M.Sc.E., P.Eng. If you required additional information, please do not hesitate to contact us.

Prepared by 

(signature)

**Rachel Jones, P.Eng.**




Reviewed by

(signature)

**Jonathan Keizer, M.Sc.E., P.Eng.**

# Table of Contents

## LIST OF TABLES



## LIST OF FIGURES



## LIST OF APPENDICES

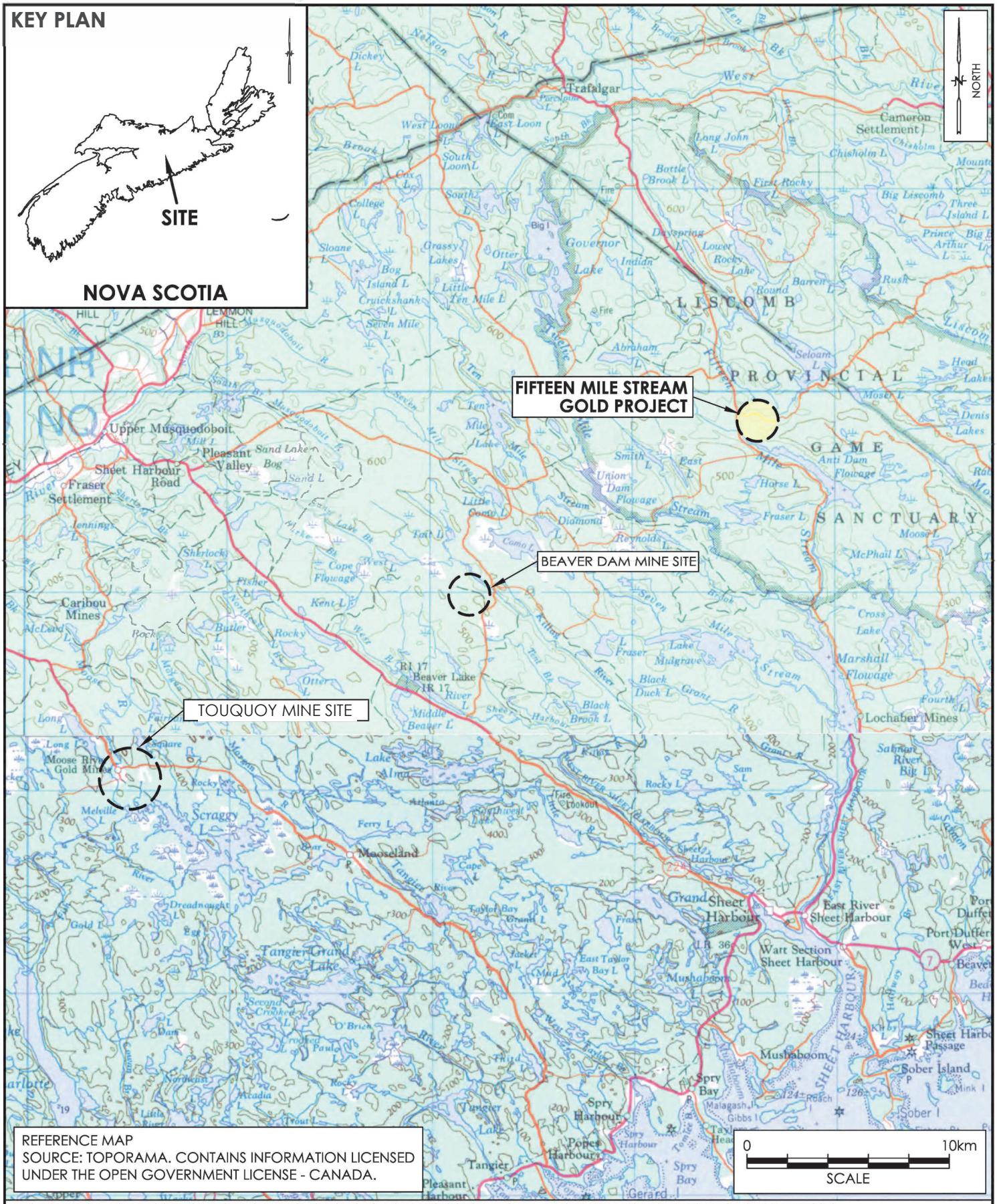
# 1.0 INTRODUCTION

The Fifteen Mile Stream (FMS) Gold Project is being developed as a satellite deposit to the Touquoy operation with haulage of concentrate ore 57 km by road to the Touquoy Mill for processing following completion of mining at Touquoy. FMS ore concentrate will be processed at the existing Touquoy mill site and will extend production at Touquoy by almost 7 years. FMS ore concentrate processing will commence in 2021, pending regulatory approval. Tailings generated by processing the FMS ore concentrate will be deposited in the exhausted Touquoy pit.

This report covers the FMS ore concentrate processing at Touquoy and does not cover the offsite open pit mines or associated haulage. The location of the FMS mine site in relation to the existing Touquoy mine site is depicted in Figure 1.1. This report summarizes the water and tailings management plan, including FMS tailings deposition and the integrated mine site water balance, in support of the environmental impact statement screening document for the FMS Gold Project.

This report is divided into four sections:

- **Section 2.0 Operational Water Management Plan** – outlines the sources of reclaim and make up water during the processing of FMS ore concentrate at the Touquoy mill site, manage site runoff, seepage and other flow components.
- **Section 3.0 Conceptual Tailings Deposition Plan** – outlines the tailings deposition methods based on subaqueous deposition, considering seasonality.
- **Section 4.0 Water Quantity Balance** – outlines the predictions of water volume discharged to the exhausted Touquoy pit, water volume available for reclaim in the Touquoy Tailings Management Facility (TMF), required freshwater make-up from Scraggy Lake, and the timing of when water could be reclaimed from the exhausted Touquoy pit rather the Touquoy TMF.
- **Section 5.0 Water Quality Balance -** outlines the predictions of water quality in the pit lake and effluent discharge to Moose River.




THIS DRAWING ILLUSTRATES SUPPORTING INFORMATION SPECIFIC TO A STANTEC CONSULTING LTD. REPORT AND MUST NOT BE USED FOR OTHER PURPOSES.

# SITE LOCATION PLAN

FIFTEEN MILE STREAM GOLD PROJECT

HALIFAX COUNTY, NOVA SCOTIA

**Client:** ATLANTIC MINING NS INC

| | |
|---|---|
| **Job No.:** | 121619250 |
| **Scale:** | 1 : 250,000 |
| **Date:** | 08-FEB-2021 |
| **Dwn. By:** | JL |
| **App'd By:** | RJ |

**Dwg. No.:** 1.1

Stantec

V:\1216\active\121619250\1_geotechnical\3_drawings_logs\2500_TOUQUOY\4_Sheet_Files\121619250.2500_EIS_1.1.dwg

# 2.0 OPERATIONAL WATER MANAGEMENT PLAN

Figure 2.1 depicts components of the operational water management plan at the Touquoy mine site, including the existing mill site, Touquoy TMF, effluent treatment plant, and the ultimate extent of the exhausted Touquoy pit. Water management at Touquoy is described in more detail in the water management plan (Stantec 2017a) and the Water Balance Report (Stantec 2016), excluding integration of the use of the exhausted Touquoy pit for tailings deposition. Figure 2.1 also illustrates the direction of flow between components, effluent discharge locations, mine component drainage areas, and locations of MDMER final discharge point(s). The MDMER final discharge point for Touquoy operations is located at SW-14 at the outlet of the Touquoy TMF polishing pond. When the exhausted Touquoy pit fills and is allowed to spill, the Final Discharge point will be located approximately 70 metres (m) downstream from the SW-2 monitoring station on Moose River for the Touquoy pit closure (Figure 2.2). Roadway access to the existing road will be maintained following the construction of the spillway.

When the Touquoy pit is exhausted of ore and the Touquoy TMF has reached its tailings storage capacity, reclamation activities will commence for the Touquoy TMF including the associated polishing pond and constructed wetland. The polishing pond and wetland dams are planned to be breached, the ponds drained, and the entire area, contoured and revegetated in closure of the Touquoy TMF, retiring the final discharge point. Tailings from the processing of FMS ore concentration will be deposited into the existing Touquoy pit. Initially, water will be reclaimed from the Touquoy TMF until water storage is not adequate to meet process water demand. After which water will be reclaimed from the exhausted Touquoy pit as a closed loop. The exhausted Touquoy pit will not be allowed to spill until water in the pit lake meets MDMER discharge limits, until such time water will be treated in the pit or pumped and treated in the existing Touquoy effluent treatment plant. The water management plan is based on operation and reclamation/ closure.

An overview of key features of the Touquoy water management plan for the FMS project are provided in the sections below. Water management is presented by project phase (Operation, Reclamation, and Closure) as it pertains to FMS Project. The operational phase of the Project corresponds to the period when FMS ore concentrate is being processed at the Touquoy mill. Following ore processing, water will be treated during the reclamation phase. Once water quality meets regulatory reclamation criteria the water level in the pit lake will be allowed to spill from the exhausted Touquoy pit and discharge to Moose River during the closure phase. As per the MDMER, water quality monitoring will be conducted to inform water management at Touquoy.

