Atlantic Gold

Appendix F.10

Simulating the Cumulative Effects of Deposition of Tailings to the Touquoy Pit – April 8, 2021
Completed for the Updated 2021 Beaver Dam Mine EIS

Simulating the Cumulative Effects of Deposition of Tailings to the Touquoy Pit

Final Report

April 8, 2021

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1.0 INTRODUCTION

Atlantic Mining NS Inc. (AMNS) proposes the operation and closure of a tailings management facility in the exhausted Touquoy pit developed for the Touquoy Project. Tailings from the processing of ore or ore concentrates from four deposits at the Touquoy mill are proposed to be disposed of in the exhausted Touquoy pit. These include the processing of lower grades of ore stockpiled for the Touquoy Project, processing of ore transported from the Beaver Dam Project, and processing of ore concentrates from the Fifteen Mile Stream Project and Cochrane Hill Projects. The cumulative effects from the disposal of tailing from these four projects on Water Resources are assessed in this report.

This report is intended to form part of the supporting documentation for the environmental impact studies required for the Fifteen Mile Stream Gold Project. Groundwater modelling, water balance modelling, and assimilative capacity modelling of the Touquoy pit for tailings disposal have been conducted for these sites, and have been reported separately. This report presents updates to the modelling completed for other studies and presents the results of the cumulative effects of these projects.

1.1 PREVIOUS MODELLING STUDIES

Several modelling studies have been prepared that assess the operation of the Touquoy open pit as a tailings management facility. This report updates the following existing models to assess the cumulative effects of the four projects:

- Groundwater flow and transport modelling of the exhausted Touquoy pit for tailings disposal for the Beaver Dam Project (Stantec 2021a)
- Water balance modelling of the exhausted Touquoy pit for tailings disposal for the Beaver Dam Project (Stantec 2021b)
- Assimilative capacity modelling of the exhausted Touquoy pit for tailings disposal for the Beaver Project (Stantec 2021c)

A description of the existing models, and the updates required to support the cumulative effects assessment are provided for groundwater in Section 2, the water balance in Section 3, and for assimilative capacity in Section 4.

1.2 CONCEPTUAL TAILINGS DEPOSITION PLAN

This section presents a conceptual plan for subaqueous deposition of conventional tailings slurry into the exhausted Touquoy pit from the processing of ores from the Touquoy, Beaver Dam (BD), Fifteen Mile Stream (FMS), and Cochrane Hill projects. The deposition of tailings into an expanded Touquoy pit is assumed to be based on an ore processing rate of 6,133 tonnes per day (t/d). A simplified approach for tailings deposition assumes that a sufficient amount of ore is available for continuous processing of ores at a constant rate from the first day of operation until the ores are expended.

Introduction

The total capacity of the expanded Touquoy pit at the proposed spillway elevation of 108.0 m is 11.83 million cubic metres (Mm^3). This is sufficient to store tailings using subaqueous deposition based on the production rates presented on Table 1.1. Considering subaqueous deposition, the exhausted Touquoy pit can accommodate the estimated total deposited volume of 7.91 Mm^3 based on an average tailings density of 1.3 tonnes per cubic metre (t/m^3).

Table 1.1 Tailings Production for Deposition to Exhausted Touquoy Open Pit

Project	Mass of Ore or Ore Concentrate to Process (Mt)	Estimated Tailings Volume Deposited Subaqueously (Mm^3)
Touquoy	2.21	1.70
Fifteen Mile Stream	0.53	0.41
Beaver Dam	7.84	6.03
Cochrane Hill	0.28	0.22
Total	**10.86**	**8.36**

Alternative methods for tailings deposition, including the planned subaqueous disposal, were presented in in Stantec (2021b). Subaqueous deposition has been deemed the most pragmatic way to deposit tailings in the exhausted Touquoy pit.

2.0 GROUNDWATER MODELLING

As described in Section 1, groundwater modelling studies have been conducted to support the individual projects. The models are calibrated to a common set of water levels and baseflow estimates, and are based on the refilling of the pit footprint and volumes approved in IA 2012-084244-08. Modelling conducted for the Beaver Dam project simulates the filling of the Touquoy pit with tailings, which are assumed to have a hydraulic conductivity of 1×10^{-6} m/s (Stantec 2021a).

In addition to the deposition of tailings from the Beaver Dam, Fifteen Mile Stream, and Cochrane Hill projects, an expansion of the Touquoy open pit is proposed to extract additional high-grade ore, subject to regulatory approval. Groundwater modelling was conducted to assess the dewatering of the expanded open pit. This model forms the basis of the modelling for the cumulative effects, following the scenarios generally described in Stantec (2021a).

The cumulative effects of the various projects on groundwater are simulated through the deposition of tailings in the expanded Touquoy open pit. This includes the volumes for the four projects as listed on Table 1.1. The processed tailings were assumed to share similar source terms for the prediction of downstream groundwater quality effects. These source terms are based on the geochemical testing conducted on the Touquoy tailings (Lorax Environmental Services (Lorax) 2018).

2.1 GROUNDWATER EFFECTS DURING OPERATION

The operation of the expanded Touquoy open pit as a tailings management area was simulated using the groundwater model presented in Stantec (2021a), using the methods described in the report to simulate an expansion to the Touquoy open pit. The predicted inflow rates to the expanded Touquoy open pit compared based on the elevation of the pit lake are presented on Figure 2.1. As shown on the figure, the inflow rates decrease from 813 m^3/d when the pit stage elevation is at -25 m CGVD2013, to 408 m^3/d at a pit stage of 108 m CGVD2013, at which point the pit lake will overflow to Moose River through a constructed spillway. The groundwater flow to the open pit remains at 408 m^3/d because the 108 m CGVD2013 level is below the natural groundwater elevation within the footprint of the open pit. However, at this elevation, there are both groundwater inflows to, and outflows from, the open pit that are not observed with the fully dewatered open pit where no outflows are observed and the inflow condition dominates.

The net baseflow to Moose River at SW-2 under pit full conditions is simulated to be 29,596 m^3/d. Compared to the existing conditions, the groundwater inflows to the Touquoy pit filled to 108 m CGVD2013 is anticipated to reduce the baseflow in Moose River at SW-2 by 1082 m^3/d. This accounts for 4.2% of the mean annual flow at Moose River at SW-2.

