EVALUATION OF THE CONSEQUENCE OF A FAILURE OF THE TAILINGS STORAGE FACILITY (TSF)

1.0 Introduction and Approach

As part of the feedback provided by the Agency with respect to the Round 1 information requests, it was requested that Treasury Metals provide an assessment of the potential effects of tailings storage facility (TSF) failure on the environment, and carry this assessment through to a significance determination. Additionally, it was indicated that Treasury Metals should clearly define and apply significance criteria, including magnitude, extent, duration, frequency, reversibility and context as applicable. It is important to point out that such a requirement is not consistent with the EIS Guidelines (CEAA, 2013) for the Project. Section 7.2.1 of the EIS Guidelines (CEAA, 2013) states the following:

> *The proponent will identify the probability of potential accidents and malfunctions related to the project, including an explanation of how those events were identified, potential consequences (including the environmental effects), the plausible worst case scenarios and the effects of these scenarios.*

The EIS Guidelines (CEAA, 2013) for the project go on to state that the EIS should include "…an identification of the magnitude of an accident and/or malfunction, including the quantity, mechanism, rate, form and characteristics of the contaminants and other materials likely to be released into the environment during the accident and malfunction events."

In order to move the EIS through the assessment process, Treasury Metals have undertaken an expanded evaluation of the effects associated with the highly unlikely scenario of a failure of the TSF. In keeping with the EIS Guidelines (CEAA, 2013), the expanded evaluation will focus on describing the "consequence" of the highly unlikely failure of the TSF. In describing the consequence of a TSF failure, the predicted effects to the environment will be characterized using the following descriptors:

- Magnitude;
- Extent;
- Timing;
- Duration;
- Frequency;
- Likelihood; and
- Irreversibility.

Although these descriptors appear similar to the ones used for determining the significance of residual adverse effects for the Project (presented in Section 8 of the revised EIS), they are evaluated and applied in a different and unique manner specifically for evaluating the consequence of the highly unlikely scenario of a failure of the TSF. The approach used is consistent with the requirements of the EIS Guidelines (CEAA, 2013). The use of the above specific nomenclature was to satisfy a specific request from the Agency. It should be noted that while the above listing includes both the "frequency" or "likelihood" descriptors, this is redundant as the requested analysis focusses on the highly unlikely scenario of a failure of the TSF. For each of the descriptors considered, "low", "medium" and "high" levels have been assigned as described in Table 1-1. For this reason, a descriptor called "irreversibility" has been used in place of the "reversibility" descriptor suggested by the Agency. The reason for doing this was to ensure consistency across how the descriptors are used. For all of the other descriptors, the "high" level indicates effects of greater consequence. However, a "high" level of reversibility would be an effect that was readily reversible, and thus of a lower consequence.

Table 1-1: Methods for Assigning Consequence Descriptors

Descriptor	Low	Medium	High
Magnitude	Magnitude is assigned based on the component of the environment considered		
Extent	Effect restricted to the land between the TSF and Blackwater Creek	Effects are restricted to Blackwater Creek	Effects extend into Wabigoon Lake
Timing	Timing is assigned based on the component of the environment considered.		
Duration	The effect lasts a period of hours to days.	The effect lasts a period of days to months.	The effect lasts a period of years.
Frequency	Occurs infrequently.	Occurs intermittently.	Occurs frequently or continuously.
Likelihood	Highly unlikely.	Unlikely.	Likely.
Irreversibility	Effects can be reversed within a period of days.	Effects can be reversed within a period of years.	Effects will be permanent.

In the above table, the magnitude and timing descriptors are indicated as varying by the component of the environment considered. The approach for determining the magnitude and timing are described below.

1.1 Magnitude

According to the Agency (CEAA, 2015), magnitude refers to "…the amount of change in a measurable parameter relative to baseline conditions or other standards, guidelines or objectives", and "…should be expressed in measureable or quantifiable terms, whenever possible." Some of the considerations that the Agency (CEAA, 2015) suggests may influence the evaluation of the magnitude of an effect include the following:

- Natural variability, normal fluctuations, or shifts in baseline conditions;
- The scale at which magnitude is considered;
- The resiliency of the component being considered and surrounding area to change; and
- Whether the component of the environment has already been adversely affected by other physical activities or natural change.

How magnitude has been established for the various components used for describing the consequence of a TSF failure is described in Table 1-2.

Table 1-2: Methods for Assigning Levels for Magnitude

Component	Low	Medium	High
Surface water quality	Surface water quality meets Provincial Water Quality Objectives (PWQO).	Surface water quality exceeds PWQO but meets drinking water standards	Surface water quality exceeds drinking water standards
Wildlife	A failure of the TSF results in the displacement of wildlife but no wildlife mortality in Blackwater Creek downstream of the TSF.	A failure of the TSF results in the mortality of some individual animals in Blackwater Creek downstream of the TSF.	A failure of the TSF results in extensive mortality of animals in Blackwater Creek downstream of the TSF.

Table 1-2: Methods for Assigning Levels for Magnitude (continued)

Component	Low	Medium	High
Migratory birds	A failure of the TSF results in the displacement of migratory birds, but no migratory bird mortality in Blackwater Creek downstream of the TSF.	A failure of the TSF results in the mortality of some individual migratory birds in Blackwater Creek downstream of the TSF.	A failure of the TSF results in extensive mortality of migratory birds in Blackwater Creek downstream of the TSF.
Fish and fish habitat	A failure of the TSF results in the displacement of stream-resident fish but no fish mortality in Blackwater Creek downstream of the TSF.	A failure of the TSF results in the mortality of some individual stream-resident fish in Blackwater Creek downstream of the TSF.	A failure of the TSF results in extensive mortality of stream-resident fish in Blackwater Creek downstream of the TSF.
	A failure of the TSF results in the displacement of migratory fish but no fish mortality in Blackwater Creek downstream of the TSF.	A failure of the TSF results in the mortality of some migratory fish in Blackwater Creek downstream of the TSF.	A failure of the TSF results in extensive mortality of migratory fish in Blackwater Creek downstream of the TSF.
	A failure of the TSF results in the displacement of lake-resident fish, but no fish mortality in Wabigoon Lake.	A failure of the TSF results in mortality of some individual lake-resident fish within Wabigoon Lake.	A failure of the TSF results in extensive mortality of lake-resident fish in Wabigoon Lake.
Vegetation	A failure of the TSF results in the loss of some shallow-rooted riparian vegetation in Blackwater Creek downstream of the TSF.	A failure of the TSF results in the loss of shallow-rooted and some deep-rooted riparian vegetation in Blackwater Creek downstream of the TSF.	A failure of the TSF results in the loss of both shallow-rooted and deep-rooted riparian vegetation in Blackwater Creek downstream of the TSF.
	The physical effects on wild rice beds result in no loss of harvest or plants.	The physical effects on wild rice beds result in the loss of that year's harvest, but not the plants.	The physical effects on wild rice beds result in the loss of both that year's harvest and the plants.
	There would be no measurable change in the quality of harvested wild rice.	The quality of harvested wild rice would be measurably affected, but is still safe for sale and consumption.	The quality of harvested wild rice is measurably affected to a point where the sale or consumption of the wild rice would be restricted.
Human health	There would be no measurable health effects as a result of a TSF failure.	There would be some short-term health effects as a result of a TSF failure that could be readily mitigated.	There would be permanent, measurable health effects to people in the region as a result of a TSF failure.
Aboriginal peoples	There would be no effects of a failure of the TSF on the ability of Indigenous people to practice traditional uses of land and resources.	There would be some effects of a TSF failure on the ability of Indigenous people the practice traditional uses of the land and resources.	A failure of the TSF would extensively affect the ability of Indigenous people the practice traditional uses of the land and resources.

1.2 Timing

According to the Agency (CEAA, 2015) timing should be considered "…when it is important in the evaluation of the environmental effect (e.g., when the environmental effect could occur during breeding season, or during a period of species migration through the area). It may also be relevant to discuss variation in timing of project activities, such as reservoir level fluctuations, and how that may cause varying environmental effects." How timing has been established for describing the effects of a TSF failure on the various components of the environment is described in Table 1-3.

Table 1-3: Methods for Assigning Levels for Timing

Component	Low	Medium	High
Surface water quality	Winter–surface water quality effects are expected to be lowest if a TSF failure occurs during winter.	Surface water quality effects are expected to be similar during the other seasons.	There are no seasons when timing for surface water quality effects would be high.
Wildlife	A failure of the TSF is expected to cause mortality of wildlife present in Blackwater Creek (i.e., beaver); therefore, timing is not expected to be relevant for wildlife.		
Migratory birds	Winter—migratory bird effects are expected to be lowest if a TSF failure occurs during the winter.	Summer— migratory bird effects are expected to be medium during the summer.	Spring and fall—migratory bird effects are expected to be highest during the periods when bird migration is occurring.
Fish and fish habitat	A failure of the TSF is expected to cause mortality to the fish downstream of the TSF in Blackwater Creek; therefore, timing is not relevant for stream-resident fish populations.		
	Winter— timing is low in the winter for migratory fish that use the lower reaches of Blackwater Creek for spawning.	Summer and fall— the timing would be medium during the summer and fall for those migratory fish populations that spawn in the lower reaches of Blackwater Creek.	Spring—timing is high in the spring for migratory fish that use the lower reaches of Blackwater Creek for spawning.
	Timing is not expected to be relevant for lake-resident fish populations.		
Vegetation	A failure of the TSF is expected to result in the loss of riparian vegetation downstream of the TSF in Blackwater Creek; therefore, timing is not relevant for riparian vegetation.		
	Winter— timing would be low in the winter for physical effects on wild rice.	Spring and summer— the timing would be medium during the spring and summer for physical effects on wild rice.	Fall—timing would be high in the fall for physical effects on wild rice as harvesting and seeding would normally occur in the fall.
	Timing is not expected to be relevant the quality of harvested wild rice due to changes Effects of changes in sediment quality as this is a long-term effect.		
Human health	Timing is not expected to be relevant for human health as there are residents living in the area year-round.		
Aboriginal peoples	Timing for Aboriginal peoples will depend in the specific components discussed above.		

2.0 Failure of Tailings Storage Facility

2.1 Tailing Storage Facility Description

The TSF is expected to have a final footprint area of approximately 88 ha. It will be constructed in stages to provide containment for the tailings solids, along with operational and storm water management. The final crest is anticipated to have an elevation of approximately 420 masl and the maximum dam height is anticipated at approximately 22 m. The slopes of the embankments have been preliminarily assigned at 2.25H:1V to 2.5H:1V and will be dependent on the final design. The TSF will include an emergency spillway, a downstream seepage collection and pump-back system, a tailings delivery and deposition pipeline to deposit the tailings into the facility and a water reclaim pipeline to route water back to the process plant for reuse in processing operations. During operations, the tailings will be deposited into the TSF in a way that allows for continuous saturation to minimize acid generating potential.

The TSF embankments will be designed as zoned structures to control potential seepage flows through the embankments. A seepage collection and pump-back system will also be utilized to capture and return potential seepage from the embankments back into the containment facility. The seepage collection ditches will be designed with sufficient capacity to accommodate the anticipated seepage rate and runoff from the upstream catchment that will include the downstream slopes of the TSF.

The design of the embankment heights will include allowances for operating pond levels, containment of the Environmental Design Storm (EDS), a spillway designed to pass unexpected flows (in accordance with the Inflow Design Flood [IDF]) and the required freeboard as identified in the CDA Dam Safety Guidelines and the *Lakes and Rivers Improvement Act* Best Management Practices, as applicable. The presence of the spillway ensures the greatest chance that overtopping of the dam can be avoided, even in the event of an unforeseen storm. Water pond levels and embankment heights will be designed for each embankment stage for operational and storm water management:

- Maximum Operating Level – Required to contain runoff from average and wet precipitation conditions considering the volume of water being removed from the facility (evaporation and water transferred to treatment and process) while maintaining tailings saturation;
- Emergency Spillway Invert Level – Pond level providing storage capacity between the invert of the spillway and Maximum Operating Water Level to contain the EDS, currently assigned as the volume of water resulting from the 1:1,000 year, 24-hour precipitation event; and
- Embankment Height – Sufficient to maintain freeboard above the invert of the spillway for each embankment stage to prevent water from overtopping the dam during the occurrence of the prescribed IDF that will be determined once the dam's hazard potential classification (HPC) has been established during final design.

