APPENDIX GG

TAILINGS STORAGE FACILITY FAILURE MODELLING

GG-1 TSF Failure Modelling
GG-2 Tailings Deposition from TSF Failure

NOTE TO READER
APPENDIX GG

In April 2015, Treasury Metals submitted an Environmental Impact Statement (EIS) for the proposed Goliath Gold Project (the Project) to the Canadian Environmental Assessment Agency (the Agency) for consideration under the Canadian Environmental Assessment Act (CEAA), 2012. The Agency reviewed the submission and informed Treasury Metals that the requirements of the EIS Guidelines for the Project were met and that the Agency would begin its technical review of the submission. In June 2015, the Agency issued a series of information requests to Treasury Metals regarding the EIS and supporting appendices (referred to herein as the Round 1 information requests). The Round 1 information requests included questions from the Agency, other federal and provincial reviewers, and members of Indigenous communities, as well as interested stakeholders. As part of the Round 1 information request process, the Agency requested that Treasury Metals consolidate the responses to the information requests into a revised EIS for the Project.

Appendix GG to the revised EIS (TSF Failure Modelling) presents the potential impacts should a failure occur at the tailings storage facility (TSF). The assessment considered worst-credible conditions of a highly unlikely hypothetical failure of the TSF. The information presented in this appendix is summarized in Section 4 of the revised EIS. Although the project design has undergone minor refinements, the changes are not substantial enough to change the overall outcomes and results contained herein. Two components are included:

- GG-1: The TSF Failure Modelling report presents the results and analysis of modelling conducted to assess potential impacts of a TSF failure.
- GG-2: Figure showing the tailings deposition footprint associated with the TSF failure modelling.

As part of the process to revise the EIS, Treasury Metals has undertaken a review of the status for the various appendices. The status of each appendix to the revised EIS has been classified as one of the following:

- **Unchanged**: The appendix remains unchanged from the original EIS, and has been re-issued as part revised EIS.
- **Minor Changes:** The appendix remains relatively unchanged from the original EIS, and has been re-issued with relevant clarification.
- **Major Revisions**: The appendix has been substantially changed from the original EIS. A re-written appendix has been issued as part of the revised EIS.
- **Superseded:** The appendix is no longer required to support the EIS. The information in the original appendix has been replaced by information provided in a new appendix prepared to support the revised EIS.
- **New**: This is a new appendix prepared to support the revised EIS.

The following table provides a listing of the appendices to the revised EIS, along with a listing of the status of each appendix and their description.

List of Appendices to the Revised EIS		
Appendix	Status	Description
Appendix A	Major Revisions	Table of Concordance
Appendix B	Unchanged	Optimization Study
Appendix C	Unchanged	Mining Study
Appendix D	Major Revisions	Tailings Storage Facility
Appendix E	Minor Changes	Traffic Study
Appendix F	Major Revisions	Water Management Plan
Appendix G	Superseded	Environmental Baseline
Appendix H	Minor Changes	Acoustic Environment Study
Appendix I	Unchanged	Light Environment Study
Appendix J	Minor Changes	Air Quality Study
Appendix K	Minor Changes	Geochemistry
Appendix L	Superseded	Geochemical Modelling
Appendix M	Minor Changes	Hydrogeology
Appendix N	Unchanged	Surface Hydrology
Appendix O	Superseded	Hydrologic Modeling
Appendix P	Unchanged	Aquatics DST
Appendix Q	Major Revisions	Fisheries and Habitat
Appendix R	Major Revisions	Terrestrial
Appendix S	Major Revisions	Wetlands
Appendix T	Unchanged	Socio-Economic
Appendix U	Minor Changes	Heritage Resources
Appendix V	Major Revisions	Public Engagement
Appendix W	Unchanged	Screening Level Risk Assessment
Appendix X	Major Revisions	Alternatives Assessment Matrix
Appendix Y	Unchanged	EIS Guidelines
Appendix Z	Unchanged	TML Corporate Policies
Appendix AA	Major Revisions	List of Mineral Claims
Appendix BB	Unchanged	Preliminary Economic Assessment
Appendix CC	Unchanged	Mining, Dynamic And Dependable For Ontario's Future
Appendix DD	Major Revisions	Indigenous Engagement Report
Appendix EE	Unchanged	Country Foods Assessment
Appendix FF	Unchanged	Photo Record Of The Goliath Gold Project
Appendix GG	Minor Changes	TSF Failure Modelling
Appendix HH	Unchanged	Failure Modes And Effects Analysis
Appendix II	Major Revisions	Draft Fisheries Compensation Strategy and Plans

List of Appendices to the Revised EIS		
Appendix	Status	Description
Appendix JJ	New	Water Report
Appendix KK	New	Conceptual Closure Plan
Appendix LL	New	Impact Footprints and Effects

APPENDIX GG-1

TSF FAILURE MODELLING

Treasury Metals Goliath Project

TSF Breach Impact Assessment Water Quality Model

704-V13203234
March 6, 2015

PRESENTED TO

Treasury Metals Inc. Toronto Office
Goliath Gold Project
The Exchange Tower
130 King Street West, Suite 3680
P.O. Box 99
Toronto, ON M5X 1B1

T: (416) 214-4654
F: (416) 599-4959

PRESENTED BY

Tetra Tech
400 - 161 Portage Ave. E.
Winnipeg, MB R3B 0Y4

T:(204)954-6800
F: (204) 988-0546

Prepared by:

Mauricio Herrera, Ph.D., P.Eng. (BC) March 6, 2015
Senior Hydrotechnical Engineer

Reviewed by:

Jim Stronach, Ph.D., P.Eng. (BC) March 6, 2015
Principal Consultant

Authorized by:

Michel Grégoire, P.Eng. March 6, 2015
Project Manager

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
EIS	Environmental Impact Statement
HTC	Humidity test cell
LGO	Low-grade ore
mg/L	Milligrams per liter
MMER	Metal Mining Effluent Regulations
TSF	Tailings Storage Facility
USGS	United States Geologic Survey
WRSF	Waste rock storage facility
PWQO	Water Quality Objectives

1.0 INTRODUCTION

Tetra Tech was retained by Treasury Metals to study the potential impacts of a failure on the proposed Tailings Storage Facility (TSF) for their Goliath Gold project (the Project). Although such a failure is extremely unlikely, an analysis is presented herein to report what can be expected shouldsuch a catastrophic event occur.

The Project is based approximately 8 km northwest of the village of Wabigoon or 20 km east of the city of Dryden, within the Eagle-Wabigoon-Manitou greenstone belt and 2 km from the Trans-Canada Highway 17.

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 crest is anticipated to have a final elevation of approximately 420 m and the maximum dam height is anticipated to be approximately 22 m. The slopes of the embankments have been preliminarily assigned to be 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, a pump-back system along with 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 use in processing operations. Approximately 9.07 million dry tonnes of tailings solids are anticipated to be directed to the TSF during the planned years of operations. A water cover is planned for the operations to minimize acid generating potential of the deposited tailings.

The TSF embankments will be designed as a zoned earth fill structure to control potential seepage flows through the embankment. A seepage collection and pump-back system will also be utilized to capture and return potential seepage from the embankments back into the containment faculty. 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 expected 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. Water pond levels and embankment heights will be designed for each embankment stage for operational and storm water management:

At this stage of the project, the TSF is projected to have an allowance for the containment of storm water that corresponds to the volume of water resulting from the EDS (Environmental Design Storm). The EDS that has been adopted is the 1:1000 yr, 24 hr storm event that has a storm depth of approximately 125 mm.

Tetra Tech understands that the CEA Agency requested Treasury Metals to add an Accidents and Malfunctions section in their environmental application, including proposed safeguards against a potential failure of the TSF. Again, this is an extremely unlikely event, and the findings presented on this report are not a reflection on the integrity of the proposed TSF.

This report presents an assessment of what would happen in the event that the TSF fails.

This report should be read along with accompanying Appendices to the EIS Submission, including:

- Appendix D. Tailings Storage Facility Alternatives Assessment. Goliath Project. July 21, 2014. WSP.
- Appendix F. Pre-Feasibility Water Management Strategy. Goliath Project. September 25, 2014. Lycopodium
- Appendix K. Geochemical Evaluation of Mine Materials at the Goliath Gold Project. EcoMetrix.

- Appendix L. Preliminary Geochemical Modeling. Goliath Project. October, 2014. Tetra Tech EBA.
- Appendix N. Hydrology 2013. Baseline Study. April, 2014. DST.
- Appendix O. Hydrologic Modeling Study. September 25, 2014. Tetra Tech WEI.

The assessment 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 modeling, to determine concentrations of selected water quality parameters from the supernatant, pore water and tailings;
- Water quality modeling of Wabigoon Lake to determine the extent of the contamination and changes in parameter concentrations in the lake.

2.0 FAILURE ASSESSMENT

The failure assessment includes two main components, first a dam break analysis was conducted to determine the potential outflow that could be released upon the occurrence of a failure in the TSF. Secondly, an inundation mapping was conducted to determine the aerial extent of the released materials, as well as the inputs to Wabigoon Lake from the hypothetical TSF failure.