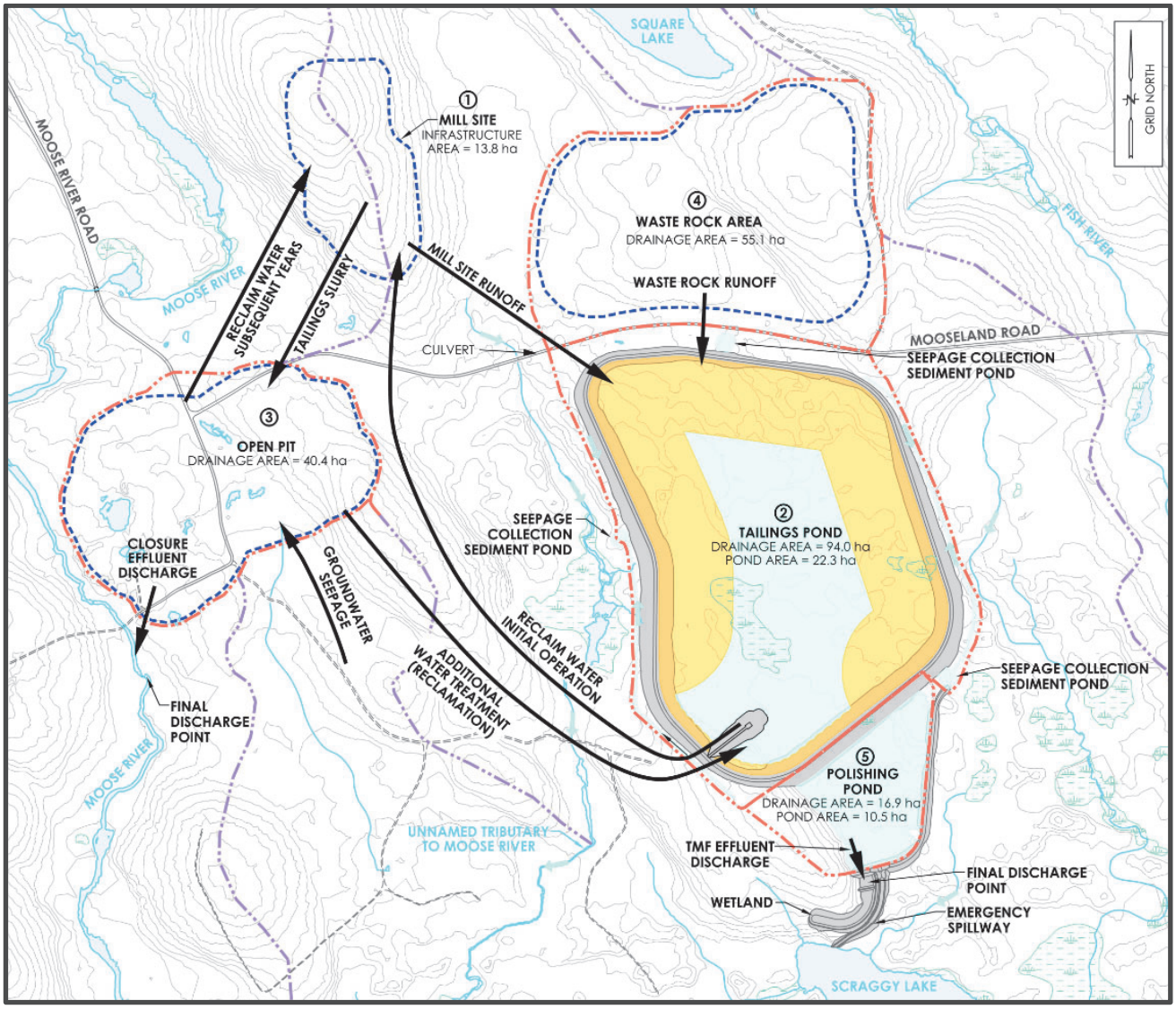



**Figure 2.1 Major Mine Site Components at Touquoy**

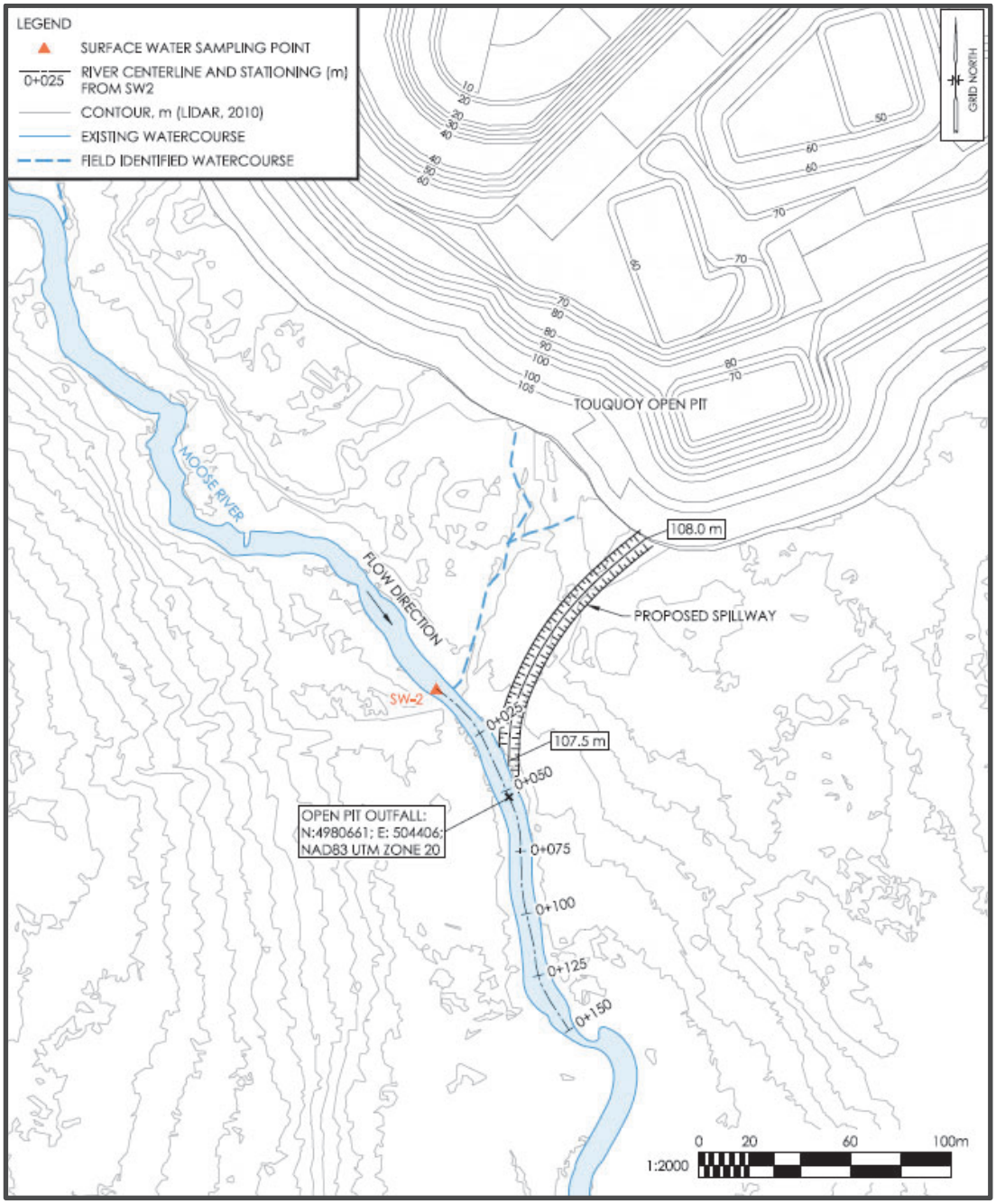



**Figure 2.2 Location of Exhausted Touquoy Pit Outfall**

## 2.1 WATER MANAGEMENT TO ACCOMMODATE FMS ORE CONCENTRATE PROCESSING

### 2.1.1 FMS Project Phase – Operation

Mill operation for FMS ore processing is planned to be consistent with Touquoy ore processing with respect to mill throughput, mill process flows, and tailings slurry density. Water Management at Touquoy to accommodate FMS concentrate ore processing during operation is described below.

- Processing of FMS ore concentrate at Touquoy involves the continued use of Touquoy water management facilities, including:
  - The TMF will continue to receive surface runoff from the waste rock pile, seepage collection ditches, and direct precipitation.
  - Seepage collection ditches will continue to collect tailings seepage around the perimeter of the Touquoy TMF and will continue to be pumped back into the TMF pond.
  - Perimeter ditches around the waste rock area will flow into three sedimentation ponds with the option to by-pass the TMF if water quality objectives are achieved.
  - Runoff from the mill site pond and run-of-mine (ROM) stockpile will continue to be included in the tailings slurry flow.
  - The TMF water surplus, that is water that is not reclaimed as process water, or lost to evaporation or seepage, will continue to discharge to the effluent treatment plant. Effluent from the treatment plant will continue to discharge to the polishing pond through geobags and subsequently to the constructed wetland and finally to the receiving environment, i.e., Scraggy Lake.
  - The effluent treatment plant and downstream discharge facilities will continue to be in operation at the TMF until surplus water meets reclamation regulatory water quality requirements as described in the reclamation plan for Touquoy (Stantec 2017b).
- Dewatering of the exhausted Touquoy pit to the TMF will cease at the end of exhausted Touquoy pit mine life. This will result in reduced water surplus from the TMF.
- FMS ore concentrate will be processed at the Touquoy mill.
- At initial stages of discharging tailings to the exhausted Touquoy pit when the TMF storage capacity is finally depleted, reclaim water will be directed to the mill from the Touquoy TMF through the existing decant tower or floating barge infrastructure for treatment and/or reuse for various mill processes. Water will continue to be reclaimed from the TMF until a water deficit is reached. Delay of water reclaim from the open pit will allow time for water inflows to collect in the pit as a start-up process water supply.
- When water is to be reclaimed from the Touquoy pit, the existing floating barge and associated infrastructure will be relocated from the TMF to the exhausted open pit. The barge will raise with the water and tailings elevation in the pit, decreasing pump head and associated pumping costs over time.
- Additional FMS ore concentrate processing start-up water supply will be sourced from Scraggy Lake, subject to NSE water withdrawal approval.
- Freshwater make-up for the process will continue to be sourced from Scraggy Lake. Additional make-up process water required in a dry year or to build a reservoir in case of a dry year will be sourced from effluent from the TMF treatment plant or Scraggy Lake, subject to NSE approval.
- FMS tailings will be deposited in the exhausted Touquoy pit. The existing tailings slurry pipeline from the mill will be redirected from the TMF to the exhausted Touquoy pit.

### 2.1.2 FMS Project Phase – Reclamation

The objective of Water Management at Touquoy to accommodate FMS ore concentrate processing during reclamation is for water in the pit lake to meet the reclamation regulatory water quality requirements or site-specific criteria. Key water management features are described below.

- The existing TMF effluent treatment plant and downstream discharge facilities will continue to be in operation to treat TMF water surplus
- Throughout reclamation as the exhausted Touquoy pit fills with water, the pit lake will be treated as a batch reactor with the objective of adjusting the pH to precipitate metals thus improving discharge quality.
- Surplus water in the exhausted Touquoy pit will be pumped to a treatment facility until such time as water quality monitoring indicates that water quality is suitable for direct discharge to the environment.
- Until water quality meets discharge criteria, the water level in the pit lake will be maintained at or below elevation 108 m (i.e., corresponding to the spillway elevation) thus reducing seepage to Moose River and normalizing treatment rates to the extent feasible.
  - A minimum of 1 m water cover will be maintained above the deposited tailings to facilitate pumping. The water cover depth will vary over the tailings depositional period.
  - The effluent treatment plant will operate intermittently during non-frozen periods (April – November, inclusive) to lower the pit lake to 103 m by the end of November thus providing storage over the period when the effluent treatment plant is shut down.
  - Assuming the existing effluent treatment rate of 300 cubic metres per hour ($m^3$/hr), the effluent treatment plant would be in operation for 6 months to pump and treat the annual climate normal surplus of the Touquoy pit watershed of 436,000 cubic metres ($m^3$).

### 2.1.3 FMS Project Phase – Closure

As described below, once water quality meets regulatory reclamation criteria the exhausted Touquoy pit can be prepared for closure, in accordance with the mine site closure plan.

- The effluent treatment plant and downstream discharge facilities are not required for the FMS Gold project during closure because effluent discharge will meet regulatory discharge criteria and will not require treatment.
- Surplus water in the exhausted Touquoy pit will be discharged via a constructed spillway/conveyance channel (see Figure 2.2) to Moose River, subject to meeting regulatory discharge criteria.
- The spillway and conveyance channel will be sized to accommodate the inflow design flood in accordance with the Canadian Dam Association (CDA) guidelines. The spillway invert is set at elevation 108 m, approximately 2 m below the lowest Touquoy pit elevation to prevent overtopping.

Similarly, TMF water surplus will continue to be treated in the existing effluent treatment plant to meet regulatory reclamation criteria at the existing Final Discharge Point (SW-14), as outlined in the Touquoy reclamation and closure plan.

# 3.0 CONCEPTUAL TAILINGS DEPOSITION PLAN

This section presents a conceptual plan for subaqueous deposition of conventional tailings slurry into the exhausted Touquoy pit from FMS ore concentrate processing. The total capacity of the exhausted Touquoy pit at the proposed spillway elevation of 108.0 m is of 8.962 million cubic metres ($Mm^3$) is sufficient to store tailings FMS ore processing using subaqueous (i.e., in water) deposition. Considering subaqueous deposition, the exhausted Touquoy pit can accommodate the estimated total deposited volume of 0.411 $Mm^3$ from FMS ore concentrate processing.

Subaqueous deposition is the most pragmatic way to deposit tailings in the confined exhausted Touquoy pit. Subaerial deposition (i.e., tailings beach) like at the Touquoy TMF was not considered for the Touquoy pit. Subaerial deposition would introduce complexities in design and operation due to the conical geometry of the pit (reducing in area over the 25 m depth), use of the pit as a process water supply, and maintaining access to the water surface. As the capacity of the pit is adequate for tailings depositions, tailings slurry alternatives such as high-density tailings and paste were not considered.

Quality of reclaim water will need to meet criteria for total suspended solids, residual reagents and other parameters to limit fouling or reduced recoveries in the mill. These criteria will need to be refined in subsequent phases of study to determine if additional treatment of reclaim water will be required.

In general, spring, summer and fall operation is more flexible than winter (frozen) operations, and appropriate planning and mitigation is required to prevent potential issues with respect to maintaining minimum capacities during frozen conditions.

## 3.1 NORMAL OPERATION (SPRING, SUMMER AND FALL)

Tailings will be transported to the Touquoy pit as thickened slurry via a tailings pipeline that runs from the mill to the exhausted pit. The existing tailings pipeline will be relocated to accommodate tailings deposition in the exhausted pit. Secondary containment is achieved by running the main tailings pipeline in a lined ditch. The tailings will be deposited into the pit by end-of-pipe discharge, beginning in the lower areas and moving radially around the exhausted Touquoy pit. The tailings discharge pipe will be suspended in the pond by floats or a floating barge. Initially, the pipe will likely discharge from surface at a lower bench as the bottom of the exhausted Touquoy pit has a deeper basin. Detailed procedures will be developed for tailings line relocation and corresponding plant shut downs to prevent plugging of the tailings pipeline.

Summer deposition will be carried out in shallower portions of the pit in preparation for the winter. Bathymetric surveys will be conducted at least once a year during the ice-free period to identify areas where tailings deposition should be concentrated and to create a tailings surface. From the tailings surface, design assumptions of tailings volume and average tailings deposited density can be checked. The tailings deposition plan should be updated routinely to check that capacity is available in deeper parts of the exhausted Touquoy pit to prepare for winter operation.

The existing TMF reclaim barge will be relocated from the tailings pond to the exhausted Touquoy pit for reclaim in ore processing for the Project. The reclaim barge will be placed in an area with the highest water depth. A floating baffle curtain will be installed around the barge should high suspended solids become an issue in processing.

Pertinent considerations and design criteria have been collated in Table 2.1. The assumptions presented in this water management plan should be updated with reported values when the final deposition plan is prepared. An average settled tailings density of 1.3 tonnes per cubic metre (t/m³) was assumed considering subaqueous tailing deposition, thus a lower average deposited tailings density than that of the Touquoy tailings pond of 1.44 t/m³ practicing sub-aerial deposition.

**Table 3.1 Project Tailings Deposition Assumptions**

| Criteria | Value | Unit | Source |
|---|---|---|---|
| **Tailings Characteristics** | | | |
| Average settled tailings density | 1.3 | t/m³ | |
| Slurry density (w/w) (% of tailings production (tonnes)) | 41 | % | |
| Specific gravity | 2.83 | --- | Stantec 2018a |
| Saturated water content (% of tailings production (tonnes)) | 36.1 | % | Calculated parameter |
| **Exhausted Touquoy Pit Characteristics** | | | |
| Touquoy pit volume at spillway elev. (108.0 m) | 8.962 | Mm³ | Ultimate Pit Design April 2017 (AMNS 2018) |
| Pit lake freezes over | December | month | |
| Pit lake ice melts | April | month | |
| Closure spillway elevation | 108 | m | |
| **Minimum water depth - pump operation** | **1** | **m** | |
| Minimum water cover - to reduce metal leaching | 1 | --- | |
| Adjustment to mean tailings elev. (underwater cones) | 8 | m | |
| **Assumed Freeboard Requirements of Touquoy pit** | **1** | **m** | |
| Inflow Design Flood | 143,000 | m³ | |

Note: Blank fields indicate an estimate or assumption as part of this study

## 3.2 WINTER (FROZEN) OPERATION

Based on a review of climate normal temperatures, frozen conditions typically occur between January and April, although solid ice cover of the pond may occur as early as December. Subaqueous deposition employed in cold climates require mitigation strategies to continue deposition when the water surface is frozen. Bubbler systems can be installed around the discharge/reclaim barge and its pontoons to reduce ice formation. The discharge/reclaim barge will be placed over a deep portion of the pond to provide storage of tailings deposited throughout the ice-covered portion of the winter. Another option is to submerge the tailings slurry discharge line below the ice depth to discharge tailings to a single point, or

over a linear array of discharge points within the pond during the winter period. It is not practical to access submerged tailings lines while the pond is frozen over.