It should also be noted that the design of the Project being advanced by Treasury Metals allows for the emergency spillway, located on the west dam of the TSF, to be directed into the open pit in an emergency circumstance. This design approach ensures that, before an overtopping event (i.e., the water levels are extremely high and flow over the dam) could occur, excess water will be directed for containment within the open pit through the emergency spillway . In order to re-open the pit, this water would be treated as needed prior to discharge to the environment, or potentially would be returned to the TSF once it had been stabilized. Raising of water levels even under extreme storm conditions, would allow a sufficient amount of time that all operation personnel will be evacuated from the open pit.

2.2 Control Measures and Preventative Procedures

The TSF will be designed using sound engineering principles and accepted standards to ensure protection of the environment during all phases of the Project. Designs will be in accordance with the latest version of the CDA Dam Safety Guidelines (2007), the MNRF Best Management Practices (2011) and the Provincial *Lakes and Rivers Improvement Act*, as applicable. The TSF will be designed for operational and storm water management based on hydrological modelling using historical climatic data. Operational pond levels will be established and an allowance to hold the volume of water resulting from the EDS will be developed. The spillway will be designed to route flows resulting from the IDF as prescribed by the HPC of the dam. The embankment heights will also be designed with the required freeboard allowances, for normal and minimum freeboard, as prescribed by the guidelines listed above. The embankments will be designed with zoned earth fill raises and meet the standards set forth by the applicable guidelines. The embankments will be designed to be stable and meet the required minimum Factors of Safety under the required conditions (Table 2-1).

Table 2-1: Minimum Factors of Safety

Loading Conditions	Minimum Factor of Safety	Slope
End of construction (before reservoir filling)	1.3	Downstream and upstream
Long-term (steady state seepage, normal reservoir level)	1.5	Downstream and upstream
Full or partial rapid drawdown	1.2 to 1.3	Upstream
Pseudo-static	1.0	Downstream and upstream
Post-earthquake	1.2 to 1.3	Downstream and upstream

A Dam Safety Management Plan will be developed and finalized prior to the start of the first dam construction on site. A further description of the Dam Safety Management plan is provided in Section 12.14 of the revised EIS, and will consist of the following:

- At least daily visual inspection during operational processes of all embankments and berms, pipelines, pumps, culverts and spillways to identify any visible problems such as pipeline damage, blockage, embankment seepage, and slope instabilities.
- A more detailed inspection of these same facilities and others, will be conducted on a monthly basis to look for any less obvious signs of potential problems.
- During and following any high potential precipitation events and spring melt, a more detailed inspection will be conducted to ensure the integrity of the TSF and related structures.
- The facility will be inspected by a qualified geotechnical engineer on an annual basis (Dam Safety Inspection) to verify that the embankments are performing as designed. The inspections will likely be carried out during or shortly after the spring melt under snow free conditions. A full Dam Safety Review will also be completed at the prescribed time intervals, but most likely on a 5-year basis.
- Ground movement sensors will be install on the TSF to detect any early movement on embankments, berms and dams.
- If any stability-related issues are identified during dam inspections or during other site reviews, a qualified geotechnical engineer will be brought to site to assess the issue and provide guidance on the appropriate path forward including remedial actions if appropriate.

The perimeter seepage collection ditches will be designed to contain the potential volume of water from seepage through the embankment and upstream runoff. All seepage will be collected and routed to a collection point to allow for pumping and return to the TSF containment area. The ditches will also be designed with sufficient freeboard to ensure that water overflows do not occur. The ditches will be lined with a low permeability material (such as geotextile) to ensure that seepage is contained within the ditch and that erosion damage does not occur.

A compliance monitoring program will be developed prior to construction to assess the performance of the TSF and associated seepage collection. Surface and groundwater monitoring programs will also be used to ensure that seepage is not impacting groundwater offsite.

2.3 TSF Failure Modeling

The EIS Guidelines require that Treasury Metals identify "…potential consequences (including the environmental effects), the plausible worst case scenarios and the effects" associated with accidents and malfunctions. In the highly unlikely case of a failure of the TSF, the consequences associated with a failure of the TSF were modelled as described in Appendix GG-1 to the revised EIS. That modelling was conducted to simulate worst-case credible conditions of a hypothetical catastrophic failure without the implementation of any mitigation measures, but are not a reflection of the actual safety conditions of the TSF after it is designed and built. The modelled consequences in the highly unlikely event of a TSF failure are summarized below. The modelling allowed Treasury Metals to describe the environmental effects likely to occur in the highly unlikely event of a TSF failure, described in Section 3, and to also develop measures to reduce or mitigate potential effects impacts to the environment and/or human health should such a highly improbable event take place.

There have been further refinements of the Project design since the TSF failure modeling was completed, including the replacement of the seepage collection pond used in the original EIS with a larger minewater pond, located to the south of the TSF. This minewater pond would provide additional storage downstream of the TSF that would absorb some of the energy of a TSF failure. In the highly unlikely event of a breach of the south TSF dam, the supernatant water and tailings from the TSF would flow into the minewater pond, prior to flowing into Blackwater Creek (the same outcome of the TSF failure model completed without the minewater pond). The minewater pond would be expected to capture some of the tailings, preventing them from reaching Blackwater Creek. This could reduce the effects on Blackwater Creek and would require less intrusive remediation of the released tailings by Treasury Metals, as compared to the current TSF failure model. Accordingly, effects predicted by the TSF failure model are more conservative without the inclusion of the minewater pond. Treasury Metals decided to retain this conservatism, rather than reassess the design.

The TSF failure model presented in Appendix GG-1 included the following steps:

- Dam breach assessment, to determine the release hydrograph from the TSF failure;
- Hydraulic routing, to determine the extent of the released materials from the TSF after the failure;
- Geochemical modelling, to determine concentrations of selected water quality parameters from the supernatant, pore water and tailings; and
- Water quality modelling of Wabigoon Lake to determine the extent of the contamination and changes in parameter concentrations in the lake.

For the selection of a credible worst-case scenario two failure modes were considered: piping (sunny-day failure) and overtopping. Overtopping was considered to be more critical for the receiving environment as the volume of released materials from the TSF would be larger, and the anticipated flows in Blackwater Creek would not provide enough dilution to alleviate the contaminant loads.

The dam breach and initial flood hydrograph was conducted to evaluate breach opening, time of dam failure and the subsequent breach flow into Blackwater Creek (Figure 2-1). The peak outflow from the breach was calculated to be 78 m^3/s, and the total spill volume was calculated at 1,695,958 m^3, which is made-up of 753,480 m^3 of settled tailings solids, 880,000 m^3 of supernatant water, and 62,478 m^3 of storm water, corresponding to the 100-year storm inflow. Worst case conditions were assumed where all of the supernatant stored in the TSF is released.

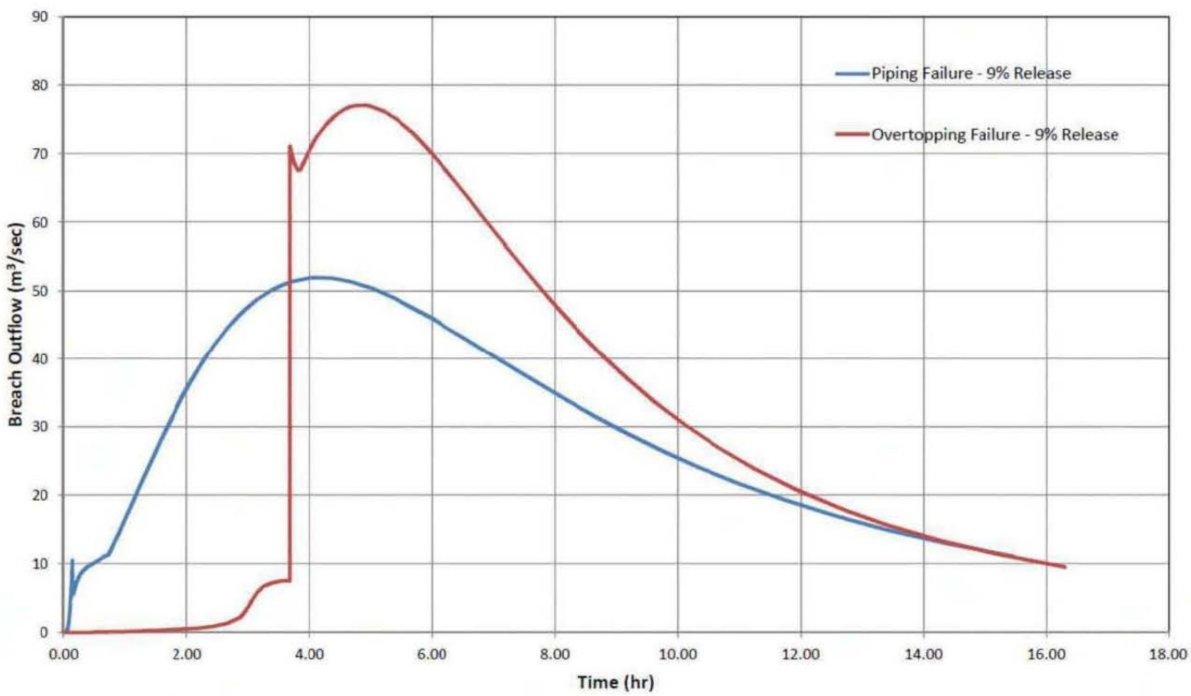

Figure 2-1: Breach Hydrograph

Using the output from the breach analysis, a two-dimensional hydraulic model was used to produce the inundation map shown in Figure 2-2. The results from the model indicate that all of the released supernatant would reach Wabigoon Lake, as well as the pore water from the tailings. As shown in Figure 2-2, the maximum depth of the flood wave of supernatant water is projected to be between 11.6 and 12.7 m at the breach of the dam, and will dissipate to between 0 and 1.3 m at the mouth of Blackwater Creek.

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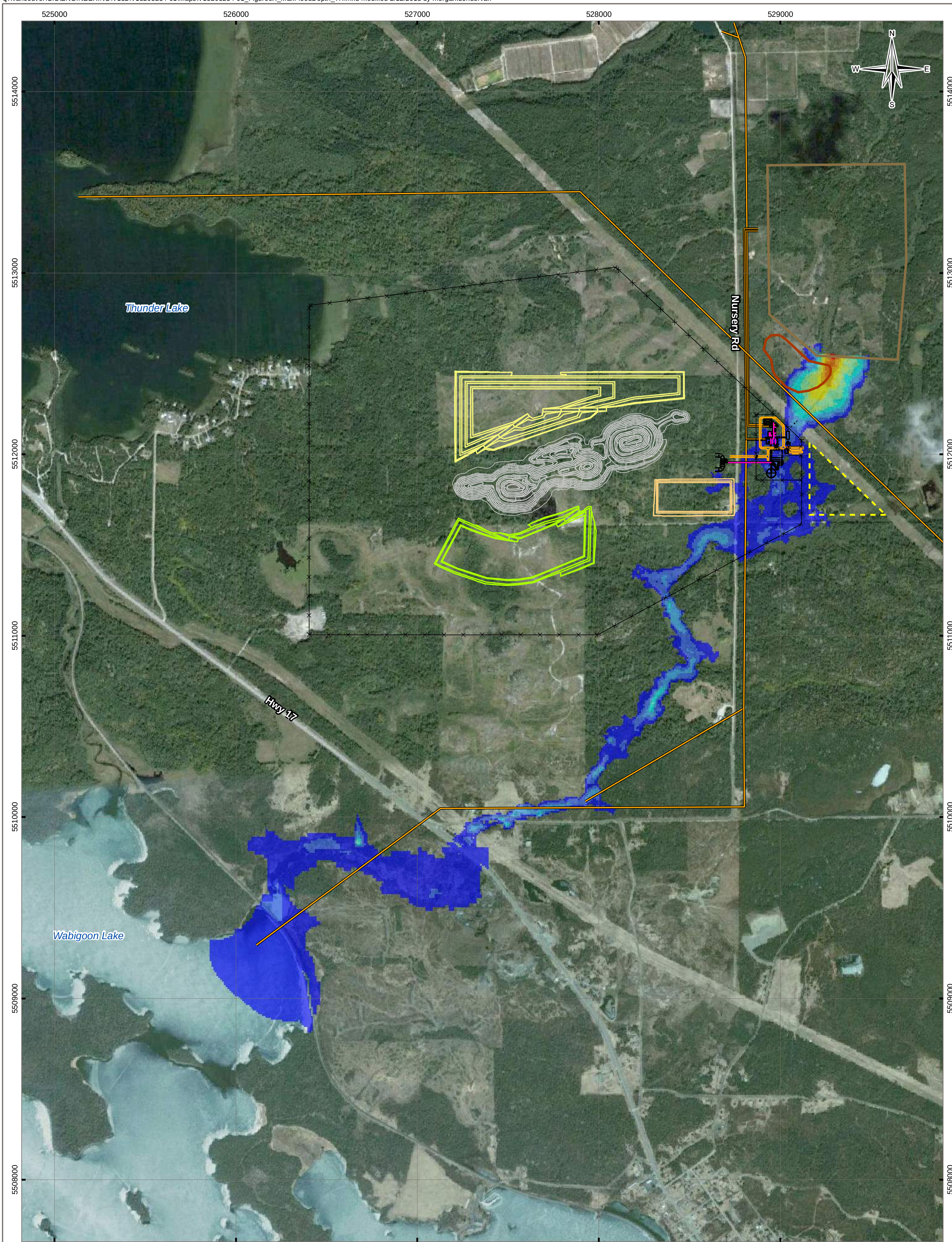


