NorthMet Plant Site Water Modeling Work Plan

July 2, 2012 - Version 6

This document is the work plan for water modeling at the NorthMet Project Plant Site as specified in the following Water Resources IAP Position Documents:

- Geochemistry (June 20, 2011)
- Groundwater (June 30, 2011)
- Surface Water (June 30, 2011)
- Impact Criteria (October 17, 2011)

In this document, Flotation Tailings are the NorthMet bulk flotation tailings, the Tailings Basin is the existing former LTV Steel Mining Company (LTVSMC) tailings basin, and the Flotation Tailings Basin refers to the NorthMet basin within the Tailings Basin. In addition, the Flotation Tailings Basin is designated FTB.

Modeling of the estimated impacts to surface and groundwater quality at the selected evaluation locations will be performed as a probabilistic Monte Carlo simulation in the GoldSim simulation software (see Reference (1) Section 3.1 *Monte Carlo Simulation Background* and Section 3.3 *GoldSim Model Overview*). The model output will be continuous from the start of mining (year 0) to approximately steady state post-closure conditions (estimated duration of 200-500 years), with calculations performed on a monthly time step and results summarized as monthly or annual values as appropriate. Steady state post-closure conditions are defined as:

- The Hydrometallurgical Residue Facility is drained and finally capped
- The Flotation Tailings on the beaches and beneath the pond within the FTB have been amended with bentonite to reduce seepage and maintain a permanent pond
- The groundwater concentrations at the furthest evaluation locations (i.e., Embarrass River) have peaked and are declining towards an approximate steady state

The model inputs that are known or have very small variability and can be modeled as deterministic (as either time-series or constant through time) are termed *deterministic inputs*. Typical deterministic inputs are engineering design parameters (basin dimensions, return water pumping rate, etc.), operational parameters (Plant discharge and demand, etc.) and physical characteristics (flow path dimensions, stream segment length, topographical elevations, etc.).

The model inputs that have uncertainty in their true values or temporal or spatial variability at any point in the life of the project are termed *uncertain inputs*. These uncertain inputs may be constant through time or vary through mine operations and closure. Typical uncertain inputs represent natural variability (annual precipitation and evaporation, stream flow, etc.), environmental parameters (average aquifer hydraulic conductivity, average recharge water quality, etc.), geochemical parameters (constituent generation rates, scale factors, concentration caps, etc.) and performance of engineered systems (cover effectiveness, permeable reactive barrier effectiveness, etc.) Each uncertain input has a defined probability distribution, frequency of sampling and correlation coefficients (if appropriate).

Table 1-1 contains a complete list of all deterministic and uncertain inputs to the Plant Site water quality model, including parameters to define all probability distributions. Tables 1-2 through 1-52 provide additional detailed input information for selected model inputs.

The probabilistic water quality model will be executed for a number of simulation realizations (runs) consistent with the desired result percentiles. The desired result percentiles will be defined in the forthcoming Impact Criteria IAP summary document. For each realization, the uncertain inputs will be randomly sampled based on the defined probability distributions. During each realization the deterministic inputs may vary as a function of time and the uncertain inputs may be sampled according to a defined frequency (e.g., precipitation sampled every year).

The model outputs are selected constituent concentrations at selected surface and groundwater evaluation locations through time. See Table 2-1 for a list of constituents and Table 2-2 for a list of the Plant Site evaluation locations (see also Large Figures 6 and 7 of Reference (2)). The model results will provide sufficient data to demonstrate compliance with specified impact criteria (ex. water quality standards). Model results will be evaluated relative to the applicable surface water and groundwater quality standards; the impact criteria will be compared to each model realization to determine compliance or non-compliance for that model realization. The number of compliant model realizations will be used to demonstrate the overall probability of project "success", which will be compared against the 90th percentile. Model compliance will be evaluated on an individual constituent and evaluation location basis, as outlined in the Final Water Resources Impact Criteria Summary Memo prepared by the Lead Agencies.

In addition to demonstrating the overall probability of a successful project, model results will be presented to quantify the overall impact of the project. The results may be presented in multiple formats, including:

1. A series of charts showing the time-series of each model output from start to stable closure as trend lines at specified probabilities (e.g., 10, 50 and 90 percent), including the applicable water quality standard (see Figure 2-1 for an example output of this type)
2. A series of charts showing the histogram or cumulative distribution function for selected time-independent outputs, such as the peak concentration from each realization at a groundwater evaluation location, including the applicable water quality standard (see Figure 2-2 for an example output of this type)

3. A series of charts showing the change in water quality exceedances (if applicable) relative to the no action condition as a histogram or cumulative probability function (e.g., there is an XX percent chance that Y more exceedances will occur at location Z, see Figure 2-3 for an example output of this type)
4. A series of tables summarizing the results shown on the above figures

The modeling described in this document is for initial modeling of potential project impacts. This modeling may be refined and/or models for additional engineering controls may be added as part of mitigations that may be developed during the modeling process. If this occurs, changes will be documented in a Change Definition Form that will identify the change as a model refinement, mitigation to be incorporated into the project or mitigation to be included as part of adaptive management. The Change Definition Form will describe the change and provide supporting information, list the Project Description, Data Package and Management Plan sections that will be updated as a result of the change and identify potential impacts of the change to other impact areas being evaluated in the SDEIS. There will be a Change Definition Form for each change.

The Change Definition Form will be submitted to the Lead Agencies for review and approval. Once modeling is complete, the information contained in all Change Definition Forms will be transferred to the Project Description, Data Packages and Management Plans and those documents will be submitted to the Lead Agencies for audit to ensure that all Change Definition Form information has been properly transferred to project documents.

There are alternate modeling assumptions that have been discussed in the Impacts Assessment Planning Process that are not included in the initial modeling of potential project impacts. These alternate modeling assumptions may be used as directed by Lead Agencies.

Conceptual Models:

The project that will be modeled is the project described in the Lead Agency Draft Alternative Summary of October 6, 2011, modified by the NorthMet Project – Refined Embarrass Lake Wild Rice Mitigation document of June 24, 2011. As modeling proceeds, model inputs that represent engineering controls may be adjusted to achieve acceptable outcomes in the most cost effective manner. If that is done, there will be multiple sets of model outputs provided – one with engineering controls as originally specified and others with modified engineering controls.

Figures A, B and C show simple block diagrams of the conceptual model for the Plant Site in operations and closure. The conceptual model includes water available (precipitation less evaporation), constituent sources, flow paths (attenuation of select constituents, dilution), engineered features (liners, covers), existing conditions, etc.

A companion model for the Draft Alternative at the Plant Site will be constructed using the same input assumptions as described in this document, but with the removal of all project-related components. This model will allow for the comparison of project impacts to modeled No Action conditions (see Reference (2) *Section 3.1.1 Tailings Basin – No Action Alternative*).

The following paragraphs describe individual conceptual model components.

<u>Water Available Conceptual Model</u>

In the probabilistic water quality model, the water available refers to precipitation less evaporation at the Plant Site. These climatic model inputs are uncertain and will vary annually to simulate natural variations. Runoff water will be an annually varying fraction of annual precipitation and will be available to receiving water bodies within each watershed.

<u>Flotation Tailings Basin (FTB) Pond Conceptual Model</u>

The FTB will be placed atop the existing LTVSMC Tailings Basin within the limits of the existing cells 1E and 2E (see Reference (3) Section 4.6.4 *Management of Process Waste Products*). To reduce loading of constituents from the Flotation Tailings and dust liftoff from the tailings beaches, it is desirable to maintain a pond within the FTB as large as possible without compromising stability of the dams. Therefore, the FTB pond is a major component in the probabilistic water quality model.

During mining operations, the FTB pond will receive water pumped from the Mine Site wastewater treatment facility (MS WWTF). The probabilistic water quality model for the Mine Site will generate output which defines distribution parameters for the MS WWTF discharge flow rates and concentrations as a function of time (see Reference (2) Section 5.3.3 *Mine Site WWTF* and Section 6.1.3.6 *Mine Site WWTF Flow*). If no treatment is required in order to meet the MS WWTF effluent targets, the effluent concentrations may be lower than the defined treatment targets. The distribution of concentrations will reflect the probability of lower-than-target concentrations. The time-varying distribution parameters are a direct input to the probabilistic water quality Plan Site model. In closure, the pond will no longer receive this water.

During operations, the FTB pond will receive slurry flow from the Beneficiation Plant consisting of the Flotation Tailings and the water used to transport them. The Flotation Tailings will continually fill the FTB through the life of the project. The plant discharge rate will be a deterministic or known input value to the model (see Reference (2) Section 6.1.3.2 *Process Plant Water*). The FTB size and shape (volumes and surface areas as a function of elevation) will also be time-varying deterministic inputs. The plant discharge will include dissolved constituent loading from the copper sulfate used in processing and from the soluble constituents produced by, and retained on, the ore. The mass loading from the use of copper sulfate will be a deterministic value because it is determined by the process design, and the mass loading from the ore will be an uncertainty input determined in a manner similar to the waste rock modeling for the Mine Site (see Reference (4) Section 10.6.3 *Process Water Loading to Pond*). In closure, the pond will no longer receive this water or mass loading because the Beneficiation Plant will not be operational.

Throughout the entire modeling time frame, the FTB pond will receive direct precipitation, lose water to evaporation from the pond surface, and receive water via runoff from contributing surfaces (i.e., Flotation Tailings beaches and unaltered forested watershed areas) (see Reference (2) Section 6.1.3.1 *Climate*).

The pond will also receive water from the collection system at the toe of the basin (surface seepage management systems and groundwater seepage interception wells). The collection system is designed to capture all surface seepage and some portion of the groundwater seepage from the basin to reduce the loading to the natural environment by pumping it back into the FTB pond creating a circular system (see Reference (2) Section 6.1.3.5 *Seepage and Recovery*). These model components are discussed later in this document.

The Project Description calls for maintaining a design water level in the FTB pond. Given the deterministic water volume demand in the pond (which changes through time due to development of the Flotation Tailings Basin) and the water available in the entire system, the probabilistic water quantity model will calculate if there is sufficient water to meet the Beneficiation Plant demand or if additional water is necessary (see Reference (2) Section 6.1.3.4 *Pond Volume and Raw Water Demand*). If the available water is insufficient, water will be pumped from Colby Lake to meet the demand; it will be assumed that this water will be added directly to the Beneficiation Plant. The quality of the Colby Lake water will be a constant deterministic input, estimated using water quality data collected between 2008 and 2010 (see Reference (2) Section 5.3.4 *Colby Lake Quality*).

<u>Saturated Flotation Tailings Conceptual Model</u>

The saturated Flotation Tailings are mostly the Flotation Tailings directly under the FTB pond. There are additional subsurface Flotation Tailings outside of the FTB pond extents that are saturated due to the extending phreatic surface within the FTB. Water from the FTB pond will be transported through the saturated tailings via pond seepage. The flow rate into and through the saturated tailings will be a deterministic value based on the three-dimensional MODFLOW model of the Project (see Reference (2) Section 5.4.5 *MODFLOW Model*).

The saturated Flotation Tailings generate a sulfate load which is dependent on the mass flux rate of dissolved oxygen into the saturated Flotation Tailings by the infiltrating water (see Reference (4) Section 10.6.1 *Oxidation of Saturated Tailings*). As the model simulates sulfate release, the loads of all other constituents will be simulated at rates based on release ratios determined from laboratory testing (see Reference (4) Section 10.1.1 *Flotation Tailings*). These loads will be added to the loads associated with the pond seepage to define the total load from the saturated tailings.

The concentration of each constituent in the seepage water will be capped by defined concentration caps, which are an uncertain input to the model (see Reference (4) Section 10.4 *Concentration Caps*).

In closure, the bottom of the pond will be amended with bentonite. This will reduce the seepage of FTB pond water thereby maintaining a permanent pond and limiting oxidation of the underlying saturated Flotation Tailings (see Reference (3) Section 4.8.3 *Reclamation of Plant Site*). The seepage through the bentonite-amended pond bottom will be dependent on the extents of the permanent pond above it (see Reference (2) Section 6.2.2 *Flotation Tailings Basin in Closure*).

<u>Flotation Tailings Beaches Conceptual Model</u>

During operations, the FTB will be developed by spigotting approximately 30% of the plant discharge onto the beaches and discharging the remaining 70% of the tailings directly into the bottom of the FTB pond (see Reference (2) Section 6.1.3.2 *Beneficiation Plant Slurry*). The exact split, however, will be calculated during each time step based on the Plant Site conditions (climate, plant discharge, water from other sources, Flotation Tailings physical properties, etc.) and the FTB dimensions (see Reference (2) Section 6.1.3.2 *Process Plant Water*). The plant discharge pipe will be moved around the perimeter dam of the FTB, creating a mostly unsaturated beach of tailings. While the plant discharge is spigotted to the Flotation Tailings beaches, the beach in the immediate vicinity of the discharge point will be fully saturated due to the discharge rate likely exceeding the hydraulic capacity of the tailings (see Reference (2) Section 6.1.3.2 *Process Plant Water*). The designed discharge method will allow significant control over the FTB as it develops. Therefore the beach dimensions will be deterministic inputs to the model.