# 4.0 WATER BALANCE MODEL

A preliminary water balance model was developed to simulate the overall operational water management of the Project in operation and reclamation. The water balance model was developed through multiple iteration and revisions simulating construction, commissioning, and operation of ore processing and tailings deposition at the Touquoy mine site to improve accuracy. Using the existing conditions water balance model at Touquoy, the model was extended to simulate the integrated water management of Project ore processing at Touquoy as part of a water and tailings management plan. Model inputs and outputs to the exhausted Touquoy pit accounted for groundwater inflows and seepage losses, surface runoff, direct precipitation, evaporation, process water, porewater lock up and reclaim to the Touquoy TMF and exhausted Touquoy pit. The objectives of the water balance model for the Project include to:

- Understand water management adjustments needed to accommodate the continued ore processing and tailings deposition
- Simulate the water and tailings volume in the exhausted Touquoy pit over the life of the Project
- Predict when it would be necessary to withdraw reclaim water from the Touquoy pit, as opposed to the TMF, under climate normal conditions

The model was run for the climate normal conditions in addition to the 1:100 Annual Exceedance Probability (AEP) wet conditions, and 1:100 AEP dry climate conditions (assuming groundwater inflow and storage in the Touquoy pit) for the during of operation, reclamation to closure. Only water elevation in the Touquoy pit is reported, as water management of the tailings pond is not changing from the Project. Considerations of flows in the TMF downstream facilities, such as the polishing pond and constructed wetland, were not incorporated into the model.

The model was run for the processing of FMS ore concentrate assumed to begin in November 2021. Water surplus in the existing Touquoy TMF will be reclaimed from the existing TMF for the FMS ore concentrate processing.

## 4.1 EXISTING CONDITIONS AND ASSUMPTIONS

Water balance assumptions for the FMS Project are listed below.

**Mill Process Flows**

- Start-up process water supply in Touquoy pit will be sourced from the following:
  - Reclaiming water from the TMF for the first five months of operation, assuming start-up in spring.
  - To offset anticipated start up reclaim deficit and build deposited tailings water cover, increase freshwater make-up from Scraggy Lake of 15,862 m³/month to the maximum monthly permitted rate of 21,900 m³/month for the first 7 months of reclaim in the Touquoy pit.
  - Stop pit dewatering five months prior to start-up of tailings deposition in the exhausted Touquoy pit. This will result in water collected in the pit for use as process supply in start-up.

  - Withdraw additional start-up volume from Scraggy Lake based on climate normal conditions (subject to a permitted water withdrawal approval from NSE).
- Freshwater make-up from Scraggy Lake of 5.8% of production is consistent with the Touquoy operations, following the initial start-up volume.
- Average tailings water discharged with tailings slurry of 9,417 m³/d
- Average reclaim water to mill of 8,977m³/d
- Moisture going into mill of 12% of tailings production (t) for FMS.
- Water lost to evaporation and spillage of 3.0% of tailings production (t).

**TMF (Drainage area of 94 ha)**

- TMF at high normal operating water level at commencement of tailings deposition in the exhausted Touquoy pit (approximately 1 $Mm^3$) to store water available for reclaim.
- TMF at ultimate spillway design elevation 128.5 m with a dam crest elevation of 130.0 m CGVD2013 assuming 7.36 million cubic meters (Mm³) of tailings storage volume and 1.30 Mm³ of water storage below the spillway invert elevation of 128.5 m.
- Minimum inactive storage in the tailings pond is 635,500 m³ in non-frozen months, and 825,500 m³ in frozen months.
- Surplus water discharge to the effluent treatment plant at a maximum rate of 300 m³/hr
- Seepage from the TMF at 1,336 m³/d, of that 200 m³/d is captured in polishing pond and 736 m³/d re-circulated to the TMF in non-frozen months and the remainder bypasses to groundwater.
- Accepts inputs from undiverted catchments (waste rock pile, mill pond runoff, and Touquoy pit dewatering).
- The elevation storage relationship for the TMF is illustrated in Figure 4.1

**Waste Rock Storage Area (Drainage area of 55.1 ha)**

- The waste rock storage area is not expanding over the life of FMS project.
- The runoff coefficient at the commencement of the Project is estimated at 28%. However, the runoff coefficient of the waste rock pile is expected to increase to 70% over 15 years as the waste rock pile starts to wet and the transmission of infiltration and recharge through the pile improves overtime.
- Runoff coefficient increases from 5 to 27% by the end of the Touquoy operation (e.g., from existing conditions in Touquoy operation to a model result from a reference waste rock site).

**Exhausted Touquoy Pit (Drainage area of 40.4 ha)**

- Touquoy pit receives 5 months of runoff (associated to remaining volume in TMF) upon commencement of FMS ore concentrate processing amounting to a water volume of 273,000 m³ with a bottom elevation from -25.0 m to 11.2 m CGVD2013
- Touquoy pit geometry as per the ultimate pit design of April 2017 at ultimate stage
- Model represents climate normal, 1:100 AEP and 1:100 AEP climate conditions, characterized by Environment Canada's Middle Musquodoboit climate station (Station ID 8203535)
- Total storage capacity at the overflow elevation 108 m CGVD2013 of 8.962 $Mm^{3.}$
- Natural filling of the Touquoy pit over time to create a pit lake water cover over of the deposited tailings
- The pit lake amounts to a minimum of approximately 98 m of water cover above the tailings, assuming the spillway invert elevation of 108 m CGVD2013
- Net groundwater inflow to the pit consistent at 768 m³/day but decreasing to 373 m³/d as the water elevation rises to a maximum of 108 m CGVD2013 (Stantec 2021a), as illustrated on Figure 4.2
- An emergency spillway in the Touquoy pit with invert of 104 m, a Touquoy pit crest elevation of 108 m to prevent overtopping and a conveyance channel to Moose River
- The elevation storage relationship for the exhausted Touquoy pit is illustrated in Figure 4.3

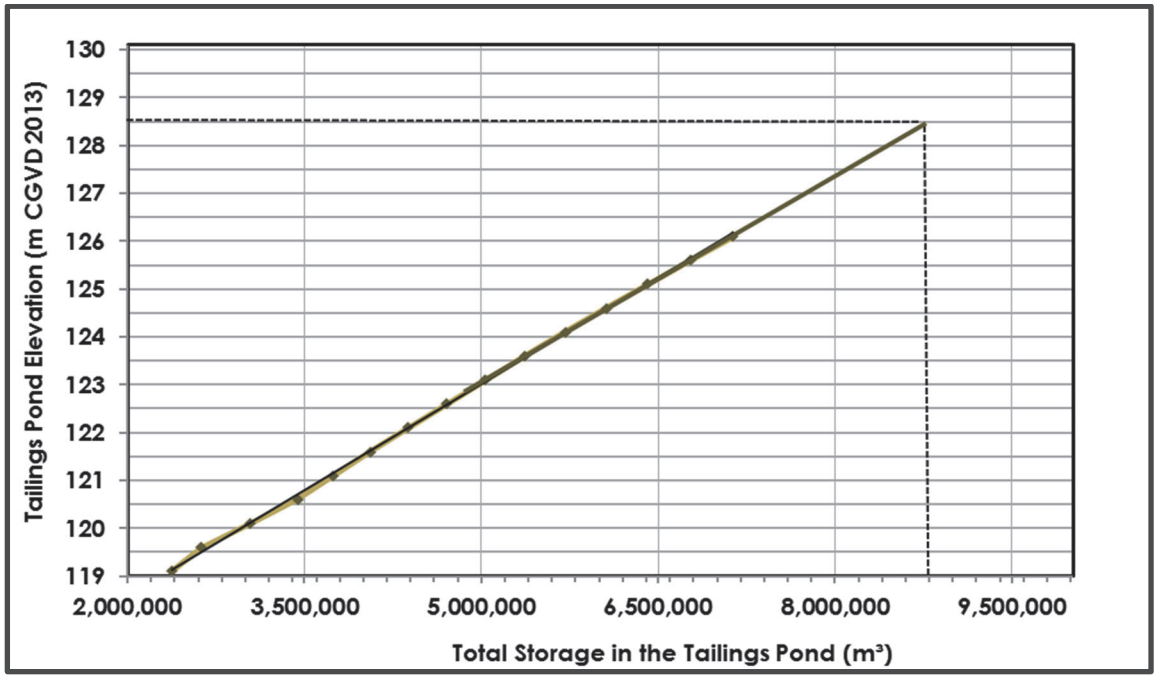



**Figure 4.1 TMF Elevation Storage Relationship**

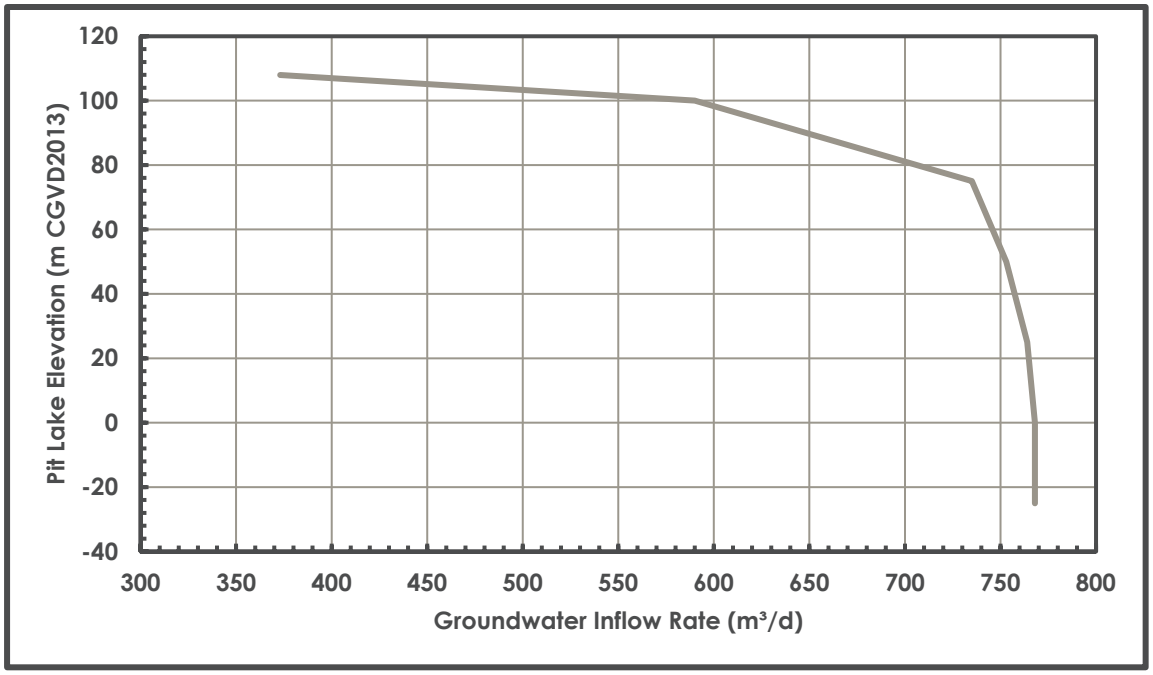



**Figure 4.2 Groundwater Inflow Rates to Pit Based on Water Elevation in Touquoy Pit**

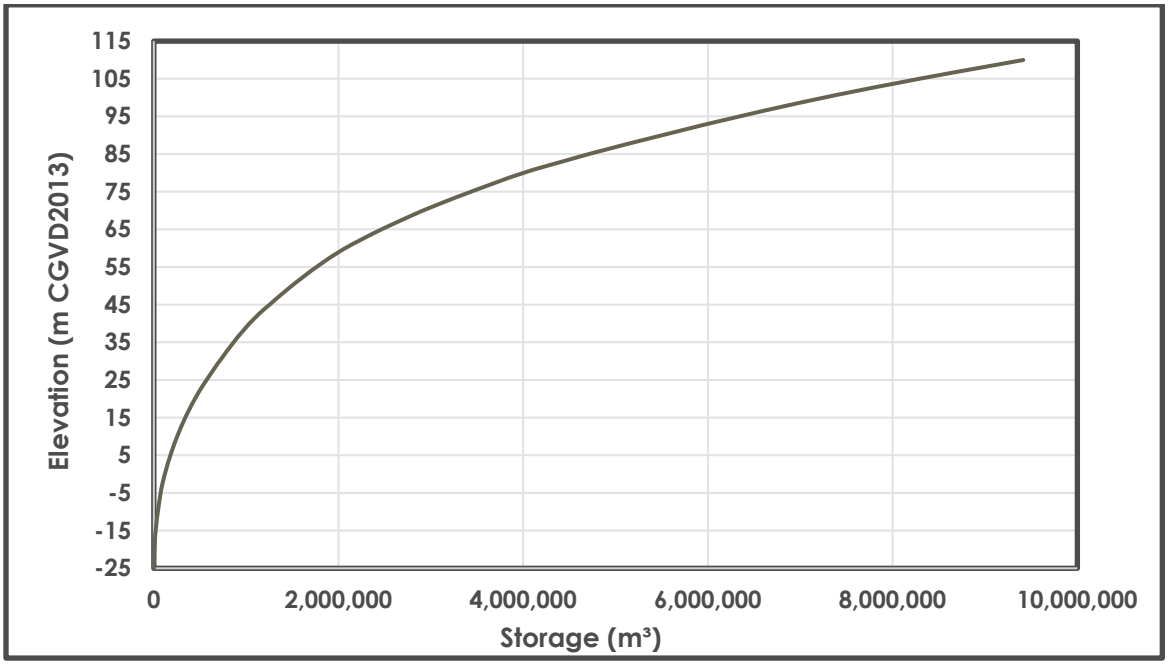



**Figure 4.3 Elevation Storage Relationship in the Exhausted Touquoy Pit**

## 4.2 MODEL RESULTS

The water balance model predicted the amount of water and tailings stored in the pit over the simulation period for FMS ore concentrate processing. Tailings will be deposited in the exhausted Touquoy pit for a total of 83 months including a five-month pre-processing period to allow the water level in the open pit to reach an elevation in the pit of 17.6 m CGVD2013. As originally planned in the approved Touquoy Gold Mine Project Reclamation Plan (Stantec 2017b), the inflow of groundwater, surface runoff and precipitation into the pit will naturally create a lake upon closure of the site. The water balance model simulated that it would take an additional 88 months or a total of 165 months from commencement of tailings deposition in the exhausted Touquoy pit to fill the pit to the spillway invert elevation. Figures 4.4 and 4.5 illustrate the predicted water and tailings elevation and storage volume in the exhausted Touquoy pit over a 20-year simulation period, respectively.