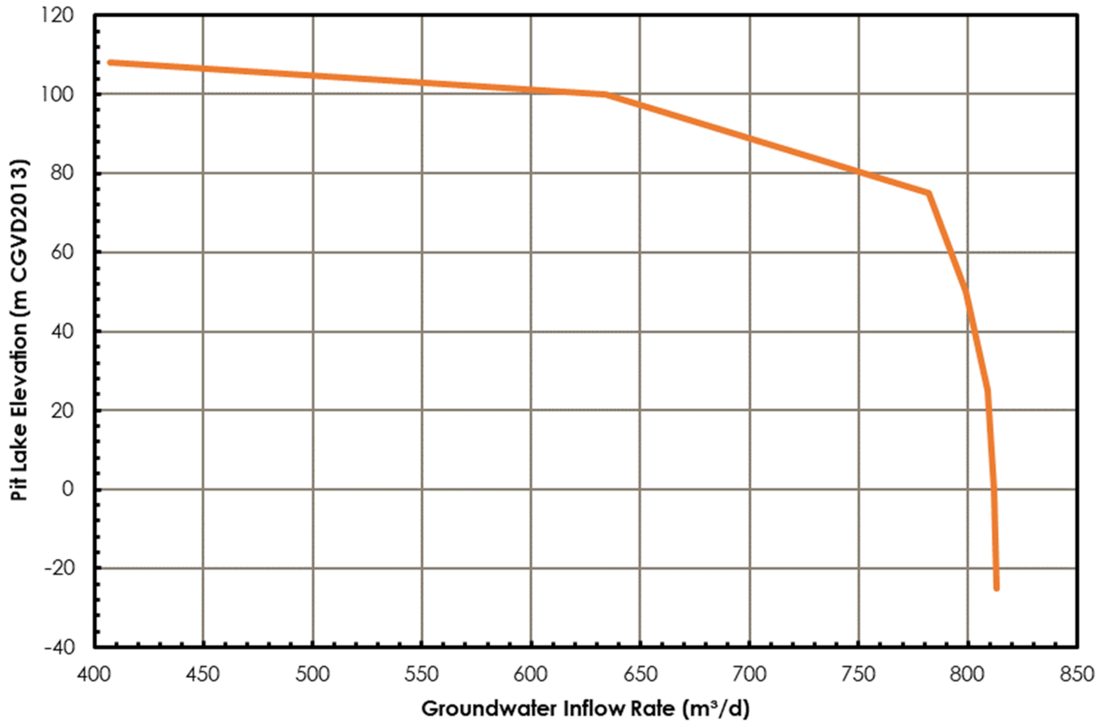


Figure 2.1 Simulated Groundwater Inflow Rates by Pit Lake Stage

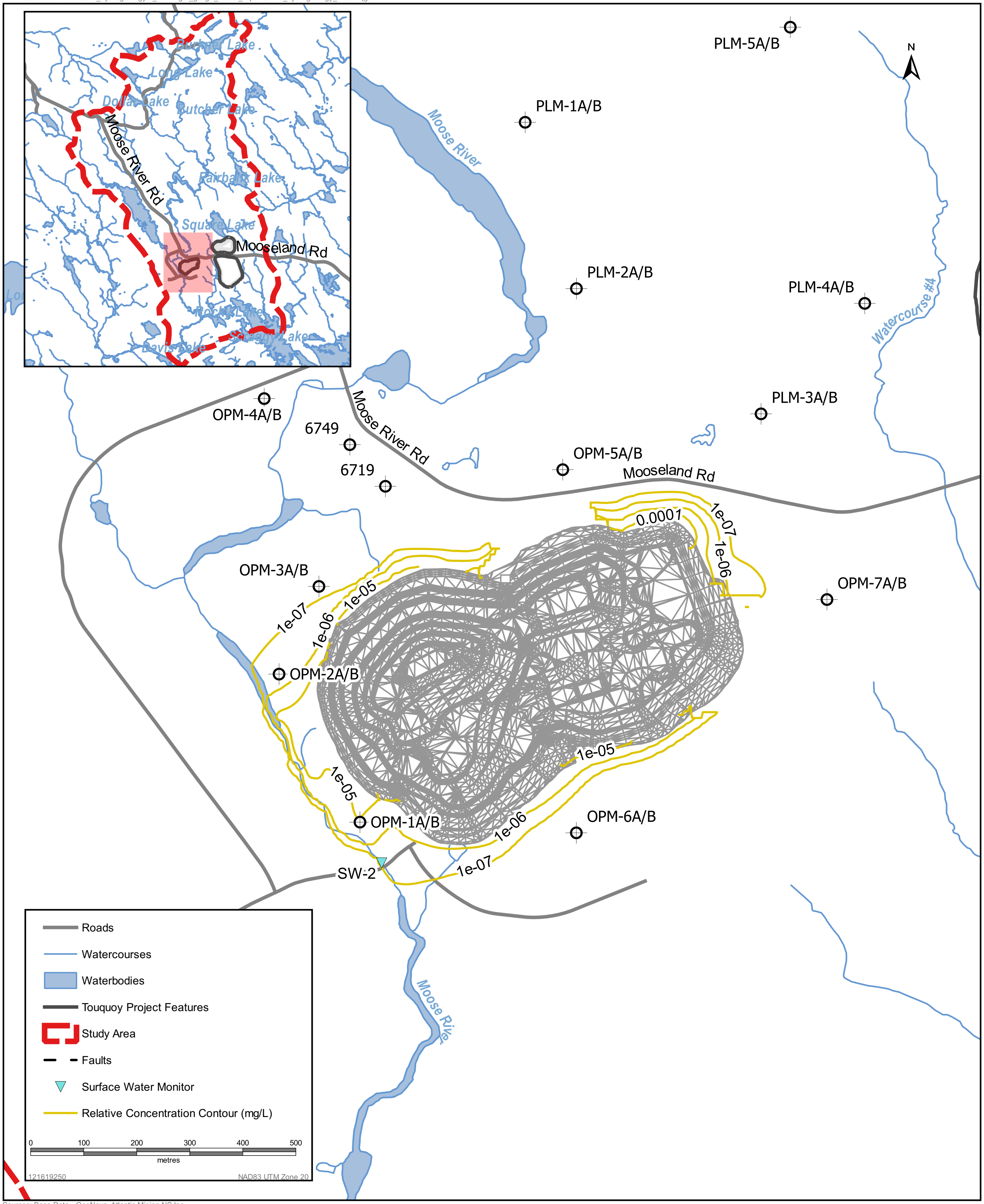
2.2 GROUNDWATER EFFECTS POST-CLOSURE

The disposal of tailings in the Touquoy open pit has the potential to degrade the water quality in the open pit. This water can then migrate from the open pit through groundwater and degrade the water quality in the receiving environments. Therefore, the transport of groundwater from the Touquoy pit to potential receptors was simulated by use of a solute transport model (MT3D-USGS) using the methodology described for the Beaver Dam tailings deposition (Stantec 2021a).

The simulation considers the transport of a conservative solute from the water in the open pit with a source concentration of 1 mg/L through the groundwater to the receiving environment over time. Solute transport was conducted for a period of 500 years. The water quality associated with the tailings pore water was determined by Lorax(2018), based on this assumption that the tailings from all projects would have the same characteristics as Touquoy based on the similarity in the characteristics of the source rock, and that the tailings will be produced by the same mill at the Touquoy site. The source terms concentrations (mg/L) for various parameters of concern determined by Lorax are presented on Table 2.1. These source terms are multiplied by the relative concentrations generated by the model to estimate the mass loading and average concentrations of groundwater discharging to surface water receptors. The water quality in the Touquoy pit lake above the tailings were conservatively assumed to have the same quality as the pore water in the tailings.

The predicted relative concentrations in groundwater originating from the filled open pit are presented on Figure 2.2. The relative concentrations are multiplied by the source term concentrations for the parameters of primary concern in the open pit to predict the concentrations and mass loadings to the receiving environment over time. The distributions of the concentrations after 500 years on Figure 2.3. These relative concentrations were multiplied by the source term concentrations for the various parameters of concern provided by Lorax (2018) to estimate the mass loading to, and average concentration in, Moose River over time, as shown on Tables 2.1 and 2.2, respectively.

The average concentrations of arsenic discharged to Moose River over the 500-year simulation period are shown on Figure 2.3. As shown on the figure, the average concentrations of arsenic (and other parameters) in the discharge to the river stabilize after about 100 years.



Sources: Base Data - GeoNova, Atlantic Mining NS Inc.

Relative Concentration Contours in Groundwater 500 Years following Pit Lake Stage Achieving 108 m CGVD2013

Stantec

Beaver Dam Gold Project

Figure 2.2

Table 2.1 Predicted Mass Loading to Moose River from Groundwater

Parameter	Source Term Concentration (mg/L)	Mass Loading (g/d)			
Elapsed Time (years)		10	50	100	500
Sulphate	897	1.8×10^{-1}	2.8×10^{-1}	3.1×10^{-1}	3.5×10^{-1}
Aluminum	0.0469	9.5×10^{-6}	1.5×10^{-5}	1.6×10^{-5}	1.8×10^{-5}
Silver	0.00001	2.0×10^{-9}	3.1×10^{-9}	3.5×10^{-9}	3.9×10^{-9}
Arsenic	3.07	6.2×10^{-4}	9.6×10^{-4}	1.1×10^{-3}	1.2×10^{-3}
Calcium	86.9	1.8×10^{-2}	2.7×10^{-2}	3.0×10^{-2}	3.4×10^{-2}
Cadmium	0.00002	4.1×10^{-9}	6.3×10^{-9}	7.0×10^{-9}	7.7×10^{-9}
Cobalt	0.0262	5.3×10^{-6}	8.2×10^{-6}	9.1×10^{-6}	1.0×10^{-5}
Chromium	0.0002	4.1×10^{-8}	6.3×10^{-8}	7.0×10^{-8}	7.7×10^{-8}
Copper	0.00937	1.9×10^{-6}	2.9×10^{-6}	3.3×10^{-6}	3.6×10^{-6}
Iron	0.0326	6.6×10^{-6}	1.0×10^{-5}	1.1×10^{-5}	1.3×10^{-5}
Mercury	0.000005	1.0×10^{-9}	1.6×10^{-9}	1.7×10^{-9}	1.9×10^{-9}
Magnesium	14.8	3.0×10^{-3}	4.6×10^{-3}	5.2×10^{-3}	5.7×10^{-3}
Manganese	0.37	7.5×10^{-5}	1.2×10^{-4}	1.3×10^{-4}	1.4×10^{-4}
Molybdenum	0.0603	1.2×10^{-5}	1.9×10^{-5}	2.1×10^{-5}	2.3×10^{-5}
Nickel	0.00685	1.4E-06	2.1E-06	2.4×10^{-6}	2.7×10^{-6}
Lead	0.0000248	5.0E-09	7.8E-09	8.7×10^{-9}	9.6×10^{-9}
Tin	0.00604	1.2E-06	1.9E-06	2.1×10^{-6}	2.3×10^{-6}
Selenium	0.000193	3.9E-08	6.0E-08	6.7×10^{-8}	7.5×10^{-8}
Tellurium	0.0000154	3.1E-09	4.8E-09	5.4×10^{-9}	6.0×10^{-9}
Uranium	0.00203	4.1E-07	6.3E-07	7.1×10^{-7}	7.9×10^{-7}
Zinc	0.0096	1.9E-06	3.0E-06	3.3×10^{-6}	3.7×10^{-6}
Weak Acid Dissociable Cyanide	0.005	1.0E-06	1.6E-06	1.7×10^{-6}	1.9×10^{-6}
Total Cyanide	0.087	1.8E-05	2.7E-05	3.0×10^{-5}	3.4×10^{-5}
Nitrate (as N)	0.053	1.1E-05	1.7E-05	1.8×10^{-5}	2.1×10^{-5}
Nitrite (as N)	0.11	2.2E-05	3.4E-05	3.8×10^{-5}	4.3×10^{-5}
Ammonia	34	6.9E-03	1.1E-02	1.2×10^{-2}	1.3×10^{-2}