The Flotation Tailings beaches and the underlying unsaturated tailings generate a sulfate load dependent on the oxidation rate of the tailings. The generated sulfate load will be dependent on the known oxygen content in air, diffusivity through the unsaturated tailings (which is dependent on the tailings saturation), the depth of unsaturated tailings, and scaling factors for temperature and the effects of surface freezing (see Reference (4) Section 10.2 *Lab to Field Scale Up* and Section 10.3 *Saturation and Oxygen Diffusion*). The generated sulfate load will also be used to determine the generated loads of other constituents based on laboratory release rate ratios (see Reference (4) Section 10.1.1 *Flotation Tailings*). The concentration of each constituent in the seepage water will be capped by defined concentration caps, which are an uncertain input to the model (see Reference (4) Section 10.4 *Concentration Caps*).

The surface of the Flotation Tailings beaches will also generate a sulfate load due to surface weathering that will be washed off by stormwater runoff into the FTB pond. Because the surface of the tailings beaches are exposed to the atmosphere and are fully oxygenated (in contrast to the underlying unsaturated tailings), this load is modeled using a different interpretation of the laboratory data on a per-unit area basis. The surface weathering load is calculated based on the exposed beach area and laboratory release rates (see Reference (4) Section 10.6.2 *Tailings Weathering*), and is assumed to be entirely transported to the FTB pond via surface runoff.

In closure, the beach will be covered by a bentonite-amended tailings layer, designed to restrict the diffusion of oxygen into the tailings and reduce constituent generation rates (see Reference (3) Section 4.8.3 *Reclamation of Plant Site*). The moisture-release properties of the bentonite-amended tailings layer controlling the layer's saturation will be deterministic input in the model. During closure, oxygen will diffuse more slowly through the highly saturated bentonite-amended tailings layer. Due to an unchanged reaction (oxygen consumption) rate in the underlying tailings and a significantly reduced oxygen diffusion rate into the tailings, the depth to which oxygen can penetrate, and the subsequent generated load, will be reduced. The generated loads of sulfate and other constituents will be calculated in the same manner as during operations.

<u>Dam Conceptual Model</u>

The dams will be constructed throughout the operational period of the NorthMet project to create the FTB. Given the dam safety criteria, the tailings discharge rate and the storage volume required to hold the Flotation Tailings, the dam design and construction schedule are known and will be deterministic inputs (see Reference (2) Section 5.1.1 *Flotation Tailings Basin (FTB) Design*).

As precipitation falls on the dams, a fraction of the water will be lost to evaporation and to surface runoff. The remaining water will be considered infiltration (see Reference (2) Section 6.1.3.1 *Climate*). The infiltrated water will be used to transport any generated constituent load within the dams to the toe of the FTB.

There will be a one-time loading of soluble constituents released from the LTVSMC tailings used to construct the dams during construction material handling due to disturbing oxidized tailings (see Reference (4) Section 10.1.2 *LTVSMC Tailings*). Each time material is added to the dams for construction, this one time loading will be applied on a per-unit mass basis. The method of ongoing constituent load generation from the dams is the same as for the Flotation Tailings beaches. The only differences are that a bentonite-amended layer of LTVSMC tailing will be applied to the exterior slopes of the dams as they are constructed (rather than in closure as is the case for the beaches), and the oxidation rate and metal release ratios will be those determined from humidity cell testing on the LTVSMC tailings (see Reference (4) Section 10.1.2 *LTVSMC Tailings*).

Existing LTVSMC Tailings Conceptual Model

The constituent loads generated from the existing LTVSMC tailings will be calculated in the same manner as the Flotation Tailings beaches. The generated sulfate load will be dependent on the known oxygen content in air, diffusivity through the existing LTVSMC unsaturated tailings (which is dependent on the tailings saturation), the depth of unsaturated tailings, and scaling factors for temperature and the effects of surface freezing (see Reference (4) Section 10.2 *Lab to Field Scale Up* and Section 10.3 *Saturation and Oxygen Diffusion*). The main differences are that the existing LTVSMC tailings will have tailings specific release rates based on laboratory testing, and the rates will be modified due to calibration to existing seepage data (see Reference (4) Section 10.2.1 *Scaling / Calibration of LTVSMC Lab Data to Field Data*). Calibrating the LTVSMC tailings release rates to field data means that the No Action model will result in seepage water quality comparable to measured values (see Reference (2) Section 3.1.1 *Tailings Basin – No Action Alternative*).

As the FTB is developed and the phreatic surface rises, it is assumed that the existing LTVSMC tailings which are covered by Flotation Tailings will cease generating load due to saturated conditions and the expected lack of oxygen at depth. Therefore, in early years of the project (once the project begins), much of the existing LTVSMC tailings in Cell 2E will no longer generate constituent loads; in later years of the project (after about year 7) LTVSMC tailings in Cell 1E will no longer generate constituent loads. The existing outer dams however will continue to generate a load because they are never covered by Flotation Tailings. It will be assumed that there is no chemical interaction between the Flotation Tailings and the existing LTVSMC tailings (see Reference (4) Section 10.5 *Flotation Tailings/LTVSMC Tailings Interaction*); the constituent loading produced by each type of tailings is assumed to be additive.

Existing LTVSMC tailings in Cell 2W will continually generate loads throughout the life of the project and beyond, although the quantity of unsaturated LTVSMC tailings in Cell 2W will change as indicated by the MODFLOW model of NorthMet operations. The MODFLOW model will be used to define depths to saturated tailings throughout different areas (coarse, fine, dams, etc.) in the tailings. It will also be used to define volumes of saturated and unsaturated tailings within each area of the tailings (see Reference (2) Section 5.4.5 *MODFLOW Model*). These will be known time-varying inputs to the model.

<u>Buttress Conceptual Model</u>

The rock buttress will be constructed with material from Area 5 South stockpiles (see Reference (4) Section 10.6.5 *Buttress Material*). The buttress water balance will be the same as that for the uncovered waste rock stockpiles at the Mine Site (see Reference (1) Section 6.1.1 *Stockpile Hydrology Modeling*). The material will be treated as Category 1 waste rock with respect to its geochemical properties (see Reference (4) Section 10.6.5 *Buttress Material*). Load and water from the north buttress will be transported to the north toe of the Tailings Basin, downstream of the interception wells. Load and water from the south buttress will be transported directly to the south toe of the Tailings Basin because the buttress is upstream of the south seepage collection system.

<u>Interception Wells for Sulfate Mitigation Conceptual Model</u>

Interception wells are planned for capturing seepage from the Flotation Tailings Basin so that the FTB does not seep water to the environment in excess of 500 gallons per acre per day. At this point, the footprint that this restriction applies to is the entire Tailings Basin footprint (Cells 1E, 2E, and 2W). The interception wells will be placed around the north and west sides of Cells 2E and 2W. Their purpose is to capture water that would otherwise be released to the environment and pump it either back to the FTB pond or to the new FTB WWTP. The efficiency of the wells (% of water available to the wells that is captured) will be an engineering control and will be adjusted in the model as needed in order to not cause water quality exceedances (see Section 6.1.3.5 of Reference (2)). The interception wells will help provide extra water to the FTB pond in operations so that less water is needed from Colby Lake. In closure, the interception wells will be used until either the seepage rate is less than 500 gallons per acre per day *or* the seepage water quality does not result in exceedances at compliance points such as the property boundary in groundwater or the nearest stream.

In addition, surface seepage exiting the FTB to the south (SD026, headwaters of Second Creek) will be captured and pumped back to the FTB pond. The efficiency of this seepage collection system will be an engineering control, assumed in the modeling to be high enough that potential downstream impacts would be minimal (see Reference (5)). The pumping will continue until the seepage meets applicable water quality discharge limits.

The quality of the water collected by the interceptions wells and at SD026 will be estimated as described in the Contaminant Transport Conceptual Model.

<u>FTB WWTP Conceptual Model</u>

The NorthMet project consists of two treatment plants; one at the Mine Site (MS WWTF) and one at the Plant Site (FTB WWTP). These two treatment plants serve different purposes and have different design objectives, based primarily on the target discharge location. Therefore, each plant has different anticipated effluent limits.

The water quantity and quality delivered to the FTB WWTP are estimated based on the flow rate of intercepted FTB seepage to comply with 500 gallons per acre per day less the capacity of the FTB pond to receive intercepted water. The FTB WWTP is designed to treat the influent water to meet applicable surface water quality discharge limits, allowing it to discharge at existing NPDES discharge locations SD006 and SD026. Water effluent concentrations are modeled as constants.

Permeable Reactive Barrier (PRB) Conceptual Model

At some point in closure when the wells will no longer be necessary (time to be determined as part of modeling work), a PRB may be installed at the toe of the tailings basin and the interception wells phased out. The PRB is designed to treat the influent water by removing a fraction of the mass load delivered to it. The constituent specific PRB efficiency is an input to the model and each constituent will have a specific removal rate (see Table 1-47). These constituent-specific removal rates will be based on the PRB bench study performed as part of the Consent Decree. When water passes through the PRB, the mass removed by the PRB is completely removed from the model. The PRB will only be included if necessary to meet applicable water quality standards.

Solute Transport Conceptual Model

Solute transport of the constituent loads from each of the source components (pond seepage, dams, Flotation Tailings beaches, saturated Flotation Tailings, buttresses, and the existing LTVSMC tailings) will be modeled using some of the specialized contaminant transport features in GoldSim (see Reference (2) Section 3.3 *GoldSim Model Platform Overview*). These features will account for travel times through the basin to the toe and from the toe to the evaluation locations, and the associated attenuation in concentrations due to mixing, dispersion, and sorption (in the case of groundwater flow).

Solute transport can be broken into two stages: transport through the tailings basin to the toe and transport through the surficial aquifer (i.e. groundwater flow) to the receiving streams. In general, seepage within the Tailings Basin flows to the north, west or south. The toe of the Tailings Basin has been divided into four segments (named North, North-West, West and South). A three-dimensional groundwater flow model was developed and calibrated using MODFLOW to represent the current LTVSMC Tailings Basin and the Tailings Basin at critical times in the project (see Reference (2) Section 5.4.5 *MODFLOW Model*). The MODFLOW model area extends approximately 3.5 miles north from the existing Tailings Basin and includes the Embarrass River. This model will be used to determine what proportions of the flow and load from each source component report to each segment of the toe of the Tailings Basin. Therefore, the flow direction of generated constituents and the rate at which they travel will be a time-varying deterministic input. Water quantity and quality estimates will be made for each toe of the Tailings Basin.

As seepage reports to the toe of the Tailings Basin, some portion will be collected by the interception wells and the SD026 seepage collection system and returned to the pond. The remainder will leave the Tailings Basin footprint and enter the groundwater and/or surface water system. Three groundwater flow paths (named North, North-West, and West) have been defined to receive seepage from the FTB (see Reference (2) Section 5.4.2 *Modeled Groundwater Flow Paths*). A southern groundwater flow path will not be modeled because all seepage in that direction is captured and pumped back into the FTB, although flow within the Tailings Basin to the south will be modeled in order to estimate the quantity and quality of the water captured by the seepage collection system.

Groundwater transport will be governed in a way similar to the Mine Site model (see Reference (2) Section 5.4.1.1 *Groundwater Flow Introduction*). Baseflow in the Embarrass River will be a known value and will determine local spatially averaged aquifer recharge rates. Specific recharge to the flow paths will be randomly generated each model realization. The recharge to the non-modeled areas will be calculated so that the total spatially averaged recharge rate is always equal to the known deterministic value in the Embarrass River watershed (see Reference (2) Section 5.5.2.2 *Groundwater Inflow from Non-Modeled Flow Paths*).

The downstream head is a constant assumed value. Hydraulic conductivity will be a randomly generated input each model realization. Based on the physical characteristics of the aquifer, a known maximum hydraulic gradient and the recharge rate to the aquifer, the total flow capacity of the aquifer is calculated at the initiation of each realization. Based on the capacity of the aquifer, seepage flow from the basin will be split between groundwater and surface flow, with all seepage beyond the aquifer capacity becoming surface flow. These two separate portions of the seepage flow will then be properly routed downstream (see Reference (2) Section 5.4.1.2 *Groundwater Flow Paths*).

In the groundwater flow paths, constituent load will be added to the model from the aerial recharge that occurs along the flow path. The mass loading rate from recharge will be added using the randomly generated recharge rate and recharge quality (see Reference (2) Section 5.3.1 *Background Groundwater*).

Attenuation due to sorption to the aquifer matrix will be simulated in the surficial aquifer for selected constituents (As, Cu, Ni, and Sb). Sorption coefficients for As, Cu, and Ni will be deterministic inputs to the model and with values determined using published information. The sorption coefficient for Sb is an uncertain input to the model due to less certainty and agreement on the published information. The flow and transport models provide estimates of the water flow and dissolved concentrations at the groundwater evaluation points (see Reference (2) Section 5.4.1.2 *Groundwater Flow Paths*).

Area 5 Conceptual Model

Flow and chemical load from the discharge at Area 5 will be included in the model as a deterministic input, based on the existing discharge. The discharge from Area 5 is to the headwaters of Spring Mine Creek (SD033), which is a tributary to the Embarrass River upstream of the Tailings Basin (see Reference (2) Section 4.4.3.3 *Pit 5NW (SD033) and Spring Mine Creek* and Section 5.5.4 *Pit 5NW (SD033) Discharge*).

Hydrometallurgical Residue Facility (HRF) Conceptual Model

The double liner system designed for the HRF will be impermeable enough so that its affect on the environment can be ignored (see Reference (5) *Key Issues and Decisions at the Tailings Basin Site, Point #8*). Therefore, there will be no water quality consideration associated with this component. The water balance of the HRF will be modeled, however, to aid in the quantification of pumping demand from Colby Lake (see Reference (2) Section 6.1.5 *Hydrometallurgical Residue Facility*).