2.1 DAM BREAK

The assessment was conducted to simulate worst-credible conditions of a hypothetical catastrophic failure. This is not a reflection of the actual safety conditions of the TSF after it is designed and built. The exercise would allow the development of an understanding of the environmental consequences of a TSF failure, and also the development of a mitigation and safeguard measures to reduce or eliminate any potential impacts to the environment and/or human health.

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. Furthermore, larger flows in Blackwater Creek would create the conditions to transport a larger amount of fine sediments and pore water liquid from the released tailings into Wabigoon Lake.

Table 1. Tailings Parameters

Tailings Parameter	Value	Note
Total Tailings Solids (dry tonnes)	9,066,600	From WSP
Total Volume of Settled Tailings (m3)	8,242,364	From WSP

During the hypothetical failure, it would be expected that all the supernatant volume would be discharged through the dam breach. However, only a portion of the actual tailings would be released. The volume of released tailings would depend on a number of factors, including type and extent of the failure, height of the embankment, volume of tailings stored in the impoundment, viscosity of the tailings, surrounding topography, and natural drainage conditions.

A literature review was conducted to study the nature and characteristics of previous tailings dam failures, and to shed some light into the definition of a CWCS. To this extent, a review of the work by Rico (2008) was conducted. Rico researched past tailings dams failures,and presented estimates of the outflow volume and the run-out distance that could be expected after a spill, based on the dam height and the stored tailings volume behind the embankment.

The characterization of the dam breach and initial flood hydrograph was conducted using the US National Weather Service Breach Erosion Model (BREACH). The BREACH model was used to evaluate breach opening, duration of the dam failure and the subsequent breach flow into Blackwater Creek. It is estimated that a total of approximately 8,242,364m3 of tailings will be deposited in the TSF (see Appendix D from WSP) at the proposed full pond level. Two breach scenarios were modelled to obtain the breach hydrograph of the TSF Dam.

- Breach Scenario 1: a “Sunny Day” event where the dam failure is triggered by earthquake or internal dam erosion (piping).
- Breach Scenario 2: an overtopping failure caused by the local 100-year storm event inflow. In this scenario, it is assumed that the water level in the TSF is already high from previous rainfall, and on top of this the 100-year storm event occurs to trigger the overtopping and erosion of the embankment.

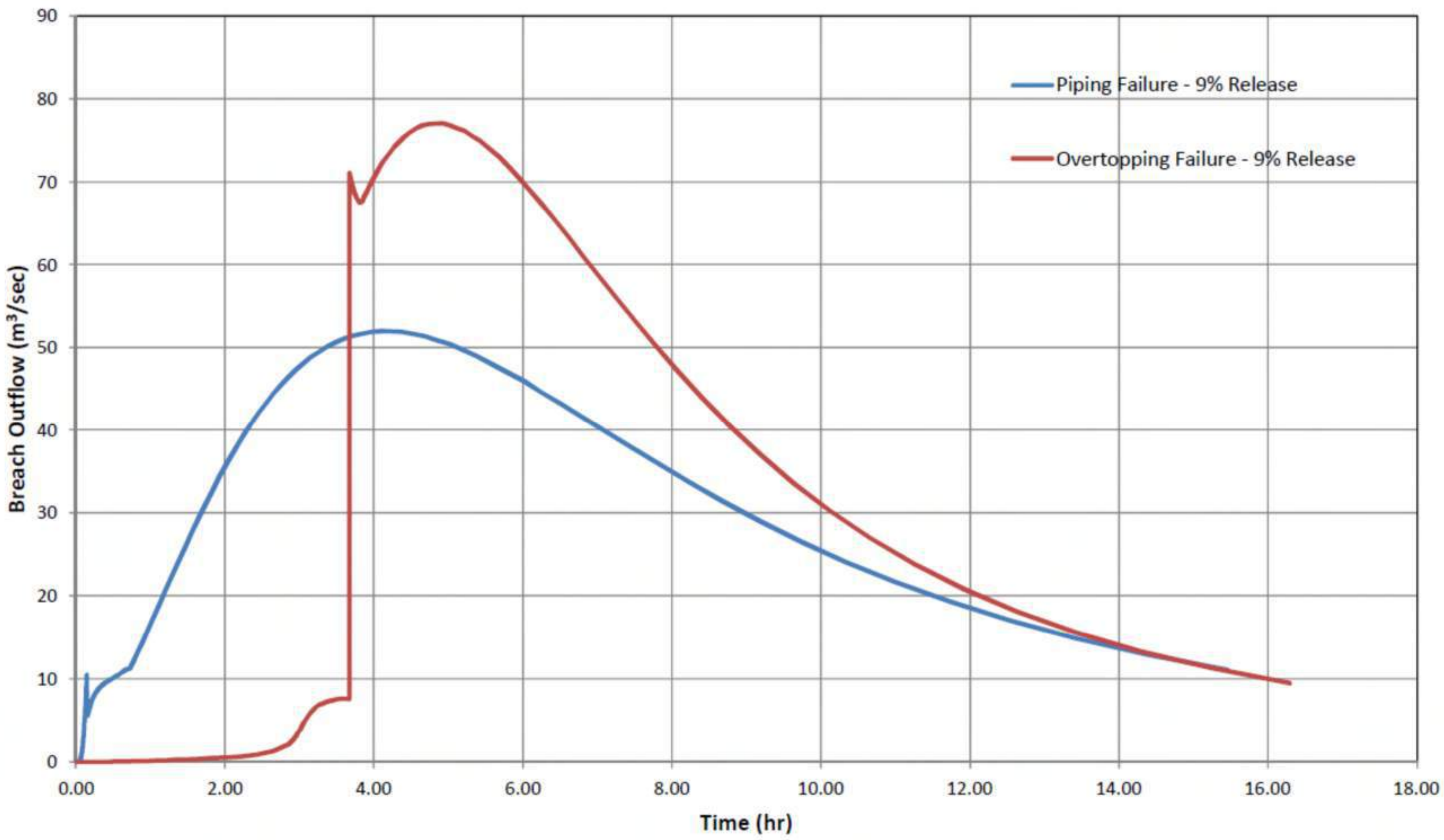
Both breach scenarios were assumed to behave as water, however, the flood routing was modeled using mixed flow for the TSF breach as further explained in Section 5.0. A summary of the selected dam breach parameters and results of the breach analyses are provided in Table 2. The breach parameters selected were the most conservative, yet realistic values based on available information. These parameters produced the highest expected peak flow from the breach. See breach outflow hydrograph in Figure 1.

Table 2. Breach Model Input

Dam Breach Parameter	Breach Scenario 1	Breach Scenario 2
Failure Mode	Piping	Overtopping
Dam Breach Elevation (m)	420	420
Volume of Tailing in TSF (m^3)	8,242,364	8,242,364
Volume of 100-yr Inflow (m^3)	N/A	62,478
Dam Slopes (H:V)	1:2.5 (u/s) and 1:1.5 (d/s)	1:2.5 (u/s) and 1:1.5 (d/s)
D_{50} Grain Size (mm) [1]	0.1 (inner) and 5 (outer)	0.1 (inner) and 5 (outer)
Porosity Ratio	0.25 (inner) and 0.30 (outer)	0.25 (inner) and 0.30 (outer)
Unit Weight (lb/ft^3)	120 (inner) and 135 (outer)	120 (inner) and 135 (outer)
Internal Friction (°)	35 (inner) and 33 (outer)	35 (inner) and 33 (outer)
Cohesive Strength (lb/ft^2)	150 (inner) and 50 (outer)	150 (inner) and 50 (outer)
Results		
Peak Flow (m^3/sec)	52	77

Notes: [1] Assumed low permeable layer on the inside and graded filter layer on the outside.

Figure 1. Breach Hydrograph



2.2 INUNDATION MAPPING

Using the output from the breach analysis, the two-dimensional hydraulic model Flo-2D was used to produce an inundation map. Flo-2D has the ability to simulate the hydraulic routing of mudflows. The results from the 2-D model indicate that all of the released supernatant would reach Wabigoon Lake, as well as the pore water from the tailings, however, the released tailings solids would remain on the land without reaching the lake. This is due for the most part to the viscous properties of the tailings which act as a hyper-concentrated fluid, and the relatively flat terrain. Figure 2 shows the extent of the inundation mapping. Based on the model output, the released tailings solids from the TSF would occupy an area of approximately 0.39 square kilometers.

Table 3. Hydraulic Structures

Stream Crossing	Estimated Road Embankment Height (m)	Drainage Structure	Estimated Dimension
Nursery Road	0.7	Bridge/Box Culvert	4m (W) X 2m (H)
Highway 17	0.7	Box Culvert	2.5m (W) X 2m (H)
Railway	1.0	Pipe Culvert	1m Dia. x 3

Notes: Estimates of the road embankment height and culvert sizes were based on site photos.