Table 2.2 Predicted Average Groundwater Concentration Discharging to Moose River

Parameter	Source Term Concentration (mg/L)	Average Concentration (mg/L)			
Elapsed Time (years)		10	50	100	500
Sulphate	897	7.3×10^{-4}	1.1×10^{-3}	1.3×10^{-3}	1.4×10^{-3}
Aluminum	0.0469	3.8×10^{-8}	5.9×10^{-8}	6.6×10^{-8}	7.3×10^{-8}
Silver	0.00001	8.2×10^{-12}	1.3×10^{-11}	1.4×10^{-11}	1.6×10^{-11}
Arsenic	3.07	2.5×10^{-6}	3.9×10^{-6}	4.3×10^{-6}	4.8×10^{-6}
Calcium	86.9	7.1×10^{-5}	1.1×10^{-4}	1.2×10^{-4}	1.4×10^{-4}
Cadmium	0.00002	1.6×10^{-11}	2.5×10^{-11}	2.8×10^{-11}	3.1×10^{-11}
Cobalt	0.0262	2.1×10^{-8}	3.3×10^{-8}	3.7×10^{-8}	4.1×10^{-8}
Chromium	0.0002	1.6×10^{-10}	2.5×10^{-10}	2.8×10^{-10}	3.1×10^{-10}
Copper	0.00937	7.6×10^{-9}	1.2×10^{-8}	1.3×10^{-8}	1.5×10^{-8}
Iron	0.0326	2.7×10^{-8}	4.1×10^{-8}	4.6×10^{-8}	5.1×10^{-8}
Mercury	0.000005	4.1×10^{-12}	6.3×10^{-12}	7.0×10^{-12}	7.8×10^{-12}
Magnesium	14.8	1.2×10^{-5}	1.9×10^{-5}	2.1×10^{-5}	2.3×10^{-5}
Manganese	0.37	3.0×10^{-7}	4.6×10^{-7}	5.2×10^{-7}	5.8×10^{-7}
Molybdenum	0.0603	4.9×10^{-8}	7.6×10^{-8}	8.4×10^{-8}	9.4×10^{-8}
Nickel	0.00685	5.6×10^{-9}	8.6×10^{-9}	9.6×10^{-9}	1.1×10^{-8}
Lead	0.0000248	2.0×10^{-11}	3.1×10^{-11}	3.5×10^{-11}	3.9×10^{-11}
Tin	0.00604	4.9×10^{-9}	7.6×10^{-9}	8.5×10^{-9}	9.4×10^{-9}
Selenium	0.000193	1.6×10^{-10}	2.4×10^{-10}	2.7×10^{-10}	3.0×10^{-10}
Tellurium	0.0000154	1.3×10^{-11}	1.9×10^{-11}	2.2×10^{-11}	2.4×10^{-11}
Uranium	0.00203	1.7×10^{-9}	2.6×10^{-9}	2.8×10^{-9}	3.2×10^{-9}
Zinc	0.0096	7.8×10^{-9}	1.2×10^{-8}	1.3×10^{-8}	1.5×10^{-8}
Weak Acid Dissociable Cyanide	0.005	4.1×10^{-9}	6.3×10^{-9}	7.0×10^{-9}	7.8×10^{-9}
Total Cyanide	0.087	7.1×10^{-8}	1.1×10^{-7}	1.2×10^{-7}	1.4×10^{-7}
Nitrate (as N)	0.053	4.3×10^{-8}	6.7×10^{-8}	7.4×10^{-8}	8.2×10^{-8}
Nitrite (as N)	0.11	9.0×10^{-8}	1.4×10^{-7}	1.5×10^{-7}	1.7×10^{-7}
Ammonia (as N)	34	2.8×10^{-5}	4.3×10^{-5}	4.8×10^{-5}	5.3×10^{-5}

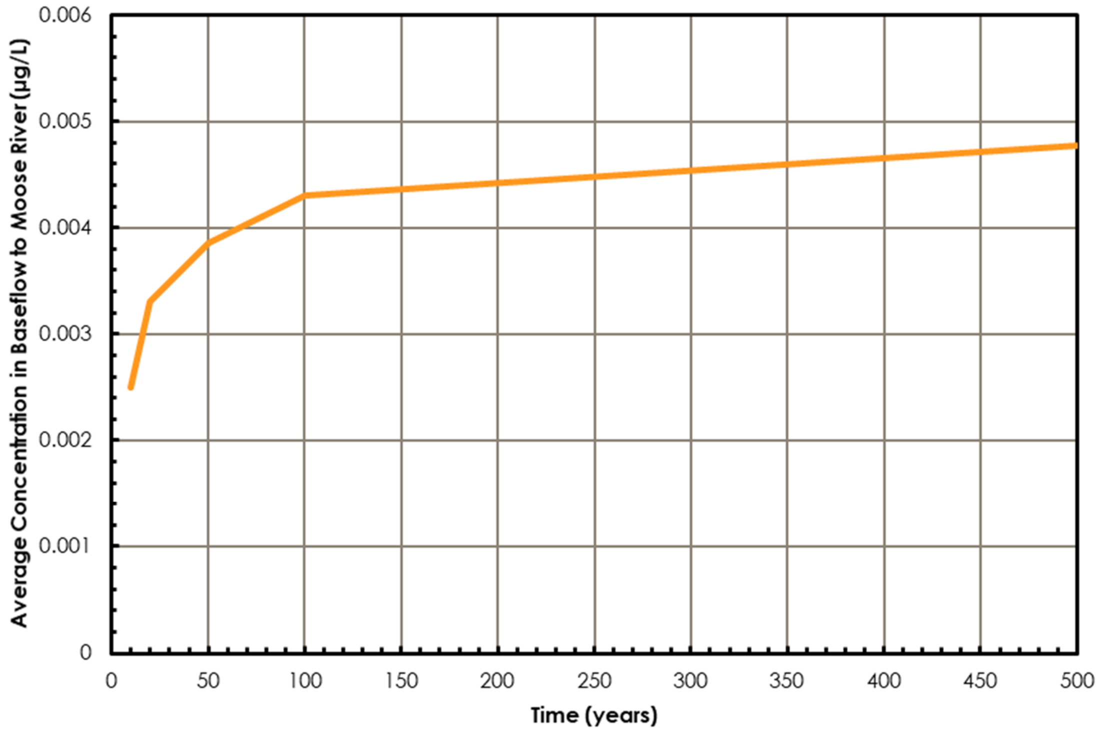


Figure 2.3 Simulated average concentrations of arsenic discharged to Moose River in groundwater seepage

3.0 WATER BALANCE MODELLING

The water balance model was used to predict the amount of water and tailings stored in the pit over the simulation period for the cumulative processing of ore from the four projects. The water balance modelling was conducted using the approach described in Stantec 2021c, with the following modifications:

- The groundwater flow rates during and after pit filling were adjusted to 813 m³/d and 408 m³/d as described in Section 2
- The area of the open pit was increased to 315,737 m²
- The elevation-storage relationship in the open pit was adjusted based on the expanded open pit, as shown on Figure 3.1
- The area of the waste rock storage area was increased to 424,600 m²
- The total volume of ore and ore concentrates was increased as shown in Section 1

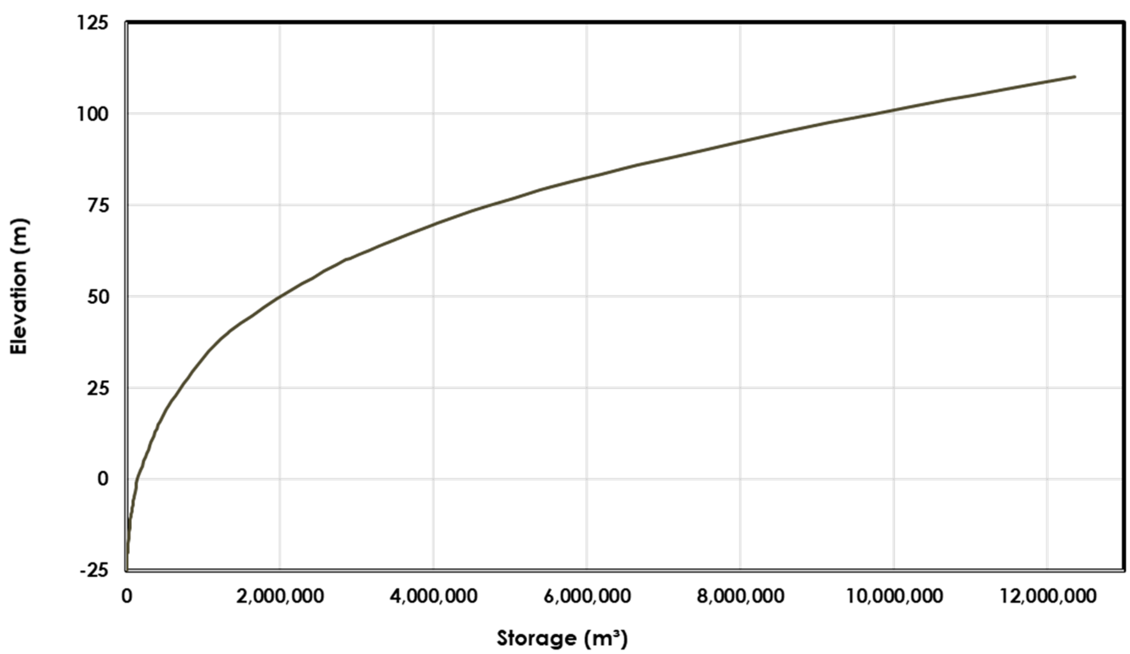


Figure 3.1 Elevation-Storage Relationship for Expanded Touquoy Open Pit

Tailings will be deposited in the exhausted Touquoy pit for a total of 47 months reaching an elevation in the pit of 94.0 m CGVD2013. As presented in the Touquoy Gold Mine Project Reclamation Plan (Stantec 2017), 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 48 months or a total of 95 months from commencement of tailings deposition in the exhausted Touquoy pit to fill the pit to the spillway invert elevation. Figures 3.2 and 3.3 illustrate the predicted water and tailings elevation and storage volume in the exhausted Touquoy pit over a 10-year simulation period, respectively.

The model simulated the predicted month of operation when the source of reclaim water is relocated from the TMF to the Touquoy pit from commencement of tailings, and the monthly volume of water spilled and conveyed to Moose River during closure. During closure, the flow volume to Moose River is simulated to be similar to pre-development conditions of the mine site.

Based on results of the water balance model, process water can be reclaimed from the TMF for approximately three to seven months depending on the climatic conditions and with no water discharged to the effluent treatment plant during this time to maintain the reservoir supply. When the TMF pond volume is no longer adequate for process water supply, process water will be reclaimed from the Touquoy pit as a closed loop, with the exception of freshwater make-up from Scraggy Lake.

As shown on Figure 3.2, the pond volume increases as tailings slurry is discharged to the pit, and starts to decrease when the process water reclaim barge is relocated to the Touquoy pit. Water supply in the Touquoy pit is adequate for operation of the Project under normal and wet climate conditions, considering the 5.8% fresh water make-up from Scraggy Lake. Should operation commence under dry climate conditions, there will be little water available in the TMF for reclaim and insufficient time to store water in the Touquoy pit prior to start-up. The water balance simulated a water deficit under dry climate conditions that would require takings exceeding the permitted water volume from Scraggy Lake for Touquoy operation. Therefore, under dry climate conditions or based on the operational requirements of pumping infrastructure, start-up water in the Touquoy pit may be supplied from Scraggy lake (subject to provincial permitting) and/or effluent from the effluent treatment plant.