Embarrass River Surface Water Conceptual Model

The probabilistic model will combine loads from the above sources transported via groundwater and surface water with other non-project sources (e.g. surface runoff, groundwater) to calculate resulting water quality in the Embarrass River at specific evaluation locations (see Table 2-2, see also Large Figure 7 of Reference (2)).

During each model time step, total watershed yield in the Embarrass River watershed is sampled from a distribution developed using observed USGS flow data (see Reference (2) Section 5.5.2 *Developing Probabilistic Model Inputs (Flow Distributions)*). The total flow at each evaluation location is a combination of groundwater and surface water components. Constituent concentrations in natural (i.e. non-project) groundwater inflow are based on probabilistic distributions of observed data (see Reference (2) Section 5.3.1 *Background Groundwater*). The mass transported from the basin to the Embarrass River, either by groundwater or the smaller local tributaries will be added to the Embarrass River model. Checks will be in place to ensure that discharge from the groundwater flow paths is proportional to the discharge from non-impacted portions of the watershed during low flow conditions (see Reference (2) Section 5.5.3 *Adjustment for Low Flow*).

Constituent concentrations in surface runoff are determined from calibration of an existing conditions model to observed concentrations in the Embarrass River (see Reference (2) Section

5.3.2 *Background Surface Runoff*). The component of surface runoff in the Embarrass River flow is the residual of the total flow minus the expected groundwater inflow (see Reference (2) Section 5.5.2.1 *Surface Runoff*).

Changes Relative to DEIS Deterministic Modeling:

There are changes in the modeling approach presented in this document compared to the approach used in the DEIS.

Modeling Approach and Tools

The DEIS used deterministic modeling that calculated a base, high and low case value for each modeled output. The deterministic models consisted of various proprietary spreadsheet and recognized specialized models with outputs of one being inputs of another. The models were run three times with a base (Embarrass River flow inputs at average values), high (Embarrass River flow inputs at high values) and low (Embarrass River flow inputs at low values). This approach accounted for uncertainty about the input Embarrass River *flow* values by calculating an absolute high and absolute low outputs but did not calculate the probability (risk) of those absolute highs and lows occurring. The modeling of the load generation in the FTB itself represented only a single case at best conservative engineering estimate values.

The approach presented will use a probabilistic modeling platform (GoldSim) that combines all models into a single integrated package (see Reference (1) Section 3.1 *Monte Carlo Simulation Background* and Section 3.3 *GoldSim Model Platform Overview*). The tool includes Monte Carlo simulation, which will run the model hundreds or thousands of times. The number of runs will be determined to achieve sufficient accuracy in the desired results. All uncertain inputs will be adjusted for each run (and time-step, if appropriate) based on their individual probability distribution.

Modeling Concept Changes

Water Available Conceptual Model:

In the modeling for the DEIS, the Water Available component was local observed climatic data. In the current work plan approach, the Water Available component is a random variable generated from a distribution created using local observed climatic data.

Flotation Tailings Basin Pond Conceptual Model:

No changes from DEIS modeling approach.

Saturated Flotation Tailings Conceptual Model:

Constituent generation rates are now based on a combination of humidity cell results, whole tailings metal to sulfur ratios, and concentration caps. The DEIS modeling used only humidity cell results. This change is because the laboratory data indicated that concentration caps in the test cells may be influencing the apparent laboratory release rate for some constituents.

The probabilistic water quality model now includes oxidation in the saturated tailings within the main model; this effect was analyzed separately in the DEIS modeling.

Flotation Tailings Beaches Conceptual Model:

Constituent generation rates are now based on a combination of humidity cell results, whole tailings metal to sulfur ratios, and concentration caps. The DEIS modeling used only humidity cell results. This change is because the laboratory data indicated that concentration caps in the test cells may be influencing the apparent laboratory release rate for some constituents.

The degree of saturation in the unsaturated tailings is now modeled using the results of physical testing and theoretical unsaturated flow equations. The tailings beaches are treated as a single mass with an uncertain ratio of coarse to fine tailings material. The DEIS modeling assumed bulk (i.e. plant discharge ratio of coarse to fine material) tailings throughout the beaches. This change is because additional data on the deposition and potential for segregation on the NorthMet beaches has become available subsequent to the DEIS.

Oxygen transport through the unsaturated tailings is based on Fick's Law with a zero-order reaction term rather than a first-order reaction term as it was in the DEIS modeling.

Dams Conceptual Model:

Constituent generation rates for the dams are now based on a combination of humidity cell results, whole tailings metal to sulfur ratios, and concentration caps that are specific to the LTVSMC tailings. The DEIS modeling used humidity cell results for Flotation Tailings as a surrogate for LTVSMC tailings. This change is because additional laboratory data for the LTVSMC tailings has become available subsequent to the DEIS.

Existing LTVSMC Tailings Conceptual Model:

Loads generated from the existing LTVSMC tailings at the Plant Site were not modeled in the DEIS modeling approach. In the current work plan approach, they are modeled using the same method as for the Flotation Tailings, but with material specific properties and calibration factors.

Buttress Conceptual Model:

Loads generated from the buttress supporting the dams were not modeled in the DEIS modeling approach. In the current approach they are modeled using the same method as for the uncovered Category 1 Waste Rock Stockpile.

Interception Wells for Sulfate Mitigation Conceptual Model:

Interception wells for seepage recovery will be included in the modeling with the fraction of seepage water recovered adjusted to result in seepage from the Tailings Basin limited to less than 500 gallons per acre per day (approximately 1000 gpm).

Permeable Reactive Barrier (PRB) Conceptual Model

A PRB was not modeled in the DEIS approach. Instead, it was one of several recommended mitigation options. In the current work plan approach, it is considered a part of the design. Therefore, it will (if necessary) be included in the modeling based on the PRB bench test conducted for the Consent Decree.

Groundwater Transport Conceptual Model:

Groundwater transport was previously simulated using MODFLOW/MT3D models that represented the groundwater flow paths between the FTB and the Embarrass River. For the current modeling, the groundwater flow paths will be incorporated into the GoldSim modeling environment using the GoldSim Contaminant Transport (CT) module (see Reference (2) Section 5.4.4 *Groundwater Transport in GoldSim*). The model will use a set of the GoldSim CT "cell pathways" linked in series for this process. The setup is essentially a finite-difference or finite-volume analysis which is similar to MODFLOW/MT3D and many other contaminant transport models.

The groundwater flow paths transport mass using a mix of analytical and numerical solution methods. In short, the flow equation is solved analytically and is an exact solution to the idealized representation of the aquifer; the transport equation is solved numerically using a series of well-mixed cells of known volume and flow characteristics. The solution to the network of cells is not explicit in a sense that one cell is solved, then the next, then the next, etc. It is a coupled system of cells so the entire system is solved at once using a set of matrices.

Results from GoldSim groundwater flow paths will be compared with MODFLOW modeling results to ensure that the models match as closely as possible (see Reference (2) Section 5.4.4.5 *Comparison of GoldSim and MODFLOW Contaminant Transport*). In the cases where the GoldSim model estimates potential groundwater exceedances, more detailed MODFLOW modeling may be completed to refine the results from GoldSim.

Area 5 Conceptual Model:

No changes from DEIS modeling approach. Additional flow and constituent loading data collected subsequent to the DEIS will be used to better define this model input.

Hydrometallurgical Residue Facility (HRF) Conceptual Model:

In the modeling for the DEIS, an estimate was made about the water quality of the seepage from the HRF. However, the design of the facility has changed substantially since that time and seepage from the HRF will no longer be modeled.

Embarrass River Surface Water Conceptual Model:

The concentrations resulting from loading to the Embarrass River will be calculated based on a cumulative probability density function (CDF) of total watershed yield to the Embarrass River (see Reference (2) Section 5.5.2 Developing Probabilistic Model Inputs (Flow Distributions)). The Embarrass River yield CDF will be re-sampled at each model time-step of each realization. This allows water quality impacts to be computed over a wide range of estimated daily flows in the Embarrass River. The results of this approach are analogous to the probability of exceeding a given concentration on a randomly selected sampling date.

In GoldSim, the groundwater loads from the Plant Site will be added to Embarrass River via the GoldSim CT pathways (and not as virtual piped discharges as was modeled in RS74A) (see Reference (2) Section 5.5.2.3 *Groundwater and Upwelling from Modeled Flow Paths*).

References

1. **PolyMet Mining Inc.** *NorthMet Project Water Modeling Data Package Volume 1 - Mine Site (v10).* July 2012.

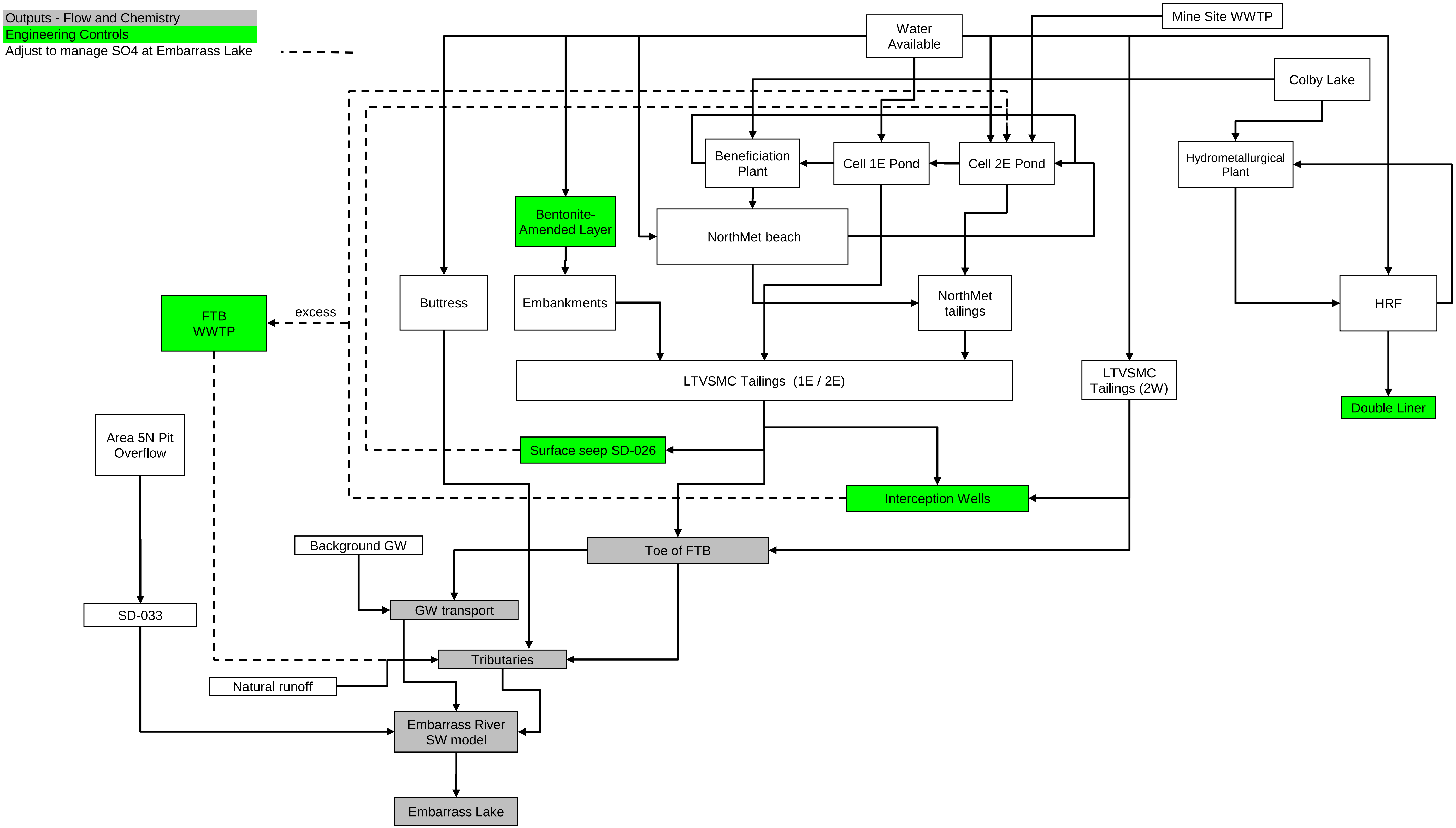
2. —. *NorthMet Project Water Modeling Data Package Volume 2 - Plant Site (v7).* July 2012.

3. —. *NorthMet Project Project Description (v3).* September 2011.

4. —. *NorthMet Project Waste Characterization Data Package (v9).* July 2012.

5. **Johnson, B., S. Arkley, J. Ahlness, T. Hale,.** Groundwater Resources Impact Assessment Planning Summary Memo. 2011.