Table 4. Mudflow Properties

Parameters	Scenario – Overtopping Failure
Tailings Specific Gravity	2.7
Volume of Tailings Release (m^3)	753,480
Volume of Water Release (m^3)	942,478

Table 5. Surface Roughness

Land Cover	Manning's n
Channel	0.04
Open Field	0.07
Forested Area	0.10
Highway	0.02

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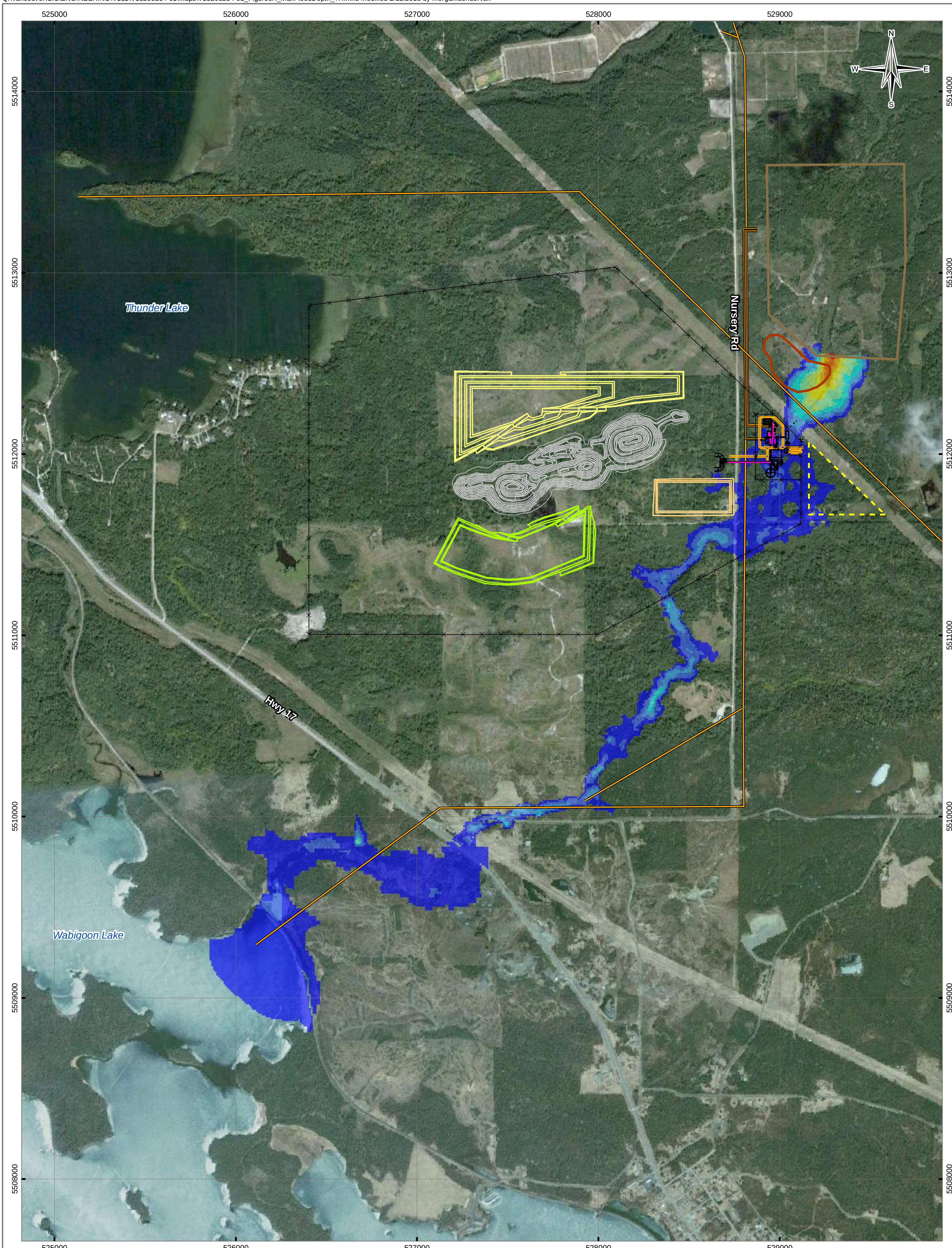

LEGEND

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

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 Depth

PROJECTION: UTM Zone 15
DATUM: NAD83
CLIENT: 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: Tt EBA-VANC
DATE: February 12, 2015

Figure 2

3.0 WATER QUALITY ASSESSMENTS

The water quality assessment included two parts, first a preliminary geochemical model was run to pre-determine the likely concentrations of water quality concentrations from the released materials, after the hypothetical failure of the TSF. The inputs from this exercise, as well as the input from the breach analysis and the inundation mapping were used to determine the inflow volume and quality that would reach Wabigoon Lake after the hypothetical TSF failure. This input, was then used to conduct a 2-dimensional model of the lake in order to determine concentration of water quality parameters at all locations in the lake, over a period of 30 days.

3.1 GEOCHEMICAL MODELING METHODOLOGY

Using the derived source terms, a preliminary geochemical model for the TSF failure impact assessment was conducted using the computer code PHREEQCi Version 2.17.4799 (Parkhurst and Appelo, 1999), supplied by the U.S. Geological Survey (USGS). For this project, the WATEQ4F database (Ball and Nordstrom, 1991) was updated using the PHREEQC database published with the computer code (Parkhurst and Appelo, 1999). The combination of the two databases provided the broad range of parameters needed to accurately model conditions at the Goliath property.

Geochemical modeling for the prediction of the annual water qualities under various TSF failure scenarios was performed, including:

- Water quality of TSF overflow failure;
- Water quality of TSF dam breach failure; and,
- Water quality of runoff from any new tailings beach material deposited downstream of the breach.

The geochemical model combines the physical and chemical components that are the basis of the geochemical computer modeling. Relative proportions of each source term were calculated as a percentage of the total release volume based upon the TSF failure assessment hydrological model.

Two parallel models were generated to provide a possible range of water qualities which may be generated by an unplanned TSF release, as follows;

1. Pore water entrained within the tailings remains unchanged after the initial deposition into the TSF and is represented by the water quality of the TSF slurry after the cyanide destruction circuit; and,
2. The solid tailings undergo initial flushing and limited surface reactions while dissolved oxygen is present. The resulting pore water is represented by the average of the first 5 weeks of tailings humidity cell leachate.

Application of the various source data aids in the sensitivity analysis of the model outputs and represents the range of concentrations which may ultimately be observed at the site.

3.2 MODEL RESULTS AND CONCLUSIONS

The results of the modeling scenarios have been provided in Appendix GG-2 and compared against the Metal Mining Effluent Regulations (MMER) water quality values. The highlighted parameter concentrations indicate an exceedance of the MMER guideline concentrations. The Ontario Drinking Water Standards and the Ontario Provincial Water Quality Objectives (PWQO) are also presented in each table for comparison. The parameter concentrations in bold indicate an exceedance of the drinking water standards. Values in italics exceed the provincial water quality objectives.

Inputs to the TSF include cyanide-treated tailings slurry from the mill, excess mine dewater, precipitation, and run-off from tailings beach areas. Assumptions regarding each input are outlined in Appendix GG-1.

3.2.1 TSF Overtopping Failure

The water quality of the TSF will be unaltered if released due to an overtopping failure of the TSF. As such, the water quality of the TSF is equivalent to the water quality of the overflow.

Concentrations of all parameters remain below the MMER limits, with the exception of lead which may increase to roughly 1.5-times the limit of 0.2 mg/L, in the unlikely event that acid generating conditions are established in the tailings material as a result of exposure to air. Aluminum, cadmium, cobalt, copper, iron, lead, mercury, selenium, silver, thallium, uranium, and cyanide may exceed their respective PWQO at the point of release, but does not take into consideration any dilution effects from the receiving waters. Sulphate concentrations decrease after the initial flushing of readily soluble material to a local minimum prior to the onset of acid-generating conditions. pH of any release should remain circumneutral.

3.2.2 TSF Dam Breach Failure

A breach in the TSF dam would result in the release of the TSF pond (or supernatant), tailings material, and entrained pore waters. For the purposes of the water quality model, the aqueous portion of the release was assumed to contain 26.9% TSF pond supernatant, 71.2% pore water, and 1.9% precipitation (rainfall/snowmelt). The water quality of the TSF pond supernatant is discussed in Section 3.2.1 above. The water quality of the precipitation is calculated based on pure rainfall with an average pH of 5.6, as discussed in Appendix GG-1.

If the water quality of the pore water remains unchanged from the mill outflow water quality, the water quality of the water released during a dam breach will be similar to the water quality of the TSF pond supernatant. This scenario assumes that there is not sufficient dissolved oxygen within the entrained pore water to allow any surface oxidation reactions to occur. In addition to the 12 exceedances listed above, arsenic and zinc may also exceed their respective PWQO. Although the model outputs indicate that the pH of the release may be as low as 5.06, this result is most likely an artifact of the assumptions used to attain charge balance in the model and are unlikely to be observed in the field.