LEGEND

- Low-Grade Stockpile
- Overburden
- Ultimate Pit
- Waste Rock Dump
- Effluent Pipe
- Electrical
- Fenceline
- Gate
- Laydown Area
- M25
- Plant
- Seapage Collection
- Tailings Area
- Tailings Pipe
- Traffic

Maximum Flood Depth (m)

- 0.0 - 1.3
- 1.4 - 2.5
- 2.6 - 3.8
- 3.9 - 5.1
- 5.2 - 6.4
- 6.5 - 7.6
- 7.7 - 8.9
- 9.0 - 10.2
- 10.3 - 11.5
- 11.6 - 12.7

NOTES
Base data source:
Imagery from Google; CNES/SPOT (2013)

STATUS
FOR INTERNAL USE ONLY

TREASURY METALS
TSF FAILURE MODELLING

Maximum Flood Water Depth Release

PROJECTION	DATUM	CLIENT
UTM Zone 15	NAD83	Treasury Metals

Scale: 1:20,000
400 200 0 400
Metres

TETRA TECH EBA

FILE NO.				
V13203234-01_Figure0X_MaxFloodDepth_TR.mxd				
PROJECT NO.	**DWN**	**CKD**	**APVD**	**REV**
V13203234-01	MEZ	-	EL	0
OFFICE	**DATE**			
Tt EBA-VANC	February 12, 2015			

Figure 2-2

Blackwater Creek discharges into Wabigoon Lake, which is a large body of water with a surface area of 104 km^2. The water level of the lake is controlled by the dam located in Dryden, approximately 18 km west of the TSF. Blackwater Creek enters Wabigoon Lake in Kelpyn Bay. A two-dimensional numerical model was created to simulate the hydrodynamic conditions in Wabigoon Lake. The inflow into Wabigoon Lake corresponding to a TSF overtopping failure is estimated to have a maximum discharge of 64.6 m^3/s a total hydrograph volume of 1.2 cubic hectometres hm^3 at the point of discharge into the lake.

As described in Appendix GG-1, a preliminary geochemical model was applied to the various components of effluent, including supernatant, pore water and tailings. The model conservatively included supernatant, pore water and tailings geochemistry that had been subject to acid generating conditions in the TSF prior to a TSF failure, and that the tailings had undergone acid rock drainage (ARD). It is important to note that the tailings would be kept in saturated conditions within the TSF to prevent to onset of ARD, and that the modelled overflow concentrations are therefore highly conservative.

The results presented in Appendix GG-1 indicate that concentrations of all parameters in the released fluids would be expected to remain below the Metal Mining Effluent Regulations (MMER) limits, with the exception of lead which may increase to roughly 1.5-times the limit of 0.2 mg/L. In the event the TSF is overtopped, aluminum, cadmium, cobalt, copper, iron, lead, mercury, selenium, silver, thallium, uranium, and cyanide concentrations in the TSF outflow water may exceed the respective Provincial Water Quality Objectives (PWQO) for the protection of aquatic life. The Ontario Drinking Water Standards would be met in the TSF outflow water for all parameters with the exception of lead, mercury, selenium and total cyanide. The predicted TSF overflow quality for an overtopping of the tailings dam is listed in Table 2-2, and does not take into consideration any dilution effects from the receiving waters. The sulphate concentrations decrease after the initial flushing of readily soluble material to a local minimum. The pH of any release is predicted to remain circumneutral.

Table 2-2: TSF Overflow Concentrations and Relevant Water Quality Criteria

Parameter (1)	TSF Overflow Concentration (mg/L)	Water Quality Criteria		
		PWQO (mg/L)	Ontario Drinking Water Standards (mg/L)	MMER (Max Monthly Mean) (mg/L)
pH	5.0616	6.5 – 8.5	—	6.5 – 9.0
Al	0.1985	0.075	—	—
Cd	0.0010	0.0002	0.005	—
Co	0.0030	0.0006	—	—
Cu	0.0652	0.005	—	0.3
Fe	0.3428	0.3	—	—
Pb	0.3046	0.005	0.01	0.2
Hg	0.0126	0.0002	0.001	—
Se	1.1748	0.1	0.01	—
Ag	0.0004	0.0001	—	—
Tl	0.3789	0.0003	—	—
U	0.0115	0.005	0.02	—
Cyanide (2)	0.2025	0.005	0.2	1

Notes:
(1) Only those parameters where the TSF overflow quality exceed the PWQO are listed
(2) Total cyanide

In the unlikely event of a TSF failure, it is assumed that the water quality in Blackwater Creek would closely reflect the TSF overflow concentrations (see Table 2-2) due to the relatively low assimilative capacity of the creek. The period of high constituent concentrations would dissipate quickly once all of the supernatant water and pore water was released from the tailings and had reached Wabigoon Lake.

The contaminant concentration of the water entering Wabigoon Lake at Blackwater Creek is set to 1.0 (unity) in the calculations, assuming a conservative constituent that changes concentrations only by dilution effects. The model results in a concentration factor that can then be applied to each water quality parameter. Water quality projections for Wabigoon Lake (maximum instantaneous projections) are shown in Figure 2-3. The concentration values shown in Figure 2-3 are relative to the concentration of water that would be released from the tailings dam. The 0.01 "red" concentration factor zone on Figure 2-3, for example, indicates that the maximum concentration within this zone would be 1% (0.01) of the TSF outflow concentration (see Table 2-2). The model shows that the greatest effects to water quality are limited to Keplyn Bay, and are diluted to 0.1% of the TSF outflow concentrations before reaching the community of Dryden. The modelling indicates that effects on water quality in Wabigoon Lake in the highly unlikely event of a TSF failure would be restricted to the areas between the mouth of Blackwater Creek (i.e., Keplyn Bay) and Dryden, and would avoid the community of Wabigoon, as well as the south-eastern portion of Wabigoon Lake towards the reserve lands of the Wabigoon Lake Ojibway Nation.

Table 2-3 presents the simulation results at five control points in Wabigoon Lake: the fish sanctuary at Christie's Island; the spawning habitat at the mouth of Thunder Creek; the fishing camp at Bonny Bay; the City of Dryden water intake; and the outlet of Wabigoon Lake in the City of Dryden. The table provided the UTM coordinates for each of these control points, along with the distance from the mouth of Blackwater Creek. Additionally, the table lists the dilution of the TSF overflow for the predicted maximum concentration (C_{max}), along with the predicted time after the failure of the TSF for levels in Wabigoon Lake to reach the maximum concentrations (C_{max}).

Table 2-3: Results at Five Control Points in Wabigoon Lake

Point	Description	Coordinates (1)		Distance (2) (km)	Dilution Factor C_{max} (3)	Time to C_{max} (day)
		X	Y			
1	Christie's Island (fish sanctuary)	525,406.2	5,509,088.1	0.74	0.37	1.6
2	Thunder Creek (spawning habitat)	525,343.5	5,509,999.8	0.92	0.021	3.6
3	Bonny Bay (fishing camp)	523,738.2	5,510,836.4	2.72	0.051	5.3
4	Dryden Water Intake	513,621.0	5,512,466.0	12.81	0.00095	23.8
5	Lake Outlet	511,277.5	5,511,910.6	15.00	0.001	25.3

Notes:

(1) NAD 1983 UTM Zone 15N
(2) Distance is measured from the mouth of Blackwater Creek
(3) The Dilution Factor C_{max} represents the maximum concentration at each control location as a fraction of the TSF overflow concentration as provided in Table 2-2

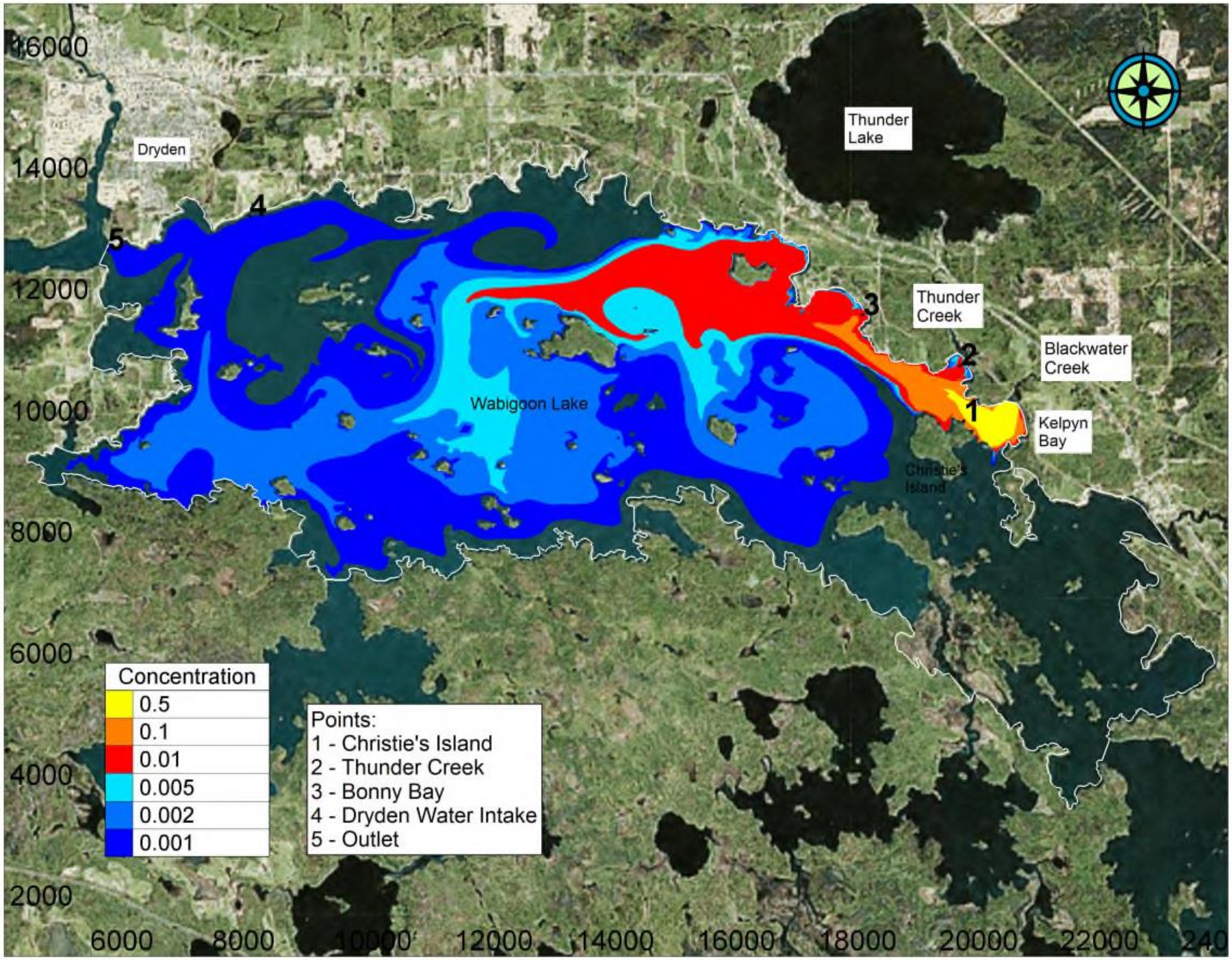


Figure 2-3: Maximum Concentration in Wabigoon Lake

By combining the TSF outflow concentrations (see Table 2-2) with the model predictions of dilution factors listed in Table 2-3 and shown in Figure 2-3, the maximum predicted concentrations (C_{max}) for each of the constituents at the control locations can be determined, as presented in Table 2-4. The table shows that, with the exception of thallium, the maximum concentrations (C_{max}) at Dryden (either the water intake or lake outflow) do not exceed the drinking water standards. In fact, the only locations where the maximum concentrations (C_{max}) are predicted to exceed the drinking standards are: the fish sanctuary at Christie's Island (lead, mercury and selenium); the spawning habitat at the mouth of Thunder Creek (selenium); and the fishing camp at Bonny Bay (lead and selenium).