As mill production rates are simulated to remain consistent throughout the processing of ores from all projects, the existing Touquoy reclaim water lines and tailings slurry lines are anticipated to be adequate both in capacity and length for continued ore processing. Additional lift booster pumps may be required to reclaim water from the Touquoy pit. Methods for tailings deposition in the Touquoy pit will differ during cold and mild climatic conditions and the tailings deposition progress should be monitored and updated as more information becomes available.

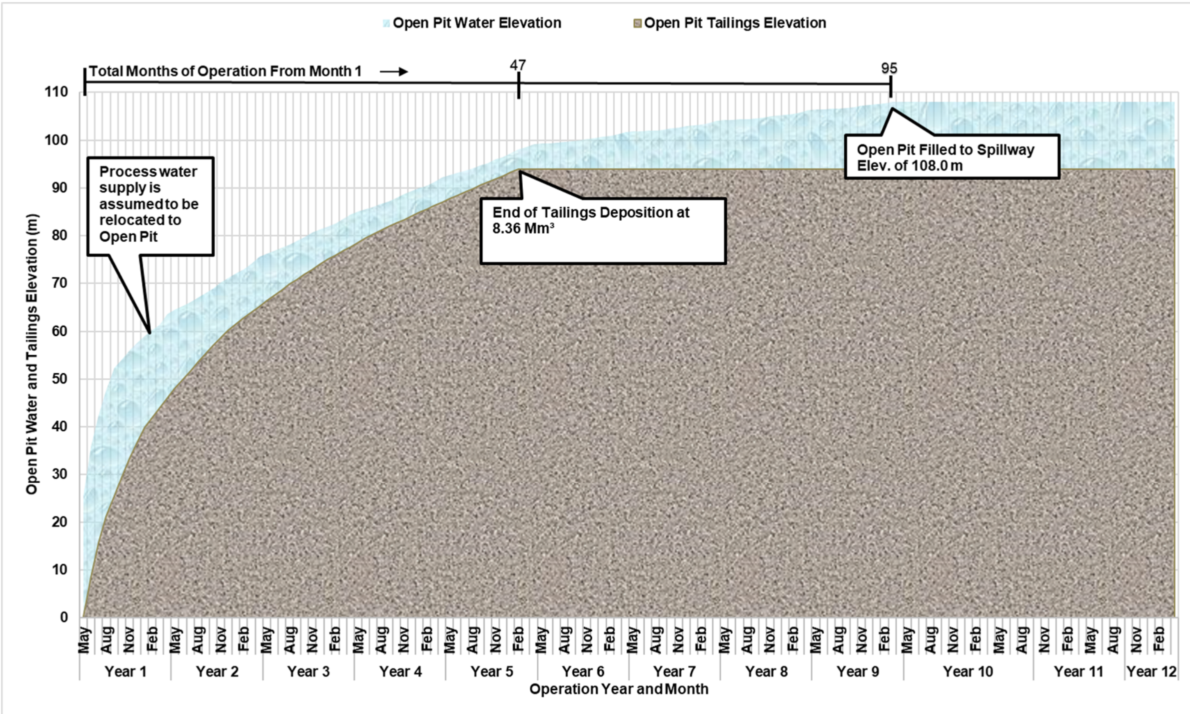


Figure 3.2 Predicted Water and Tailings Elevation in Expanded Touquoy Open Pit

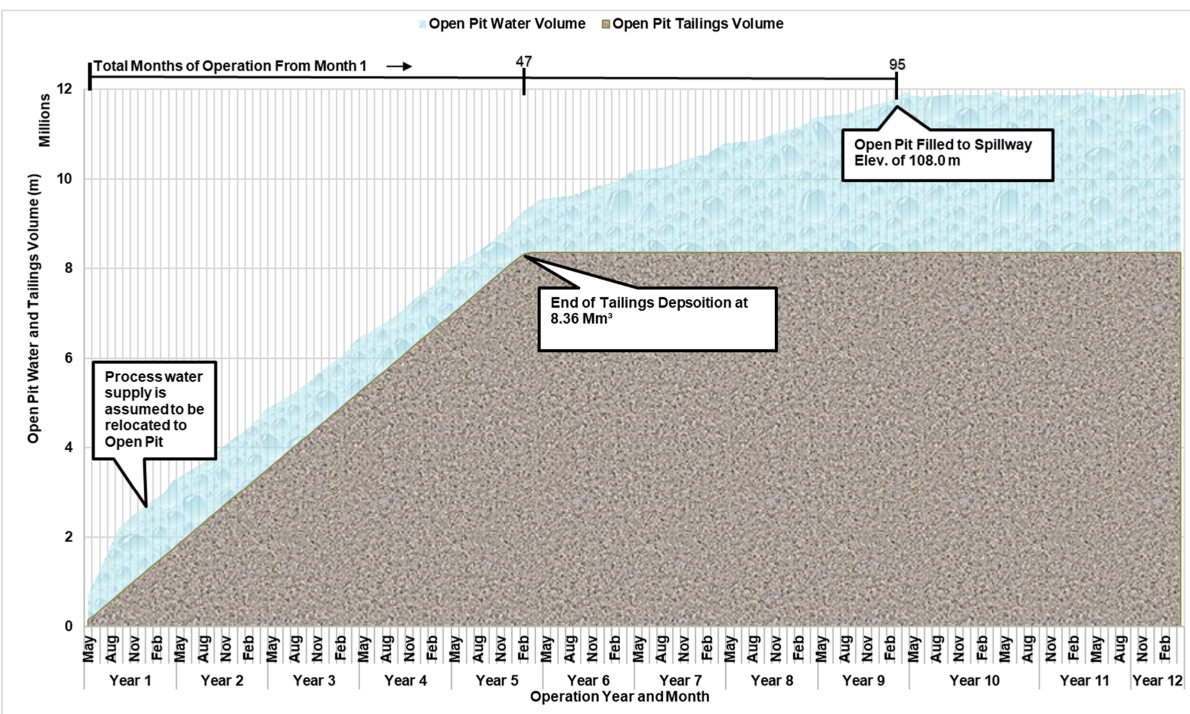


Figure 3.3 Predicted Water and Tailings Storage in Expanded Touquoy Open Pit

4.0 ASSIMILATIVE CAPACITY MODELLING

The cumulative effects of processing Beaver Dam and Touquoy ores with Fifteen Mile Stream and Cochrane Hill ore concentrates was simulated as part of the Beaver Dam EIS. The assimilative capacity model developed for the Beaver Dam Project (Stantec 2021c) was updated based on the changes to groundwater quality predicted in Section 2, and the water quality modelling from Section 3. The 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 pit and the water quality of the mixture based on the geochemistry of the individual water quality parameters using source terms presented by Lorax (2018). The 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.

The updated water quality modelling presented in Section 3 shows that the pit lake is simulated to reach the spillway elevation in March of Year 9 of the operation of the expanded Touquoy pit for tailings disposal. The corresponding water quality model predicted elevated concentrations of arsenic, cobalt, copper, nitrate, nitrite as summarized in Table 4.1 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 4.1 Predicted Water Quality Concentrations to Moose River, Not Considering Water Treatment

Parameter	Effluent Discharge Concentration (mg/L) in Year 9-10	Groundwater Seepage Concentration (mg/L) in Year 50	Schedule 4 Limits MDMER Monthly Mean Concentration (mg/L)
Sulphate	244	1.1×10^{-3}	
Aluminum	0.044	5.9×10^{-8}	
Arsenic	**0.94**	1.3×10^{-11}	0.30
Calcium	68.9	3.9×10^{-6}	
Cadmium	0.00001	1.1×10^{-4}	
Cobalt	0.071	2.5×10^{-11}	
Chromium	0.0004	3.3×10^{-8}	
Copper	0.039	2.5×10^{-10}	0.30
Iron	0.037	1.2×10^{-8}	
Mercury	0.000021	4.1×10^{-8}	
Magnesium	6.4	6.3×10^{-12}	
Manganese	0.139	1.9×10^{-5}	

Table 4.1 Predicted Water Quality Concentrations to Moose River, Not Considering Water Treatment

Parameter	Effluent Discharge Concentration (mg/L) in Year 9-10	Groundwater Seepage Concentration (mg/L) in Year 50	Schedule 4 Limits MDMER Monthly Mean Concentration (mg/L)
Molybdenum	0.009	4.6×10^{-7}	
Nickel	0.018	7.6×10^{-8}	0.50
Lead	0.0003	8.6×10^{-9}	0.10
Selenium	0.0008	3.1×10^{-11}	
Silver	0.00004	7.6×10^{-9}	
Uranium	0.0046	2.4×10^{-10}	
Zinc	0.0027	1.9×10^{-11}	0.5
Weak Acid Dissociable Cyanide	0.134	2.6×10^{-9}	0.5
Total Cyanide	0.384	1.2×10^{-8}	
Nitrate (as N)	5.90	6.3×10^{-9}	
Nitrite (as N)	0.63	1.1×10^{-7}	
Ammonia	1.68 (0.006 unionized)	6.7×10^{-8}	0.50 (Unionized)

Note: **Bold** indicates an exceedance of MDMER discharge limit without treatment
Monthly unionized ammonia calculated from average monthly field pH and temperatures

Similar to the approach used in the Beaver Dam assimilative capacity modelling (Stantec 2021c), 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 the pit lake is simulated to take about 10 years to fill from commencement of tailings deposition in the exhausted Touquoy pit, the final water treatment design will be fully developed during operation and pit filling.

As presented in the assimilative capacity study of Moose River by Stantec (2021c), the effluent concentrations under normal discharge from the filled exhausted 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 exhausted Touquoy pit and Moose River. Based on results of the assimilative capacity model (Stantec 2021c), once mixed with the background water quality in Moose River, the concentration 100 m downstream of SW-2 is predicted to be 0.0238 mg/L for arsenic and 0.184 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 75th 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).

Groundwater seepage discharging to Moose River will be consistent between scenarios and therefore groundwater quality predictions are also consistent with the Beaver Dam project.