Based on results of the water balance model, process water can be reclaimed from the TMF for the duration of FMS ore concentrate processing for the modelled climatic conditions. Adequate water supply is available for start-up as the process water demand is low in comparison to Touquoy processing.

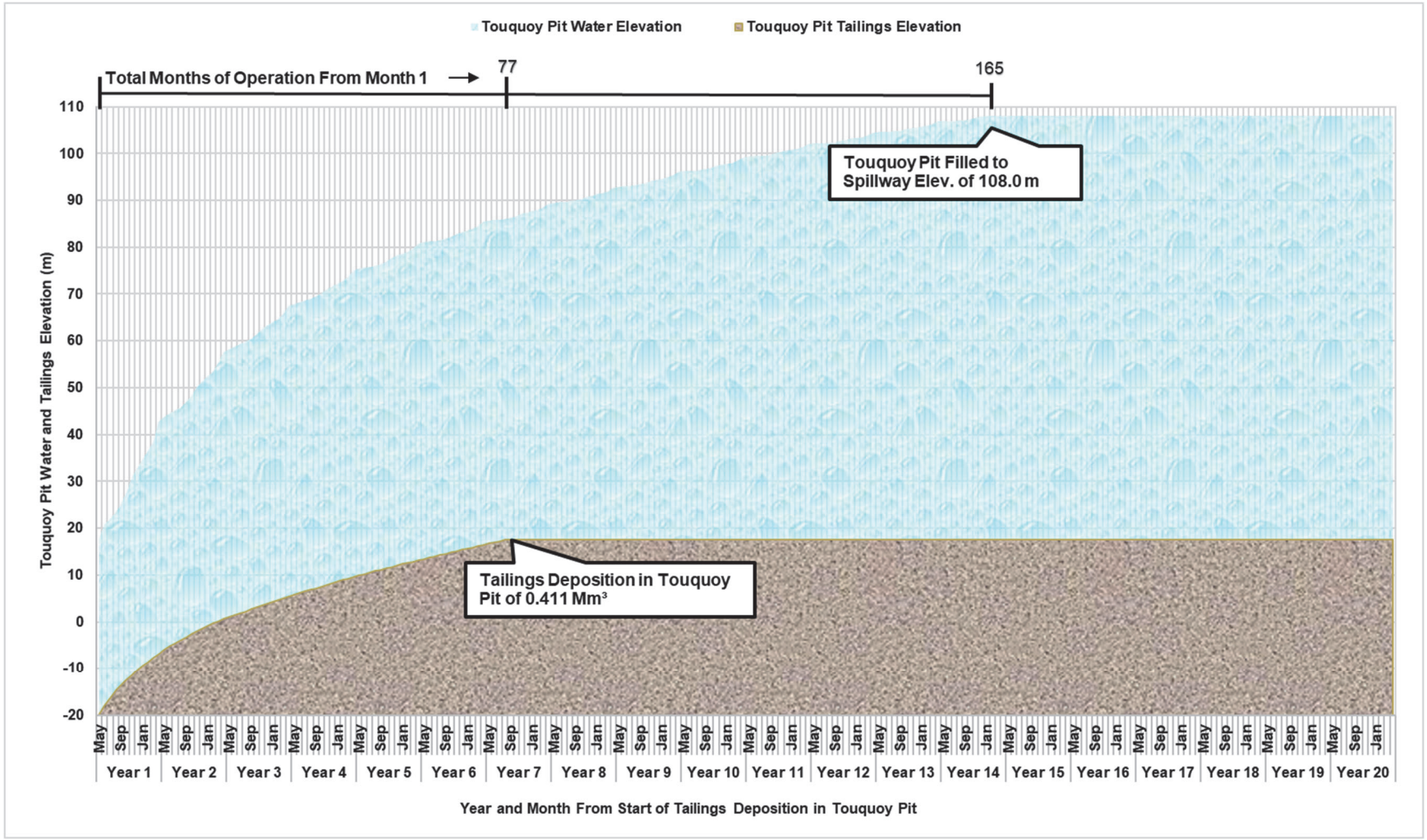



**Figure 4.4 Tailings and Water Elevation in the Exhausted Touquoy Pit**

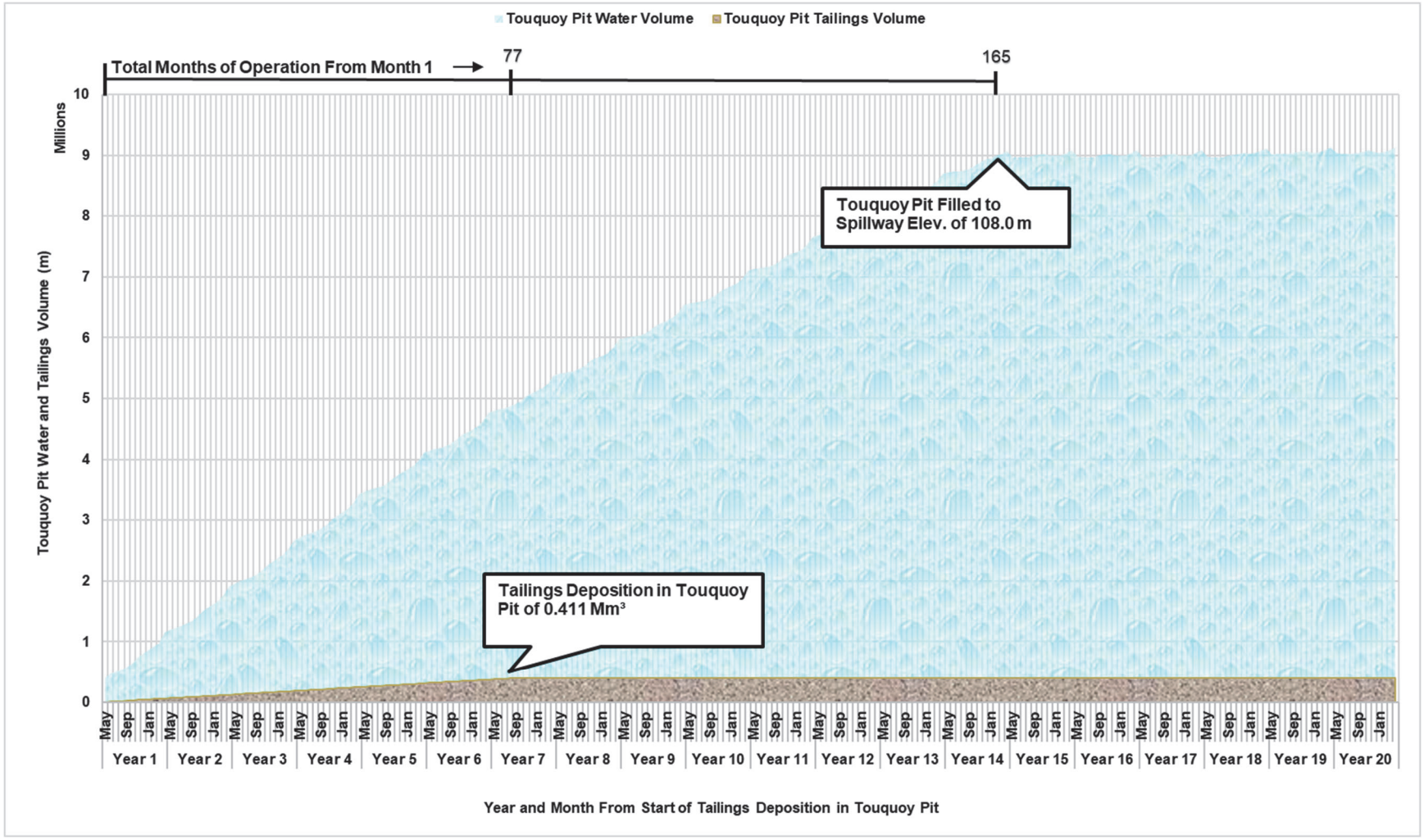



**Figure 4.5 Tailings and Water Storage Volume in the Exhausted Touquoy Pit**

# 5.0 WATER QUALITY MODEL

Deposition of tailings in the exhausted Touquoy pit will alter water quality in the pit compared to filling of the pit as per the Touquoy reclamation plan (Stantec 2017b). The monthly water quality model for the exhausted Touquoy pit was developed to simulate the overall water quality of metal parameters, cyanide, and nitrogen species (including ammonia, nitrate, and nitrite) during operation, reclamation, and closure of the Project. This model was run for the Base and Alternative Scenarios. The objectives of the Touquoy water quality model are to predict future water quality and inform water treatment required prior to the pit lake effluent discharge to Moose River, and the water quality of effluent discharge to Moose River at aquatic monitoring stations. The environmental effects of predicted discharge water quality in Moose River are assessed.

## 5.1 MODEL INPUTS AND ASSUMPTIONS

### 5.1.1 Geochemical Source Terms

Water quality modelling considered the pore water quality in the tailings, the groundwater inflow quality in the pit floor/ walls, surface runoff, direct precipitation, process water surplus, and the geochemistry of the individual water quality parameters. As discussed in the source terms memo (Lorax 2018), the pore water quality in the tailings and pit walls/floor was based on geochemical source term model predictions derived from upscaling of kinetic tests and Touquoy monitoring data. The geochemical model simulated the oxidation and reduction reactions to understand the water quality of the mixed pit lake quality based on the geochemistry of the individual water quality parameters during operation and reclamation. The kinetic testing and Touquoy monitoring data were considered representative for the Project as the ore bodies are from the same geologic formation as the Touquoy ore with similar marker parameter content.

Using the Touquoy TMF as a site analogue for saturation indices (Lorax 2018), solubility caps were predicted for iron (0.10 mg/L at end of mine and 0.039 mg/L at closure) and aluminum (0.178 mg/L at end of mine and 0.057 mg/L at closure). As recommended by Lorax (2018), a degradation rate for ammonia of $y = -0.0134x^2 + 0.4915x + 0.0676$ was applied, where x is the ammonia concentration in a given year. The degradation rate for ammonia was capped at 4.57 mg/L/yr for ammonia concentrations of 18.35 mg/L or above. Degraded ammonia was converted to nitrate and nitrite in operation and reclamation, at ratios provided by Lorax. During operation, a higher proportion of nitrite was predicted due to competing oxygen-consuming mechanisms where 25% as $NO_3$ and 75% as $NO_2$ (Lorax 2018). Within approximately 3 years following completion of tailings deposition, most of the nitrite was estimated to oxidize to nitrate with 98% as $NO_3$ and 2% as $NO_2$.

The water quality of the source terms are combined with the water balance model flows to predict monthly discharge water quality over 50 years beginning at the start of discharge into the exhausted Touquoy pit dis, simulating steady state conditions for all source terms provided by Lorax.

Process freshwater make-up water requirements of approximately 5.8% of production will be sourced from Scraggy Lake as per the existing NSE approval for Touquoy ore processing or other sources as

directed in the NSE approval for FMS and Beaver Dam. Should additional process make-up water be required in a water reclaim deficit scenario, the Scraggy Lake supply will be supplemented with treated effluent from the existing Touquoy mine polishing pond.

Based on results of the groundwater flow model (Stantec 2021a), the Touquoy pit acts as a sink (i.e., gaining groundwater to the Touquoy pit) until the groundwater level reaches the shallow weathered bedrock layer. The interaction between the Touquoy pit lake and Moose River is limited to groundwater flow from Moose River to the pit during this period. Therefore, no water quality effects to Moose River are predicted during this period. When the pit lake level rises to the spillway elevation of 108 m, the groundwater flow gradients allow for seepage from the Touquoy pit will migrate towards the Moose River as baseflow at a rate of approximately 258 $m^3$/d. The flow rate in Moose River in April is 125 times this rate, and therefore represents a dilution ratio of approximately 125.