Table 2-4: Predicted Maximum Concentrations in Wabigoon Lake

Parameter (1)	Predicted Maximum Concentrations at Control Locations in Wabigoon Lake (2)				
	Christie's Island	Thunder Creek	Bonny Bay	Dryden Water Intake	Lake Outlet
	0.37 (3)	***0.021*** (3)	***0.051*** (3)	***0.00095*** (3)	***0.001*** (3)
Al	0.0734	0.0042	0.0101	0.0002	0.0002
Cd	0.0004 (4)	0.0000	0.0001	0.0000	0.0000
Co	0.0011	0.0001	0.0002	0.0000	0.0000
Cu	0.0241	0.0014	0.0033	0.0001	0.0001
Fe	0.1268	0.0072	0.0175	0.0003	0.0003
Pb	**0.1127**	0.0064	**0.0155**	0.0003	0.0003
Hg	**0.0047**	0.0003	0.0006	0.0000	0.0000
Se	**0.4347**	**0.0247**	**0.0599**	0.0011	0.0012
Ag	0.0001	0.0000	0.0000	0.0000	0.0000
Tl	0.1402	0.0080	0.0193	0.0004	0.0004
U	0.0043	0.0002	0.0006	0.0000	0.0000
Cyanide (6)	0.0749	0.0043	0.0103	0.0002	0.0002

Notes:

(1) Only those parameters where the TSF overflow quality exceed the PWQO are listed.

(2) The maximum concentrations are calculated by multiplying the TSF outflow concentrations are presented in Table 1.3.1-1 by the maximum dilution factors (C_{max}) listed in Table 4.3.2.3-2.

(3) These numbers represent the predicted dilution factors (C_{max}) listed in Table 1.3.1-2.

(4) The results highlighted with grey shading indicates where the predicted C_{max} concentrations of a compound exceed the corresponding PWQO.

(5) The results highlighted with grey shading and bold-faced type indicates where the predicted C_{max} concentrations of a compound exceed the corresponding Drinking Water Standards.

(6) Total cyanide.

As shown in Table 2-5, elevated concentrations within Wabigoon Lake are predicted to dissipate over a relatively short time period. The longest lasting effects are predicted at Christie's Island, which is expected given its proximity to the mouth of Blackwater Creek. At the most distant location (i.e., City of Dryden water intake and the outlet of Wabigoon Lake), the maximum concentrations (C_{max}) do not exceed the PWQO, or in the case of thallium, exceed for a period much less than a day.

Table 2-5: Duration of Predicted Concentration in Excess of PWQO

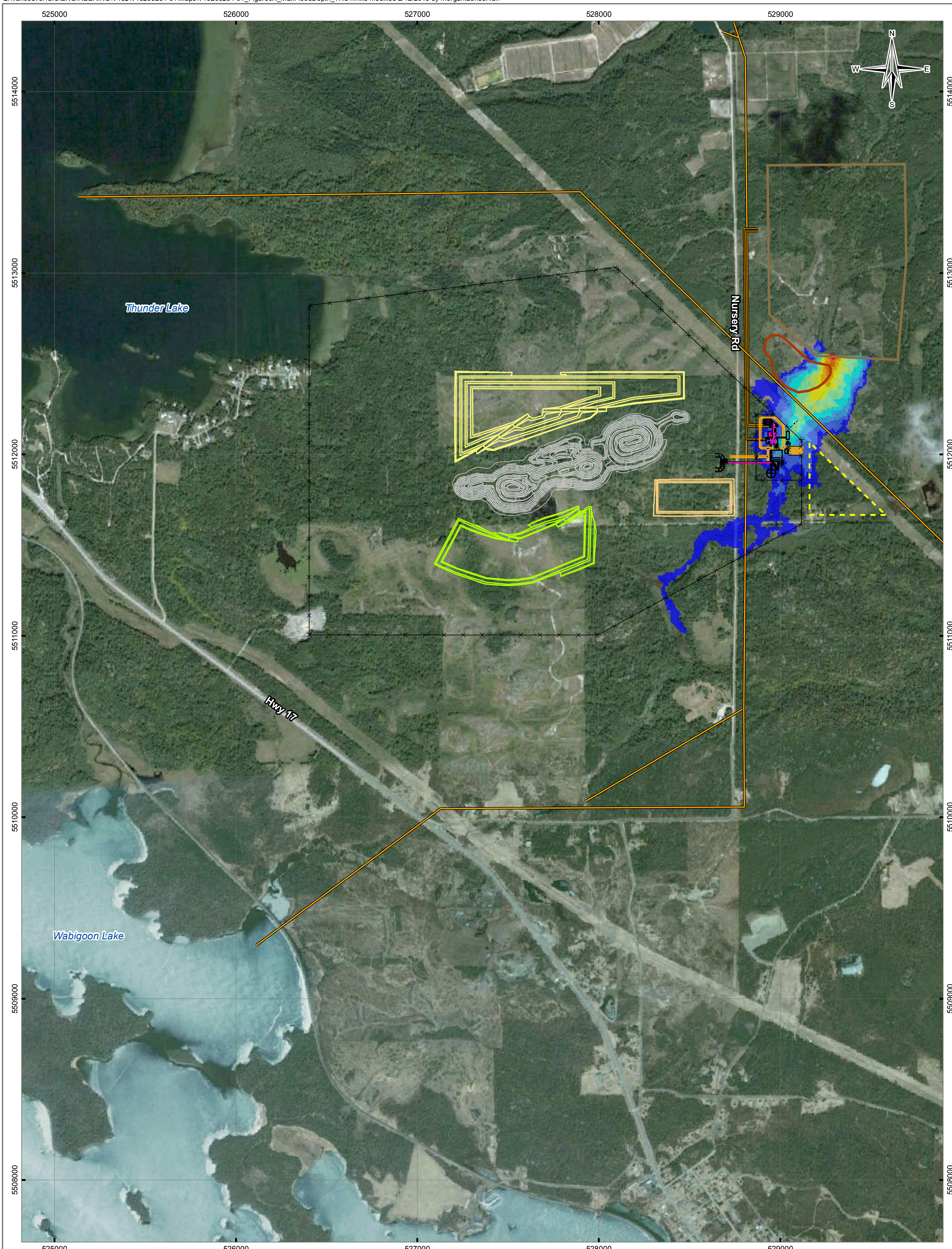
Parameter (1)	Number of Days with Concentrations Predicted above PWQO				
	Christie's Island	Thunder Creek	Bonny Bay	Dryden Water Intake	Lake Outlet
Al	0	0	0	0	0
Cd	1 (2)	0	0	0	0
Co	1	0	0	0	0
Cu	3	0	0	0	0
Fe	0	0	0	0	0
Pb	10	1	5	0	0
Hg	10	1	9	0	0
Se	4	<< 1 (3)	<< 1	0	0
Ag	1	0	0	0	0
Tl	20	10	12	<< 1	<< 1
U	0	0	0	0	0
Cyanide (5)	1	0	2	0	0

Notes:

(1) Only those parameters where the TSF overflow quality exceed the PWQO are listed.
(2) The results highlighted with grey shading indicates where the predicted C_{max} concentrations of a compound exceed the corresponding PWQO.
(3) Although the C_{max} at these locations was predicted to exceed the PWQO, the modelling indicates this situation would last much less than a day.
(5) Total cyanide.

As demonstrated in Figure 2-4, the majority of tailings solids that would be released in the unlikely event of a TSF failure would be deposited on the ground between the TSF and Blackwater Creek, or would be deposited in a short stretch of Blackwater Creek in the vicinity of the Project. Modelling shows that the tailings solids would not reach Wabigoon Lake.

All TSF solids deposited on the ground and within Blackwater Creek would be removed in accordance with the spill management plan. The majority of the tailings would be deposited on the land between the TSF and Blackwater Creek., which would be removed and placed back into the TSF as soon as practicable once the TSF dam had been reconstructed. The tailings that are deposited within the small stretch of Blackwater Creek would be removed as soon as practicable using a remediation plan developed through consultation with regulators (e.g., DFO and MNRF) and Indigenous communities. In the unlikely event of a TSF failure, sediment control measures in Blackwater Creek would occur as soon as conditions are safe to do so. Blackwater Creek is in relatively close proximity to Tree Nursery Road, and can also be readily accessed where the creek crosses Tree Nursery Road and Anderson Road. It is likely that, given the ready access to the stream, sediment containment measures could be implemented manually without the use of heavy equipment.



LEGEND

- Low-Grade Stockpile
- Overburden
- Ultimate Pit
- Waste Rock Dump
- Effluent Pipe
- Electrical
- Fenceline
- Gate
- Laydown Area
- M25
- Plant
- Seapage Collection
- Tailings Area
- Tailings Pipe
- Traffic

Maximum Flood Depth (m)

- 0.0 - 1.3
- 1.4 - 2.5
- 2.6 - 3.8
- 3.9 - 5.1
- 5.2 - 6.4
- 6.5 - 7.6
- 7.7 - 8.9
- 9.0 - 10.2
- 10.3 - 11.5
- 11.6 - 12.7

NOTES
Base data source:
Imagery from Google; CNES/SPOT (2013)

STATUS
FOR INTERNAL USE ONLY

TREASURY METALS
TSF FAILURE MODELLING

Depth and Extent of Tailings Deposition

PROJECTION	DATUM	CLIENT
UTM Zone 15	NAD83	Treasury Metals

Scale: 1:20,000
400 200 0 400
Metres

TETRA TECH EBA

FILE NO.
V13203234-01_Figure0X_MaxFloodDepth_TRST.mxd

PROJECT NO.	DWN	CKD	APVD	REV
V13203234-01	MEZ	-	EL	0

OFFICE	DATE
Tt EBA-VANC	February 12, 2015

Figure 2-4

The tailings released in the highly unlikely event of a TSF failure would not be left in the environment, but would be contained and remediated as soon as practicable. While the specific details of the tailings remediation would be dependent on the extent and nature of the release, a general strategy would involve remediating the tailings spilled on land between the TSF and the creek as soon as the TSF could be stabilized to receive the spilled tailings. Tailings that reach Blackwater Creek would need to be contained with sediment traps, and would then be remediated when appropriate. Given the physiography of Blackwater Creek and the proximity to Tree Nursery Road, it is possible that limited manual remediation activities could proceed immediately following discussions with DFO, other regulatory bodies and Indigenous communities. The bulk of the remediation activities would likely require the use of heavy equipment and would occur during the first winter, when the ground bordering the creek is frozen for improved access, and when creek flows are predictably low.

Treasury Metals recognizes that, in the highly unlikely event of a TSF failure, there could be changes to the chemical composition of the lake sediments in Wabigoon Lake, which could affect the aquatic food web of the lake. Contaminants that reach Wabigoon Lake with the TSF outflow water could deposit within the water column and affect lake sediments. An analysis of potential contaminant levels within the sediments of Wabigoon Lake and within the aquatic food web following a TSF failure, was completed with a focus on contaminants that persist in the environment, bioaccumulate in fish or are toxic to fish, migratory birds or humans. This was conducted using a worst-case sediment concentration calculation, with the worst case proportional water column concentrations shown in Figure 2-3, where the values in the figure represent fractions of the TSF outflow water concentrations (see Table 2-2). This analysis was completed for cadmium, lead and mercury, which were selected due to their bioaccumulation potential, and as they are known to be the most problematic metals from a biomagnification, as well as for human and wildlife health perspective.