5.0 CONCLUSIONS

The cumulative effects of the disposal of tailings from the processing of ore from the Beaver Dam project with ore from the Touquoy project and ore concentrates from the Fifteen Mile Stream and Cochrane Hill projects were assessed by adjusting the models used to develop the effects assessment for the Beaver Dam project (Stantec 2021a, b, c). These models were also updated to reflect the proposed expansion of the Touquoy open pit.

Three-dimensional steady-state groundwater flow and solute transport modelling was used to simulate groundwater conditions for the disposition of tailings in the expanded Touquoy open pit. Upon the filling of the open pit to its ultimate lake stage at 108 m CGVD2013, groundwater flow is anticipated to flow from the pit to Moose River through the glacial till and weathered fractured bedrock. Solute transport in this case is dominated by advection (movement with the flow of groundwater). The open pit is predicted to capture between 408 and 813 m^3/d of groundwater. Solute transport modelling using the model simulates a slow migration of solutes to Moose River, with concentrations approaching a steady state after about 100 years of travel. These effects are slightly larger than those predicted for the Beaver Dam Gold Project, considering the larger footprint occupied by the expanded Touquoy open pit.

The water balance model developed for assessing the refilling of the open pit, and the eventual overflow of effluent to Moose River was updated based on the updated groundwater inflow rates, the increased deposition of tailings, and the expansion of the Touquoy open pit. The changes result in pit filling times of about 10 years following the initial placement of tailings in the Touquoy open pit, and effluent concentrations that generally meet MDMER without treatment, with the exception of arsenic. Therefore, it is predicted that some water treatment will continue to be required to meet MDMER discharge limits.

The effects of the cumulative discharge of effluent from the Touquoy open pit, combined with groundwater discharge, indicates that the water quality from the Touquoy open pit at or below MDMER discharge limits will meet CCME FAL or NSE Tier 1 EQS guidelines for parameters with the exception of arsenic. An assessment of the potential environmental effects of elevated arsenic in the downstream environment in Moose River are presented in Intrinsik (2021) and the cumulative effects of operating the four projects are not likely to result in adverse arsenic concentrations for the existing aquatic environment.

6.0 REFERENCES

Intrinsik Corp. 2021. Evaluation of Potential for Aquatic Effects as a Result of Effluent Releases Related to Beaver Dam 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). 2017. Reclamation Plan Rev. 1, Touquoy Gold Project. Prepared for Atlantic Gold Corp. Rev. 1.

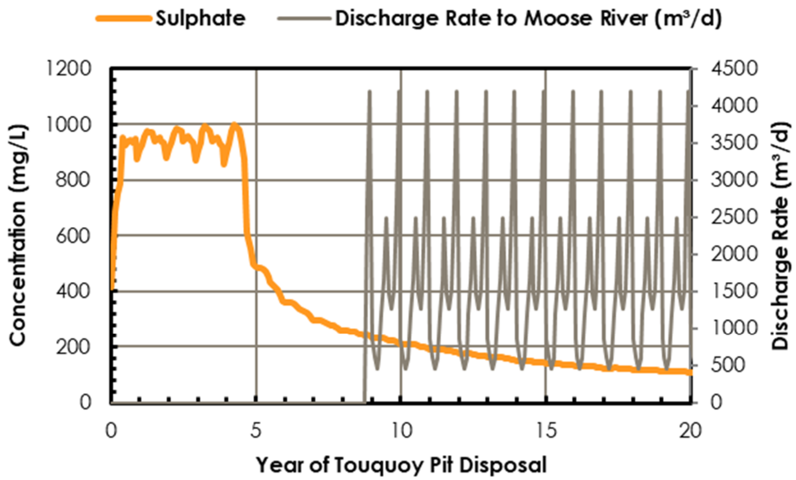
Stantec Consulting Ltd. (Stantec). 2021a. Groundwater Flow and Solute Transport Modelling to Evaluate Disposal of Tailings in Exhausted Touquoy Pit. Prepared for Atlantic Mining NS Inc.

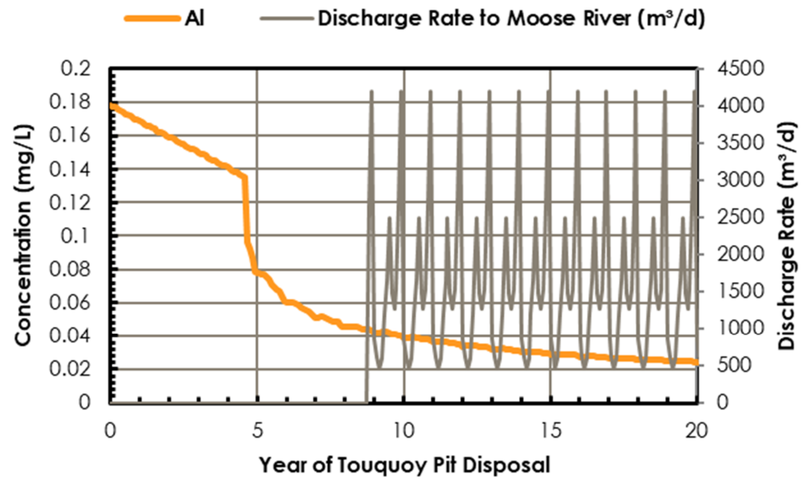
Stantec Consulting Ltd. 2021b. Touquoy Integrated Water and Tailings Management Plan – Beaver Dam Gold Project. Prepared for Atlantic Mining NS Inc.

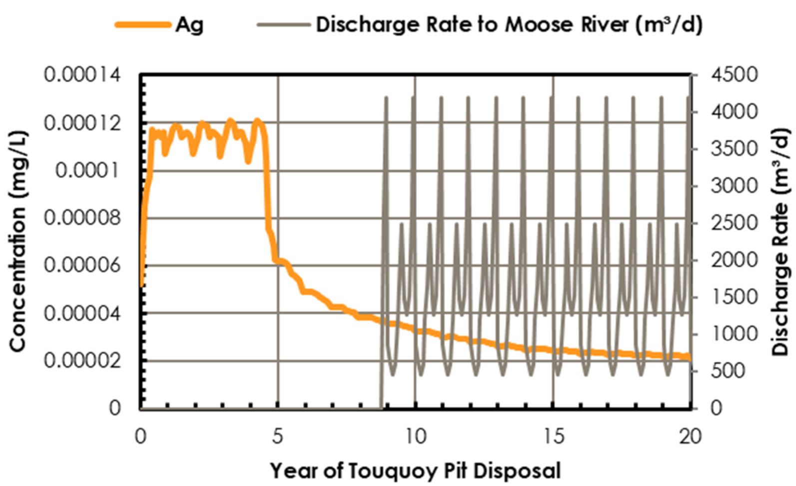
Stantec Consulting Ltd. 2021c. Beaver Dam Assimilative Capacity Study of Moose River – Touquoy Pit Discharge. Prepared for Atlantic Mining NS Inc.

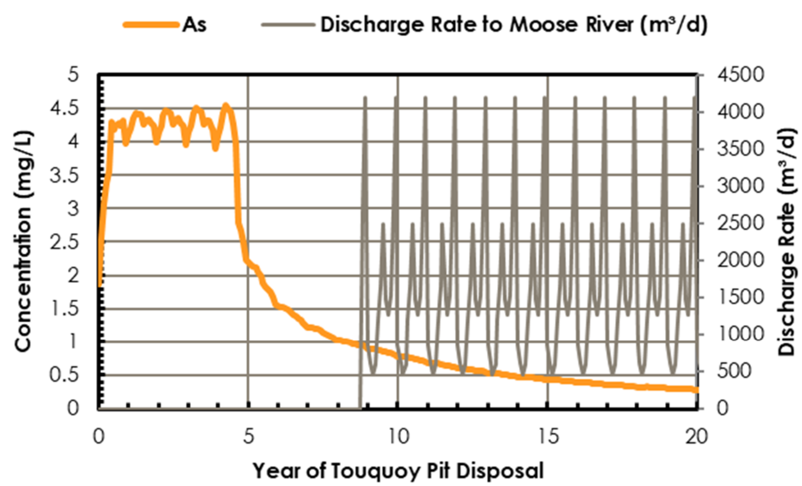
APPENDIX A

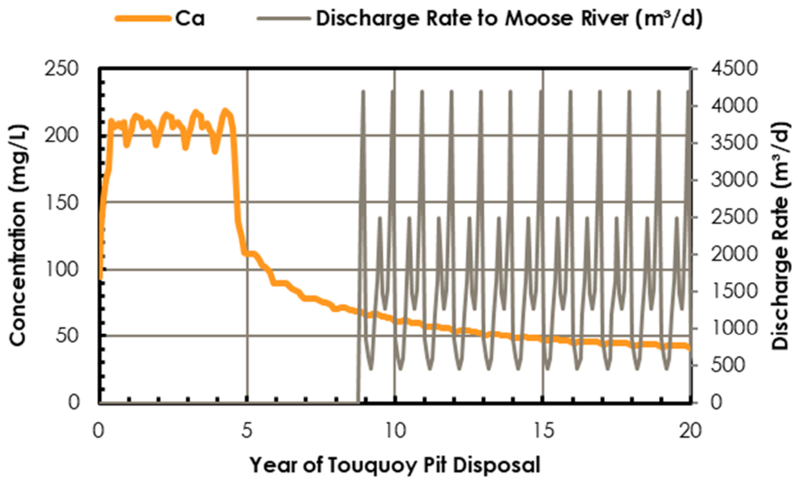
Effluent Water Quality from Expanded Touquoy Open Pit


Sulphate
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
Year of Touquoy Pit Disposal
1200
1000
800
600
400
200
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
5
10
15
20