The water quality model predicts the effluent discharge quality from the Touquoy pit during reclamation and closure. Effluent discharge water quality from the pit lake to Moose River is required to meet MDMER discharge limits. Therefore, it was assumed that any effluent quality for any parameter that exceeds the MDMER limits will be treated to meet the MDMER limits. Discharge from the Touquoy pit is not anticipated until after 2021, therefore the MDMER discharge limits for an existing mine after June 1, 2021 were used as minimum treatment criteria for effluent discharges to Moose River. An assimilative capacity study of Moose River (Stantec 2021b) was completed to simulate the mixed water quality at the future MDMER biological monitoring stations located at 100 m, 200 m, and 1000 m downstream of the effluent discharge point.

### 5.1.2 Water Treatment

Similar to Touquoy ore processing, the tailings slurry from the processed ore will be subject to cyanide destruction at the process plant before flowing to the exhausted Touquoy pit. Based on water quality monitoring results at Touquoy for existing operation, cyanide destruction to cyanate is 99.5% effective (Lorax 2018). Cyanate readily complexes with metals and can precipitate under increased pH conditions. The majority of the residual cyanide reagent introduced to the tailings during ore processing will be degraded and hydrolyzed to carbon dioxide and ammonium during storage in the tailings pond. Similarly, this will be expected to occur for the FMS and Beaver Dam tailings being stored in the Touquoy pit. Potential failures related to cyanide recovery and proposed Touquoy pit disposal will be addressed in updates to the existing Touquoy groundwater contingency plan (Stantec 2019a), as required in the Industrial Approval for the Touquoy mine site.

Continued use of the existing effluent treatment plant located downstream of the tailings pond is planned to treat the pit lake until MDMER discharge limits are met. The water quality of the pit lake will be monitored during the pit filling and as the pit level approaches the spillway elevation. The water quality will be compared to the MDMER discharge limits and will be treated as required to meet these limits and any additional regulatory closure criteria or site-specific guidelines. The MDMER discharge limits will decrease from the existing limits to those presented in Table 5.1 effective June 1, 2021. The discharge from the Touquoy mine site is anticipated to occur after this period, and therefore the lower MDMER limits for an existing mine will apply.

**Table 5.1 Schedule 4 Limits of the Metal and Diamond Mining Effluent Regulations**

| Deleterious Substance | Maximum Authorized Monthly Mean Concentration | Maximum Authorized Concentration in a Composite Sample | Maximum Authorized Concentration in a Grab Sample |
|---|---|---|---|
| Arsenic | 0.30 mg/L | 0.45 mg/L | 0.6 mg/L |
| Copper | 0.30 mg/L | 0.45 mg/L | 0.60 mg/L |
| Cyanide | 0.5 mg/L | 0.75 mg/L | 1.00 mg/L |
| Lead | 0.10 mg/L | 0.15 mg/L | 0.20 mg/L |
| Nickel | 0.50 mg/L | 0.75 mg/L | 1.00 mg/L |
| Zinc | 0.50 mg/L | 0.75 mg/L | 1.00 mg/L |
| Total Suspended Solids | 15.00 mg/L | 22.50 mg/L | 30.00 mg/L |
| Radium 226 | 0.37 Bq/L | 0.74 Bq/L | 1.11 Bq/L |
| Un-Ionized Ammonia | 0.50 mg/L (as nitrogen) | Not applicable | 1.00 mg/L (as nitrogen) |

## 5.2 MODEL RESULTS

Water quality modelling considered the pore water quality in the tailings and the pit floor/ walls, the dilution from surface runoff, direct precipitation in the exhausted Touquoy pit and the water quality of the mixture based on the geochemistry of the individual water quality parameters. As presented by Lorax (2018), geochemical source term predictions of pore water quality of pit walls/floor had elevated metal (e.g., arsenic, cobalt, copper), ammonia, nitrate and cyanide concentrations thus reducing pit lake water quality at the time of discharge. In May of Year 18 at the commencement of discharge from the Touquoy pit when the pit lake is simulated to reach the spillway elevation, the water quality model predicted elevated concentrations of arsenic and nitrite as summarized in Table 5.2 not considering planned water treatment. Results of the water quality model in the exhausted Touquoy pit over time for metals, ammonia, and cyanide parameters are presented in Appendix A, not considering planned water treatment. These figures show the water quality trend over time and the outflow to Moose River.

**Table 5.2 Predicted Water Quality Concentrations to Moose River, Not Considering Water Treatment**

| Parameter | Effluent Discharge Concentration (mg/L) in Year 14 | Groundwater Seepage Concentration (mg/L) in Year 50 | Schedule 4 Limits MDMER Monthly Mean Concentration (mg/L) |
|---|---|---|---|
| ($SO_4$) Sulphate | 122 | $1.3\times10^{-3}$ | |
| (Al) Aluminum | 0.05 | $6.6\times10^{-8}$ | |
| (As) Arsenic | **0.359** | $4.3\times10^{-6}$ | 0.30 |
| (Ca) Calcium | 45.1 | $1.2\times10^{-4}$ | |
| (Cd) Cadmium | 0.000007 | $2.8\times10^{-11}$ | |
| (Co) Cobalt | 0.026 | $3.7\times10^{-8}$ | |
| (Cr) Chromium | 0.00029 | $2.8\times10^{-10}$ | |
| (Cu) Copper | 0.0146 | $1.3\times10^{-8}$ | 0.30 |
| (Fe) Iron | 0.038 | $4.6\times10^{-8}$ | |
| (Hg) Mercury | 0.000021 | $7.1\times10^{-12}$ | |

**Table 5.2 Predicted Water Quality Concentrations to Moose River, Not Considering Water Treatment**

| Parameter | Effluent Discharge Concentration (mg/L) in Year 14 | Groundwater Seepage Concentration (mg/L) in Year 50 | Schedule 4 Limits MDMER Monthly Mean Concentration (mg/L) |
|---|---|---|---|
| (Mg) Magnesium | 5.5 | $2.1\times10^{-5}$ | |
| (Mn) Manganese | 0.101 | $5.2\times10^{-7}$ | |
| (Mo) Molybdenum | 0.005 | $8.5\times10^{-8}$ | |
| (Ni) Nickel | 0.011 | $9.7\times10^{-9}$ | 0.50 |
| (Pb) Lead | 0.00017 | $3.5\times10^{-11}$ | 0.10 |
| (Se) Selenium | 0.00043 | $2.7\times10^{-10}$ | |
| (Ag) Silver | 0.00002 | $1.6\times10^{-11}$ | |
| (U) Uranium | 0.004 | $4\times10^{-9}$ | |
| (Zn) Zinc | 0.0016 | $3.2\times10^{-9}$ | 0.5 |
| (WAD CN) Weak Acid Dissociable Cyanide | 0.049 | $1.5\times10^{-8}$ | 0.5 |
| (Total CN) Total Cyanide | 0.141 | $8.0\times10^{-9}$ | |
| ($NO_3$) Nitrate (as N) | 0.99 | $1.4\times10^{-7}$ | |
| ($NO_2$) Nitrite (as N) | 0.714 | $8.5\times10^{-8}$ | |
| ($NH_3$) Ammonia | 0.0037 | $1.8\times10^{-7}$ | 0.50 (Unionized) |

Note: **Bold numbers** indicates an exceedance of MDMER discharge limit

Water quality that is predicted to exceed the MDMER discharge limits will be treated prior to discharge. The pit lake will be treated to meet MDMER discharge limits for an existing mine prior to discharge to Moose River, as presented on Table 5.2. As the pit lake is simulated to take approximately 18 years to fill from commencement of depositing tailings in the exhausted pit, the final water treatment design will be fully developed during operation and pit filling. Based on results of the assimilative capacity model (Stantec 2021b), once mixed with the background water quality in Moose River, the concentration 100 m downstream of SW-2 is predicted to be 0.021 mg/L for arsenic and 0.183 mg/L for aluminum. Similar to the base case scenario, although the simulated arsenic concentration is above the NSE Tier 1 and CCME guidelines of 0.005 mg/L, the background levels at SW-2 also exceed the guidelines at 0.018 mg/L. The aluminum concentration is predicted below the 75$^{th}$ percentile receiver quality in Moose River. The potential environmental effects in Moose River from this predicted water quality are presented in the study by Intrinsik (2021).

Water quality that is predicted to exceed the MDMER discharge limits will be treated prior to discharge. The pit lake will be treated to meet MDMER discharge limits for an existing mine prior to discharge to Moose River, as presented on Table 5.2. As the pit lake is simulated to take almost 14 years to fill from commencement of tailings deposition in the exhausted pit, the final water treatment design will be fully developed during operation and pit filling. Proposed water treatment strategies include:

- Initial treatment of the pit as a batch reactor with the objective of adjusting the pH to precipitate metals to improve water quality in the pit lake as the pit is filling. As an additional benefit of the slow filling of the pit over time, the residence time and exposure to sunlight will increase, thus enhancing the natural UV degradation of cyanide and improving water quality in the pit lake.

- Should water treatment still be necessary, effluent from the pit will be pumped for treatment to the existing effluent treatment plant and discharged to the downstream polishing pond facilities and Scraggy lake receiving environment. Once water quality meets discharge criteria (i.e., representing closure conditions), surplus water in the pit will spill to a channel and discharge to Moose River. Discharge water quality will continue to be monitored against discharge criteria to identify if the pit should continue to be pumped and treated at the Touquoy effluent treatment plant.
- Pump and treat water in the Touquoy pit opportunistically, as the pit is filling and capacity is available in the existing effluent treatment plant.

As presented in the assimilative capacity study of Moose River by Stantec (2021b), the effluent concentrations under normal discharge from the filled Touquoy pit, combined with the groundwater seepage contributions in Moose River under the same climate conditions are predicted. Moose River will primarily be driven by climatic conditions, with April flows representing a worst-case dilution ratio between the effluent discharge from the Touquoy pit and Moose River. Based on results of the assimilative capacity model (Stantec 2021b), once mixed with the background water quality in Moose River, the concentration 100 m downstream of SW-2 is predicted to be 0.021 mg/L for arsenic and 0.183 for aluminum. Although the simulated arsenic concentration is above the NSE Tier 1 and CCME guidelines of 0.005 mg/L, the background levels at SW-2 also exceed the guidelines at 0.018 mg/L. The aluminum concentration is predicted below the 75$^{th}$ percentile receiver quality in Moose River. The potential environmental effects in Moose River from this predicted water quality are presented in the study by Intrinsik (2021).

Concentrations of cobalt, copper and nitrite in groundwater seepage discharging as baseflow to Moose River are predicted to be higher than the CCME FAL or NSE EQS guidelines (Stantec 2021b). The groundwater seepage quality is simulated based on the source terms pore water quality of the tailings, with an estimated average concentration of 0.002 mg/L of arsenic to Moose River. However, based on the assimilative capacity model results, the mass loading from groundwater to Moose River is very small, and these parameters will meet CCME FAL/NSE EQS after mixing with Moose River within 100 m of the discharge point.

# 6.0 MODEL SENSITIVITY AND LIMITATIONS

Results of the water balance and quality model are based on information available at the time of the study, as sections above. It is recommended that the existing conditions and assumptions be updated as information becomes available, such as further developed reclamation plan, updates of the water balance/water management plan, updates to the mine plan, testing to predict settled tailings density, and the results of operational monitoring.

The 1:100 AEP wet and the 1:100 AEP dry climate statistics are used to provide an upper and lower bound of predicted climate normal conditions. Assuming the model assumptions reflect future conditions, water levels in the TMF and exhausted Touquoy pit during the 77 months of processing of FMS and Beaver Dam ore, should fall within these bounds. Stochastic combinations of wet and dry years were not modelled.

Model sensitivity to predicted Touquoy pit groundwater inflows were conducted by adjusting the groundwater contribution of 768 m³/d associated to a pit water elevation of -25.0 m (CGVD2013) to the groundwater contribution filled with water to elevation 108.0 m (CGVD2013) of 373 m³/d. This change would delay the timing of when the process water reclaim is relocated from the TMF to the exhausted Touquoy pit by 1 day.

The variation in the initial pond water volume between low and high operating levels in the TMF on the available water reclaim at time of commencement of tailings deposition in the exhausted Touquoy pit was modelled. Should the pond at the time of start-up be at a low operating level opposed to a high operating level, than the relocation of process water reclaim from the TMF to the exhausted Touquoy pit would be initiated 3 months after start-up, approximately 2 months earlier than if the pond is at a high operating level at start-up. Under this scenario, additional start-up water supplied by Scraggy lake would be required.

Sensitivity on the deposited tailings density in the exhausted Touquoy pit was simulated. The average deposited tailings density of 1.3 t/m³ is expected, with a lower tailings density at start-up and a higher density as tailings are deposited in the exhausted Touquoy pit due to the consolidation of the tailings from the tailings and water mass. Should we consider the lower tailings density in the first year from 1.3 t/$m^3$ to 1.2 t/$m^3$, this will result in approximately 13,000 $m^3$/month of additional pore water lock-up, reducing the water available for reclaim during start-up.