Figure A - Tailings Basin Water Modeling - Operations (early years)



Probabilistic Aspects

Mine Site model output

precipitation, evaporation, watershed runoff

plant and pond flow and chemistry

runoff, evaporation, infiltration

O2 diffusion, sulfate generation rates, scale up, metal release ratios, NM tailings permeability

soluble loading, LTVSMC tailings permeability

capture efficiency

capture efficiency (0%, 100%, no return)

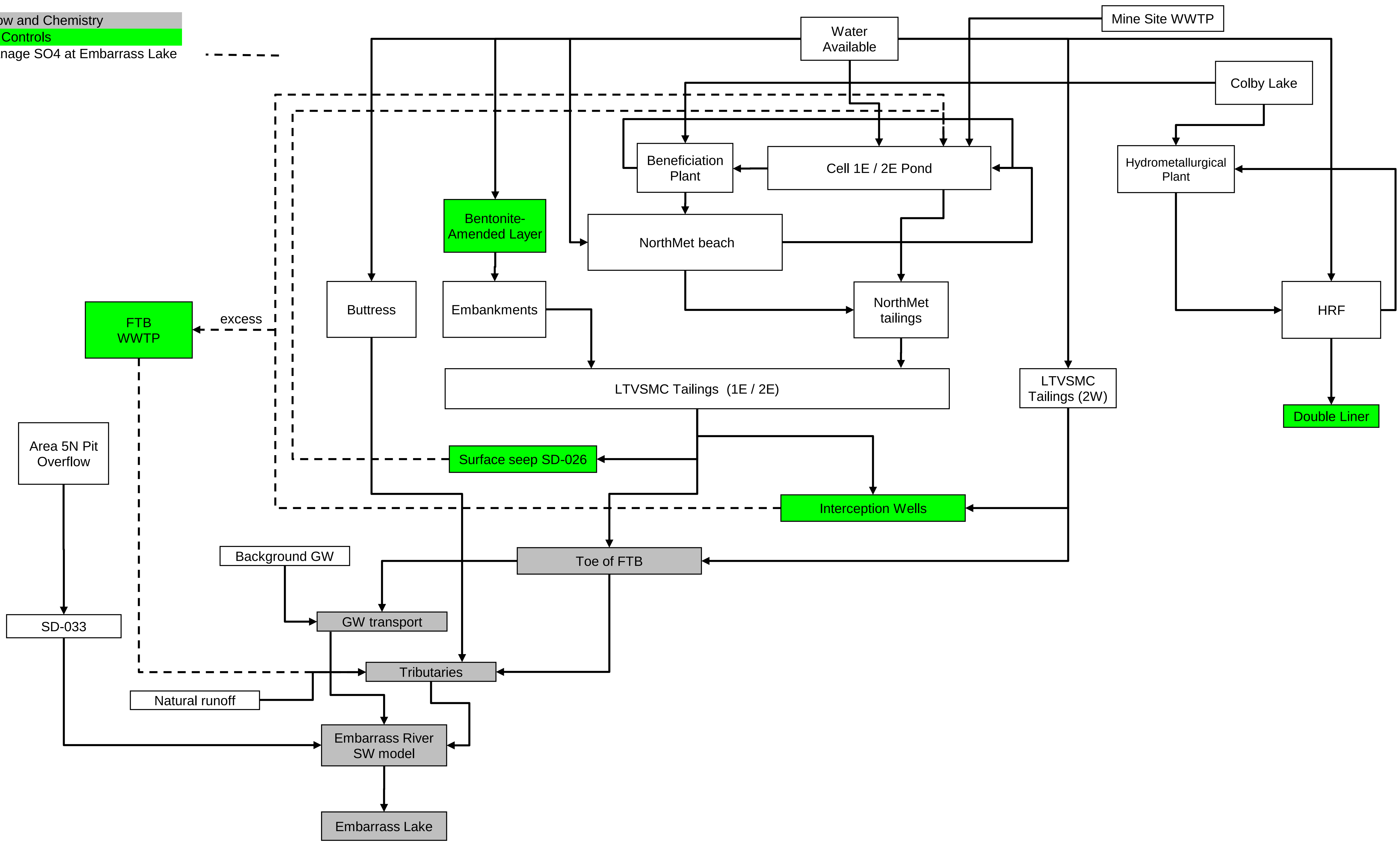
metals sorption, recharge rate, dilution

SW & GW input flow and chemistry

flow and chemistry

Figure B - Tailings Basin Water Modeling - Operations (later years)

Outputs - Flow and Chemistry
Engineering Controls
Adjust to manage SO4 at Embarrass Lake - - - -



Probabilistic Aspects

Mine Site model output

precipitation, evaporation, watershed runoff

plant and pond flow and chemistry

runoff, evaporation, infiltration

O2 diffusion, sulfate generation rates, scale up, metal release ratios, NM tailings permeability

soluble loading, LTVSMC tailings permeability

capture efficiency

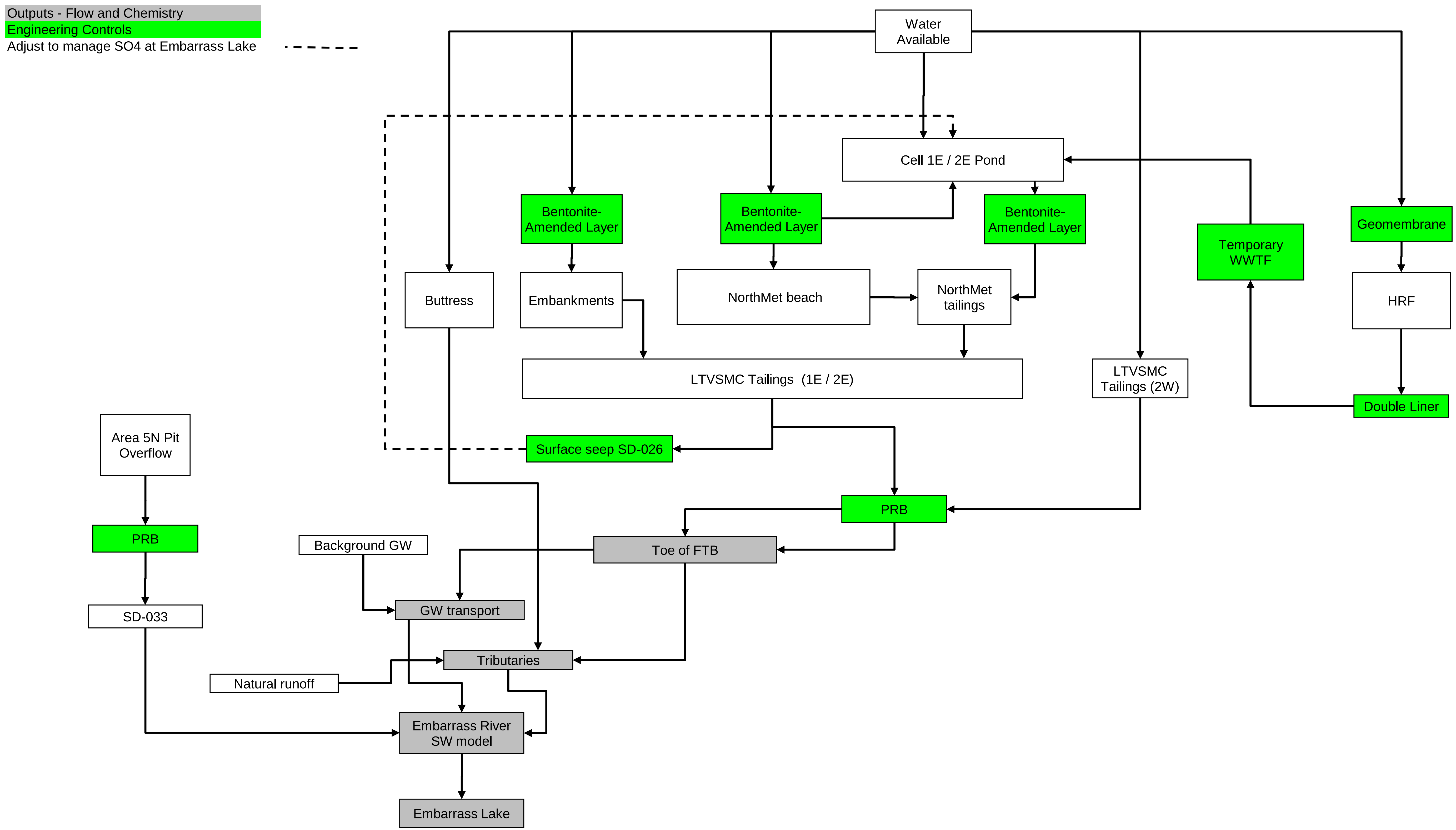
capture efficiency (0%, 100%, no return)

metals sorption, recharge rate, dilution

SW & GW input flow and chemistry

flow and chemistry

Figure C - Tailings Basin Water Modeling - Closure - Model until closure activities complete and pond water chemistry/level stabilize



Probabilistic Aspects

precipitation, evaporation, watershed runoff

plant and pond flow and chemistry

runoff, evaporation, infiltration

O2 diffusion, sulfate generation rates, scale up, metal release ratios, NM tailings permeability

soluble loading, LTVSMC tailings permeability

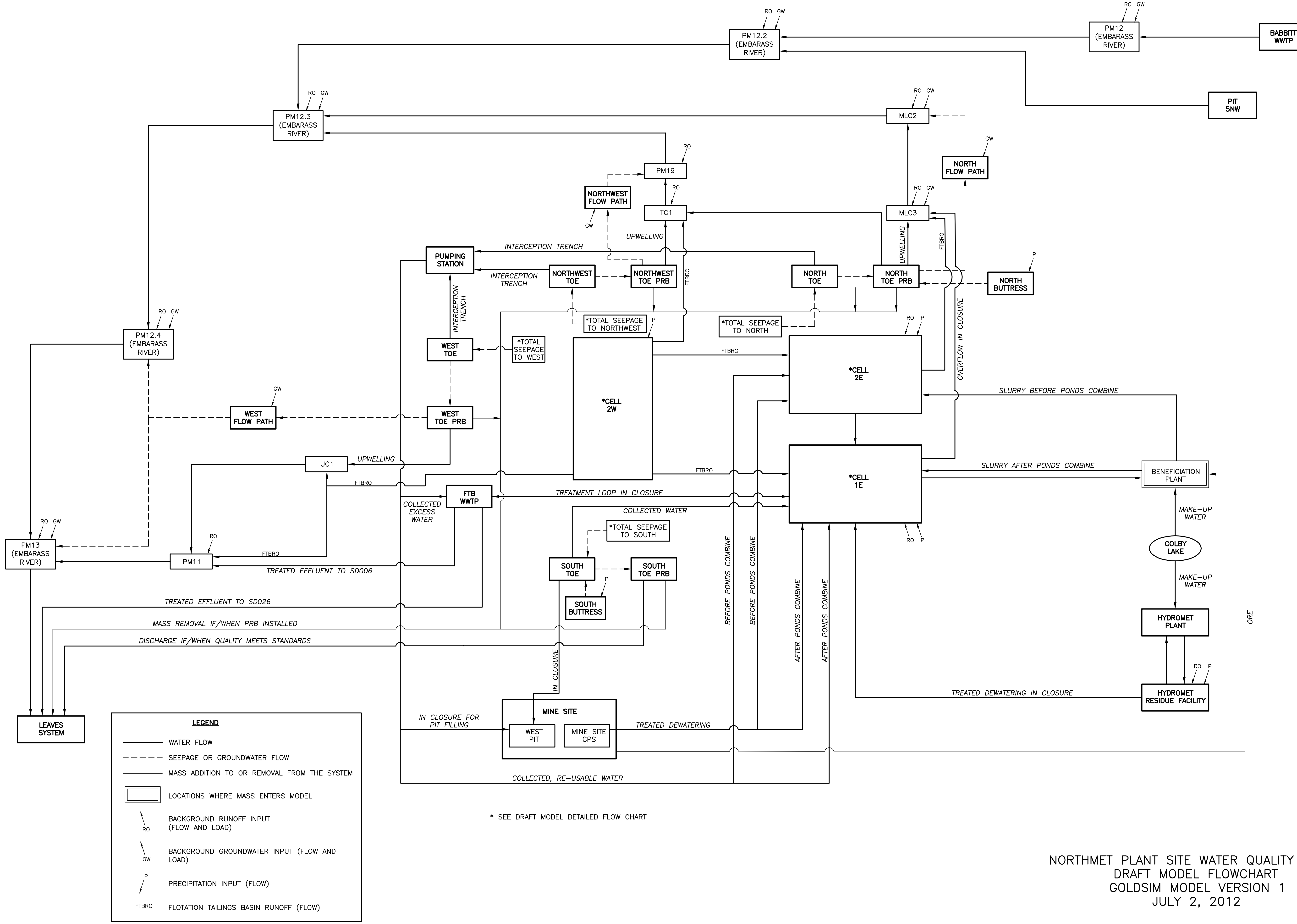
capture efficiency

capture efficiency (0%, 100%, no return)