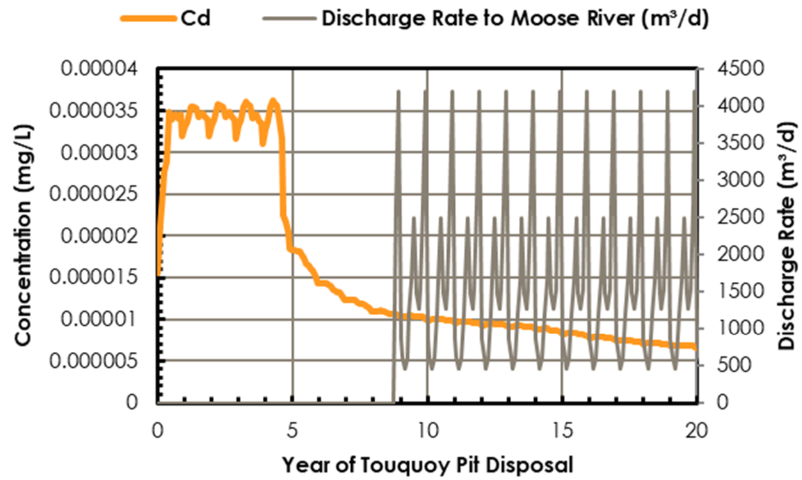

Al
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
Year of Touquoy Pit Disposal
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
5
10
15
20


Ag
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
Year of Touquoy Pit Disposal
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
5
10
15
20

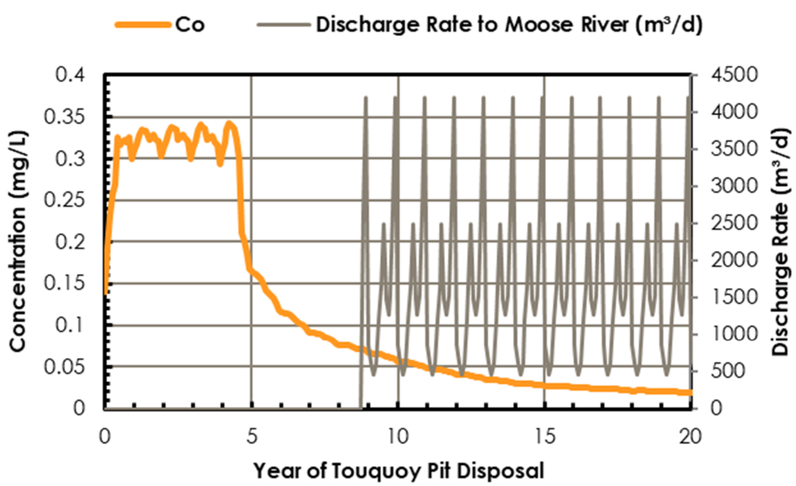

As
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
Year of Touquoy Pit Disposal
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
5
10
15
20



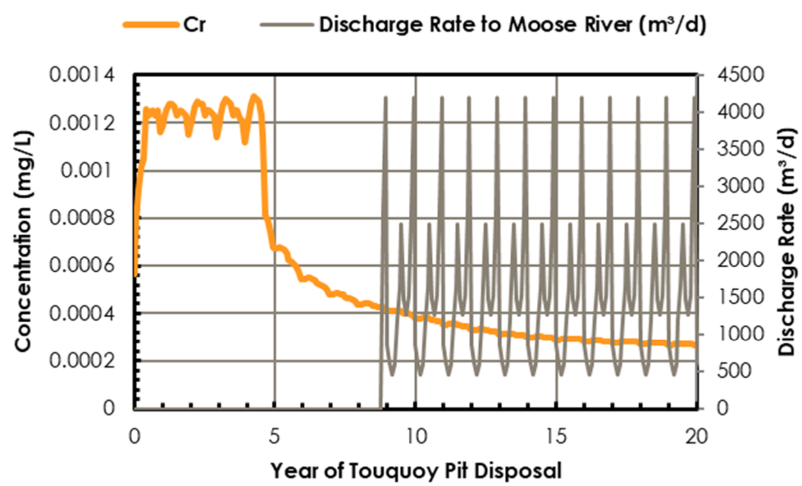
Ca
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
250
200
150
100
50
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Discharge Rate (m³/d)
0
5
10
15
20
Year of Touquoy Pit Disposal



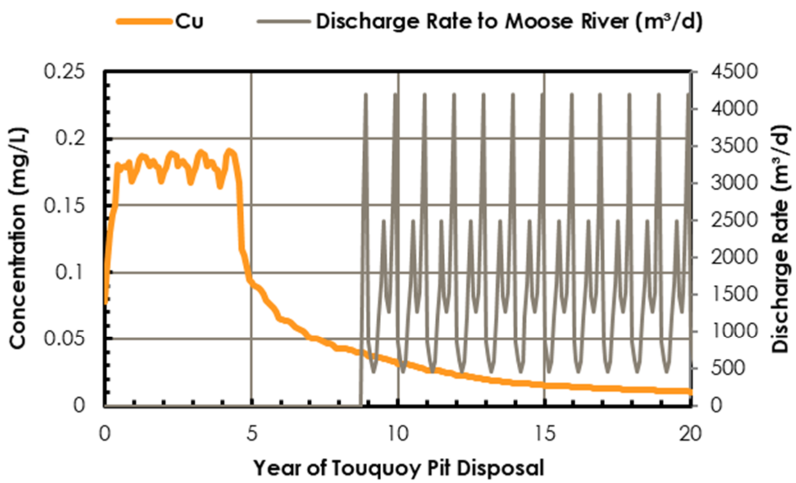
Cd
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
0.00004
0.000035
0.00003
0.000025
0.00002
0.000015
0.00001
0.000005
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Discharge Rate (m³/d)
0
5
10
15
20
Year of Touquoy Pit Disposal

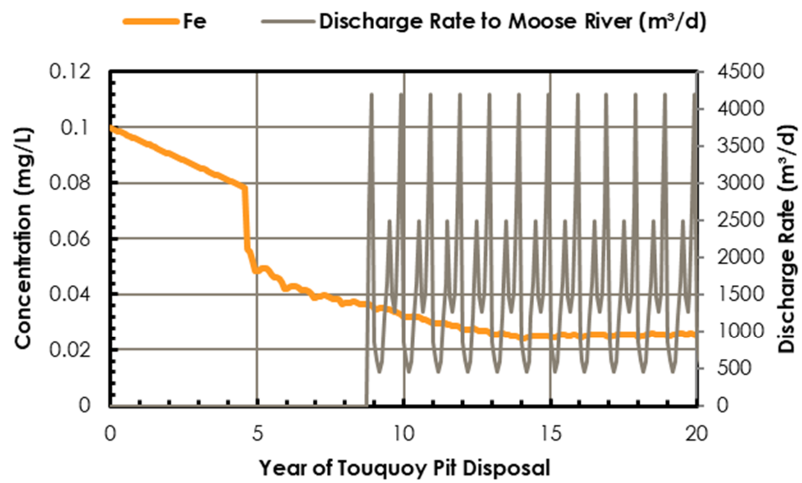


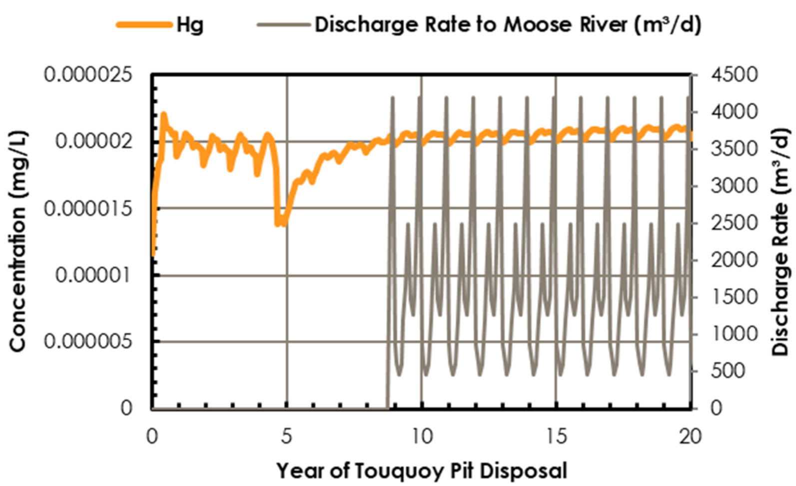
Co
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Discharge Rate (m³/d)
0
5
10
15
20
Year of Touquoy Pit Disposal

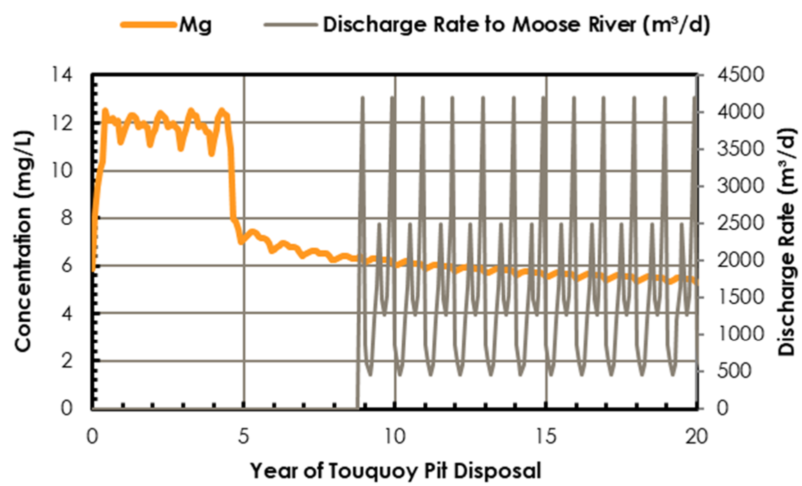


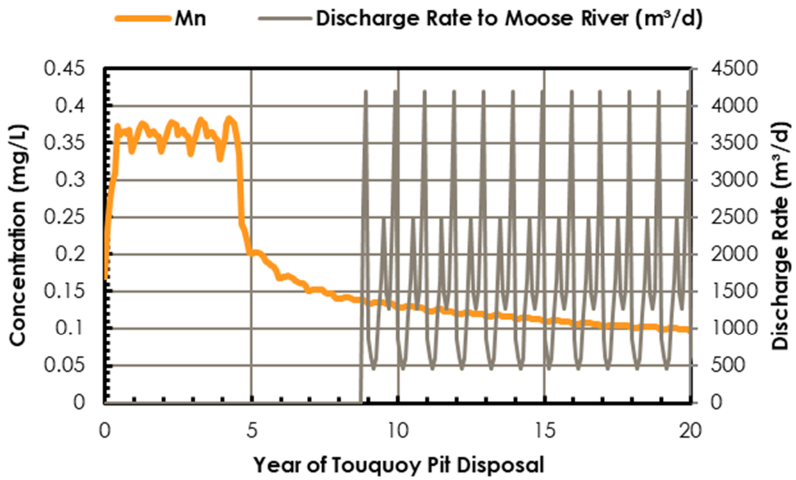
Cr
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Discharge Rate (m³/d)
0
5
10
15
20
Year of Touquoy Pit Disposal