If surface oxidation reactions between the mill outflow water and the solid tails proceed until all dissolved oxygen is consumed, water quality of the pore water may be more similar to the water quality of the HTC (Humidity Test Cells) leachate during the initial weeks of HTC operation. As with the other scenario, the same 14 parameters may exceed their respective PWQO. However, the concentration of thallium may be significantly higher than the other scenarios due to the partial oxidation of the tails surfaces. The pH of the release may be circumneutral to slightly alkaline, but within MMER and PWQO.

3.2.3 Tailings Beach Runoff

In the event of a dam breach, the solid tails will be washed downstream and deposited along the area of inundation to create approximately 0.4 km^2 of new tailings beach area. Runoff from these flood-deposited tails will also drain into the receiving water, and will be a continuing source of metals leaching over time. Water quality from these tails at three stages of oxidative aging (initial, intermediate, and long term) were modelled based on an average active depth of 0.1 m.

Over time, the pH of the tails runoff will decrease from circumneutral to approximately 4.4 as sulphide oxidation becomes dominant. With the exception of antimony, cobalt, silver, and zinc, concentrations of all PWQO-regulated metals will increase over time. As acid-generating conditions become established, concentrations of the following metals may increase to above the respective PWQO; aluminum, arsenic, cadmium, chromium, cobalt, copper, iron, lead, molybdenum, nickel, selenium, thallium, uranium, vanadium, and zinc.

3.2.4 Conclusions and Limitations

In the event of a TSF failure, a cleanup program will be deployed to collect the released solids as quickly as possible. If solids are allowed to sit there for several weeks, the pore water that will leak from the spilled tailings may exceed the MMER guidelines for lead. In the extremely unlikely event that the TSF is overtopped, aluminum, cadmium, cobalt, copper, iron, lead, mercury, selenium, silver, thallium, uranium, and cyanide may exceed their respective PWQO at the point of release. If the dam is breached, arsenic and zinc may also exceed their respective PWQO at the point of release, in addition to the 12 parameters previously listed. The beached tails deposited by the inundation may also generate runoff that could exceed the PWQO for aluminum, arsenic, cadmium, chromium, cobalt, copper, iron, lead, molybdenum, nickel, selenium, thallium, uranium, vanadium, and zinc. These results do not take into consideration any dilution effects from the receiving waters and are modeled concentrations from the point of release only.

In addition, the assumptions presented in Appendix GG-1 are conservative estimates based on current knowledge of the site. As additional information becomes available, it is recommended that these assumptions be refined to generate a more representative model of future site water quality.

This geochemical model and report are to be considered as preliminary, and will be living documents to be refined at later phases of the project as additional information becomes available, including the mine plan and closure plan.

3.3 LAKE WATER QUALITY MODELING

3.3.1 Wabigoon Lake

Wabigoon Lake is a large body of water with a surface area of 104 km^2 (NRCAN, 2014). 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.

The Lake has a maximum depth of 15 m and an average depth of approximately 5 m (OMNR, 2008). The lake depth in Kelpyn Bay ranges from 1 m to 4 m.

Christie’s Island is located offshore of Kelpyn Bay and is identified as a fish sanctuary by the Ontario Ministry of Natural Resources (OMNR, 2013).

3.3.2 Model Description

A two-dimensional numerical model was created to simulate the hydrodynamic conditions in WabigoonLake using the TELEMAC-2D software, version 6.2, developed by Électricité de France (EDF). Figure 3 presents the simulation mesh made of 41,840 nodes and 77,713 triangular elements. The mesh density ranges between 10 and 100 m. Figure 4 presents a close-up view of the mesh in the region of Kelpyn Bay.

Hydraulic parameters (such as water depth, water velocity and effluent concentration) are computed at each node of the simulation mesh. The values computed in TELEMAC-2D are depth-averaged, so variability in velocity and concentration in the vertical are not simulated. The model was calibrated based on the results of the field tracer study conducted by Tetra Tech on July 30, 2014. Overall, the model calibration is deemed acceptable since it reproduces well the velocity, wind-induced flow in the Kelpyn Channel, and the maximum concentration at 250 m distance from an injected dye source, where vertical mixing was observed in the field study to be largely complete. The concentration at 250 m is a key feature for this study. The total lake volume in the computational domain is 574.8 hm^3.

Figure 3. Wabigoon Lake Simulation Mesh

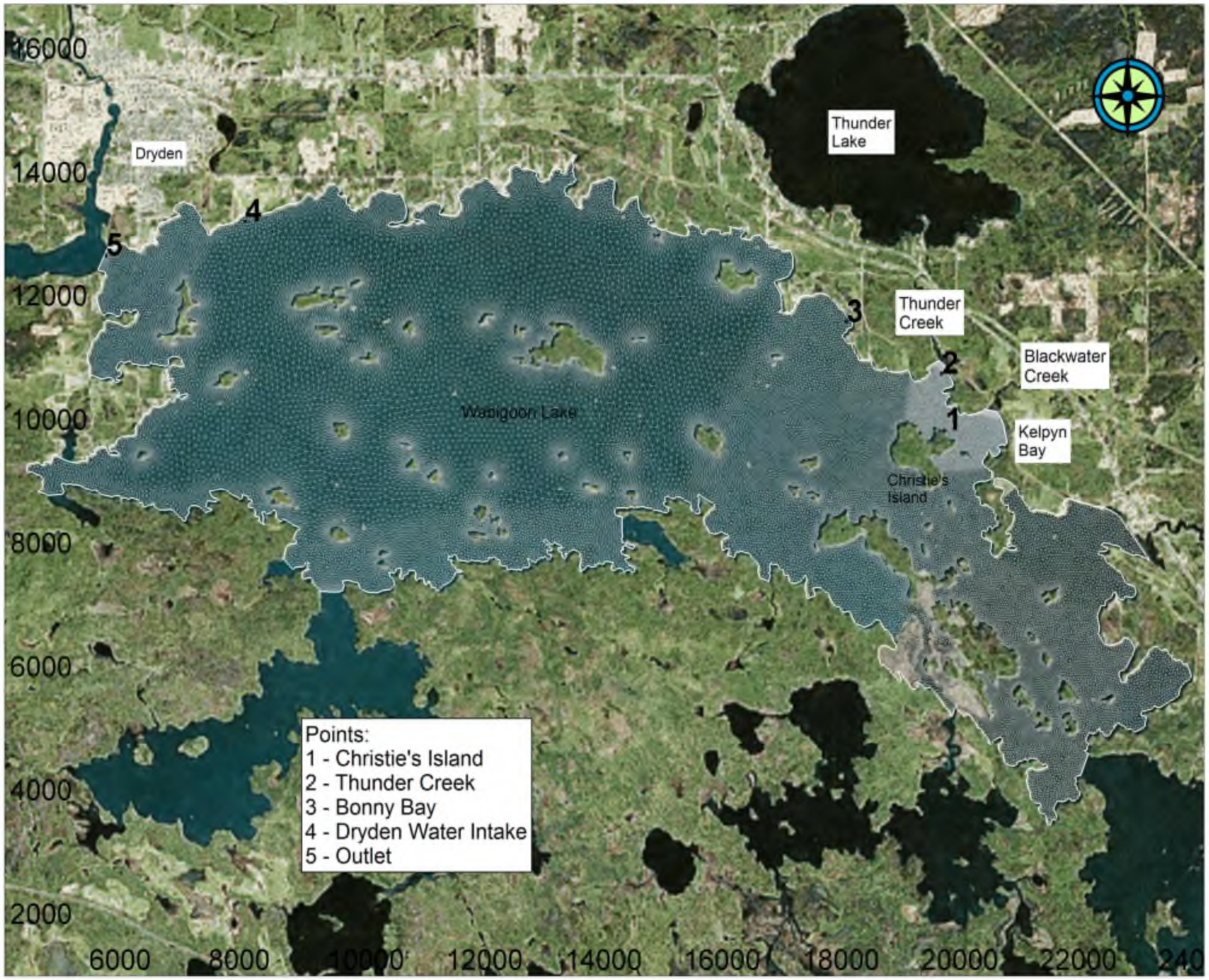

Figure 4. Simulation Mesh in the Region of Kelpyn Bay

3.3.3 Model Input

Model inputs are: natural inflow to Wabigoon Lake, TSF failure hydrograph and wind conditions.

The natural inflow to Wabigoon Lake considered in the calculations is the annual average discharge computed from historical data of hydrometric station #05QD016 located on the Wabigoon River at Dryden (14.9 m^3/s).

The failure inflow hydrograph corresponds to TSF overtopping failure from the dam breach and hydraulic routing analysis. The maximum discharge from this hydrograph is 64.6 m^3/s and the total hydrograph volume is 1.2 hm^3. 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 which changes concentrations only by dilution effects. The model results in concentration factor that can be applied to each water quality parameter.

The wind conditions considered in the calculations corresponds to a “long-term moderate wind scenario” as defined in previous report (Tetra Tech, 2014) using historical data from meteorological station #6032119 (Climate Ontario). The wind speed and direction are constants in the simulation: 15 km/h and 225 degrees (blowing from the southwest).