For the highly unlikely scenario of a complete TSF failure (which is not expected to occur), there would be: a slight increase in cadmium concentrations in all modelled zones of Wabigoon Lake; a substantive concentration increase of lead in the yellow zone; and substantive concentration increases for mercury in both the yellow and orange zones (see Figure 2-3). The calculated sediment concentrations for cadmium would meet the PSQG LEL levels in all zones. The calculated lead concentrations would exceed the PSQG LEL within all zones; however, the measured background concentrations of lead in the sediment of Wabigoon Lake suggest that lead levels already exceed the PSQG LEL. The predicted mercury concentrations in sediment will not exceed the PSQG LEL in the orange or red zones, but will exceed in the yellow zone. None of the predicted sediment concentrations are expected to exceed PSQG Severe Effect Levels (SEL). Metals do not biodegrade or disappear, but over time it would be expected that they would become distributed within a greater depth of the sediment column due to wave action, the actions of sediment burrowing organisms, and as a result of new sediment influx from lake inflow waters. As such, initial metal concentrations observed in the upper 2 cm layer of the lake sediment would become gradually reduced over time. The results of this analysis are presented in Table 2-6, along with the assumptions used.

Table 2-6: Calculated Change in Lake Sediment Metals Concentrations

Condition / Lake Zone	Metal		
	Cd	**Pb**	**Hg**
TSF overflow concentration (mg/L) (1)	0.001	0.3046	0.0126
Modelled dilution factor (2)			
Yellow zone	0.5	0.5	0.5

Table 2-6: Calculated Change in Lake Sediment Metals Concentrations (continued)

Condition / Lake Zone	Metal		
	Cd	**Pb**	**Hg**
Orange zone	0.1	0.1	0.1
Red zone	0.01	0.01	0.01
Wabigoon Lake water column concentration (C_{max}) in mg/L (or g/m^3) (3)			
Yellow zone	0.0005	0.1523	0.0063
Orange zone	0.0001	0.03046	0.00126
Red zone	0.00001	0.003046	0.000126
Weight of metals added from 3 m (a) × 1 m^2 column of water (g) (4)			
Yellow zone	0.0015	0.4569	0.0189
Orange zone	0.0003	0.09138	0.00378
Red zone	0.00003	0.009138	0.000378
Weight of 2 cm × 1 m^2 volume of sediment (g) (b)	26,000	26,000	26,000
Increase in sediment concentration (c) in the top 2 cm (µg/g) (5)			
Yellow zone	0.058	17.573	0.727
Orange zone	0.012	3.515	0.145
Red zone	0.001	0.351	0.015
Background Sediment Concentration (µg/g) (d)			
Yellow zone	0.50	34.4	0.05
Orange zone	0.50	34.4	0.05
Red zone	0.50	34.4	0.05
Effect induced concentration in top 2 cm of sediment (µg/g) (6)			
Yellow zone	0.558	57.978	0.777
Orange zone	0.512	37.915	0.195
Red zone	0.501	34.751	0.065
PSQG LEL for Comparison (µg/g)	0.6	31	0.2
PSQG SEL for Comparison (µg/g)	10	250	2

Assumptions:

(a) Average water column depth in yellow, orange and red zones is 3 m

(b) Average total material density of the upper sediment column is 1.3 g/cm

(c) 100% of waterborne metals settle out and become homogeneously mixed in top 2 cm of the sediment column

(d) Background sediment metal concentration are based on the highest background sediment values measured in Wabigoon Lake (Table 5.8.2.2-1 of the revised EIS).

Notes:

(1) Values from Table 2-2.

(2) Taken from Figure 2-3.

(3) 1 mg/L is equivalent to 1 g/m^3.

(4) Weight of metals added from the water column is calculated by multiplying the "water column concentration" in g/m^3 times the depth of water in m times the area considered (1 m^2).

(5) The increase in sediment concentration is calculated by dividing the weight of metals deposited by the weight of the top 2 cm of sediment. To avoid using scientific notation, the concentration are presented in units of µg/g. To convert from g/g to µg/g a conversion factor of 1,000,000 is used.

(6) The "effect induced concentration" is the sum of the increase in sediment concentrations d sediment and background sediment concentrations.

In addition to the potential metals deposition in Wabigoon Lake from the TSF supernatant water and pore water, there is the potential that tailings solids deposited in Blackwater Creek could partially re-suspend and migrate to Wabigoon Lake. In the highly unlikely event of a TSF failure, Treasury Metals would implement remediation measures in Blackwater Creek to minimize the potential for tailings resuspension. As Blackwater Creek is easily accessible from a number of locations on Tree Nursery Road and Anderson Road, remediation measures (e.g., sediment traps) would be implemented soon after the initial TSF failure. In keeping with the request from the CEA Agency, the resuspension potential of the tailings has been assessed assuming no remediation measures have been implemented.

The stretch of Blackwater Creek that modelling has indicated will have tailings deposition in the unlikely event of the TSF failure is classified as low gradient stream habitat with a sinuous channel and a substrate of primarily fine silt and clay (see Section 4.2.1.2 of Appendix Q). The length of creek that will have deposited tailings in the creek bed is approximately 1.1 km of the 10.4 km of total creek length.

Figure 2-5 provides the statistics of the baseline TSS concentrations in Blackwater Creek. The lower end of the box shows the 25th percentile of the data, the upper end of the box shows the 75th percentile of the data, and the diamond symbol indicates the average concentration. The line extending below the box represents the minimum concentration observed and the line extending above the box represents the 95th percentile observed. The 95th percentile was used for the graph to expand enlarge the box and allow for better readability. The baseline TSS concentration data for Blackwater Creek indicates that:

- The 95th percentile for TSS in Blackwater Creek is 49.6 mg/L;
- There is sufficient energy in Blackwater Creek to periodically suspend the silt and clay substrate;
- TSS concentrations are episodic likely a result of storm events and spring freshet, which is evident by the average being greater than the 75th percentile in winter, spring and fall; and
- TSS concentrations are less dependent on seasonality.

Based on the baseline data, it is probable that there would be some resuspension of the tailings in Blackwater Creek that would enter Wabigoon Lake. It is unlikely, given baseline characteristics of sediment within Blackwater Creek (i.e., fine silt and clay substrate), that TSS concentrations entering Wabigoon Lake will change measurably from background conditions as a result of the re-suspension of tailings deposited within Blackwater Creek. However, the chemical properties of the re-suspended tailings would be different from the baseline TSS. Based on the description of potential effects on sediments in Wabigoon Lake from the release of water during a TSF failure (described above), the resuspension of tailings deposited in Blackwater Creek would have minimal effects on sediment quality, in the range of an order of magnitude less than the results presented in Table 2-6.

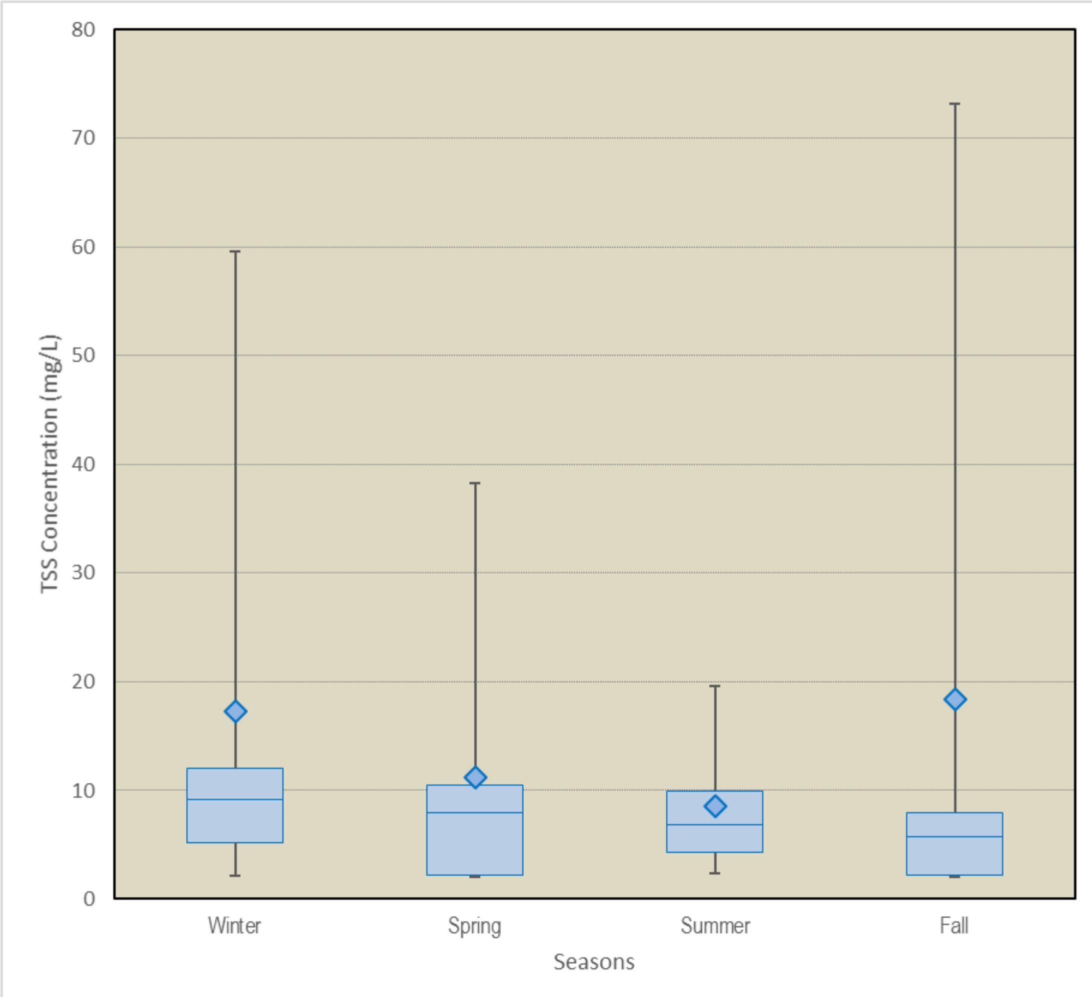


Figure 2-5: Background TSS Readings in Blackwater Creek

3.0 Potential Environmental Effects

The description below is provided for an unmitigated failure of the TSF, not considering mitigation during the event, such as measures that would be required to control the movement of any tailings that are deposited within Blackwater Creek. Hence, the discussion below of potential environmental effects should be considered conservative.

3.1 Surface Water Quality

Modelling indicates that, in the highly unlikely event of a TSF failure, there would be a degradation in water quality in both Blackwater Creek and Wabigoon Lake. The parameters modelled to exceed PWQO in the TSF outflow are: aluminum, arsenic, cadmium, cobalt, copper, iron, lead, mercury, selenium, silver, thallium, uranium, zinc and cyanide. It is anticipated that the during the failure of the TSF, the water quality in Blackwater Creek would be the same as the quality of the TSF outflow as Blackwater Creek has little or no assimilative capacity. However, the increased concentrations in Blackwater Creek would only occur for a relatively short period of time and would quickly dissipate to near background concentrations once the TSF supernatant and pore water reach Wabigoon Lake.

In the highly unlikely event of a TSF failure, the surface water quality in Blackwater Creek would exceed Ontario Drinking Water Standards for some parameters, resulting in a "high" magnitude, but would have a "low" duration in the order of a few hours. Additionally, it would have a "low" irreversibility, recovering within a day. If the failure of the TSF were to occur during the winter, it can be assumed that some of the tailings and water would freeze and would have less of an environmental effect resulting in a "low" timing. If the TSF failure was to occur in any other season, the timing would be "medium".

The modelling of surface water quality in Wabigoon Lake shows concentrations in excess of the PWQO. These levels are isolated to Keplyn Bay and the area just north of Keplyn Bay (primarily the yellow and orange areas shown in Figure 2-3) for all parameters except thallium, and water quality would drop below the PWQO within 20 days for all parameters (most parameters would be less than PWQO within a few days). Some of the parameters (lead, mercury and selenium) would also exceed the Ontario Drinking Water Standard for some locations in Wabigoon Lake. It should be noted that this model conservatively looked at dilution as the only mechanism for constituent concentration changes in the water column, ignoring all additional processes (e.g., precipitation, sorption) which would reduce the spatial and temporal extent of the elevated parameters.