# 7.0 SUMMARY & RECOMMENDATIONS

## 7.1 WATER MANAGEMENT

Water management at Touquoy for the FMS ore concentrate processing was developed considering the existing process water requirements, existing water management infrastructure, the water inventory at the mine site, the available freshwater sources, and effluent water quality. Consistent with existing water management at the site, the TMF will receive runoff from the waste rock piles, and seepage collection ditches. Initially, process water will be reclaimed from the TMF until pond volumes are inadequate to meet process water requirements and reclaim will be taken from the exhausted Touquoy pit. Tailings slurry will be discharged to the exhausted Touquoy pit upon commencement of processing of the FMS ore concentrate. Additional freshwater may be required from Scraggy lake for start-up under dry conditions. Surplus water in the TMF will be managed through the existing downstream discharge facilities and to the receiving environment at Scraggy Lake. Surplus water in the exhausted Touquoy pit will be managed through a spillway/channel to Moose River.

The water management plan should be updated to reflect the next stage of design. The Touquoy Closure plan should be updated to reflect the FMS tailings deposition and the resultant accelerated filling of the exhausted Touquoy pit and the changes to water quality. A water withdrawal approval from Scraggy Lake will be required from NSE for start-up process water supply.

## 7.2 TAILINGS DEPOSITION

It is assumed that tailings deposition will be performed using subaqueous deposition of a conventional tailings slurry through a barge. Deposition strategies will require routine modification based on the season. An approximate volume of deposited tailings of 0.411 $Mm^3$ is required for processing of FMS ore concentrate, including the pore water lockup. The capacity of the exhausted Touquoy pit can manage both the tailings and water volume, accommodating flood storage and freeboard.

The tailings management plan should be updated to reflect the next stage of design. A tailings deposition plan should be developed to support operation to define the monthly deposition areas.

## 7.3 WATER BALANCE MODEL

The water balance model provides an understanding of the water and tailings management for processing of the FMS ore concentrate.

The exhausted Touquoy pit in combination with the TMF is predicted to have sufficient process water for the FMS mine life. However, additional process water may be required from Scraggy Lake for start-up under dry climate conditions. The source of process water reclaim is triggered by the water elevation in the exhausted Touquoy pit, as a water management strategy. For example, initially process water will be reclaimed to the mill from the TMF through the existing reclaim barge and related water piping infrastructure until pond volumes are no longer adequate for process water reclaim. In approximately 5

months, process water will be reclaimed from the exhausted Touquoy pit as a closed loop between the pit and mill. Reclaiming process water initially from the TMF will reduce the required capacity of booster pumps in the exhausted Touquoy pit, as a greater capacity is required with depth. The existing reclaim water lines and decant pump could be retrofitted to accommodate the change to the source of the process water reclaim supply.

The water balance should be updated to reflect the next stage of design.

## 7.4 WATER QUALITY MODEL

Water quality modelling considered the pore water quality in the tailings and the pit floor and walls, dilution from surface runoff, direct precipitation in the pit, and the water quality of the mixture based on the geochemistry of the individual water quality parameters. Water quality is simulated to include elevated metals (e.g., arsenic, cobalt, copper), ammonia, nitrate and cyanide concentrations thus reducing pit lake water quality at the time of pit overflow discharge. The pit lake will be treated to meet applicable MDMER discharge limits for an existing mine prior to discharge to Moose River. As the pit lake was simulated to take approximately 14 years to fill from commencement of FMS ore concentrate, the water treatment design will be fully developed during operation and pit filling.

Water quality predictions and assimilative capacity in Moose River should be updated following an update of source terms as a result of the on-going FMS geochemistry assessment. Following this study, a water treatment plan should be further developed for implementation in operation and reclamation of FMS project.

# 8.0 REFERENCES

Ausenco Engineering Canada Inc. (Ausenco). 2015. NI 43-101 Technical Report Feasibility Study for Moose River Consolidated Project, Nova Scotia. Prepared for Atlantic Gold Corporation. Vancouver BC. Issue Date August 13, 2015.

Atlantic Gold Mining NS Corporation (AMNSC). 2017. Skype meeting with Alastair Tiver (AGMNSC) and Paul Deering (Stantec) on November 17, 2017. Stated that mill site water balance and properties of tailings can be consistent with Touquoy ore processing.

Doneker, R.L. and G.H. Jirka, CORMIX User Manual: A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters, EPA-823-K-07-001, Dec. 2007. Available for download at http://www.mixzon.com/downloads/

Environment Canada. 2012. Metal Mining Technical Guidance for Environmental Effects Monitoring. Government of Canada. ISBN 978-1-100-20496-3, Cat. no.: En14-61/2012E-PDF.

Environment Canada. 2015a. Climate, Canadian Climate Normals, 1981-2010 Canadian Climate Normals & Averages. Middle Musquodoboit, Nova Scotia. Website: http://climate.weather.gc.ca/climate_normals/index_e.html. Reviewed on January 6, 2016.
GHD 2017. Beaver Dam Mine Project Environmental Impact Statement Summary. Marinette, Nova Scotia. Report No. 5. Revised June 12, 2017. Dartmouth, NS.

Golder Associates Limited (Golder). 2007. Touquoy Gold Project Feasibility Study Tailings Disposal Facility. Nova Scotia. Submitted to Atlantic Gold.

Intrinsik Corp. 2021. Evaluation of Potential for Aquatic Effects as a Result of Effluent Releases Related to Fifteen Mile Stream Mine. Submitted to Atlantic Mining NS.

Lorax Environmental. 2018. Draft Beaver Dam Project Geochemical Source Term Predictions for Waste Rock, Low-Grade Ore, Tailings and Overburden.

Stantec Consulting Ltd. (Stantec). 2016. Water Balance Report Revision 2.0. Atlantic Gold Tailings Management Facility. Fredericton, NB. November 25, 2016. Prepared for Atlantic Gold Corp.

Stantec Consulting Ltd. (Stantec). 2017a. Water Management Plan Version 1.0 Atlantic Gold Tailings Management Facility. Fredericton, NB. February 9, 2017. Prepared for Atlantic Gold Corp.

Stantec Consulting Ltd. (Stantec). 2017b. Reclamation Plan Rev. 1, Touquoy Gold Project. Prepared for Atlantic Gold Corp. Rev. 1

Stantec Consulting Ltd. (Stantec). 2018a. Physical Characteristics of Tailings at the Touquoy Gold Mine. Moose River, Nova Scotia. October 18, 2018.

Stantec Consulting Ltd. (Stantec). 2019a. Touquoy Gold Project Groundwater Contingency Plan Revision 1.2.

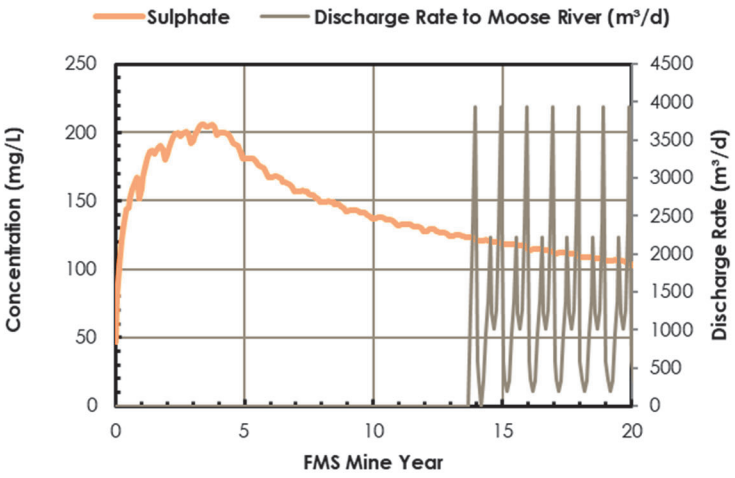
Stantec Consulting Ltd. (Stantec). 2021a. Groundwater Flow and Solute Transport Modelling to Evaluate Disposal of Fifteen Mile Stream Tailings in Exhausted Touquoy Pit – Fifteen Mile Stream Gold Project.

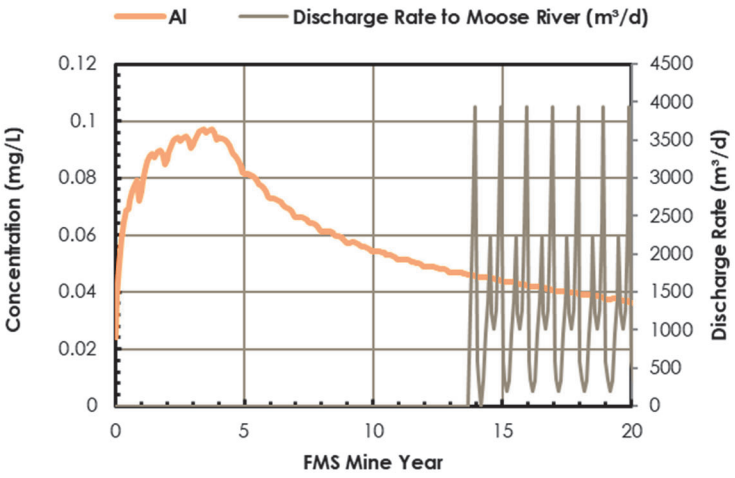
Stantec Consulting Ltd. (Stantec). 2021b. Assimilative Capacity of Moose River - Exhausted Touquoy Pit Discharge.

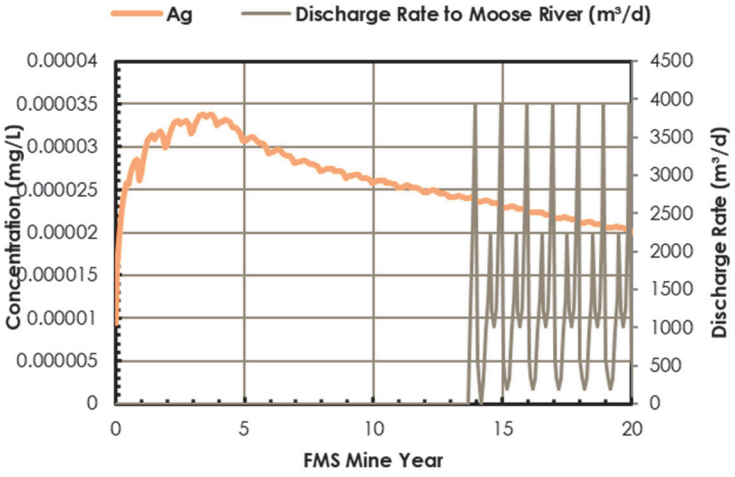
v:\1216\active\121619250\3_hydrotechnical\8_reports\2019_fms_eis\technical_report\issue_20190829_emext\rpt_20210208_water_tailings_management_plan.docx

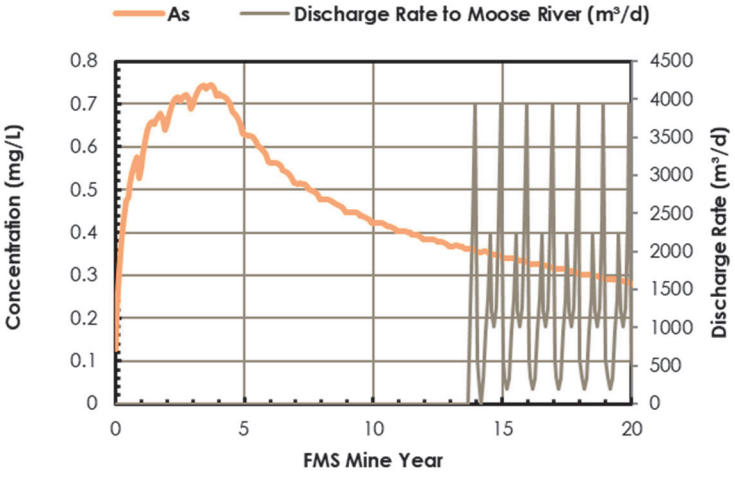
# APPENDIX A

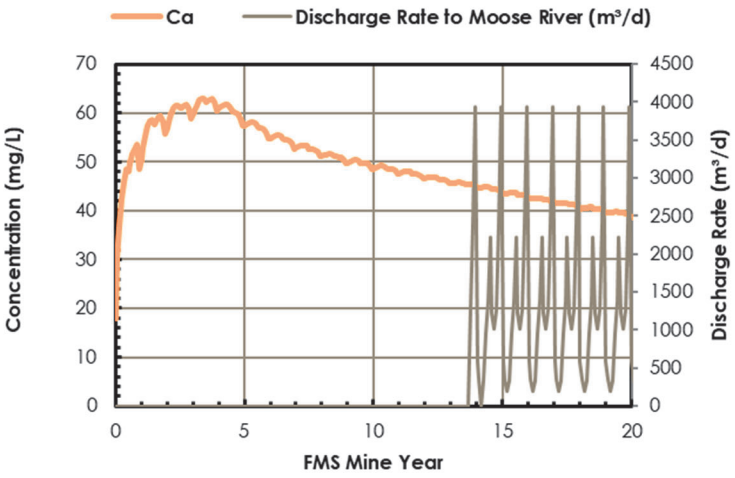
## Water Quality Predictions

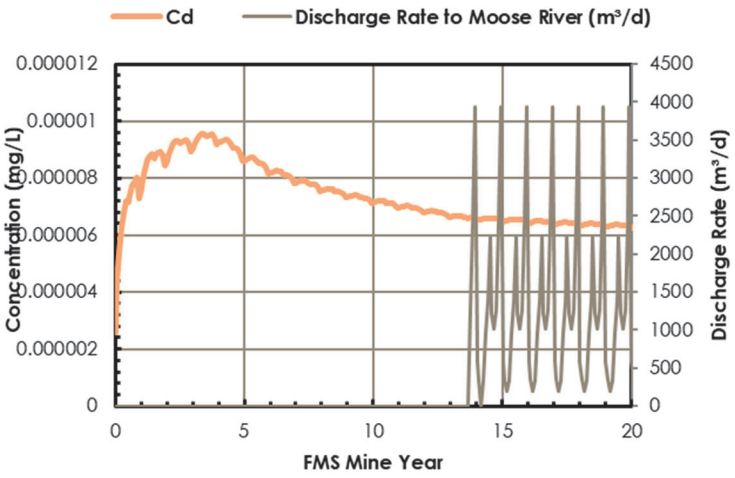

Sulphate
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0
50
100
150
200
250
500
1000
1500
2000
2500
3000
3500
4000
4500
5
10
15
20