3.3.4 Results

The simulation was run for 30 days following TSF failure. The flood wave enters Wabigoon Lake 6.9 hours after failure. Figure 5 illustrates the maximum concentration computed in the lake at all points during the entire simulation, not the changes in concentration over time. Figure 6 shows the changes in the concentration factor over time at key locations in the lake. Actual concentrations for each parameter can be obtained by multiplying the concentration factor by the actual concentration obtained from the geochemical model. The dam breach flow enters Kelpyn Bay and then moves in the western direction along the North shore of the lake. High concentration (>50%) were only computed in Kelpyn Bay and Kelpyn Channel. The plume only comes in contact with the north side of Christie’s Island. The 10% concentration boundary is located 3.4 km away from the mouth of Blackwater Creek, near Bonny Bay. Also, The 1% concentration boundary is located 9.0 km away from Blackwater Creek, in the middle of the lake. Results show that 0.1% concentration reaches the lake outlet at Dryden 22 days after TSF failure.

Table 6 presents the simulation results at five (5) control points in Wabigoon Lake: maximum concentration (Cmax) and time after failure to obtain Cmax. Table 8 presents the exceedance duration in days of water quality parameters above the Project Water Quality Objective at the five control points in Wabigoon Lake. Table 7 shows actual concentrations for the parameters that exceeded the PWQO, and Table 8 shows the duration of exceedances above the PWQO (in days) at each of the five locations. Results from the simulation show that no contaminant is transported in the East part of the Lake. Therefore, the community of Wabigoon is not impacted by the TSF failure.

Figure 5 Maximum concentration in Wabigoon Lake

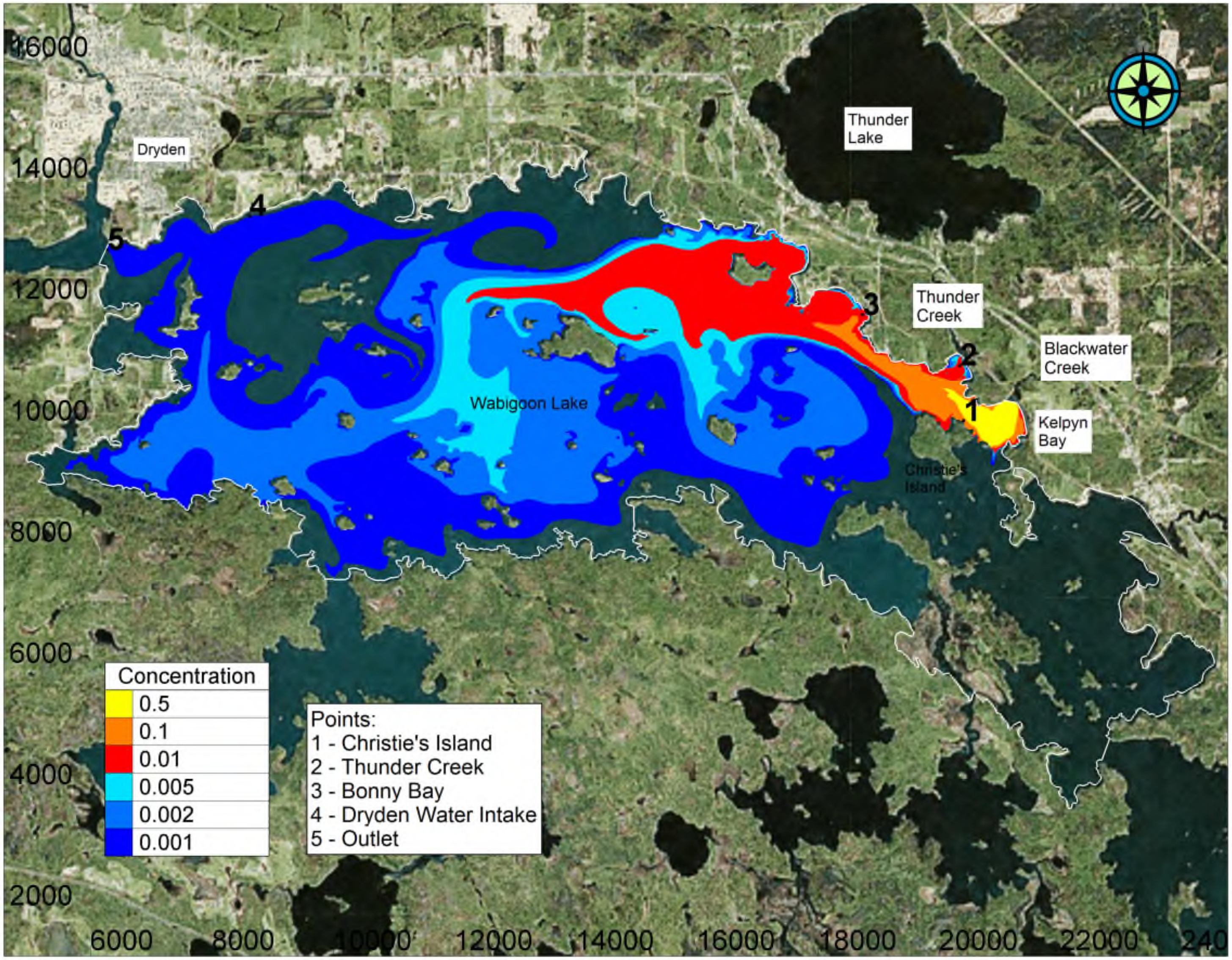

Figure 6. Changes in Concentration Factor over time at key locations in Wabigoon Lake.

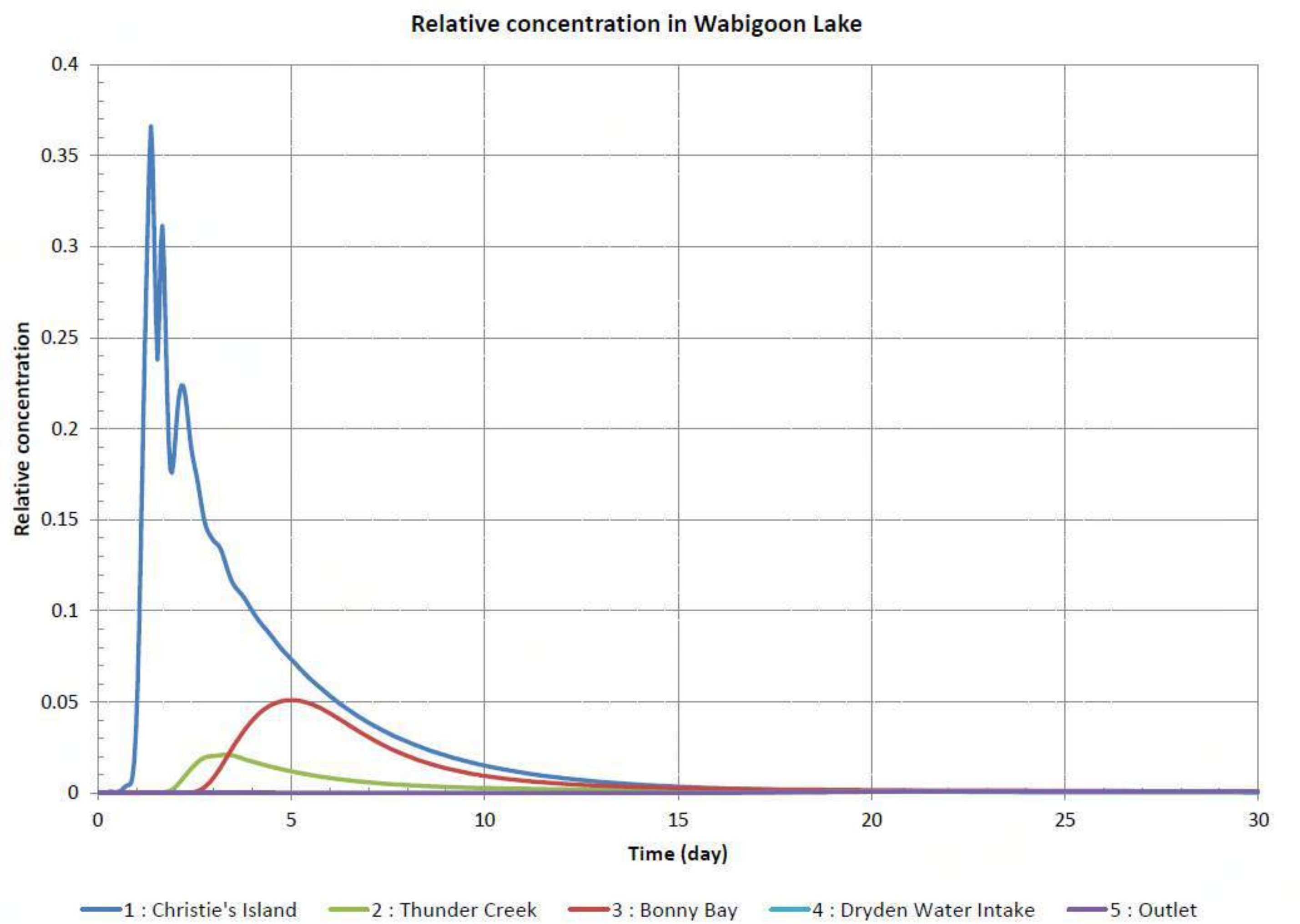

Table 6 - Results at 5 control points in Wabigoon Lake

Point	Description	Coordinates*(m)		Distance** (km)	Cmax ***	Time to Cmax (day)
		X	Y			
1	Christie's Island (fish sanctuary)	525406.2	5509088.1	0.74	3.7E-01	1.6
2	Thunder Creek (spawning habitat)	525343.5	5509999.8	0.92	2.1E-02	3.6
3	Bonny Bay (fishing camp)	523738.2	5510836.4	2.72	5.1E-02	5.3
4	Dryden Water Intake	513621.0	5512466.0	12.81	9.5E-04	23.8
5	Lake Outlet	511277.5	5511910.6	15.00	1.0E-03	25.3