In the highly unlikely event of a TSF failure, the surface water quality in Wabigoon Lake could exceed the Ontario Drinking Water Standards for some of parameters, giving it a "high" magnitude. However, this situation would only last for a day or so resulting in a "low" duration. Concentrations were predicted to be of "medium" magnitude (i.e., in excess of the PWQO) for a "medium" duration (i.e., a few weeks) for some parameters. The effects on surface water in Wabigoon Lake would be "medium" irreversibility, recovering within a year. The timing would be "low" if the failure occurred in the winter and "medium" if it occurred in the other seasons.

3.2 Effects on Fish and Fish Habitat

For the stream-resident fish in Blackwater Creek downstream of the TSF, it is expected that there would be individual fish mortalities from the high kinetic energy associated with the release, and suffocation from the high suspended solids content. A number of individuals could also become stranded on the floodplain as the flood pulse waters receded. The height of the pulse wave expected to flow down Blackwater Creek is between 5.1 m near the TSF, to 0 m at the limits of the flood plain. This flood wave will also have the potential to damage or destroy plants in its path, as well as cause erosion along Blackwater Creek until the flood wave velocity is attenuated, as it reaches bends and beaver ponds along the creek. The aquatic habitat in the zone affected by the higher velocity of the flood wave could be damaged or destroyed. In addition to the flood wave, the tailings solids could coat the ground surface and sections of Blackwater Creek in the vicinity of the failure and affect the aquatic environment in the short-term. Treasury Metals has committed that, in the highly unlikely event of a TSF failure, to remove the tailings solids deposited in Blackwater Creek as soon as reasonable and in consultation with applicable regulatory authorities (e.g., DFO) and Indigenous communities. Due to the much greater effect to stream-resident fish from the percussive force of the flood water and the low duration of surface water quality changes in Blackwater Creek, water quality is not anticipated to appreciably affect stream-resident fish.

In the highly unlikely event of a TSF failure, it is anticipated that there would be mortality of a large number of individual stream-resident fish in Blackwater Creek, yielding a "high" magnitude. The extent of this effect is "medium", as it is restricted to Blackwater Creek. The duration of the effects are considered "medium", while the irreversibility is also medium as it could take several years while the habitat in the creek is fully re-established. Timing of the TSF failure is not relevant for stream-resident fish populations as the failure of the TSF is expected to cause mortality to the fish downstream of the TSF regardless of season.

For lake-resident fish populations, the percussive force of the initial flood wave from a TSF failure would dissipate prior to reaching Wabigoon Lake, and is not anticipated to result in an effect to lake-resident fish. The modelled surface water quality within Wabigoon Lake (Table 2-4) would not be at levels that could be toxic to fish.

Tailings solids would not reach Wabigoon Lake; however, there would be some reduction in water quality in the lake should a TSF failure occur. Based on the modelling of the TSF failure, the maximum concentrations of some parameters (see Table 2-4) could exceed the PWQO values for the portion of Wabigoon Lake near to the Blackwater Creek inlet (primarily the yellow and orange areas shown in Figure 2-3). Although there are some predicted exceedances of the PWQO, Table 2-5 shows the temporal extent of the exceedance. Most parameters that will be greater than PWQO will only occur for a few days, which is expected to not be long enough to effect fish in Wabigoon Lake.

Thallium is expected to be the only parameter after a TSF failure that would be present in concentrations above PWQO as far as Dryden. For a location at a distance such as the Dryden control point from the mouth of Blackwater Creek elevated thallium concentrations last much less than a day (see Table 2-5), and concentrations near the mouth of Blackwater Creek remaining above the PWQO for as much as 20 days. While thallium concentrations are predicted to be above the PWQO after a TSF failure, this does not necessarily mean that there would be a toxic effect on aquatic life. The literature on thallium toxicity is limited and the PWQO value of 0.0003 mg/L is viewed as overly conservative relative to federal and British Columbia accepted guideline for the protection of aquatic organisms 0.0008 mg/L. Therefore, based on multiple lines of evidence the overall risk to aquatic organisms from toxicity is anticipated to be low.

It is also important to note that PWQO values are defined for longer / indefinite exposure, and shorter term exposures would have more limited effects. It is therefore unlikely that higher trophic level species (e.g., walleye and pike) would accumulate elevated levels of metals from the water column compared to background conditions as a result of a TSF failure. It is recognized; however, that there is some potential for an adverse effect to fish and other aquatic life due to reduced water quality, including the potential for some mortality should a TSF failure occur.

If sediments in mainly the yellow and orange zones of Figure 2-3 were to become contaminated with additional metals as per Table 2-6, it would be expected that benthic organisms would ingest these sediments. Fish that feed upon these organisms would take up additional metal concentrations. In this scenario, it would also be expected that fish that feed upon these fish, such as pike and walleye, would also tend to biomagnify metals such as cadmium, lead and mercury. The extent to which such metal uptake would be expected to occur would depend on the fish species involved and the amount of time they spend feeding in the yellow and orange zones. With the levels of uncertainty, it is not reasonably possible to predict increased body burden concentrations of metals that could occur in the different fish species over time.

It is recognized that metals such as cadmium, lead and mercury biomagnify within aquatic food chains. However, the ecological health risk of sediment contamination in the event of a catastrophic spill is considered to be limited, as the zone of influence is expected to be confined primarily to the yellow and orange zones and tailings solids will not enter the lake. These zones comprise a very small portion of the lake area, and would therefore be expected to have only a limited effect, on fish tissue metal levels as measured on a lake-wide basis.

In the highly unlikely event of a TSF failure, it is anticipated that the duration water quality exceeds PWQO in Wabigoon Lake is short enough that there will be no mortality of lake-resident fish populations, so the magnitude would be "low". The extent of effects is considered "high" as they will reach into Wabigoon Lake. The effects will have a "medium" irreversibility as the effects will dissipate within a few months. It is anticipated that a TSF failure in the winter would have a "low" timing as there would be a reduced quantity of supernatant water that would reach Wabigoon Lake due to freezing. In the event a TSF failure where to occur in spring, summer or fall, the timing would be "medium".

For migratory fish populations, there could be the added effect of both water quality in Wabigoon Lake and the percussive force of the flood wave in Blackwater Creek. This is highly dependent on the timing of the TSF failure, and what season it occurs in. The greatest potential effect to migratory fish populations would be if the TSF failure occurred in the spring during the spawning season. It is assumed that the percussive force of the flood wave at the mouth of Blackwater Creek could cause some mortality to individuals, eggs and fry, depending on the timing of the failure. Based on the Baseline Fisheries Report (Appendix Q), the mouth of Blackwater Creek provides spawning habitat for pike and muskellunge, but is not suitable for walleye spawning. It can be assumed that the quantity of those fish that spawn in the mouth of Blackwater Creek would be reduced in Wabigoon Lake, but would not be substantial due to the large quantity of similar spawning habitat at other locations on the lake.

In the highly unlikely event of a TSF failure, the magnitude of effects to migratory fish is highly dependent on the timing of the event. It can be assumed that if the TSF failure occurs in the spring, there would be a "medium" magnitude to migratory fish populations as there would be some mortality at the mouth of Blackwater Creek. The duration of this would be "low" and the extent would be "medium" (i.e., effects would be limited to Blackwater Creek). The irreversibility would be "medium", as the effects would be reversed in the next spawning season.

3.3 Effects on Wildlife and Wildlife Habitat

For the assessment of potential effects to wildlife and wildlife habitat as a result of a TSF failure, Treasury Metals recognizes that there is the potential for different species to be within the inundation zone shown in Figure 2-2. However, the wildlife species that is most likely to be affected as a result of the TSF failure are beaver within Blackwater Creek. As indicated in the Summary Wildlife Report (Appendix R), Blackwater Creek provides suitable beaver habitat and shows signs of recent beaver activity. In the highly unlikely event of a TSF failure, the percussive force from the flood wave would likely cause mortality for beaver downstream of the TSF. It can also be assumed that the beaver dams and lodges within Blackwater Creek would be destroyed by the force of the flood wave.

In the highly unlikely event of a TSF failure, the magnitude of effects to beaver would be "high" with extensive mortality of the beaver population downstream of the TSF in Blackwater Creek. The extent of this would be "medium" and would be restricted to Blackwater Creek. Along with the mortality of the beaver population, there would be extensive effects to the beaver habitat along Blackwater Creek in the riparian zone. Although it could take several years for the riparian vegetation to be fully re-established in Blackwater Creek, the beaver populations are expected to return within a few years ("medium" irreversibility). Timing of the TSF failure would not be relevant for effects to beaver as the mortality would be the same regardless of season.

3.4 Effects on Migratory Birds

The potential effect to migratory birds is highly dependent on the time of the year the TSF failure event were to occur. The greatest effect of a TSF failure to migratory birds would specifically be to migratory birds that nest on the ground or in low shrubs in the riparian zone of Blackwater Creek. These birds would be susceptible to the effects of the initial flood wave released by a failure of the TSF. Migratory birds using Wabigoon Lake should be largely unaffected by a failure of the TSF.

The magnitude of effects to migratory birds from a highly unlikely failure of the TSF would be of "medium" magnitude and "medium" extent (i.e., restricted to Blackwater Creek). The timing would be "high" if the failure occurs in the spring when migratory birds are nesting in the area, "medium" if the failure occurs in either the summer or fall, and "low" if the failure occurs in winter. The irreversibility would be medium as the environment will recover in a period of years.

3.5 Effects on Vegetation

In the highly unlikely scenario of a TSF failure, the resulting pulse wave would damage or uproot the shallow-rooted vegetation, and some of the deep-rooted vegetation in the riparian zone of Blackwater Creek. The vegetation directly downstream of the TSF, shown in Figure 2-2, would have the greatest potential to be affected by the greater velocities and pressure of the pulse wave.

In the highly unlikely event of a TSF failure, the magnitude of effects to riparian vegetation would be "medium" as the flood wave would likely eliminate much of the shallow-rooted vegetation and some of the deep-rooted vegetation along Blackwater Creek. The extent would be "medium" as the effect would be limited to Blackwater Creek, with a "high" duration lasting a few years until the riparian vegetation recovers. The effect would be reversible within a few years, which equates to a "medium" irreversibility. Timing is not considered to be a factor in the effect of the flood wave to riparian vegetation as the time of year would not alter the amount of vegetation loss.

Treasury Metals understands that the mouth of Blackwater Creek is known to have wild rice that are of spiritual importance to a number of Indigenous communities in the region. The flood wave is expected to be attenuated to below 1.3 m in depth by the time it reaches Wabigoon Lake. The expected height and velocity of the water is not anticipated to cause an appreciable physical damage to the wild rice stands in Blackwater Creek, as these wild rice stands would be subject to similar wave action from Wabigoon Lake during high winds. That stated, the flood wave could result in a loss of harvestable wild rice in Blackwater Creek if the TSF failure were to occur in fall with the force of the wave possibly dislodging wild rice.

In the highly unlikely event of a TSF failure, the magnitude of effects from the flood wave on wild rice would be "medium" magnitude as the harvestable wild rice could be lost for the season if the TSF failure were to occur in the fall. The extent of the effect would be limited to the mouth of Blackwater Creek in the wild rice beds (medium) with a "high" duration lasting for that year's harvest. The effect to the wild rice harvest would be a year if it were to occur in the fall as the wild rice would return the following year. There would be the least effect of the flood wave on wild rice during the winter as the wild rice stands would be dormant.

In addition to the potential effects on wild rice from the flood wave, there is the potential that metal constituents released as a result of a TSF failure could be retained within the lake sediments, and could potentially be taken up by wild rice at the mouth of Blackwater Creek. However, it is anticipated that the concentration of metals in the sediment and resultant content in the plant tissue would be sufficiently low to not harm humans, or wildlife if consumed. In the highly unlikely event of a TSF failure, a monitoring program would be developed that would include wild rice samples taken from the mouth of Blackwater Creek and tested for metals against other wild rice stands in Wabigoon Lake (and a control lake outside of the system if practical) in order to provide confidence to potential consumers.