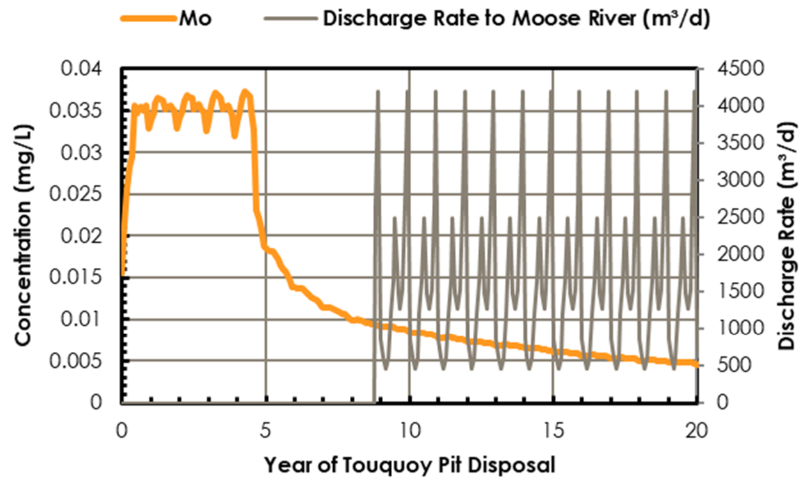

Cu
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
0.25
0.2
0.15
0.1
0.05
0
Discharge Rate (m³/d)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
Year of Touquoy Pit Disposal

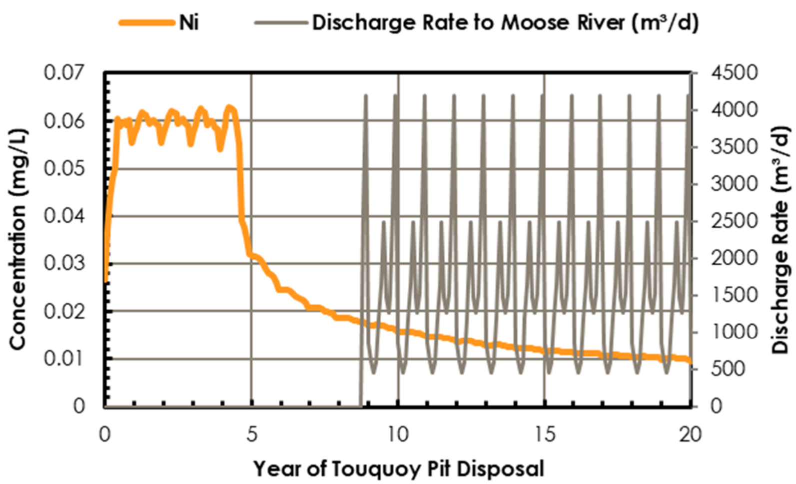

Fe
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
Discharge Rate (m³/d)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
Year of Touquoy Pit Disposal

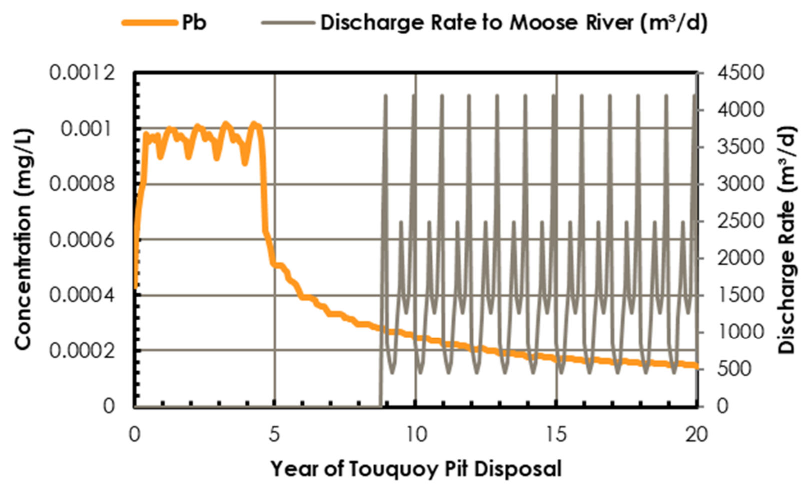

Hg
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
0.000025
0.00002
0.000015
0.00001
0.000005
0
Discharge Rate (m³/d)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
Year of Touquoy Pit Disposal

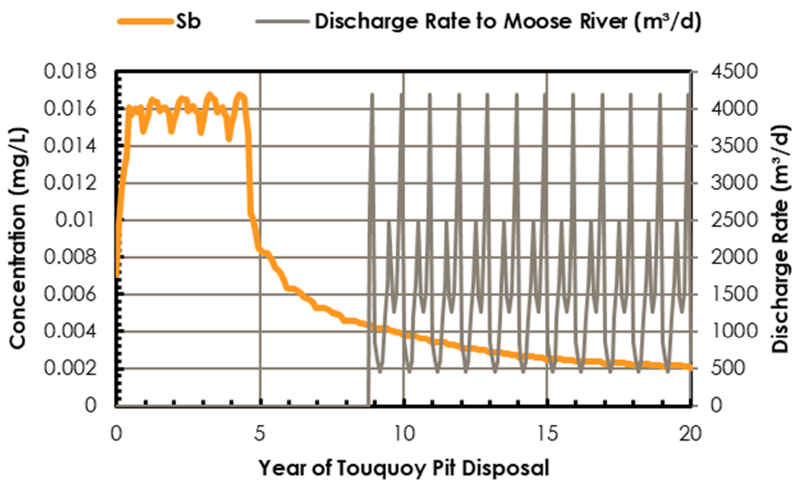

Mg
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
14
12
10
8
6
4
2
0
Discharge Rate (m³/d)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
5
10
15
20
Year of Touquoy Pit Disposal

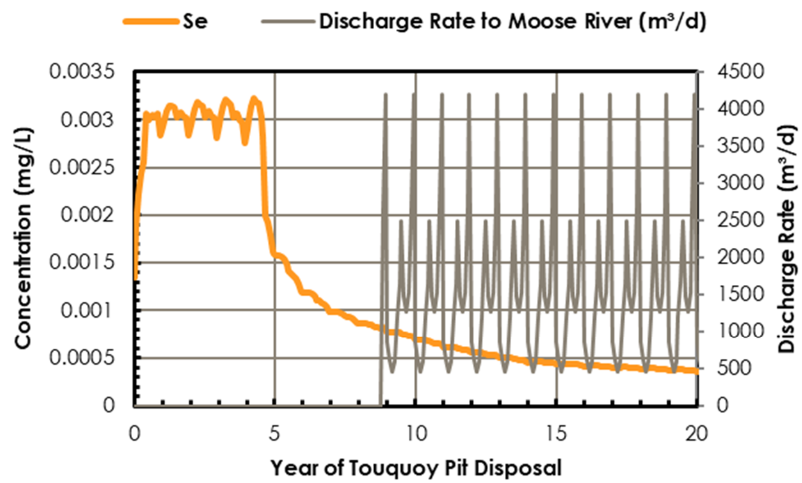

Mn
Discharge Rate to Moose River (m³/d)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Concentration (mg/L)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Discharge Rate (m³/d)
0
5
10
15
20
Year of Touquoy Pit Disposal

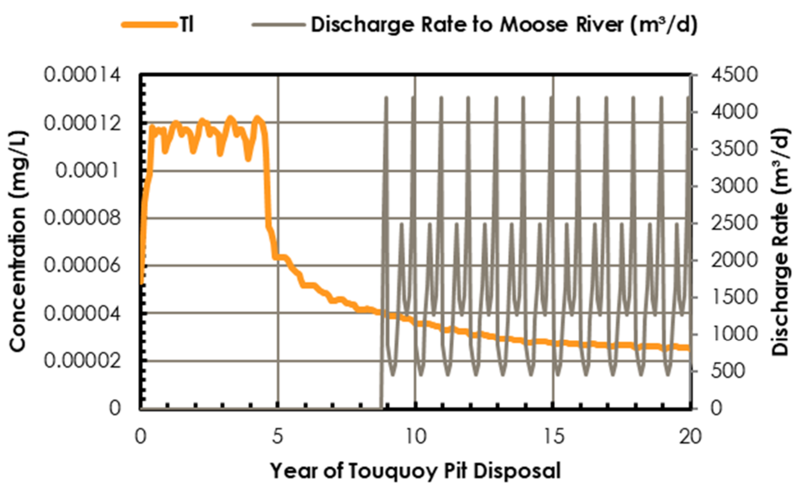

Mo
Discharge Rate to Moose River (m³/d)
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Concentration (mg/L)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Discharge Rate (m³/d)
0
5
10
15
20
Year of Touquoy Pit Disposal