metals sorption, recharge rate, dilution

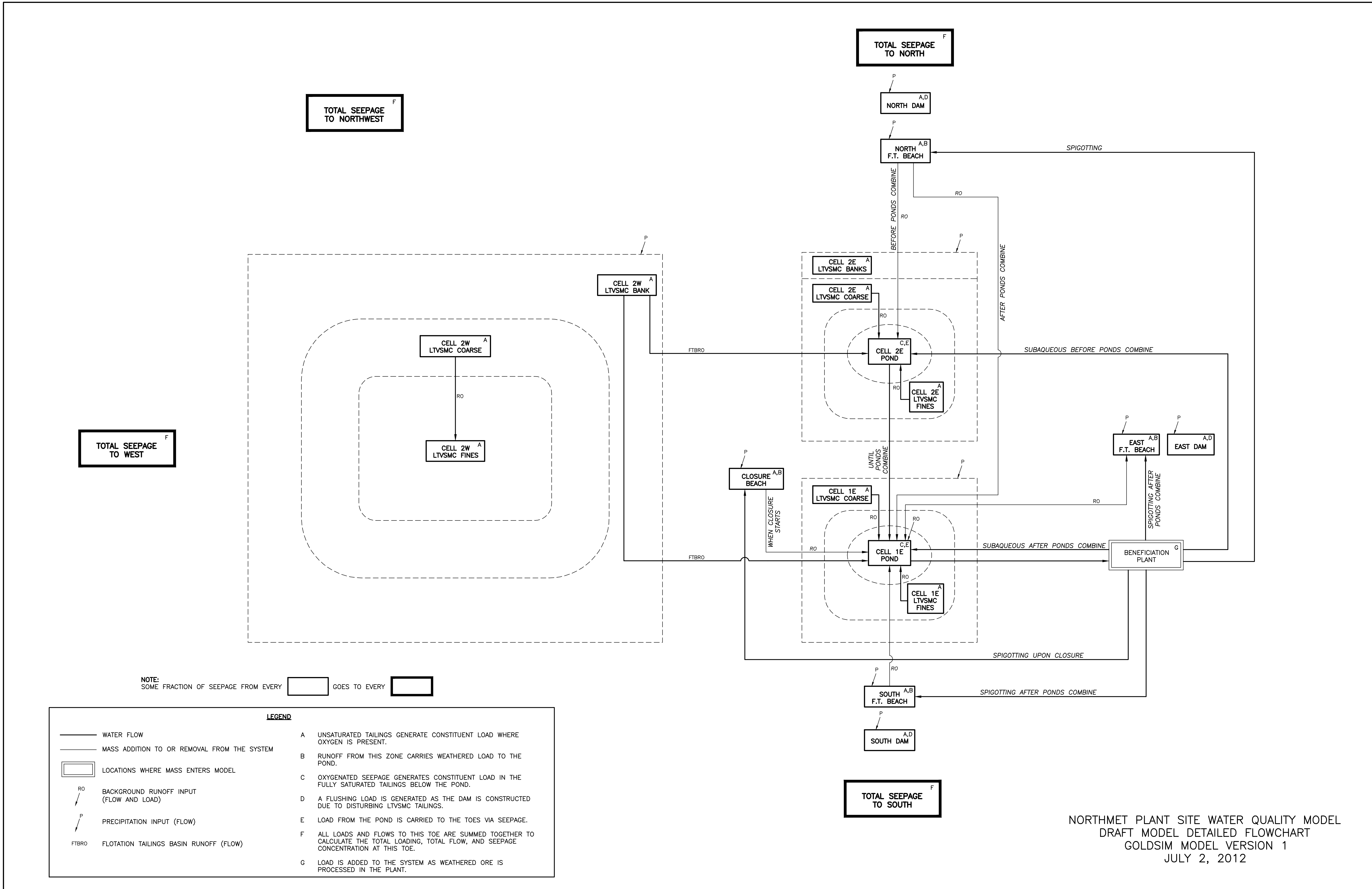
SW & GW input flow and chemistry

flow and chemistry



NORTHMET PLANT SITE WATER QUALITY MODEL
DRAFT MODEL FLOWCHART
GOLDSIM MODEL VERSION 1
JULY 2, 2012

CADD USER: Rick Gustner FILE: M:\ADEPTWORK\RLG\23690862000_MASS FLOW DIAGRAM PFD.DWG PLOT SCALE: 1:2 PLOT DATE: 6/29/2012 2:25 PM



CADD USER: Rick Gustner FILE: M:\ADEPTWORK\RLG\2369086200_NORTHMET SITE PLANT WQ MODEL DETAILED FLOWCHART.DWG PLOT SCALE: 1:2 PLOT DATE: 6/28/2012 3:25 PM

NorthMet Plant Site Water Quality Model
Model Feature Timeline
GoldSim Model Version 1 (July 2, 2012)

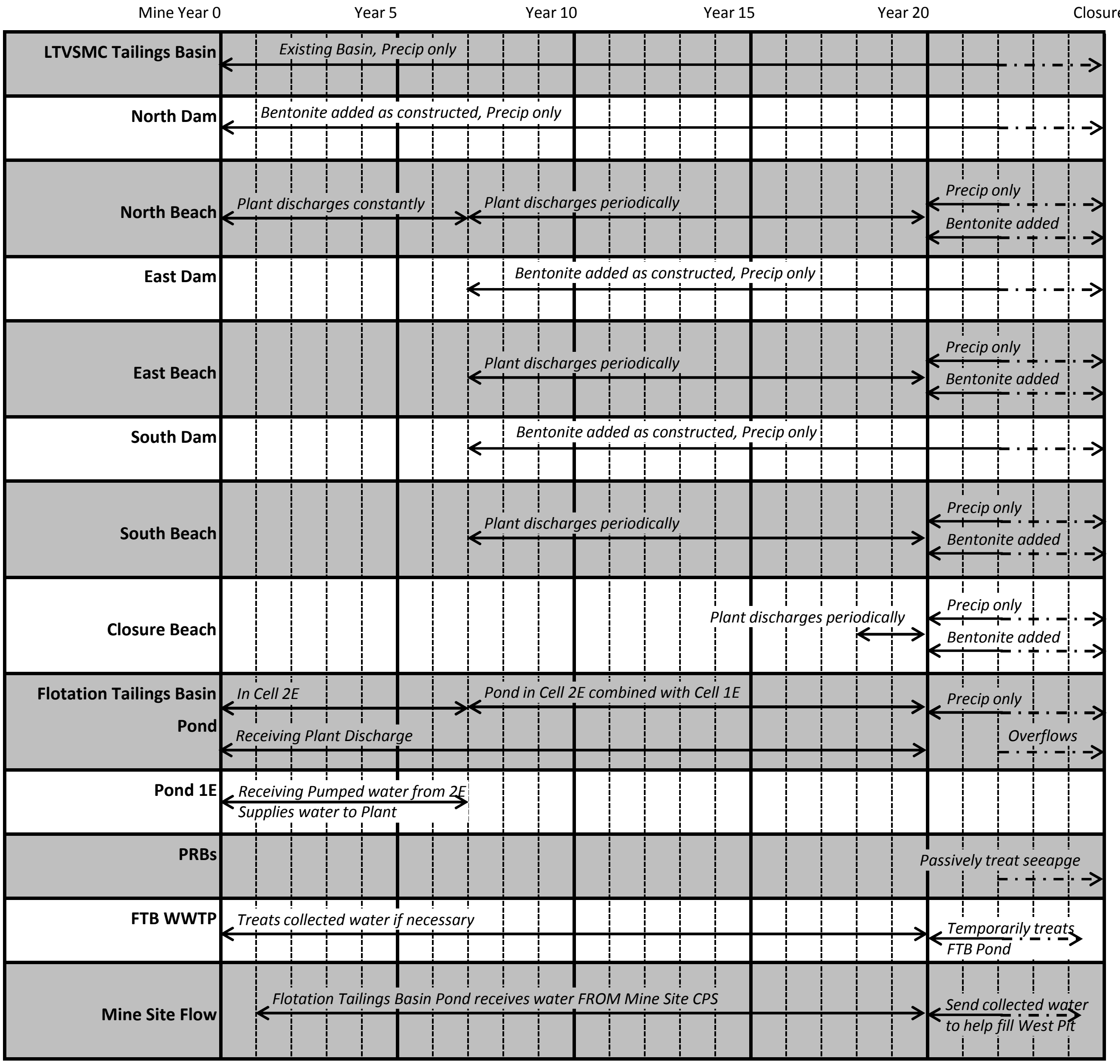


Table 1-1 **Input Variables for the Plant Site Model**

Variable Name	*Units*	*Deterministic/ Uncertain*	*Sampling/ Calculation Frequency*	*Distribution*	*Mean or Mode*	*Standard Deviation*	*Minimum*	*Maximum*	*Description*	*Source of Input Data*	*Modeling Package Section*
Water Quality Standards											
Surface_Constant_Standards	[mg/L]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-2				Constant surface water quality standards applicable to the project	MN Rules 7050 and 7052	Water Section 2.1 - *MN SW Standards*
SW_Hardness_Standard	[mg/L]	Deterministic	N/A	Constant	500	N/A	N/A	N/A	Constant surface water standard for hardness	MN Rule 7050	Water Section 2.1 - *MN SW Standards*
Surface_Hardness_Standards	[--]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-3				Hardness-dependent surface water quality standards applicable to the project	MN Rules 7050 and 7052	Water Section 2.1 - *MN SW Standards*
Ground_Primary_Standards	[mg/L]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-4				Constant Primary groundwater quality standards applicable to the project	MN Rules 7050 and 4717	Water Section 2.3 - MN GW Standards
Prim_GW_Hardness_Stand	[mg/L]	Deterministic	N/A	Constant	999999	N/A	N/A	N/A	Primary groundwater standard for hardness	MN Rules 7050 and 4717	Water Section 2.3 - MN GW Standards
Ground_Secondary_Standards	[mg/L]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-4				Constant Secondary groundwater quality standards presented for reference	MN Rules 7050 and 4717	Water Section 2.3 - *MN GW Standards*
Sec_GW_Hardness_Stand	[mg/L]	Deterministic	N/A	Constant	999999	N/A	N/A	N/A	Secondary groundwater standard for hardness	MN Rules 7050 and 4717	Water Section 2.3 - MN GW Standards
General Engineering Variables											
Closure_Year	[yr]	Deterministic	N/A	Constant	20	N/A	N/A	N/A	Year when operations cease	Project Description	Water Section 5.1.1 - *Flotation Tailings Basin Design*
Water_Depth	[in]	Deterministic	N/A	Constant	0.1	N/A	N/A	N/A	Average depth of water at the bottom of stockpile (for volume calculation)	See Mine Site Work Plan Tables	None
Tiny_Area	[acre]	Deterministic	N/A	Constant	0.001	N/A	N/A	N/A	Tiny area to prevent dividing by zero	See Mine Site Work Plan Tables	None
Tiny_Mass	[kg]	Deterministic	N/A	Constant	0.001	N/A	N/A	N/A	Tiny mass to prevent dividing by zero	See Mine Site Work Plan Tables	None
Tiny_Volume	[m^3]	Deterministic	N/A	Constant	0.001	N/A	N/A	N/A	Tiny volume to prevent dividing by zero	See Mine Site Work Plan Tables	None