The magnitude of the effect to wild rice quality at the mouth of Blackwater Creek is expected to be "low". The extent of the effects is "medium", limited to the wild rice at the mouth of Blackwater Creek and no other wild rice stands in Wabigoon Lake are anticipated to be affected. The duration of the effect could last a number of years as metals deposited in the sediment could potentially persist before being flushed through the system, but would be reversible once the metals flush through the system. Timing is not considered a factor in the effect to wild rice quality at the mouth of Blackwater Creek as the metal in the sediments of the wild rice bed could occur at any time of the year.

3.6 Effects on Human Health

Humans, other mammals and birds are much less sensitive to the effect of a TSF failure, including indirect effects related to reduced water quality than are aquatic life, which is reflected in the provincial soil, groundwater and surface water guidelines. Drinking water quality standards would continue be met for all parameters in Wabigoon Lake with the exception of total mercury, lead and selenium, for a short period of time, which would be mostly isolated to Keplyn Bay (Table 2 4). In the highly unlikely event of a TSF failure, Treasury Metals would work with regulators and local Indigenous communities to implement a drinking water consumption restriction for the locations on Wabigoon Lake that exceed the Ontario Drinking Water Standards. Such exceedances would be for a few parameters and would only last for a few days. The water supplies for Dryden, Wabigoon Lake Ojibway Nation and village of Wabigoon are all outside the effect zone shown in Figure 2-2: Dryden draws its municipal water supply from the far western end of the lake; Wabigoon Lake Ojibway Nation draws its water supply from Dinorwic Lake, which is upstream of Wabigoon Lake; and that the Village of Wabigoon is also outside of the potential effect zone.

The magnitude of the effects to human health from drinking water in Wabigoon Lake is "medium", but of a "low duration. The effects could be readily mitigated with consumption warnings and provision of suitable drinking water for the couple of days when the levels are elevated above the standards. The extent of the effects to drinking water quality would be isolated to certain areas in Wabigoon Lake, mostly isolated to Keplyn Bay. The irreversibility would be "low", recovering within a few days.

A TSF failure would nevertheless be expected to have some potential implications on the food web and remedial effort would be required and is proposed. Irrespective of the Goliath Gold Project, there is already a fish consumption advisory in effect for the area surrounding the Project to address pre-existing concerns regarding the concentration of mercury in fish (as discussed in Section 6.19 of the Revised EIS. Given the risk management measures already in place for the protection of human health via the fish ingestion pathway, this would be considered sufficient to ensure exposure risk reduction in the unlikely event of a TSF failure. In the highly unlikely event of a TSF failure, although the predictions are that fish flesh would not materially change from background concentrations, Treasury Metals would implement a fish flesh monitoring program to verify that the effects to contaminant concentrations in fish tissues has not substantively increased as a result of the failure.

The magnitude of the effects to human health from the consumption of fish in Wabigoon Lake is not anticipated to be measurable and would not affect the current fish consumption advisory already in place. This effect would not extend outside of Wabigoon Lake, which equates to a "high" extent.

Meaningful contaminant uptake by plants, including wild rice, is not anticipated in the event of a TSF failure. As previously stated, in the highly unlikely event of a TSF failure, a monitoring program would be developed that would include wild rice samples be taken from the mouth of Blackwater Creek and tested for metals against other wild rice stands in Wabigoon Lake, and likely a control lake outside of the system.

In the highly unlikely event of a TSF failure, the "low" magnitude of the effects to human health from consumption of wild rice at the mouth of Blackwater Creek are not anticipated to be measurable and would not extend further than the mouth of Blackwater Creek.

3.7 Effects to Aboriginal Peoples Traditional Land and Resource Use

Treasury Metals recognizes that Aboriginal people live, work, hunt, fish, trap, drink water, and gather/harvest throughout their lands and rely on them for their individual as well as their community's overall cultural, social, spiritual, physical, and economic well-being. In the highly unlikely event of a TSF failure, potential effects to traditional land and resource use by members of Indigenous communities have been identified in relation to changes in water quality, effects on fish and fish habitat, and effects on vegetation used for traditional purposes.

As previously stated, in the highly unlikely event of a TSF failure the drinking water quality standards are predicted to continue to be met in Wabigoon Lake for all parameters, with the exception of lead, mercury and selenium in Keplyn Bay, selenium at Thunder Creek, and lead and selenium in Bonny Bay (Table 2-2). These effects would last for a couple of days, at most. The water supplies for Dryden, Wabigoon Lake Ojibway Nation and Village of Wabigoon are all outside the effect zone shown in Figure 2-2; Dryden draws its municipal water supply from the far western end of the lake; Wabigoon Lake Ojibway Nation draws its water supply from Dinorwic Lake which is upstream of Wabigoon Lake; and the Village of Wabigoon is south of the potential effect zone. That stated, Treasury Metals is committed to provide suitable, clean drinking to those people that rely on drinking water from those portions of Wabigoon Lake where water quality is briefly predicted to exceed the Ontario Drinking Water Standards, until water quality returns to levels that are below the standards.

In the highly unlikely event of a TSF failure, the effects to drinking water quality for Aboriginal people would have a "medium" magnitude as it may inhibit some individuals from using water from areas of Wabigoon Lake for consumptive purposes. The extent of the effect would be "high" as it extends into Wabigoon Lake, but is isolated to locations close to the mouth of Blackwater Creek. The changes to water quality would only last as much as 20 days, which equates to a "medium" duration and would have a "low" irreversibility of a few days. Timing is not considered a factor in the potential effects to drinking water quality.

In the highly unlikely event of a TSF failure, the potential to affect fish within Wabigoon Lake has been identified as a concern for members of Indigenous communities. Modelling shows that the flood wave will have largely dissipated by the time it reaches Wabigoon Lake (Figure 2-2), therefore there should be no physical impacts on fish within the lake. From a water quality perspective, modelling of a TSF failure shows that maximum predicted concentrations of some parameters (see Table 2-4) could exceed the PWQO values for the portion of Wabigoon Lake, near to the Blackwater Creek inlet (primarily the yellow and orange areas shown in Figure 2-3). Concentrations in excess of the PWQO are predicted to last as much as 20 days, but generally will be more short-lived (see Table 2-5). Exposures of these durations are not expected to be long enough to effect fish in Wabigoon Lake. It is also important to note that PWQO values are defined for protecting aquatic life for long-term, indefinite exposures. For shorter-term exposures, elevated concentrations would have more limited effects. It is therefore unlikely that higher trophic level species that are relied on by members of the Indigenous communities (e.g., walleye and pike) would experience mortality or noticeable decreases in the fish abundance or population as a result of changes in water quality due to a highly unlikely TSF failure.

It is also recognized that metals such as cadmium, lead and mercury can biomagnify within aquatic food chains. However, the ecological health risk of sediment contamination in the event of a TSF failure is considered to be limited, as the zone of influence is expected to be confined primarily to the portion of Wabigoon Lake, near to the Blackwater Creek inlet (primarily the yellow and orange areas shown in Figure 2-3), and the tailings solids will not enter the lake (see Figure 2-4). These zones comprise a very small portion of the lake area, and would therefore be expected to have only a limited effect, on metal levels in fish tissue on a lake-wide basis. Additionally, that changes in metal levels in fish tissue would not be sufficient to alter the current fish consumption advisory in effect for Wabigoon Lake to protect human receptors from mercury exposure.

In the unlikely event of a TSF failure, the high kinetic energy would cause substantial mortality to the small-bodied, stream-resident fish in Blackwater Creek downstream of the TSF. Therefore, Blackwater Creek would not be available for bait fish harvesting until any tailings deposited within the creek are remediated, and the stream-resident fish populations in the creek re-established. However, Blackwater Creek has not been identified as an area where members of Indigenous communities currently harvest bait fish for traditional or commercial purposes.

In the highly unlikely event of a TSF failure, effects to fish in Wabigoon Lake would be of a “low” magnitude and a “high” extent (effects extend to Wabigoon Lake). Within Blackwater Creek, the effects would be of “medium” magnitude and “medium” extent for the stream-resident fish. There would be some effects of the TSF failure on the ability of Indigenous peoples to practice traditional uses of the land and resources within Blackwater Creek. The duration of the event causing the effects would be “high”, and the level of irreversibility would be “medium” (recovery within a year).

The flood wave released from a TSF failure would have sufficient kinetic energy to uproot and remove riparian vegetation along Blackwater Creek. By the time this flood wave reaches mouth of Blackwater Creek (Figure 2-2), the water depth would be similar to wave action in Wabigoon Lake during high wind events. In addition, the contaminants released in the unlikely event of a TSF failure could affect the concentrations of metals in lake sediment, and ultimately may affect metal levels within the wild rice at the mouth of Blackwater Creek. However, any increased concentrations in the plant tissue are not likely not be above levels that would affect humans or wildlife consuming wild rice. In the highly unlike event of a TSF failure, Treasury Metals would develop a monitoring program that would look at the concentration levels in the wild rice at the mouth of Blackwater Creek to verify that the metals concentrations were not elevated relative to other stands within the Wabigoon Lake system, or at levels harmful to wildlife and humans.

In the highly unlikely event of a TSF failure, effects to wild rice quality and quantity are anticipated to have a “low” magnitude as there could be some effects of the TSF failure on the ability of Indigenous peoples to practice traditional uses of the land and utilize resources. Only the wild rice at the mouth of Blackwater Creek would be affected by a TSF failure, which equates to a “medium” extent. The duration of the event causing the effect to wild rice would be “high” as metals deposited in the sediment could potentially persist before being flushed through the system, and would have a “medium” irreversibility once the metals flush through the system.

4.0 Contingency and Emergency Response

The following emergency response and contingency procedures have been identified in the event that a TSF dam breach occurs:

- Processing plant operations would be immediately shut down;
- The seepage reclaim system would be shut down;
- The reclaim system would be re-routed to transfer water to the open pit for temporary storage if worker safety is not compromised;
- In the event of a pump failure, a temporary pump can be installed during repairs; and
- In the event that water breaches the seepage collection system; the area would be cleaned up by removal and proper disposal of the potentially impacted material into the TSF.

After the short-term actions of the Emergency and Spill Response Management Plan (ESRMP) consultation would be initiated immediately with applicable government agencies and Indigenous communities, and a remediation plan would be developed. The damaged TSF embankment would be stabilized and reconstructed to ensure that containment of tailings solids and impacted water is reinstated. Released tailings and impacted natural ground are expected to be removed by excavation and deposited into the reinstated facility. Thereafter remediation efforts will be started, to support habitat recovery, including through seeding and revegetation.

Details of the recovery strategy would be dependent on the extent and nature of the spill. Tailings that were released from the TSF impoundment structure will need to be contained by temporary measures to limit additional spreading and damage to the surrounding environment. As a general strategy, tailings spilled on land between the TSF and the creek would be cleaned up as soon as the TSF could be stabilized to receive the spilled tailings. Tailings that are spilled on land could be cleaned-up within a reasonable timeline (likely one year) using dozers, excavators, loaders and haul trucks, well before the onset of acid mine drainage. Spilled tailings in the creek would need to be cleaned up mainly in winter, where the ground bordering the creek can be frozen for improved access, and when creek flows are predictably low. Access to the creek would be provided by an emergency winter road constructed parallel to the creek. Heavy equipment (excavators, loaders, dozers) would operate from off the winter road, and spilled tailings would be excavated and transferred to trucks for transport back to the TSF. Once the spilled tailings have been removed, the creek would be remediated using natural channel restoration strategies, in parallel with, or after tailings removal. Rock check control structures would likely be required at critical points in the system, to reduce creek flow velocities and erosion potentials until the creek banks can be successfully revegetated.

Another primary concern in the event of a dam breach will be to ensure site personnel and worker safety. By shutting down the processing plant, tailings will no longer be produced and routed to the TSF, which will eliminate additional tailings solids and water from entering the facility. An ESRMP will be prepared and in-place during the operations of the Project. It will be expected that personnel responsible for the operations of the TSF as well as other site managers, will be familiar with and trained to implement the ESRMP. The ESRMP will be initiated and temporary remedial works implemented to limit environmental effects, once worker safety is no longer compromised.