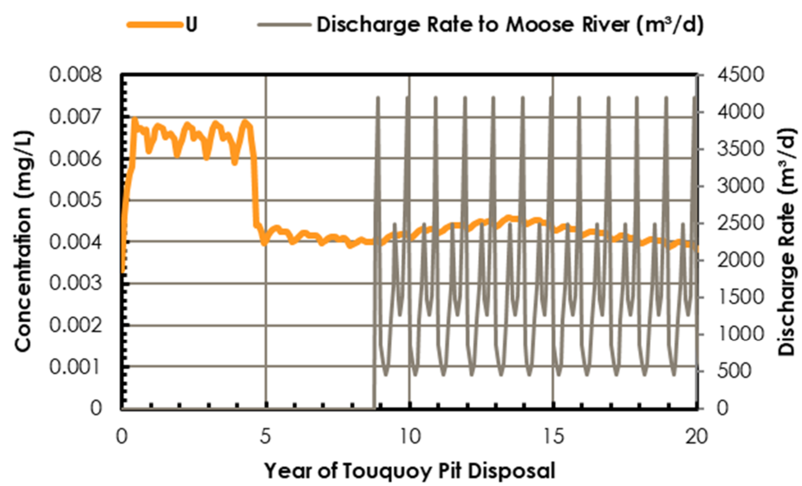

Ni
Discharge Rate to Moose River (m³/d)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Concentration (mg/L)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Discharge Rate (m³/d)
0
5
10
15
20
Year of Touquoy Pit Disposal

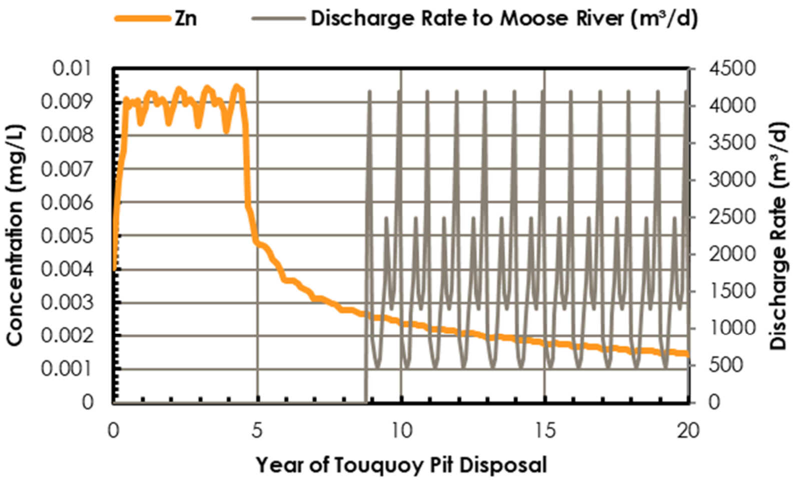

Pb
Discharge Rate to Moose River (m³/d)
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Concentration (mg/L)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Discharge Rate (m³/d)
0
5
10
15
20
Year of Touquoy Pit Disposal

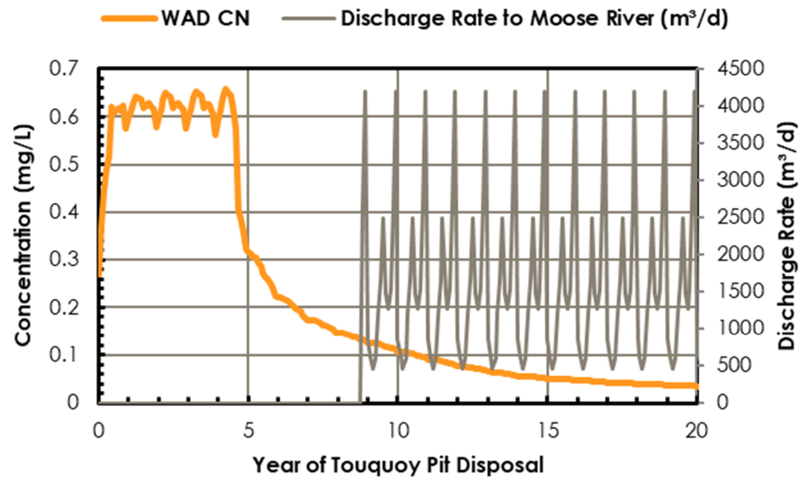

Sb
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
Year of Touquoy Pit Disposal

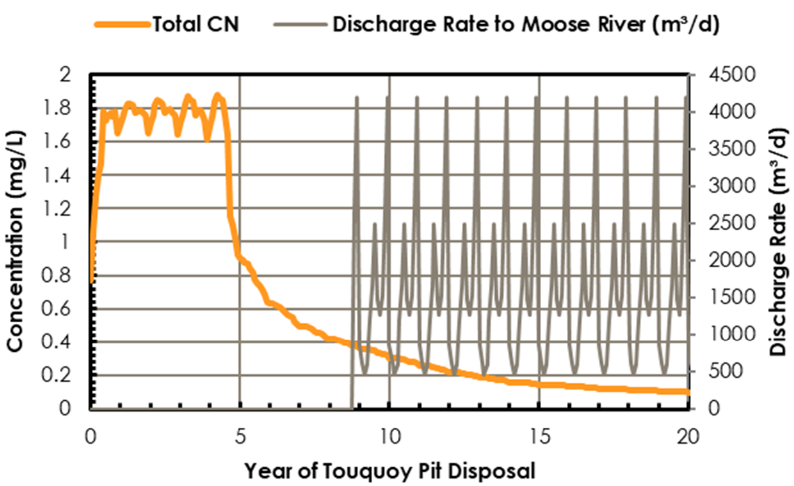

Se
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
Year of Touquoy Pit Disposal

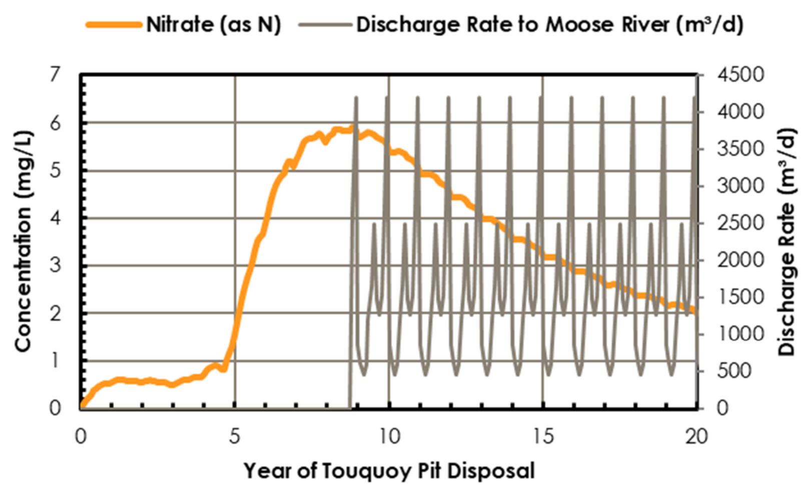

Tl
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
Year of Touquoy Pit Disposal

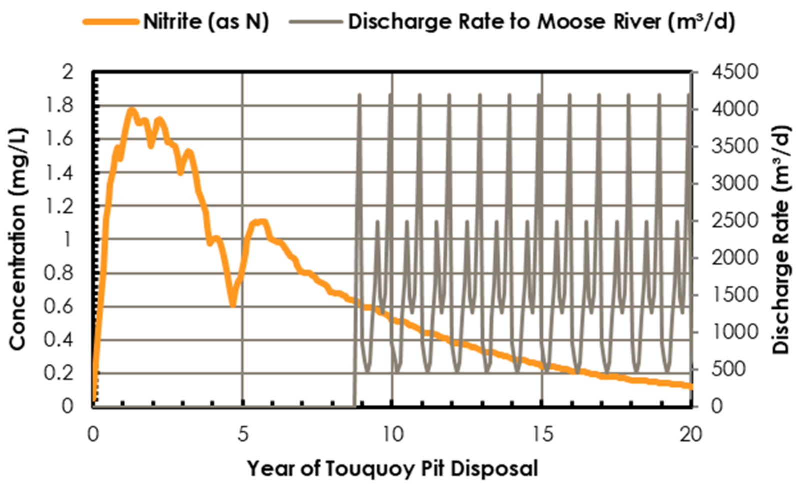

U
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
Year of Touquoy Pit Disposal

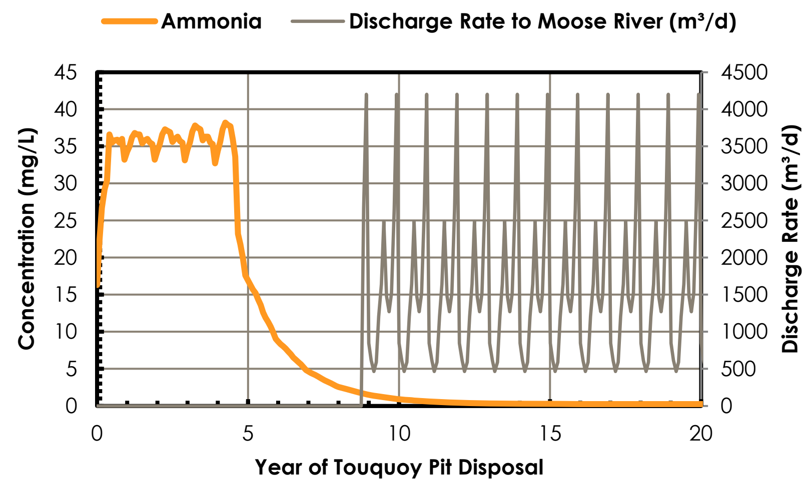

Zn
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
Year of Touquoy Pit Disposal
0.01 0.009 0.008 0.007 0.006 0.005 0.004 0.003 0.002 0.001 0
4500 4000 3500 3000 2500 2000 1500 1000 500 0
0 5 10 15 20


WAD CN
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
Year of Touquoy Pit Disposal
0.7 0.6 0.5 0.4 0.3 0.2 0.1 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)
Year of Touquoy Pit Disposal
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


Nitrate (as N)
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
Year of Touquoy Pit Disposal
7 6 5 4 3 2 1 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)
Year of Touquoy Pit Disposal
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
500
1000
1500
2000
2500
3000
3500
4000
4500
0
5
10
15
20


Ammonia
Discharge Rate to Moose River (m³/d)
Concentration (mg/L)
Discharge Rate (m³/d)
Year of Touquoy Pit Disposal
0
5
10
15
20
25
30
35
40
45
0
500
1000
1500
2000
2500
3000
3500
4000
4500
0
5
10
15
20