Table 1-1 **Input Variables for the Plant Site Model**

Variable Name	*Units*	*Deterministic/ Uncertain*	*Sampling/ Calculation Frequency*	*Distribution*	*Mean or Mode*	*Standard Deviation*	*Minimum*	*Maximum*	*Description*	*Source of Input Data*	*Modeling Package Section*
Plant Site Hydrology											
Precip_cuberoot	[--]	Uncertain	Annually	Normal	3.03	0.15	N/A	N/A	Cubed root of the annual precipitation in inches	HiDen Climate network for Mine Site (1981-2010 climate normal)	Water Section 5.2.1 - *Precipitation*
Annual_P_Variation	[yr/mon]	Deterministic	N/A	Constant	Vector by month. Reference Table 1-51				Fraction of annual precipitation that falls each month	HiDen Climate network for Mine Site (1981-2010 climate normal)	Water Section 5.2.1 - *Precipitation*
Open_Water_Evap_OPS_Early	[in/yr]	Uncertain	Annually	Normal	32.5	0.56	N/A	N/A	Evaporation rate from open water in Cell 2E only during operations (artificially heated water)	Meyer Model, developed for the DEIS modeling (RS-13B), and updated for the new climate normal	Water Section 6.1.3.1 - *Climate*
Open_Water_Evap_OPS_Late	[in/yr]	Uncertain	Annually	Normal	30.8	0.69	N/A	N/A	Evaporation rate from open water in combined Cell2E and 1E during operations (artificially heated water)	Meyer Model, developed for the DEIS modeling (RS-13B), and updated for the new climate normal	Water Section 6.1.3.1 - *Climate*
Open_Water_Evap_CLSR	[in/yr]	Uncertain	Annually	Normal	17.1	2.16	N/A	N/A	Evaporation rate from open water after operations (normal temperature water)	Meyer Model, developed for the DEIS modeling (RS-13B), and updated for the new climate normal	Water Section 5.2.2 - *Evaporation*
Annual_E_Variation	[yr/mon]	Deterministic	N/A	Constant	Vector by month. Reference Table 1-51				Fraction of annual evaporation that occurs each month	HiDen Climate network for Mine Site (1981-2010 climate normal)	Water Section 5.2.2 - *Evaporation*
Beach_Evap_Frac	[--]	Uncertain	Annually	Normal	0.528	0.046	N/A	N/A	Fraction of precipitation that evaporates from the Flotation Tailings beaches	Meyer Model, developed for the DEIS modeling (RS-13B), and updated for the new climate normal	Water Section 6.1.3.1 - *Climate*
Beach_RO_Frac	[--]	Uncertain	Annually	Normal	0.195	0.043	N/A	N/A	Fraction of precipitation that becomes runoff from the beaches	Meyer Model, developed for the DEIS modeling (RS-13B), and updated for the new climate normal	Water Section 6.1.3.1 - *Climate*
Delta_Evap	[in/yr]	Uncertain	Annually	Normal	46.0	0.69	N/A	N/A	Evaporation rate from the active delta in the Flotation Tailings beach	Meyer Model, developed for the DEIS modeling (RS-13B), and updated for the new climate normal	Water Section 6.1.3.1 - *Climate*
Beach_BNT_Evap_Frac	[--]	Uncertain	Annually	Normal	0.662	0.073	N/A	N/A	Fraction of precipitation that evaporates from the bentonite-amended Flotation Tailings beaches	HELP modeling conducted by Golder	Water Section 6.1.3.1 - *Climate*
Beach_BNT_RO_Frac	[--]	Uncertain	Annually	Trunc. Normal	0.126	0.063	0	N/A	Fraction of precip that runs off the amended beaches	HELP modeling conducted by Golder	Water Section 6.1.3.1 - *Climate*
Rec_Bank_Evap_Frac	[--]	Uncertain	Annually	Normal	0.662	0.073	N/A	N/A	Fraction of precipitation that evaporates from the bentonite-amended dams	HELP modeling conducted by Golder	Water Section 6.1.3.1 - *Climate*
Rec_Bank_RO_Frac	[--]	Uncertain	Annually	Trunc. Normal	0.126	0.063	0	N/A	Fraction of precip that runs off the amended dams	HELP modeling conducted by Golder	Water Section 6.1.3.1 - *Climate*
LTVSMC_Tailings_Evap_Frac	[--]	Uncertain	Annually	Normal	0.449	0.045	N/A	N/A	Fraction of precipitation that evaporates from the LTVSMC tailings in Cells 1E, 2E, & 2W	Coeff. of Var. from updated Meyer Model, calibrated to updated ex. cond. MODFLOW model	Water Section 6.1.3.1 - *Climate*
Cell2W_RO_Frac	[--]	Uncertain	Annually	Normal	0.074	0.011	N/A	N/A	Fraction of precip that runs off the coarse tailings in Cell 2W	Coeff. of Var. from updated Meyer Model, calibrated to updated ex. cond. MODFLOW model	Water Section 6.1.3.1 - *Climate*
Cell1E_Coarse_RO_Frac	[--]	Uncertain	Annually	Normal	0.469	0.072	N/A	N/A	Fraction of precip that runs off the coarse tailings in Cell 1E	Coeff. of Var. from updated Meyer Model, calibrated to updated ex. cond. MODFLOW model	Water Section 6.1.3.1 - *Climate*
Cell1E_Fines_RO_Frac	[--]	Uncertain	Annually	Normal	0.501	0.077	N/A	N/A	Fraction of precip that runs off the fine tailings in Cell 1E	Coeff. of Var. from updated Meyer Model, calibrated to updated ex. cond. MODFLOW model	Water Section 6.1.3.1 - *Climate*
Cell2E_Coarse_RO_Frac	[--]	Uncertain	Annually	Normal	0.373	0.057	N/A	N/A	Fraction of precip that runs off the coarse tailings in Cell 2E	Coeff. of Var. from updated Meyer Model, calibrated to updated ex. cond. MODFLOW model	Water Section 6.1.3.1 - *Climate*
Cell2E_Fines_RO_Frac	[--]	Uncertain	Annually	Normal	0.416	0.064	N/A	N/A	Fraction of precip that runs off the fine tailings in Cell 2E	Coeff. of Var. from updated Meyer Model, calibrated to updated ex. cond. MODFLOW model	Water Section 6.1.3.1 - *Climate*
Cell2E_Bank_Evap_Frac	[--]	Uncertain	Annually	Normal	0.560	0.057	N/A	N/A	Fraction of precip that evaporates from the banks of Cell 2E	Coeff. of Var. from updated Meyer Model, calibrated to updated ex. cond. MODFLOW model	Water Section 6.1.3.1 - *Climate*
Cell2W_Bank_Evap_Frac	[--]	Uncertain	Annually	Normal	0.471	0.048	N/A	N/A	Fraction of precip that evaporates from the banks of Cell 2W	Meyer Model, developed for the DEIS modeling (RS-13B), and updated for the new climate normal	Water Section 6.1.3.1 - *Climate*
Cell2W_Bank_RO_Frac	[--]	Uncertain	Annually	Normal	0.248	0.038	N/A	N/A	Fraction of precipitation that becomes runoff from the embankments of Cell 2W	Meyer Model, developed for the DEIS modeling (RS-13B), and updated for the new climate normal	Water Section 6.1.3.1 - *Climate*
Min_Climate_Infiltration	[in/yr]	Deterministic	N/A	Constant	0.1	N/A	N/A	N/A	Minimum infiltration allowed in the tailings beaches and dams for model stability purposes (eliminate divide by zero)	Assumed	Water Section 6.1.3.1 - *Climate*

Table 1-1 **Input Variables for the Plant Site Model**

Variable Name	*Units*	*Deterministic/ Uncertain*	*Sampling/ Calculation Frequency*	*Distribution*	*Mean or Mode*	*Standard Deviation*	*Minimum*	*Maximum*	*Description*	*Source of Input Data*	*Modeling Package Section*
Bare_ET	[--]	Uncertain	Realization	Normal	0.524	0.020	N/A	N/A	ET from bare waste rock as a fraction of precipitation	See Mine Site Work Plan Tables	Water (Volume 1) Section 6.1.1 - *Stockpile Hydrology Modeling*
Bare_RO	[--]	Deterministic	N/A	Constant	0	N/A	N/A	N/A	Runoff from bare waste rock as a fraction of precipitation	See Mine Site Work Plan Tables	Water (Volume 1) Section 6.1.1 - *Stockpile Hydrology Modeling*
SnowMelt_Start	[--]	Deterministic	N/A	Constant	4	N/A	N/A	N/A	Month of the year when snow melt starts	Analysis of flow record and watershed yield	Water Section 5.5.5 - *Seasons*
SnowMelt_Stop	[--]	Deterministic	N/A	Constant	5	N/A	N/A	N/A	Final snow melt month of the year	Analysis of flow record and watershed yield	Water Section 5.5.5 - *Seasons*
Frozen_Period	[mon]	Uncertain	Annually	Triangular	3.4	N/A	2.4	4.4	Number of months each year that the inactive tailings are frozen and limit oxygen diffusion	Analysis of site specific temperature data	Waste Section 10.2 - Lab to Field Scale Up

Plant Site Chemistry

GW_Alpha_Rand (see Table 1-5)	[--]	Uncertain	Realization	Normal	GW_Alpha_Mean	GW_Alpha_Stdev	N/A	N/A	Vector by constituent, mean of the LN transformed baseline groundwater quality	Analysis of groundwater on-site groundwater wells	Water Section 5.3.1 - *Background Groundwater*
GW_Beta	[--]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-5				Standard Deviation of the LN transformed baseline groundwater quality	Analysis of groundwater on-site groundwater wells	Water Section 5.3.1 - *Background Groundwater*
SW_RO_Concentration (see Table 1-6)	[ug/L]	Uncertain	Timestep	Lognormal	RO_Mean	RO_StDev	N/A	N/A	Concentration of surface runoff in the un-impacted watershed	Calibration to existing water quality in the Embarrass River	Water Section 5.3.2 - *Background Surface Runoff*
INIT_Concs	[mg/L]	Deterministic	N/A	Constant	Matrix by constituent and location. Reference Table 1-7				Initial Concentrations in the surface water evaluation locations	Sampled water quality data	Water Section 4.4.3 - *Embarrass River Watershed Water Quality*

Mine Site Water

Mine_Site_Flow_Rate	[gpm]	Uncertain	Timestep	Trunc. Normal	Reference Table 1-8		0	1E+10	Flow at any point in time from the Mine Site WWTF to the FTB, auto-correlated (0.9) per data package	Mine Site probabilistic water quality model	Water Section 6.1.3.6 - *Mine Site WWTF Flow*
Mine_Site_Conc	[mg/L]	Uncertain	Timestep	Trunc. Normal	Table 1-9	Table 1-10	0	1E+10	Concentration for all constituents at any time in the water from the Mine Site WWTF to the FTB	Mine Site probabilistic water quality model	Water Section 5.3.3 - *Mine Site WWTF*

Colby Lake

CL_Quality	[mg/L]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-44				Mean concentration for all constituents at any time in the water from Colby Lake	Sampled Surface Water Data	Water Section 5.3.4 - *Colby Lake Quality*

Table 1-1 **Input Variables for the Plant Site Model**

Variable Name	*Units*	*Deterministic/ Uncertain*	*Sampling/ Calculation Frequency*	*Distribution*	*Mean or Mode*	*Standard Deviation*	*Minimum*	*Maximum*	*Description*	*Source of Input Data*	*Modeling Package Section*
NorthMet Tailings Hydraulic Properties											
NM_SG	[--]	Deterministic	N/A	Constant	3.0	N/A	N/A	N/A	Specific gravity of the NorthMet tailings (both coarse and fine fractions)	DBS&A Analysis and Report	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
Beach_Porosity	[cm^3/cm^3]	Uncertain	Annually	Triangular	0.4012	N/A	0.3668	0.4685	Porosity of the tailings in the NorthMet beaches	Interpretation of the SAFL Depositional Study	Waste Section 5.1.3.1 - *Depositional Study*
Pond_Porosity	[cm^3/cm^3]	Uncertain	Annually	Triangular	0.5602	N/A	0.4049	0.5696	Porosity of the tailings under the Flotation Tailings Basin pond	Interpretation of the SAFL Depositional Study	Waste Section 5.1.3.1 - *Depositional Study*
Mean_Perc_Fines	[%]	Deterministic	N/A	Constant	35	N/A	N/A	N/A	Average percentage of the flotation tailings beach that is made up of fine flotation tailings	Interpretation of the SAFL Depositional Study	Waste Section 5.1.3.1 - *Depositional Study*
Perc_Fines_Retained	[%]	Uncertain	Annually	Normal	Mean_Perc_Fines	3.04	N/A	N/A	Percent of the NorthMet tailings in the beaches that are from the fine fraction (by mass)	Interpretation of the SAFL Depositional Study	Waste Section 5.1.3.1 - *Depositional Study*
Perc_Coarse_Feed	[%]	Uncertain	Annually	Normal	38	1.82	N/A	N/A	Percent of the NorthMet tailings feed that is in the coarse fraction (by mass)	Interpretation of the SAFL Depositional Study	Waste Section 5.1.3.1 - *Depositional Study*
Ksat_Coeff	[--]	Deterministic	N/A	Constant	Function coefficients. Reference Table 1-11				Function coefficients to determine the saturated hydraulic conductivty of the NorthMet tailings	DBS&A Analysis and Report	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
ResMoist_Coeff	[--]	Deterministic	N/A	Constant	Function coefficients. Reference Table 1-11				Function coefficients to determine the residual moisture content of the NorthMet tailings	DBS&A Analysis and Report	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
AirSuct_Coeff	[--]	Deterministic	N/A	Constant	Function coefficients. Reference Table 1-11				Function coefficients to determine the air entry suction parameter of the NorthMet tailings	DBS&A Analysis and Report	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
VGBeta_Coeff	[--]	Deterministic	N/A	Constant	Function coefficients. Reference Table 1-11				Function coefficients to determine the Van Genuchten parameter β of the NorthMet tailings	DBS&A Analysis and Report	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
BNT_SG	[--]	Deterministic	N/A	Constant	3.0	N/A	N/A	N/A	Specific gravity of the bentonite amended tailings	The same as the specific gravity of the NorthMet Flotation Tailings	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
BNT_Porosity	[cm^3/cm^3]	Deterministic	N/A	Constant	0.36	N/A	N/A	N/A	Porosity of the bentonite amended tailings	HYDRUS model database for a silty-clay	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
BNT_Ksat	[cm/s]	Deterministic	N/A	Constant	5.56E-06	N/A	N/A	N/A	Saturated hydraulic conductivity of the bentonite amended tailings	HYDRUS model database for a silty-clay	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
BNT_ResMoist	[cm^3/cm^3]	Deterministic	N/A	Constant	0.07	N/A	N/A	N/A	Residual moisture content of the bentonite amended tailings	HYDRUS model database for a silty-clay	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
BNT_AirSuct	[1/cm]	Deterministic	N/A	Constant	0.005	N/A	N/A	N/A	Air entry suction parameter for the bentonite amended tailings	HYDRUS model database for a silty-clay	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
BNT_VGBeta	[--]	Deterministic	N/A	Constant	1.09	N/A	N/A	N/A	Van Genuchten Beta parameter for the bentonite amended tailings	HYDRUS model database for a silty-clay	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
LTVSMC Tailings Hydraulic Properties											
LTVSMC_SG	[--]	Deterministic	N/A	Constant	Vector by tailings type. Reference Table 1-12a				Specific gravity of the different classes of the LTVSMC tailings	Unsaturated geotechnical modeling	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
LTVSMC_Porosity	[cm^3/cm^3]	Deterministic	N/A	Constant	Vector by tailings type. Reference Table 1-12a				Porosity of the different classes of the LTVSMC tailings	Unsaturated geotechnical modeling	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
LTVSMC_Ksat	[cm/s]	Deterministic	N/A	Constant	Matrix by tailings and Cell. Reference Table 1-12a & Table 1-12b				Saturated hydraulic conductivity of the LTVSMC tailings	Unsaturated geotechnical modeling	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
LTVSMC_ResMoist	[cm^3/cm^3]	Deterministic	N/A	Constant	Vector by tailings type. Reference Table 1-12a				Residual moisture content of the LTVSMC tailings	Unsaturated geotechnical modeling	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
LTVSMC_AirSuct	[1/cm]	Deterministic	N/A	Constant	Vector by tailings type. Reference Table 1-12a				Air entry suction parameter for the LTVSMC tailings	Fitted curves to data from the unsaturated geotechnical modeling	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
LTVSMC_VGBeta	[--]	Deterministic	N/A	Constant	Vector by tailings type. Reference Table 1-12a				Van Genuchten Beta parameter for the LTVSMC tailings	Fitted curves to data from the unsaturated geotechnical modeling	Waste Section 10.3 - *Saturation and Oxygen Diffusion*