The effects of a TSF failure (however unlikely to occur) on Wabigoon Lake, would be expected to be localized and short-term in nature due to the very large assimilative potential of the lake. The perception of contamination of the lake could potentially be of greater importance than the effects of the failure itself, and it would be up to Treasury Metals to demonstrate that the water, fish, sediments and vegetation in the lake would not be harmful to aquatic life in the longer term through monitoring and the sharing of monitoring data in an interactive environment. Further to the ability to implement mitigation measures in the event of a catastrophic TSF failure and/or remediate such an occurrence, the company will be expected to carry reasonable insurance for operational failures. This is in line with industry standard practice for other mine and mine projects. It is also expected that should the mine project create sufficient value and the decision to proceed to construction and operational phases is made, the company will be in an adequate financial position to cover any such failures.

5.0 TSF Failure Follow-up Program

In the unlikely event of a TSF failure, an in-depth review will be conducted, which may warrant design changes, procedure changes, or need for additional measures.

A follow-up monitoring program would be developed to ensure that cleanup activities are effective, which is proposed to include water quality, sediments, fish tissue and key vegetation (i.e., wild rice) monitoring. This program would be developed through discussion with Indigenous communities and government agencies.

6.0 Recovery Strategy

In the highly unlikely event of a TSF failure, Treasury Metals would rely on the follow-up program to identify effects that are greater than those predicted, and areas where recovery strategies will need to be developed to help the environment recover to near pre-disturbance conditions. Such recovery strategies would be developed through consultation with regulators and Indigenous communities. Based on the results of the analysis of effects resulting from the highly unlikely event of a TSF failure, the following discuss the effects and consequence of a TSF failure on environmental components, as well as the potential for requiring a recovery strategy beyond the contingency measures discussed above.

6.1 Surface Water Quality

In the highly unlikely event of a TSF failure, there will be changes in water quality to Blackwater Creek and Wabigoon Lake for a relatively short period of time. Modelling shows the water quality will return to acceptable levels (PWQO) within weeks, and will continue to recover with time. There are no identified needs for recovery strategies for changes to water quality in these waterbodies.

6.2 Fish and Fish Habitat

In the highly unlikely event of a TSF failure, there would be a loss of the small-bodied, stream-resident fish present in the water downstream of the TSF. It is expected that once the rehabilitation of Blackwater Creek is completed, it is anticipated that comparable species of fish from upstream areas would reestablish the fish populations downstream of the TSF. If follow-up monitoring determines that fish populations are not reestablishing themselves naturally, Treasury Metals will consider fish relocation activities to help re-stablish the populations of stream-resident fish in Blackwater Creek through consultation with DFO and Indigenous communities.

Following a TSF failure, Treasury Metals would develop a plan for the removal of tailings from Blackwater Creek and rehabilitation of the watercourse through consultation with government agencies (e.g., DFO) and Indigenous communities. Once the deposited tailings have been removed, the creek would be re-shaped, using natural channel restoration strategies, and rock check control structures would likely be required at critical points in the system to reduce creek flow velocities and erosion potentials until the creek banks can be successfully revegetated.

As described in Section 3, Treasury Metals recognizes that certain species of fish use the lower reaches of Blackwater Creek for spawning. In the highly unlikely event of a TSF failure, there is the potential that the current spawning areas would not be used to the same level in the future. If follow-up monitoring were to determine that usage of these spawning areas are measurably affected, Treasury Metals would identify suitable actions to remediate the current spawning areas or construct suitable spawning habitat in another area of Wabigoon Lake. A plan would be developed through consultation with government agencies (e.g., DFO) and Indigenous communities. In addition, if the TSF failure occurs in the spring, there could be a loss of some fish that spawn in the mouth of Blackwater Creek, or the substantial loss of the current year's recruitment. If follow-up monitoring were to determine that fish populations known to spawn in Blackwater Creek had decreased in Wabigoon Lake, Treasury Metals would work with government agencies (e.g., DFO) and Indigenous communities to identify a strategy to help the population of these fish recover in Wabigoon Lake.

Based on the conservative surface water modelling results of a highly unlikely TSF failure, provided in Section 2.3, there are not anticipated to be any measurable changes to concentrations of metals in fish tissue in Wabigoon Lake. Therefore, no specific recovery strategy is identified for either the lake-resident fish, or the commercial and recreational fisheries that rely on them. If follow-up monitoring were to determine that concentrations of metals in fish tissue were elevated to a point where the current fish consumption advisories would need to be, Treasury Metals would work with DFO, MOECC and the Indigenous communities to help the communities recover from a potential loss of revenue.

6.3 Wildlife and Wildlife Habitat

In the unlikely event of a TSF failure, it is expected that the beaver population in Blackwater Creek downstream of the TSF would be lost. Additionally, there would be some alteration to the habitat along Blackwater Creek downstream of the TSF. Based on the large beaver population in the area, it is expected that beaver would readily repopulate Blackwater Creek within a relatively short period of time. Therefore, there are no recovery strategies planned for wildlife and wildlife habitat. If follow-up monitoring were to determine that beaver populations are not re-established in Blackwater Creek, Treasury Metals would work with government agencies (e.g., ECCC) and Indigenous communities to identify a strategy to help the recovery of beaver populations.

6.4 Migratory Birds

In the highly unlikely event of a TSF failure, it is expected that migratory birds using Blackwater Creek downstream of the TSF would be displaced, with little or no loss of life. However, if a failure of the TSF were to occur during the spring, there may be individual mortality of migratory birds that nest in shrubs or riparian areas along Blackwater Creek. As the habitat will be reestablished in the creek, there are not anticipated to be long-lasting effects to migratory birds. If follow-up monitoring were to determine that migratory bird use of the areas along Blackwater Creek downstream of the TSF, Treasury Metals would work with government agencies (e.g., ECCC) and Indigenous communities to identify a strategy for migratory bird recovery that would include considerations such as habitat augmentation.

6.5 Vegetation

In the unlikely event of a TSF failure, it is expected that there would be some destruction of the shallow-rooted and deep-rooted vegetation in the riparian zone of Blackwater Creek. The riparian vegetation is anticipated to naturally reestablish within a relatively short period of time. If follow-up monitoring determines that the riparian vegetation is not naturally reestablishing, Treasury Metals will consider re-vegetation of areas along Blackwater Creek through consultation with government agencies and Indigenous communities.

There is also the potential that a TSF failure could affect the wild rice stand at the mouth of Blackwater Creek. This could include physical damage of the wild rice stands, or changes to the chemical composition of wild rice harvested from this area. If follow-up monitoring determines that the wild rice stand at the mouth of Blackwater Creek has been affected chemically or physically, Treasury Metals will consider rehabilitating the wild rice stand through consultation with government agencies and Indigenous communities.

6.6 Human Health

In the highly unlikely event of a TSF failure, there is the potential that human health could be affected due to changes in water quality above the Ontario Drinking Water Standards, fish consumption and vegetation consumption. During the period that water quality in isolated areas of Wabigoon Lake may exceed the Ontario Drinking Water Standards, Treasury Metals will provide clean, suitable drinking water to those communities affected.

Based on the conservative surface water modelling results of a highly unlikely TSF failure, provided in Section 2.3, there are not anticipated to be any measurable changes to concentrations of metals in fish tissue in Wabigoon Lake. Therefore, no specific recovery strategy is identified for either the lake-resident fish, or the commercial and recreational fisheries that rely on them. If follow-up monitoring were to determine that concentrations of metals in fish tissue were elevated to a point where the current fish consumption advisories would need to be, Treasury Metals would work with DFO, MOECC and the Indigenous communities to help the communities recover from a potential loss of revenue.

There is also the potential that a TSF failure could affect the wild rice stand at the mouth of Blackwater Creek. This could include physical damage of the wild rice stand, or changes to the chemical composition of wild rice harvested from this area. If follow-up monitoring determines that the wild rice stand at the mouth of Blackwater Creek has been affected chemically or physically, Treasury Metals will consider rehabilitating the wild rice stand through consultation with government agencies and Indigenous communities.

6.7 Aboriginal Peoples

In the highly unlikely event of a TSF failure, there could be direct effects to Indigenous people's use of the land including the potential for changes in water quality, fish abundance and quality, wildlife abundance and vegetation abundance and quality.

As described in Section 3, Treasury Metals recognizes that certain species of fish use the lower reaches of Blackwater Creek for spawning. In the highly unlikely event of a TSF failure, there is the potential that the current spawning areas would not be used to the same level in the future. If follow-up monitoring were to determine that usage of these spawning areas are measurable affected, Treasury Metals would identify suitable actions to remediate the current spawning areas or construct suitable spawning habitat in another area of Wabigoon Lake. A plan would be developed through consultation with government agencies (e.g., DFO) and Indigenous communities. In addition, if the TSF failure occurs in the spring, there could be a loss of some fish that spawn in the mouth of Blackwater Creek, or the substantial loss of a year class of fry. If follow-up monitoring were to determine that fish populations known to spawn in Blackwater

Creek had decreased in Wabigoon Lake, Treasury Metals would work with government agencies (e.g., DFO) and Indigenous communities to identify a strategy to help the population of these fish recover in Wabigoon Lake.

Conservative surface water modelling of a highly unlikely TSF failure, provided in Section 2.3 shows there are not anticipated to be any measurable changes to concentrations of metals in fish tissue in Wabigoon Lake. Therefore, no specific recovery strategy is identified for either the lake-resident fish, or the commercial and recreational fisheries that rely on them. If follow-up monitoring were to determine that concentrations of metals in fish tissue were elevated to a point where the current fish consumption advisories would need to be, Treasury Metals would work with DFO, MOECC, MNRF and the Indigenous communities to help the communities recover from a potential loss of revenue.

In the highly unlikely event of a TSF failure, there would be a loss of the small-bodied, stream resident fish present in the water downstream of the TSF. It is anticipated that once the rehabilitation of Blackwater Creek is completed, comparable species of fish from upstream areas would reestablish the fish populations downstream of the TSF. If follow-up monitoring determines that fish populations are not reestablishing themselves naturally, Treasury Metals will consider fish relocation activities to help re-stablish the populations of stream-resident fish in Blackwater Creek through consultation with DFO, MNRF and Indigenous communities.

In the unlikely event of a TSF failure, it is expected that the beaver population in Blackwater Creek downstream of the TSF would be lost, which would therefore be unavailable for trapping. Additionally, there would be some alteration to the habitat along Blackwater Creek downstream of the TSF. Based on the large beaver population in the area, it is expected that beaver would readily repopulate Blackwater Creek within a relatively short period of time. Therefore, there are no recovery strategies planned for wildlife and wildlife habitat. If follow-up monitoring were to determine that beaver populations are not re-established in Blackwater Creek, Treasury Metals would work with government agencies (ECCC and MNRF) and Indigenous communities to identify a strategy to help the recovery of beaver populations.

In the highly unlikely event of a TSF failure, it is expected that migratory birds using Blackwater Creek downstream of the TSF would be displaced, with little or no loss of life. However, if a failure of the TSF were to occur during the spring, there may be individual mortality of migratory birds that nest in shrubs or riparian areas along Blackwater Creek, which could potentially affect hunting success, such as for waterfowl, in the short-term. As the habitat will be reestablished in the creek, there are not anticipated to be long-lasting effects to migratory birds. If follow-up monitoring were to determine that migratory bird use of the areas along Blackwater Creek downstream of the TSF, Treasury Metals would work with government agencies (ECCC and MNRF) and Indigenous communities to identify a strategy for migratory bird recovery that would include considerations such as habitat augmentation.

Although not identified as a commercial wild rice harvesting area by Indigenous communities, there is also the potential that a TSF failure could affect the wild rice stand at the mouth of Blackwater Creek. This could include physical damage of the wild rice stand, or changes to the chemical composition of wild rice harvested from this area. If follow-up monitoring determines that the wild rice stand at the mouth of Blackwater Creek has been affected chemically or physically, Treasury Metals will consider rehabilitating the wild rice stand through consultation with government agencies and Indigenous communities.

7.0 References

Canadian Environmental Assessment Agency (CEAA). 2013. Environmental Impact Statement Guidelines. Guidelines for the preparation of an Environmental Impact Statement for an environmental assessment conducted pursuant to the Canadian Environmental Assessment Act, 2012, Goliath Gold Project. Prepared for Treasury Metals Inc., dated February 21, 2013.

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