* NAD 1983 UTM Zone 15N

** from mouth of Blackwater Creek

*** Cmax : maximum concentration

Table 7. TSF Overflow Concentrations for parameters that Exceeded the Water Quality Objective

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

Table 8. Duration of Exceedances above Water Quality Objectives in Wabigoon Lake

	Duration exceedance above Water Quality Objective After Spill into Wabigoon Lake (days)				
Water Quality Parameter	Christie's Island	Thunder Creek	Bonny Bay	Dryden Water Intake	Outlet
Al	0.0	0.0	0.0	0.0	0.0
As	0.0	0.0	0.0	0.0	0.0
Cd	1.0	0.0	0.0	0.0	0.0
Co	1.0	0.0	0.0	0.0	0.0
Cu	2.5	0.0	0.0	0.0	0.0
Fe	0.0	0.0	0.0	0.0	0.0
Pb	10.0	1.0	5.0	0.0	0.0
Hg	10.0	1.0	9.0	0.0	0.0
Se	4.0	0.0	0.0	0.0	0.0
Ag	1.0	0.0	0.0	0.0	0.0
Tl	20.0	10.0	12.0	0.0	0.0
U	0.0	0.0	0.0	0.0	0.0
Zn	0.0	0.0	0.0	0.0	0.0
Cyanide	1.0	0.0	2.0	0.0	0.0

4.0 DESIGN AND MONITORING

The TSF will meet regulatory requirements and will be constructed to resist the probable maximum flood and a maximum credible earthquake. The TSF will be able to hold the Environmental Design Flood (EDF), and an emergency spillway will allow the safe evacuation of any excess flows. Therefore, the result of a catastrophic failure as modelled in this report is highly improbable.

At the operational level, a number of safeguards will be implemented, including monitoring of seepage discharges through the dam, foundation; phreatic surface in the tailings dam; pore pressures in the dam; and horizontal and vertical movements in the dam. Proper long term monitoring will be put in place. In case that any repairs are required, they will be implemented in a timely fashion.

5.0 RECOMMENDATIONS

5.1 EMERGENCY RESPONSE PROCEDURES

The first line of response will be oriented towards the protection of human health and safety. If a failure is imminent, an emergency plan would be triggered. This plan could include the following actions: stopping pumping of tailings into the TSF if applicable, emergency repairs if safe to do so, pumping of ponded supernatant out of the TSF. In addition, and if possible, temporary barriers will be installed to contain the spill to the extent possible.

Treasury Metals will have a communications plan in place to ensure that nearby residents are informed of the spill. Potential temporary traffic disruptions on Hwy 17 will be mitigated as well. Based on modeling results, a maximum water depth of 0.3 m. on the road could be expected. This maximum would occur about 8 hrs after the breach occurs.This maximum water depth will subside quickly before becoming negligible. Appropriate traffic controls will be put in place to guarantee the safety of travelling vehicles while there is flowing water on top of the road.

Following the spill, a remedial plan will be implemented in consultation with relevant government agencies. Released tailings will be contained and covered as needed in order to eliminate the release of fine sediments and minimize the release of contaminated pore water.

A surface and groundwater monitoring program will be developed to monitor the movement of contaminants in Blackwater Creek and Wabigoon Lake.

6.0 REFERENCES

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Rico, M.; Benito, G.; Diez-Herrero, A. (2008), Floods from tailings failures. Journal from Hazardous Materials. 154 (2008) 79-87.

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APPENDIX GG1 GEOCHEMICAL MODELING ASSUMPTIONS

Assumptions	
Source Data Set	**Assumptions**
All	This PHREEQCI model is based upon the water balance titled "Goliath Gold Project Pre-Feasibility Water Management Strategy", (Lycopodium, June 2014) and the geochemical characterization work titled "DRAFT Geochemical Characterization of the Goliath Gold Project" (Ecometrix, September 2013).
	All facilities were modeled annually based on average annual precipitation less the average annual evaporation (as provided in the Water Management Strategy). Additional detail for monthly water management requires a site water balance to be presented on a monthly basis, which has not yet been developed.
	For analytes with reported concentrations less than the analytical detection limit (<DL), a numerical value of 1/2 of the analytical detection limit was used for calculations of average concentrations/loadings and all subsequent model inputs.
	A full suite of anion concentrations in the humidity cells was not reported for all sampling events, but are needed to provide a charge balance for the solutions. Sulphate, silicon (present at silicate), and alkalinity (assumed to be present as carbonate) have been reported. Charge balance with the other solution consituents was attained by adding chloride or sodium as a surrogate (where approrpiate) for any unreported anion or cation concentrations, respectively. Because sodium and chloride are inert, the use of either parameter to provide charage balance will not affect any precipitation reactions.
	All mixing was performed within PHREEQCI, and common secondary mineral phases were allowed to precipitate if the solution became saturated.
	The model assumes the same temperature dependance modelled by the Arrhenius equation for all sulphide oxidation and metal leaching reactions based on an average summer temperature of 11.5°C, resulting in a scaling factor of 0.555.
	For the purposes of this preliminary water quality model, all run-off and seepage waters are considered to be collected and diverted to the TSF.
	Water quality of effluent to the environment based on the water quality of the outflow from the TSF. At this time, no changes in the water quality are expected in the polishing pond.
Mine Dewater	Water quality of groundwater seepage into the pit and the underground workings is taken from Hydrogeological Pre-Feasibility/EA Support Study Appendix E, AMEC 2014. However, because ARD reactions can occur at GW seeps into the underground workings, all groundwater pumped from the underground is estimated to have the same water quality as the pit wall run-off.

Assumptions	
Source Data Set	**Assumptions**
Overburden	Median results of Overburden SFE tests from appropriate area samples were used to represent overburden runoff from cover materials implaced upon the closed WRSF and pits (Table 6.9, KCB 2012). Concentrations were scaled based on the final area of each impoundment (as needed), assuming that the final area of the impoundment will be fully covered with overburden and a 0.5 m active depth into the surface of the overburden. The Overburden SFE test results were scaled to 50% of the SFE concentration to better approximate the long-term leachate profile, such as would be present in a humidity cell test (HTC) sample after steady state conditions have been estabilished.* Background surface water quality was also used as a comparison using monitoring point TL2 median concentrations (Table 4.2, KCB 2012).
WRSF and Pit	All water contacting the waste rock was conservatively considered as seepage, assuming no kinetic limitations for water interaction with the rock surfaces.
	The ratio of the different rock types in the WRSFs and open pits were assumed to be constant through the life of mine and were based on the following percentages: 70% BMS, 15% MSED, and 15% MSS. (e-mail communication from Mark Wheeler via Lara Reggin)
	For each rock type, the geometric average of the three columns were averaged over the given time interval to generate a loading for the initial period (<5 weeks), an intermediate steady state (20-40 weeks). After week 63, two of the three HTCs for each rock type were discontinued. For the long-term steady state (60-80 weeks), only a single column from each rock type remained in operation. (Treasury_HC Test Summary_29Aprl14.xls, provided by EcoMetrix).
	All loading values were scaled to correct for surface area in the HTC vs. field conditions (0.10) and for rinsing efficiency (0.3) for a total scaling factor of 0.03. Calculated run-off concentrations were compared to measured values to calibrate the scaling assumptions, and were within a factor of 2 of the measured values.
	For the WRSFs, the quality of the HTC leachate was scaled based on the total surface area, an assumed active depth of 2.0 meters, and total monthly precipitation.
	Pit wall HTC-derived runoff was assumed to be equal to the area of exposed pit wall, with an assumed active depth of 1.0 meters and a scaling factor of 0.03.
	During flooding, the pit lake will be formed by the accumulation of surface runoff, RO plant treated effluent, and groundwater from nearby wells with a total fill time of 9 years.
	An average density for waste rock of 2.7 tonnes/m^3 was used for all placed rock (WRSF and LGO stockpiles).