Table 1-1 **Input Variables for the Plant Site Model**

Variable Name	*Units*	*Deterministic/ Uncertain*	*Sampling/ Calculation Frequency*	*Distribution*	*Mean or Mode*	*Standard Deviation*	*Minimum*	*Maximum*	*Description*	*Source of Input Data*	*Modeling Package Section*
Saturation-Diffusion Inputs											
O2_Air_Diff	[m^2/s]	Deterministic	N/A	Constant	1.80E-05	N/A	N/A	N/A	Free diffusion coefficient of oxygen in air	Cussler, 1997	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
O2_Water_Diff	[m^2/s]	Deterministic	N/A	Constant	2.20E-09	N/A	N/A	N/A	Free diffusion coefficient of oxygen in water	Cussler, 1997	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
Tortuosity	[--]	Deterministic	N/A	Constant	0.273	N/A	N/A	N/A	Tortuosity factor	Elberling, 1993	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
C	[--]	Deterministic	N/A	Constant	3.28	N/A	N/A	N/A	Empirical coefficient in the Elberling equation	Elberling, 1993	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
KH	[--]	Deterministic	N/A	Constant	33.9	N/A	N/A	N/A	Henry's constant for oxygen	Known value	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
O2_Conc_Air	[mol/m^3]	Deterministic	N/A	Constant	8.89	N/A	N/A	N/A	Concentration of oxygen in the air (boundary condition)	Known value	Waste Section 10.3 - *Saturation and Oxygen Diffusion*
Pond_DO (see Table 1-18)	[mg/L]	Uncertain	Monthly	Normal	Pond_DO_Mean	Pond_DO_SD	N/A	N/A	Oxygen concentration in the tailings basin ponds which seeps into the tailings generating chemical load	DO saturation at expected yet conservative pond water temperatures	Waste Section 10.6.1 - *Oxidation of Saturated Tailings*
NorthMet Tailings Chemical Loading											
NM_Fines_Release	[varies]	Uncertain	Realization	Varies	Vector by constituent. Reference Table 1-13				Distribution parameters for constituent release rates and ratios from the fine fraction of the NorthMet tailings	Analysis of HCT, Aqua Regia, and Microprobe data	Waste Section 10.1.1 - *NorthMet Tailings*
NM_Coarse_Release	[varies]	Uncertain	Realization	Varies	Vector by constituent. Reference Table 1-14				Distribution parameters for constituent release rates and ratios from the coarse fraction of the NorthMet tailings	Analysis of HCT, Aqua Regia, and Microprobe data	Waste Section 10.1.1 - *NorthMet Tailings*
Ratio_or_Conc_NM	[--]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-13 & Table 1-14				Defines whether a release rate is from a release ratio (1) or from a concentration (0)	Release Method	Waste Section 10.1.1 - *NorthMet Tailings*
Atmospheric_pH	[--]	Uncertain	Realization	Uniform	N/A	N/A	7.8	8.1	Estimate of the pH in the areas of the FTB dominated by advection of surface water	See Mine Site Work Plan Tables	Waste Section 10.4 - *Concentration Caps*
Enriched_pH	[--]	Uncertain	Realization	Discrete	7.1	N/A	N/A	N/A	Estimate of the pH in the CO2 enriched areas of the FTB	CDF056	Waste Section 10.4 - *Concentration Caps*
NM_Solubility	[mg/L]	Uncertain	Realization	Varies	Vector by constituent. Reference Table 1-15				Concentration cap distributions for each constituent in the NorthMet Tailings	Category 1 Waste Rock	Waste Section 10.4 - *Solubility Limits*
NM_Content	[mg/kg]	Deterministic	N/A	Constant	Matrix by Constituent and Tailings Class. Reference Table 1-16				Whole tailings content for depletion modeling	Aqua Regia data	Waste Section 10.6.6 - *Depletion*
NM_Tailings_Weathering	[mg/m^2/mon]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-17				Weathering rate by the NorthMet tailings beaches	RS46	Waste Section 10.6.2 - *Tailings Weathering*
LTVSMC Tailings Chemical Loading											
Dist_Params_LTVSMC_Release	[varies]	Uncertain	Realization	Varies	Matrix by constituent and parameter. Reference Table 1-19				Distribution parameters for the release rates from the existing LTVSMC tailings	Analysis of HCT, Aqua Regia, and Microprobe data	Waste Section 10.1.2 - *LTVSMC Tailings*
LTVSMC_Flush	[mg/kg]	Uncertain	Realization	Beta	Matrix by constituent and parameter. Reference Table 1-20				One-time loading from the disturbed LTVSMC tailings as the dams are constructed	Analysis of HCT, Aqua Regia, and Microprobe data	Waste Section 10.1.2 - *LTVSMC Tailings*
Coarse_Calib_Fact	[--]	Deterministic	N/A	Constant	0.185	N/A	N/A	N/A	Calibration factor to modify the SO4 release rate from the coarse LTVSMC tailings	Calibration of the existing conditions / No Action Model	Waste Section 10.2.1 - *Scaling / Calibration of LTVSMC Lab Data to Field Data*
Fine_Calib_Fact	[--]	Deterministic	N/A	Constant	0.360	N/A	N/A	N/A	Calibration factor to modify the SO4 release rate from the fine LTVSMC tailings	Calibration of the existing conditions / No Action Model	Waste Section 10.2.1 - *Scaling / Calibration of LTVSMC Lab Data to Field Data*
LTVSMC_Calib_Fact	[--]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-21				Calibration factor applied to each constituent so that the theoretical loading matches the observed seepage data	Calibration of the existing conditions / No Action Model	Waste Section 10.2.1 - *Scaling / Calibration of LTVSMC Lab Data to Field Data*
Ratio_or_Conc_LTV	[--]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-21				Defines whether a release rate is from a release ratio (1) or from a concentration (0)	Release Method	Waste Section 10.2.1 - *Scaling / Calibration of LTVSMC Lab Data to Field Data*
LTVSMC_Content	[mg/kg]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-22				Whole tailings content for depletion modeling	Aqua Regia data	Waste Section 10.6.6 - *Depletion*

Table 1-1 **Input Variables for the Plant Site Model**

Variable Name	*Units*	*Deterministic/ Uncertain*	*Sampling/ Calculation Frequency*	*Distribution*	*Mean or Mode*	*Standard Deviation*	*Minimum*	*Maximum*	*Description*	*Source of Input Data*	*Modeling Package Section*
Geochemical Parameters for Scaling											
Activation_energy	[kJ/mol]	Uncertain	Realization	Uniform	N/A	N/A	47	63	Activation energy of pyrrhotite for the Arrhenius equation	Literature-reported range	Waste Section 8.3 - *Lab to Field Scale Up*
Contact_factor	[--]	Uncertain	Realization	Triangular	0.5	N/A	0.1	0.9	Fraction of Ore contacted by water	Professional judgement	Waste Section 8.3 - *Lab to Field Scale Up*
Field_temp	[C]	Uncertain	Annually	Normal	2.004	1.388	N/A	N/A	Average annual site air temperature, assumed the same temperature as the Ore and tailings	HiDen Climate data for 1981-2010	Waste Section 8.3 - *Lab to Field Scale Up*
O2_Mol_Weight	[g/mol]	Deterministic	N/A	Constant	32.00	N/A	N/A	N/A	Molecular weight of oxygen	Known value	Waste Section 10.1.1 - *NorthMet Tailings*
SO4_Mol_Weight	[g/mol]	Deterministic	N/A	Constant	96.07	N/A	N/A	N/A	Molecular weight of sulfate	Known value	Waste Section 10.1.1 - *NorthMet Tailings*
S_Mol_Weight	[g/mol]	Deterministic	N/A	Constant	32.07	N/A	N/A	N/A	Molecular weight of sulfide	Known value	Waste Section 10.1.1 - *NorthMet Tailings*
Lab_temp	[C]	Deterministic	N/A	Constant	20	N/A	N/A	N/A	Laboratory temperature (known)	RS 53/42	Waste Section 8.3 - *Lab to Field Scale Up*
Size_factor	[--]	Uncertain	Realization	Trunc. Normal	0.18	0.061	0	1.00E+10	Scaling factor to adjust to field scale Ore	Analysis of Equity Silver Mine data	Waste Section 8.3 - *Lab to Field Scale Up*
Scale_Factor_LAM	[--]	Uncertain	Annually	Beta	0.128	0.085	0.019	0.687	Scaling factor for buttress material	MDNR Analysis of Dunka Mine Data	Waste Section 10.6.5 - *Buttress Material*
Sulfate_gen_ratio	[mol SO4 / mol O2]	Deterministic	N/A	Constant	0.444	N/A	N/A	N/A	Ratio of the number of moles of sulfate produced for every mole of oxygen consumed	Pyrrhotite reaction stoichiometry	Waste Section 10.3 - *Saturation and Oxygen Diffusion*

Table 1-1 **Input Variables for the Plant Site Model**

Variable Name	Units	Deterministic/ Uncertain	Sampling/ Calculation Frequency	Distribution	Mean or Mode	Standard Deviation	Minimum	Maximum	Description	Source of Input Data	Modeling Package Section
Engineered Dam Characteristics											
Dam_Volume	[$yard^3$]	Deterministic	N/A	Time Series	Time series by dam. Reference Table 1-23				Cumulative volume of bulk LTVSMC tailings used to construct the FTB dams through time	Flotation Tailings Basin design	Water Section 5.1.1 - *Flotation Tailings Basin (FTB) Design*
Dam_Outer_Area	[acre]	Deterministic	N/A	Time Series	Time series by dam. Reference Table 1-23				The surface area of the outer slope of the dams of the FTB	Flotation Tailings Basin design	Water Section 5.1.1 - *Flotation Tailings Basin (FTB) Design*
Crest_Elevation	[ft]	Deterministic	N/A	Time Series	Time series. Reference Table 1-24				The elevation of the top of the dams of the FTB	Flotation Tailings Basin design	Water Section 5.1.1 - *Flotation Tailings Basin (FTB) Design*
Crest_Area	[acre]	Deterministic	N/A	Time Series	Time series. Reference Table 1-24				The plan-view area within the dam crest (helps define the storage volume within the FTB)	Flotation Tailings Basin design	Water Section 5.1.1 - *Flotation Tailings Basin (FTB) Design*
Beach_Elevation	[ft]	Deterministic	N/A	Time Series	Time series. Reference Table 1-24				Elevation of the NorthMet tailings beach where it meets the constructed dams of the FTB	Flotation Tailings Basin design	Water Section 5.1.1 - *Flotation Tailings Basin (FTB) Design*
Beach_Areas	[acres]	Deterministic	N/A	Time Series	Time series by dam. Reference Table 1-24				Areas of the NorthMet tailings beaches that are contributing load to the seepage	Flotation Tailings Basin design	Water Section 5.1.1 - *Flotation Tailings Basin (FTB) Design*
Beach_Slope	[%]	Deterministic	N/A	Constant	1.0	N/A	N/A	N/A	The slope of the beach formed using NorthMet tailings from the dam to the pond's edge	Flotation Tailings Basin design, validated by SAFL Deposition study	Waste Section 5.1.3.1 - *Depositional Study*
Beach_Width	[ft]	Deterministic	N/A	Constant	625	N/A	N/A	N/A	The width of the beach formed using NorthMet tailings from the dam to the pond's edge	Flotation Tailings Basin design	Water Section 6.1.3.2 - *Beneficiation Plant Slurry*
Delta_Angle	[deg]	Deterministic	N/A	Constant	75	N/A	N/A	N/A	The angle at which spigotted water and tailings will spread as they flow down the NorthMet tailings beach	Value carried forward from RS-13B	Water Section 6.1.3.2 - *Beneficiation Plant Slurry*
Delta_Flow_Frac	[%]	Deterministic	N/A	Constant	30	N/A	N/A	N/A	The fraction of the delta area that is receiving active flow	Value carried forward from RS-13B	Water Section 6.1.3.2 - *Beneficiation Plant Slurry*
Dam_Flow_Direction	[%]	Deterministic	N/A	Time Series	Time series by dam and by toe. Reference Table 1-25				Time series of the proportion of water that flows through the dams that will report to each toe of the FTB	MODFLOW model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Dam_Sat_Volume	[acre-ft]	Deterministic	N/A	Time Series	Time series by dam and by toe. Reference Table 1-26				Time series of the proportion of water that flows through the dams that will report to each toe of the FTB	MODFLOW model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Beach_Flow_Direction	[%]	Deterministic	N/A	Time Series	Time series by dam and by toe. Reference Table 1-27				Time series of the proportion of water that flows through the beaches that will report to each toe of the FTB	MODFLOW model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Beach_Sat_Volume	[acre-ft]	Deterministic	N/A	Time Series	Time series by dam and by toe. Reference Table 1-28				Time series of the proportion of water that flows through the beaches that will report to each toe of the FTB	MODFLOW model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Dam_WT_Depth	[ft]	Deterministic	N/A	Time Series	Time series by Dam. Reference Table 1-29				Time series of the depth to the phreatic surface under each Dam (where chemical production would cease)	MODFLOW model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Beach_WT_Depth	[ft]	Deterministic	N/A	Time Series	Time series by Dam. Reference Table 1-29				Time series of the depth to the phreatic surface under each NorthMet tailings beach	MODFLOW model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Buttresses											
N_Buttress_Volume	[$yard^3$]	Deterministic	N/A	Time Series	Time series by buttress. Reference Table 1-23				Volume of the north buttress	Flotation Tailings Management Plan	Water (Volume 1) Section 6.1.1 - *Stockpile Hydrology Modeling*
N_Buttress_Area	[acres]	Deterministic	N/A	Time Series	Time series by buttress. Reference Table 1-23				Area of the North Buttress	CAD drawing of the proposed Flotation Tailings Basin	Water (Volume 1) Section 6.1.1 - *Stockpile Hydrology Modeling*
S_Buttress_Volume	[$yard^3$]	Deterministic	N/A	Time Series	Time series by buttress. Reference Table 1-23				Volume of the south buttress	Flotation Tailings Management Plan	Water (Volume 1) Section 6.1.1 - *Stockpile Hydrology Modeling*
S_Buttress_Area	[acres]	Deterministic	N/A	Time Series	Time series by buttress. Reference Table 1-23				Area of the South Buttress	CAD drawing of the proposed Flotation Tailings Basin	Water (Volume 1) Section 6.1.1 - *Stockpile Hydrology Modeling*
Buttress_Sulfur	[%]	Deterministic	N/A	Constant	0.063	N/A	N/A	N/A	Mass-weighted average sulfur content of the buttresses	See Mine Site Work Plan Tables	Waste Section 4.3.2 - *Sulfur Content*
Buttress_Content	[mg/kg]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-16				Content of constituent of concern in waste rock	Analysis of Aqua Regia Data	Waste Section 8.4.1 - *Depletion*
Buttress_Bulk_Density	[lbs/ft^3]	Deterministic	N/A	Constant	140	N/A	N/A	N/A	Bulk density of the material used to form the buttresses	Geotechnical design group	Water Section 6.1.3.8 - *Buttresses*