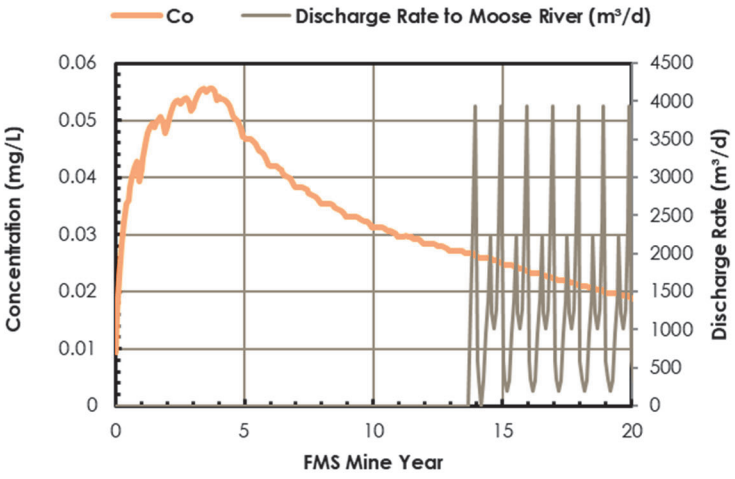

Al
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0
0.02
0.04
0.06
0.08
0.1
0.12
500
1000
1500
2000
2500
3000
3500
4000
4500
5
10
15
20

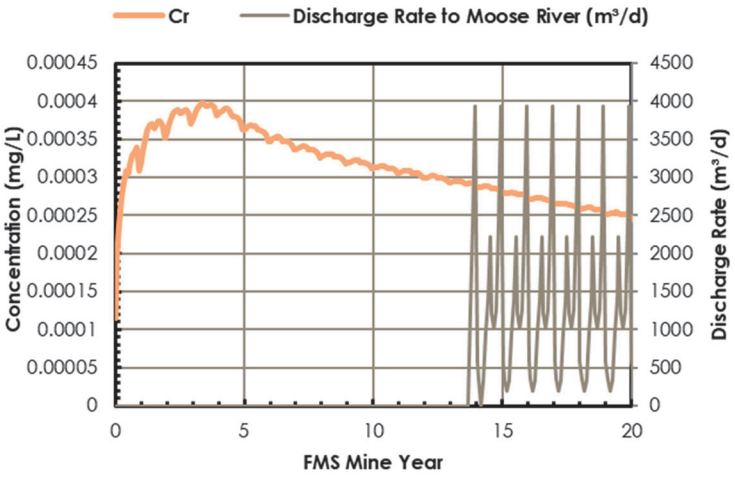

Ag
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0
0.000005
0.00001
0.000015
0.00002
0.000025
0.00003
0.000035
0.00004
500
1000
1500
2000
2500
3000
3500
4000
4500
5
10
15
20

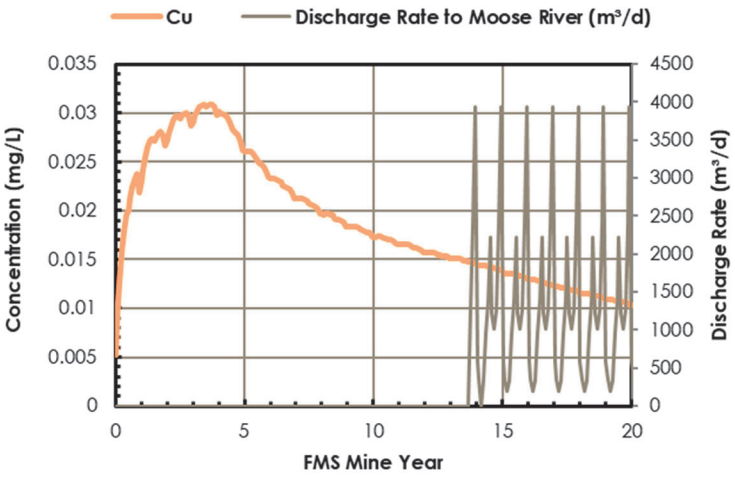

As
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
500
1000
1500
2000
2500
3000
3500
4000
4500
5
10
15
20

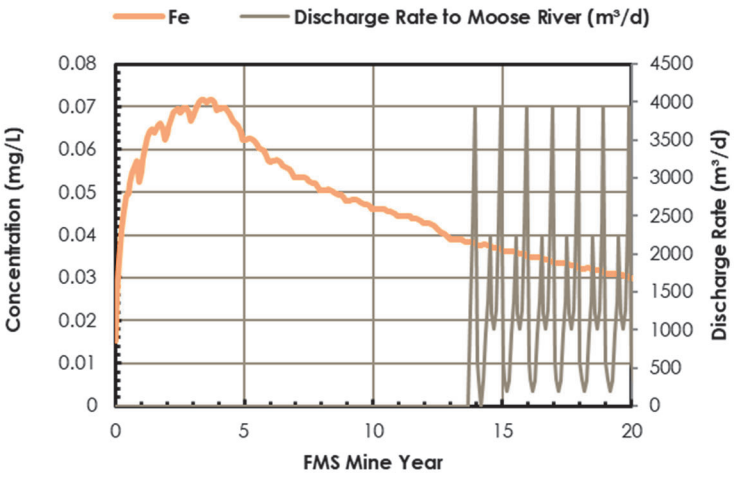

Ca
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0
10
20
30
40
50
60
70
0
500
1000
1500
2000
2500
3000
3500
4000
4500
0
5
10
15
20

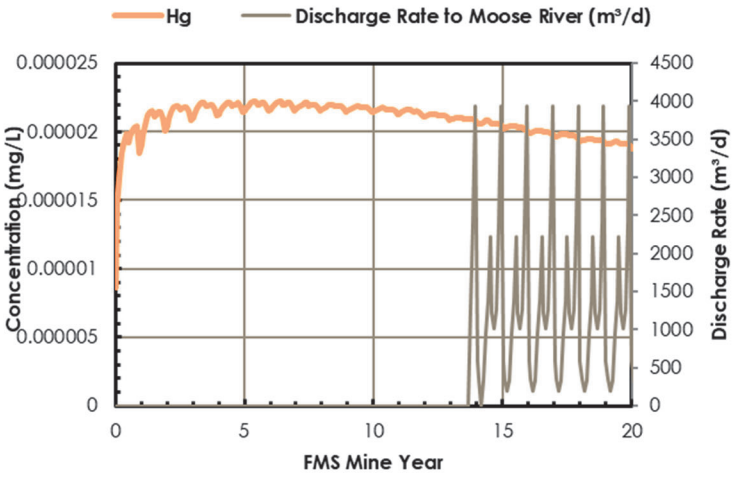

Cd
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0
0.000002
0.000004
0.000006
0.000008
0.00001
0.000012
0
500
1000
1500
2000
2500
3000
3500
4000
4500
0
5
10
15
20

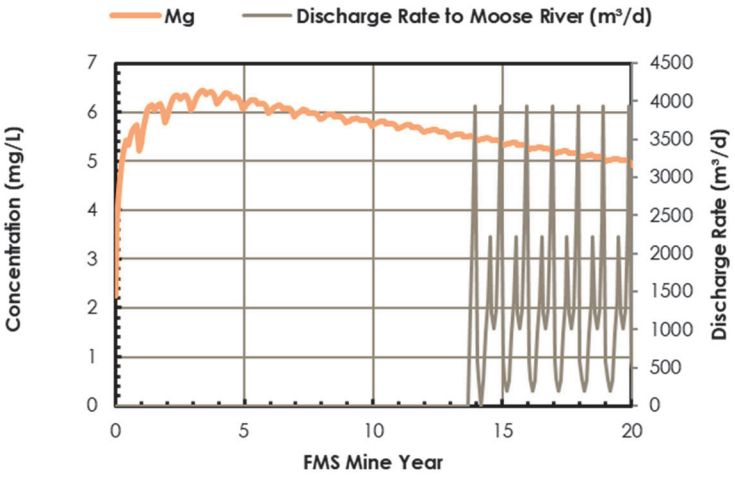

Co
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0
0.01
0.02
0.03
0.04
0.05
0.06
0
500
1000
1500
2000
2500
3000
3500
4000
4500
0
5
10
15
20

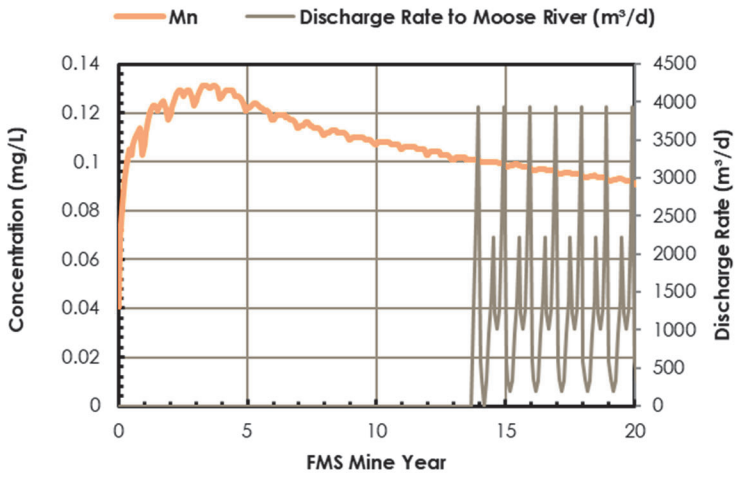

Cr
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0
0.00005
0.0001
0.00015
0.0002
0.00025
0.0003
0.00035
0.0004
0.00045
0
500
1000
1500
2000
2500
3000
3500
4000
4500
0
5
10
15
20

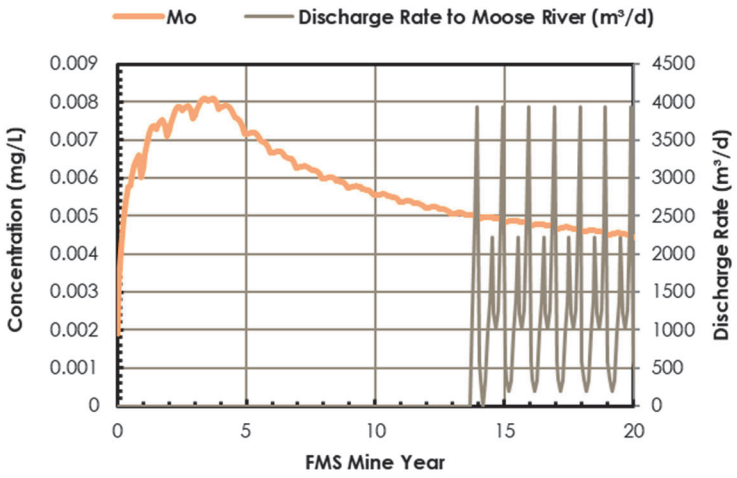

Cu
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20

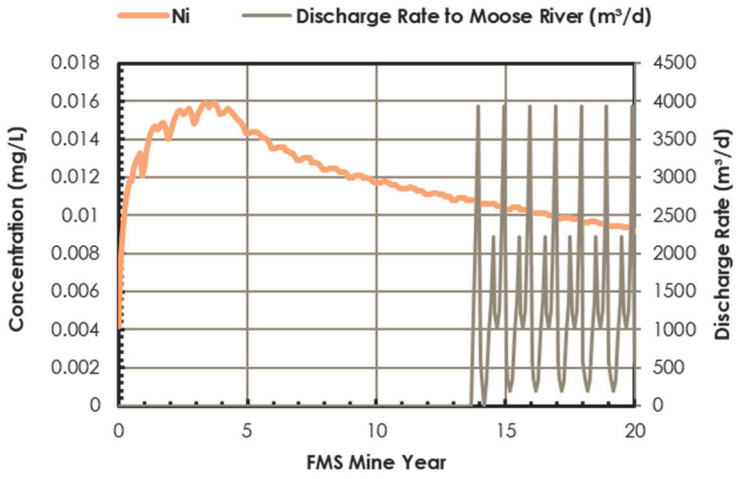

Fe
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20

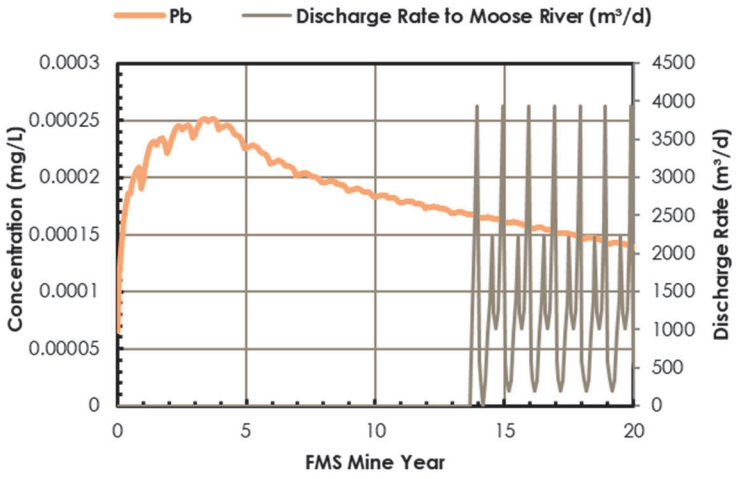

Hg
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0.000025
0.00002
0.000015
0.00001
0.000005
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20