Assumptions	
Source Data Set	**Assumptions**
	Blasting residues, such as ammonia and nitrate, have not been considered in the water quality of the runoff from the pit or WRSF at this time.
	The water quality derived from the field test leachate was not scaled and is considered to be directly representative of the run-off water quality.
Ore Stockpile	Geochemical characterization of the low grade ore has not yet been completed. The water quality of the MSS host rock has been used as a surrogate for the low grade ore as a preliminary approximation. The water quality of the runoff from the ore stockpile was calculated based on the surface area and assumed an active depth of 2.0 meters.
	For MSS host rock surrogate data, the geometric average of the three columns were averaged over the given time interval to generate a loading for the initial period (<5 weeks), an intermediate steady state (20-40 weeks). After week 63, two of the three HTCs for each rock type were discontinued. For the long-term steady state (60-80 weeks), only a single column from each rock type remained in operation. (Treasury_HC Test Summary_29Aprl14.xls, provided by EcoMetrix).
	All loading values were scaled to correct for surface area in the HTC vs. field conditions (0.10) and for rinsing efficiency (0.3) for a total scaling factor of 0.03. Calculated run-off concentrations were compared to measured values to calibrate the scaling assumptions, and were within a factor of 2 of the measured values.
	The quality of the HTC leachate was scaled based on the total surface area, an assumed active depth of 2.0 meters, and total annual precipitation.
	The water quality derived from the field test leachate was not scaled and is considered to be directly representative of the run-off water quality.
Collection Ponds	Collection ponds will have no carry-over volume from year-to-year and are considered temporary storage only.
TSF	Tailings HTC data was originally reported in the "DRAFT Geochemical Evaluation of the Goliath Gold Project" (Ecometrix, 2013).
	In accordance with the water management strategy (Lycopodium, 2014), all tailings material shall be deposited sub-aqueously. However, a maximum exposed tailings area of 10% of the TSF footprint has been assumes to provide a conservative estimate of TSF water quality. As such, the water quality of mill outflows are presented in Table 4.5 of the "Goliath Gold Project Pre-Feasibility Water Management Strategy" (Lycopodium June 2014) will be blended with tails and other site runoff and precipitation to determine the water quality of the TSF and subsequently the Polishing Pond.

Assumptions	
Source Data Set	**Assumptions**
	The sodium or chloride concentrations of the tailings runoff were allowed to adjust in order to attain charge balance in order to maintain the measured pH value.
	Because Tailings HTC material is identical to material ultimately depositied in the TSF, the HTC loading data did not require scaling to represent field conditions as was done for waste rock, LGO, and pit walls. An assumed active depth of 0.5 m was applied
	Any and all water discharged from the TSF will be contained within Polishing Pond, which will contain no other inflows.
Treated Effluent	Water quality of treated effluent (inputs into the Polishing Pond) are presented in Table 4.5 of the "Goliath Gold Project Pre-Feasibility Water Management Strategy", Lycopodium June 2014. For concentrations reported as less than the analytical detection limit, the numerical value of the analytical detection limit was used in lieu of the 1/2 detection limit value typically employed. This approach will provide a more conservative estimate of site effluent water quality.
Pit Lake	The pit lake is assumed to be actively filled using treated effluent from the reverse osmosis treatment system, groundwater from nearly extraction wells, and natural surface runoff. Natural runoff was assumed to be represented by the pit wall run-off during the intermediate timeframe (prior to the onset of acid generating conditions).

APPENDIX GG2 GEOCHEMICAL MODEL RESULTS

Model Outputs

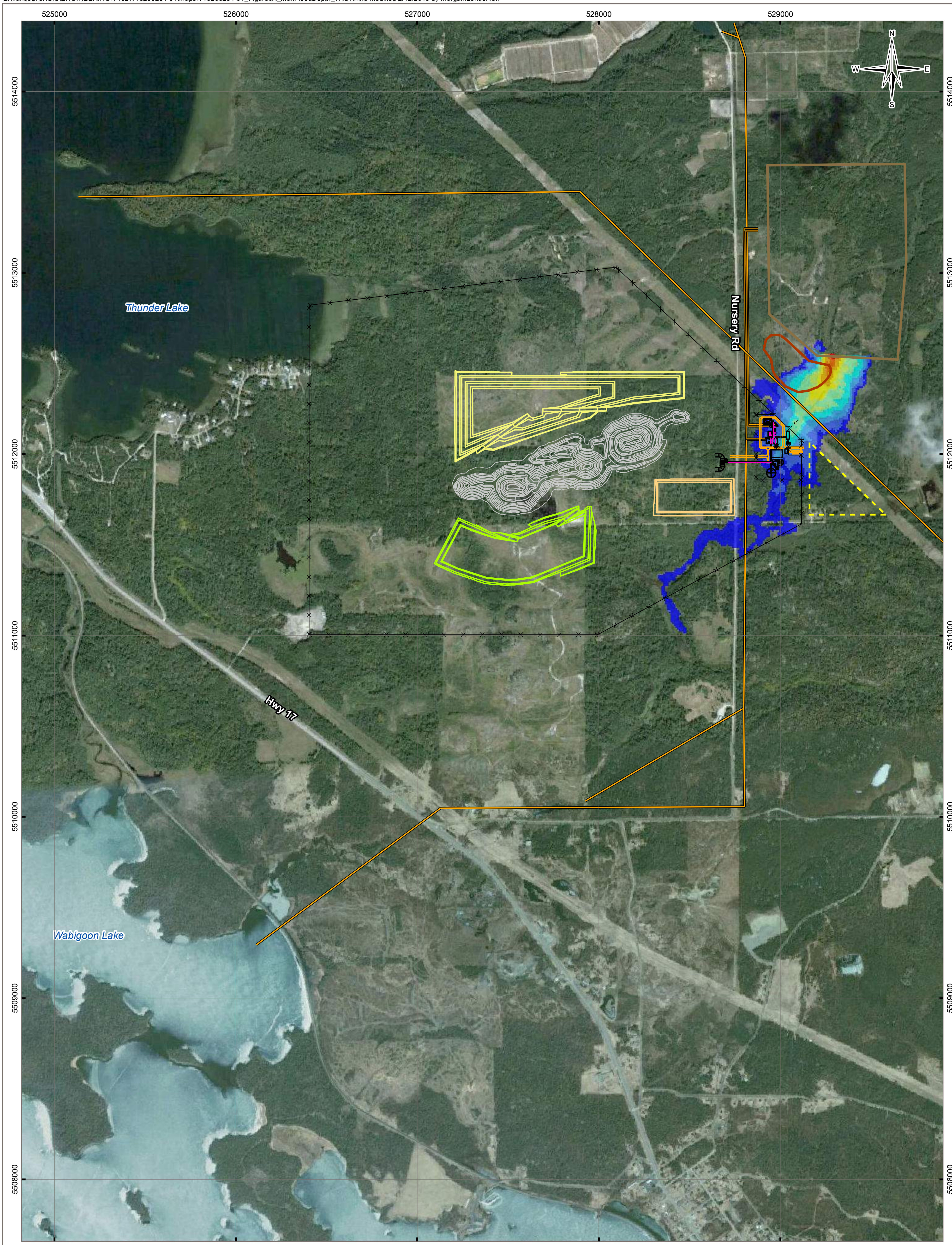
Source Group	Description	pH	Hardness (mg/L CaCO3)	Sulphate (mg/L)	Al (mg/L)	Sb (mg/L)	As (mg/L)	Ba (mg/L)	Be (mg/L)	Bi (mg/L)	B (mg/L)	Cd (mg/L)	Ca (mg/L)	Cr (mg/L)	Co (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Li (mg/L)	Mg (mg/L)	Mn (mg/L)	Mo (mg/L)
Ontario Drinking Water Standards						0.006	0.025	1			5	0.005		0.05				0.01				
Water Quality Objectives		6.5 - 8.5			0.075	0.02	0.005				0.2	0.0002		0.1	0.0006	0.005	0.3	0.005				0.01
MMER (Max Monthly Mean)		6.5 - 9.0					0.5									0.3		0.2				
Contact Water	WRSF Runoff and Mine Dewater- Initial	7.56	43.82	28.1443	0.17364	0.00445	0.00197	0.00500	0.0005	0.0005	0.02500	0.00012	13.5009	0.00050	0.00508	0.01255	0.29626	0.00635	0.03	2.4550	0.1109	0.00118
Contact Water	WRSF Runoff and Mine Dewater- Intermediate	7.16	23.20	15.4406	0.13971	0.00230	0.00192	0.00500	0.0005	0.0005	0.02500	0.00006	7.1551	0.00050	0.00210	0.00657	0.31750	0.00513	0.03	1.2958	0.0520	0.00070
Contact Water	WRSF Runoff and Mine Dewater- Final	7.16	23.20	15.4406	0.13971	0.00230	0.00192	0.00500	0.0005	0.0005	0.02500	0.00006	7.1551	0.00050	0.00210	0.00657	0.31750	0.00513	0.03	1.2958	0.0520	0.00001
Collection Pond	WRSF/LGO Runoff - Initial	7.56	43.82	28.1472	0.17344	0.00447	0.00197	0.00500	0.0005	0.0005	0.02500	0.00012	13.5026	0.00050	0.00507	0.01257	0.29595	0.00636	0.03	2.4543	0.1109	0.00118
Collection Pond	WRSF/LGO Runoff - Intermediate	7.16	23.19	15.4349	0.13967	0.00231	0.00192	0.00500	0.0005	0.0005	0.02500	0.00006	7.1527	0.00050	0.00210	0.00657	0.31728	0.00514	0.03	1.2949	0.0519	0.00070
Collection Pond	WRSF/LGO Runoff - Long Term	7.16	23.19	15.4349	0.13967	0.00231	0.00192	0.00500	0.0005	0.0005	0.02500	0.00006	7.1527	0.00050	0.00210	0.00657	0.31728	0.00514	0.03	1.2949	0.0519	0.00001
TSF	TSF - Initial	7.56	44.64	87.9379	0.18397	0.00531	0.00383	0.00491	0.0005	0.0005	0.02399	0.00020	13.6344	0.00745	0.00509	0.02584	0.29794	0.00940	0.02	2.5729	0.1068	0.00117
TSF	TSF - Intermediate	7.03	23.25	75.0922	0.14997	0.00226	0.00376	0.00671	0.0005	0.0005	0.02398	0.00073	6.9022	0.00745	0.00230	0.02017	0.31805	0.02861	0.02	1.4625	0.0532	0.00066
TSF	TSF - Long Term	7.00	23.13	78.2429	0.16642	0.00221	0.00383	0.00507	0.0005	0.0005	0.02400	0.00084	6.8533	0.00745	0.00260	0.02387	0.33776	0.34068	0.02	1.4633	0.0579	0.00001
Pit Lake	Final Pit Lake	7.43	25.70	36.1920	0.14605	0.00225	0.00257	0.00548	0.0005	0.0005	0.02525	0.00008	7.7655	0.00294	0.00215	0.01128	0.32179	0.00609	0.03	1.5333	0.0542	0.00070
TSF Overflow	TSF Overflow - 26.9% Final TSF WQ, 71.2% Mill Outflow, 1.9% Precipitation	5.06	22.85	260.0160	0.19855	0.00191	0.00953	0.00439	0.0004	0.0004	0.02075	0.00099	5.9246	0.02881	0.00304	0.06525	0.34283	0.30458	0.02	1.9599	0.0501	0.00001
TSF Overflow	TSF Overflow - 26.9% Final TSF WQ, 71.2% Initial Tails Runoff, 1.9% Precipitation	8.48	407.24	302.5920	0.47390	0.20413	0.00741	0.03266	0.0008	0.0023	0.05943	0.00147	154.3000	0.00683	0.00477	0.02154	0.34398	0.33784	0.03	5.2423	0.3020	0.00820
TSF Overflow	New Tailings Beach Runoff, Initial Runoff (0.39 km^2)	7.75	583.90	354.4859	0.49764	0.30491	0.00618	0.04264	0.0006	0.0029	0.05832	0.00112	223.7227	0.00060	0.00381	0.00137	0.07840	0.06532	0.01	5.9990	0.3799	0.01236
TSF Overflow	New Tailings Beach Runoff, Intermediate Runoff (0.39 km^2)	6.44	83.49	139.4394	0.01171	0.01853	0.00058	0.55528	0.0006	0.0028	0.05655	0.16733	27.1442	0.00057	0.01407	0.00829	0.05296	5.84406	0.00	3.8113	1.0542	0.00028
TSF Overflow	New Tailings Beach Runoff, Final Runoff (0.39 km^2)	4.42	49.33	1028.8518	4.65542	0.00475	0.01867	0.08951	0.0010	0.0031	0.06197	0.19782	13.1581	0.00062	0.09898	1.05032	5.61724	93.90157	0.01	4.0084	2.3872	0.00031

Source Group	Description	Hg	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Nitrate	Ammo-nia	Carbon-ate	Cyanide	Cl
		(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Ontario Drinking Water Standards		0.001				0.01									0.02			44.3			0.2	
Water Quality Objectives		0.0002	0.025			0.1		0.0001				0.0003			0.005	0.007	0.02				0.005	0.002
MMER (Max Monthly Mean)			0.5														0.5				1	
Contact Water	WRSF Runoff and Mine Dewater- Initial	0.00001	0.04425	0.02	2.5289	0.00050	0.0000	0.00005	3.3807	0.07	9.4005	0.00015	0.001	0.0062	0.00250	0.00050	0.06444	5.44385	0.00	15.019	0.00000	5.29729
Contact Water	WRSF Runoff and Mine Dewater- Intermediate	0.00001	0.01658	0.04	1.4284	0.00050	0.0000	0.00005	1.1666	0.03	5.1573	0.00015	0.001	0.0037	0.00250	0.00050	0.02236	4.74864	0.00	6.606	0.00000	0.82045
Contact Water	WRSF Runoff and Mine Dewater- Final	0.00000	0.00069	0.04	0.0166	1.42854	0.0000	0.00050	0.0001	1.17	5.1573	0.03174	0.000	0.0005	0.00500	0.00250	0.00050	4.74864	0.00	6.609	0.00000	0.82045
Collection Pond	WRSF/LGO Runoff - Initial	0.00001	0.04424	0.02	2.5303	0.00050	0.0000	0.00005	3.3818	0.07	9.4015	0.00015	0.001	0.0062	0.00250	0.00050	0.06465	5.44323	0.00	14.996	0.00000	5.29836
Collection Pond	WRSF/LGO Runoff - Intermediate	0.00001	0.01657	0.04	1.4282	0.00050	0.0000	0.00005	1.1661	0.03	5.1554	0.00015	0.001	0.0037	0.00250	0.00050	0.02241	4.74653	0.00	6.580	0.00000	0.81999
Collection Pond	WRSF/LGO Runoff - Long Term	0.00000	0.00070	0.04	0.0166	1.42839	0.0000	0.00050	0.0001	1.17	5.1554	0.03173	0.000	0.0005	0.00500	0.00250	0.00050	4.74653	0.00	6.583	0.00000	0.81999
TSF	TSF - Initial	0.00310	0.04276	0.03	2.7385	0.00049	0.0265	0.00005	31.7354	0.07	29.3722	0.41841	0.000	0.0059	0.00435	0.00078	0.07118	7.73388	0.00	12.808	0.04970	5.03922
TSF	TSF - Intermediate	0.00310	0.01649	0.04	1.6188	0.00048	0.0275	0.00005	29.6548	0.03	25.0816	0.17786	0.000	0.0035	0.00435	0.00076	0.03115	7.07234	0.00	4.273	0.04970	0.78121
TSF	TSF - Long Term	0.00309	0.00228	0.04	0.3109	1.35898	0.0408	0.00048	29.8985	1.11	26.1339	0.43613	0.000	0.0005	0.00675	0.00274	0.01036	7.07234	0.00	4.015	0.04970	0.78050
Pit Lake	Final Pit Lake	0.00108	0.01638	0.04	1.4943	0.00050	0.0000	0.00005	11.1830	0.03	12.0885	0.00035	0.001	0.0037	0.00313	0.00061	0.02523	5.52445	0.00	10.279	0.01733	0.95414
TSF Overflow	TSF Overflow - 26.9% Final TSF WQ, 71.2% Mill Outflow, 1.9% Precipitation	0.01260	0.00409	0.04	0.8420	1.17477	0.0353	0.00041	117.3249	0.96	86.8481	0.37888	0.000	0.0004	0.01153	0.00329	0.04060	14.31828	0.00	0.711	0.20254	0.67472
TSF Overflow	TSF Overflow - 26.9% Final TSF WQ, 71.2% Initial Tails Runoff, 1.9% Precipitation	0.00267	0.00391	1.18	29.2011	1.17674	5.0114	0.00052	31.4618	1.28	101.0689	78.71491	0.000	0.0008	0.04375	0.00510	0.01275	6.11394	0.00	123.168	0.04296	0.67472
TSF Overflow	New Tailings Beach Runoff, Initial Runoff (0.39 km^2)	0.00000	0.00293	1.72	43.6290	0.00296	16.0510	0.00017	8.4655	0.48	118.1206	0.00040	0.001	0.0572	0.00412	0.00572	0.18034	0.00000	0.00	0.000	0.00000	0.00000
TSF Overflow	New Tailings Beach Runoff, Intermediate Runoff (0.39 km^2)	0.00000	0.01890	1.69	23.1159	0.00058	16.6708	0.00011	3.7618	0.13	50.2601	0.00046	0.001	0.0566	0.00010	0.00566	37.18383	0.00000	0.00	0.000	0.00000	0.00000
TSF Overflow	New Tailings Beach Runoff, Final Runoff (0.39 km^2)	0.00000	0.27020	1.86	32.9201	0.00530	24.6405	0.00006	3.8002	0.06	114.4270	0.00067	0.001	0.0620	0.01941	0.00620	94.84356	0.00000	0.00	0.000	0.00000	0.00000

APPENDIX GG-2

TAILINGS DEPOSITION FROM TSF FAILURE

Q:\Vancouver\GIS\ENGINEERING\V132\V13203234-01\Maps\V13203234-01_Figure0X_MaxFloodDepth_TRST.mxd modified 2/12/2015 by morgan.zondervan



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 Depth
9% Tailings Release – Settled Tailings Only

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 X