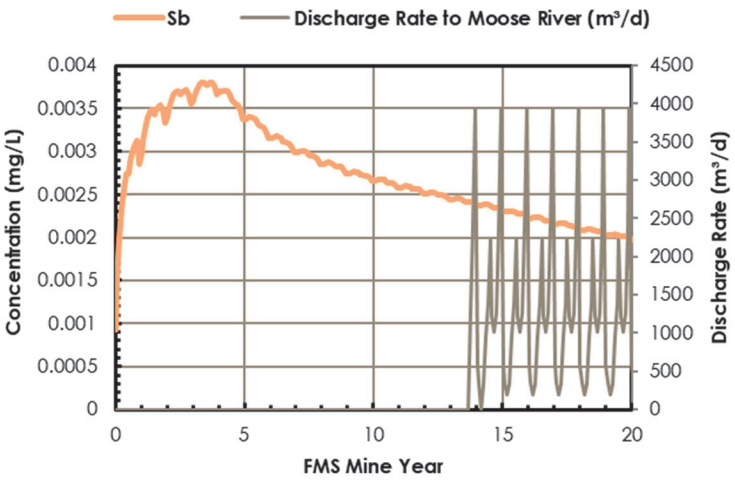

Mg
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
7
6
5
4
3
2
1
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20

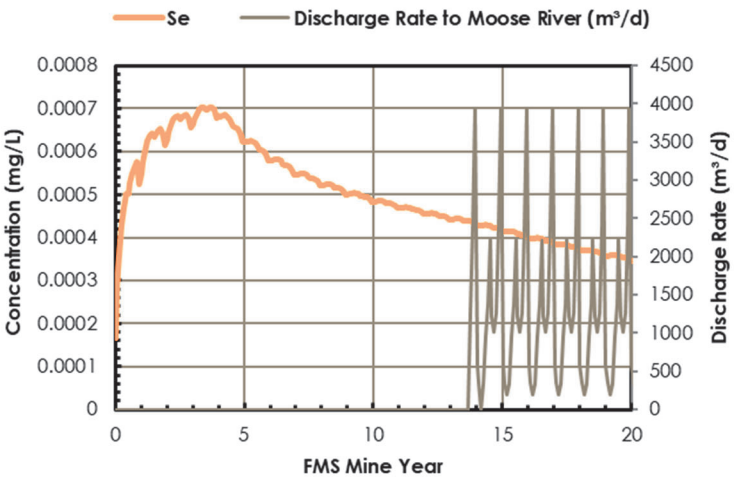

Mn
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20

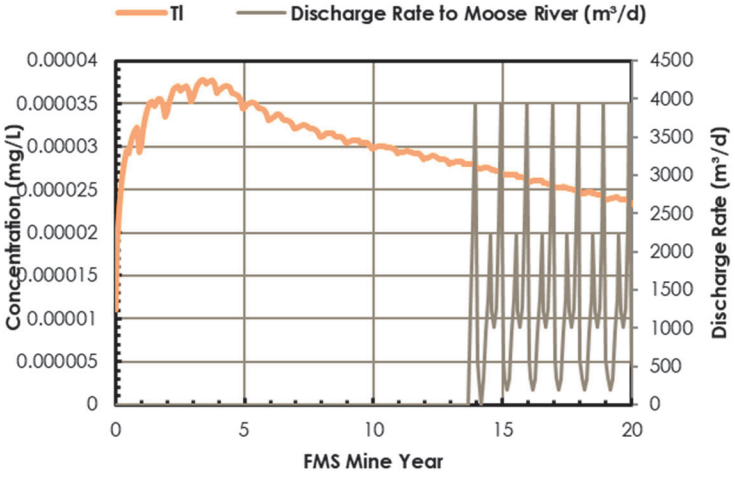

Mo
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20

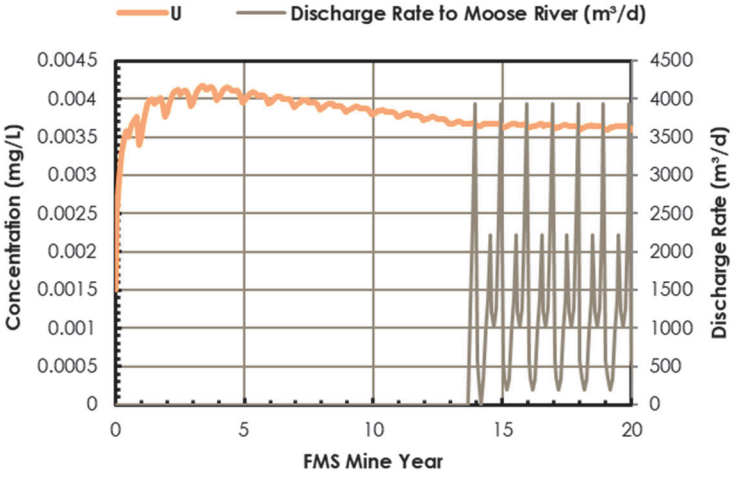

Ni
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20

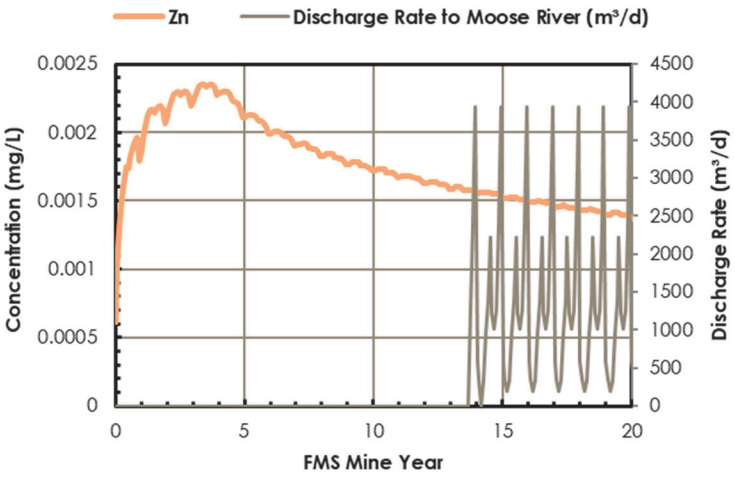

Pb
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20

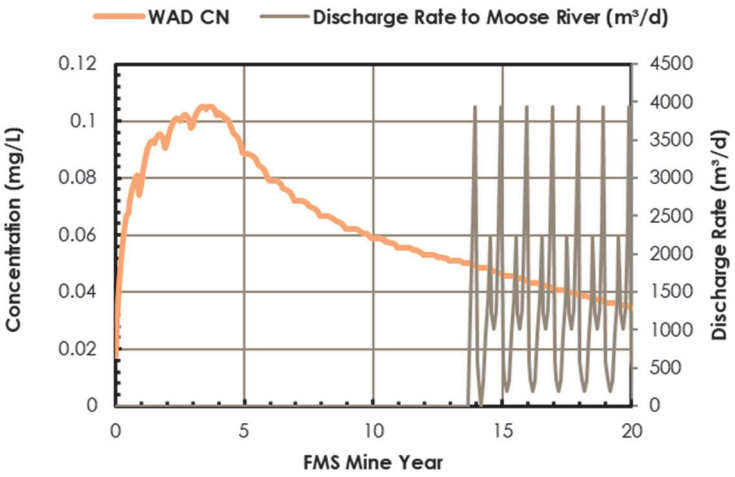

Sb
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20

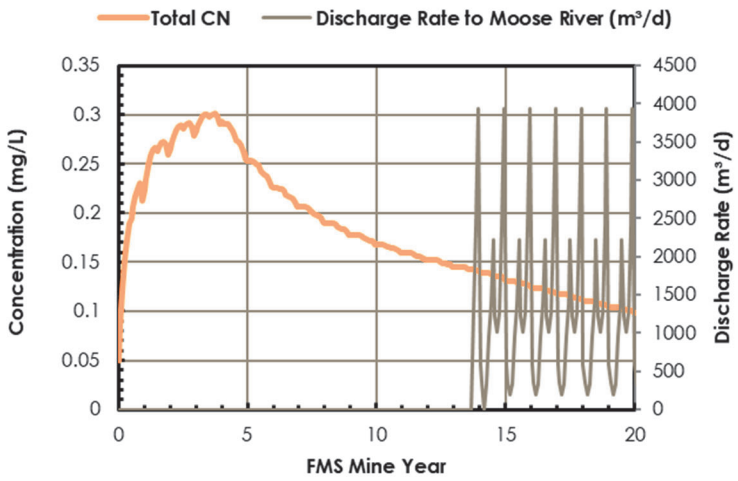

Se
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20

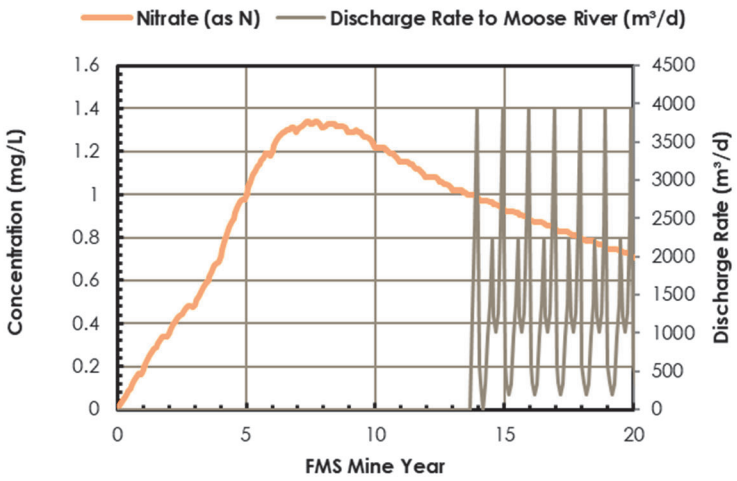

Tl
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0.00004
0.000035
0.00003
0.000025
0.00002
0.000015
0.00001
0.000005
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20

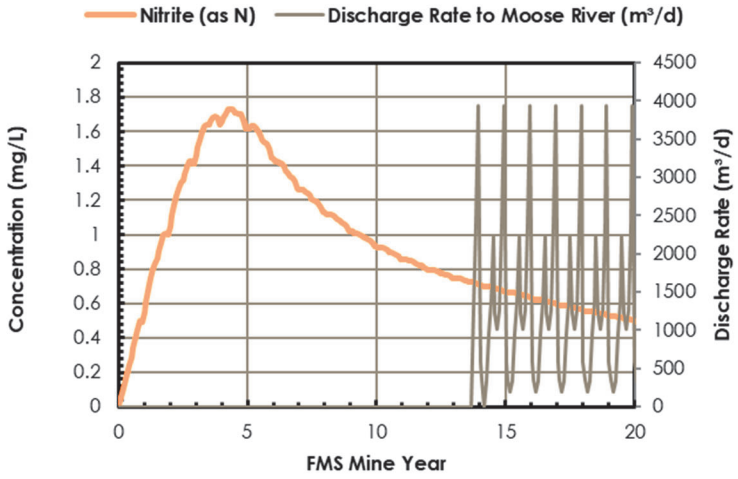

U
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20

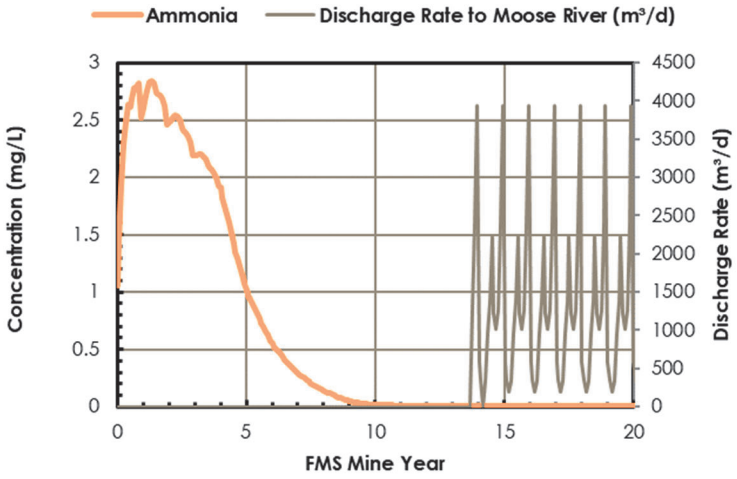

Zn
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0.0025
0.002
0.0015
0.001
0.0005
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20


WAD CN
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0.12
0.1
0.08
0.06
0.04
0.02
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20


Total CN
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20


Nitrate (as N)
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20


Nitrite (as N)
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20


Ammonia
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
FMS Mine Year
3
2.5
2
1.5
1
0.5
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20