Table 1-1 **Input Variables for the Plant Site Model**

Variable Name	*Units*	*Deterministic/ Uncertain*	*Sampling/ Calculation Frequency*	*Distribution*	*Mean or Mode*	*Standard Deviation*	*Minimum*	*Maximum*	*Description*	*Source of Input Data*	*Modeling Package Section*
Flotation Tailings Basin Details											
Pond_Bottom_Area	[acre]	Deterministic	N/A	Time Series	Time series. Reference Table 1-30				The plan-view area of the bottom of the FTB pond	Flotation Tailings Basin design	Water Section 5.1.1 - *Flotation Tailings Basin (FTB) Design*
Pond_Top_Area	[acre]	Deterministic	N/A	Time Series	Time series. Reference Table 1-30				The plan-view area of the top of the FTB pond (where optimum depth is reached and the slope breaks)	Flotation Tailings Basin design	Water Section 5.1.1 - *Flotation Tailings Basin (FTB) Design*
Design_Depth	[ft]	Deterministic	N/A	Constant	8	N/A	N/A	N/A	Designed optimum depth of the FTB pond	Flotation Tailings Basin design	Water Section 5.1.1 - *Flotation Tailings Basin (FTB) Design*
Pond_Slope	[%]	Deterministic	N/A	Constant	3	N/A	N/A	N/A	The slope of the NorthMet tailings under the FTB pond water surface	Flotation Tailings Basin design	Water Section 5.1.1 - *Flotation Tailings Basin (FTB) Design*
Pond_Seepage_Rate	[in/yr]	Deterministic	N/A	Time Series	Time series. Reference Table 1-31				Seepage rate of water from the FTB pond into the saturated NorthMet tailings	MODFLOW model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Pond_Seepage_Direction	[%]	Deterministic	N/A	Time Series	Time series by toe. Reference Table 1-31				Time series of the proportion of water that seeps from the pond that will report to each toe of the FTB	MODFLOW model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Pond_Saturated_Volume	[acre-ft]	Deterministic	N/A	Time Series	Time series. Reference Table 1-31				Time series of the volume of saturated tailings below the NorthMet Flotation Tailings pond	MODFLOW model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Initial_Pond_Volume	[acre-ft]	Deterministic	N/A	Constant	1800	N/A	N/A	N/A	Volume of the water that is currently in Cell 2E where the FTB pond will begin	Using the area of the pond from the MODFLOW model and assuming a 3 meter depth	Water Section 5.4.5 - *MODFLOW Model*
Pond_1E_Volume	[acre-ft]	Deterministic	N/A	Constant	3700	N/A	N/A	N/A	Volume of the water that is currently in Cell 1E	Using the area of the pond from the MODFLOW model and assuming a 3 meter depth	Water Section 5.4.5 - *MODFLOW Model*
Gal_per_Acre_per_Day	[gal/acre/day]	Deterministic	N/A	Constant	500	N/A	N/A	N/A	Regulated seepage limit from the Tailings Basin	EPA limit	Water Section 6.1.3.5 - *Seepage and Seepage Recovery*
Contr_Embank_Area	[acres]	Deterministic	N/A	Time Series	Time series. Reference Table 1-32				Area contributing runoff to Cells 1E & 2E from the embankments of Cell 2W	Contour data and Flotation Tailings Basin Design	Water Section 6.1.3.1 - *Climate*
Contr_Watershed	[acres]	Deterministic	N/A	Time Series	Time series. Reference Table 1-32				Area contributing runoff to Cells 1E & 2E from the surrounding forested areas	Contour data and Flotation Tailings Basin Design	Water Section 6.1.3.1 - *Climate*
Pond_Transport_Time	[yr]	Deterministic	N/A	Constant	5	N/A	N/A	N/A	Transport time for flow and load from under the ponds in the FTB	Assumed value in RS74B, September 2008, Figure 8-11	Water Section 6.1.3.5 - *Seepage and Seepage Recovery*
Interior_Transport_Time	[yr]	Deterministic	N/A	Constant	7	N/A	N/A	N/A	Transport time for flow and load from the NorthMet beaches and the coarse and fine interior LTVSMC tailings	Assumed value in RS74B, September 2008, Figure 8-10	Water Section 6.1.3.5 - *Seepage and Seepage Recovery*
Dam_Transport_Time	[yr]	Deterministic	N/A	Constant	10	N/A	N/A	N/A	Transport time for flow and load from the dams of the FTB	Assumed value in RS74B, September 2008, Figure 8-9	Water Section 6.1.3.5 - *Seepage and Seepage Recovery*
Erlang_Dispersion	[--]	Deterministic	N/A	Constant	25	N/A	N/A	N/A	A value greater than or equal to 1 representing some amount of dispersion where 1 is the maximum amount of dispersion.	Assumed	Water Section 6.1.3.5 - *Seepage and Seepage Recovery*

Table 1-1 **Input Variables for the Plant Site Model**

Variable Name	*Units*	*Deterministic/ Uncertain*	*Sampling/ Calculation Frequency*	*Distribution*	*Mean or Mode*	*Standard Deviation*	*Minimum*	*Maximum*	*Description*	*Source of Input Data*	*Modeling Package Section*
Existing LTVSMC Tailings Basin											
Cell_Areas	$[m^2]$	Deterministic	N/A	Time Series	Time series by Cell and by tailings class. Reference Table 1-33				Reactive areas of the tailings in the existing Tailings Basin	MODFLOW Model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Cell_WT_Depths	[ft]	Deterministic	N/A	Time Series	Time series by Cell and by tailings class. Reference Table 1-34				Depth to the phreatic surface in the existing Tailings Basin	MODFLOW Model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Cell2W_Seepage_Direction	[%]	Deterministic	N/A	Time Series	Time series by Cell and by tailings class. Reference Table 1-35				Percent of seepage within each zone of Cell 2W that reports to each toe of the Tailings Basin	MODFLOW Model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Cell2W_Sat_Volume	[acre-ft]	Deterministic	N/A	Time Series	Time series by tailings class and by toe. Reference Table 1-36				Saturated volume of tailings below each zone in Cell 2W that reports to each toe of the Tailigns Basin	MODFLOW Model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Cell2E_Seepage_Direction	[%]	Deterministic	N/A	Time Series	Time series by tailings class and by toe. Reference Table 1-37				Percent of seepage within each zone of Cell 2E that reports to each toe of the Tailings Basin	MODFLOW Model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Cell2E_Sat_Volume	[acre-ft]	Deterministic	N/A	Time Series	Time series by tailings class and by toe. Reference Table 1-38				Saturated volume of tailings below each zone in Cell 2E that reports to each toe of the Tailigns Basin	MODFLOW Model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Cell1E_Seepage_Direction	[%]	Deterministic	N/A	Time Series	Time series by tailings class and by toe. Reference Table 1-39				Percent of seepage within each zone of Cell 1E that reports to each toe of the Tailings Basin	MODFLOW Model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Cell1E_Sat_Volume	[acre-ft]	Deterministic	N/A	Time Series	Time series by tailings class and by toe. Reference Table 1-40				Saturated volume of tailings below each zone in Cell 1E that reports to each toe of the Tailigns Basin	MODFLOW Model of the FTB through time	Water Section 5.4.5 - *MODFLOW Model*
Initial_Pond_Concs_2E	[mg/L]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-44				Initial concentrations in the pond water in Cell 2E	Samples where available, model calibration of existing conditions at the toes.	Waste Section 10.2.1 - *Scaling / Calibration to LTVSMC Field Data*
Initial_Pond_Concs_1E	[mg/L]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-44				Initial concentrations in the pond water in Cell 1E	Samples where available, model calibration of existing conditions at the toes.	Waste Section 10.2.1 - *Scaling / Calibration to LTVSMC Field Data*
Cell2E_Exist_Seepage	[in/yr]	Deterministic	N/A	Constant	46.0	N/A	N/A	N/A	Seepage rate from the existing pond in Cell 2E	MODFLOW Model of the existing Tailings Basin	Water Section 5.4.5 - *MODFLOW Model*
Cell1E_Exist_Seepage	[in/yr]	Deterministic	N/A	Constant	48.7	N/A	N/A	N/A	Seepage rate from the existing pond in Cell 1E	MODFLOW Model of the existing Tailings Basin	Water Section 5.4.5 - *MODFLOW Model*
Hydrometallurgical Residue Facility											
V_El	[acre-ft]	Deterministic	N/A	Time Series	Lookup Table. Reference Table 1-41				Volume as a function of elevation of the final constructed HRF	CAD design of the facility	Water Section 6.1.5 - *Hydrometallurgical Residue Facility (HRF)*
A_El	[acre]	Deterministic	N/A	Time Series	Lookup Table. Reference Table 1-41				Area as a function of elevation of the final constructed HRF	CAD design of the facility	Water Section 6.1.5 - *Hydrometallurgical Residue Facility (HRF)*
Crest_El	[ft]	Deterministic	N/A	Time Series	Time series. Reference Table 1-42				Crest elevation of the dams constructed to form the HRF	CAD design of the facility	Water Section 6.1.5 - *Hydrometallurgical Residue Facility (HRF)*
Forest_WS_Area	[acre]	Deterministic	N/A	Time Series	Time series. Reference Table 1-42				Area of the forested contributing watershed to the south-west of the HRF	CAD design of the facility	Water Section 6.1.5.1 - *Climate*
Cell2W_WS_Area	[acre]	Deterministic	N/A	Time Series	Time series. Reference Table 1-42				Area of Cell 2W that contributes runoff to the HRF	CAD design of the facility	Water Section 6.1.5.1 - *Climate*
Residue_Porosity	$[cm^3/cm^3]$	Uncertain	Realization	Triangular	0.57	N/A	0.53	0.61	Porosity of the hydrometallurgical residue	RS13, March 2007	Water Section 6.1.5.3 - *Entrainment*
Residue_Sp_Gr	[--]	Deterministic	N/A	Constant	2.76	N/A	N/A	N/A	Specific gravity of the hydrometallurgical residue	Bateman MetSim model	Water Section 6.1.5.3 - *Entrainment*
Residue_Sat_K	[cm/s]	Deterministic	N/A	Constant	3.40E-05	N/A	N/A	N/A	Saturated hydraulic conductivity of the hydrometallurgical residue	NorthMet Data Package - Geotechnical, Volume 2	Water Section 6.2.3 - *Hydrometallurgical Residue Facility (HRF) in Closure*
Geomembrane_Defect_Size	[cm]	Deterministic	N/A	Constant	1	N/A	N/A	N/A	Assumed diameter of a circular defect in the upper geomembrane liner under the HRF	Values assumed for the same geomembrane liners at the Mine Site used to determine leakage rates	Water Section 6.2.3 - *Hydrometallurgical Residue Facility (HRF) in Closure*
Defects_Per_Acre	[1/acre]	Uncertain	Realization	Lognormal	2	1.82	N/A	N/A	Number of defects per acre in the geomembrane liner	Values assumed for the same geomembrane liners at the Mine Site used to determine leakage rates	Water Section 6.2.3 - *Hydrometallurgical Residue Facility (HRF) in Closure*

Table 1-1 **Input Variables for the Plant Site Model**

Variable Name	*Units*	*Deterministic/ Uncertain*	*Sampling/ Calculation Frequency*	*Distribution*	*Mean or Mode*	*Standard Deviation*	*Minimum*	*Maximum*	*Description*	*Source of Input Data*	*Modeling Package Section*
Beneficiation Plant											
Clean_H2O_Demand	[gpm]	Deterministic	N/A	Constant	3.29	N/A	N/A	N/A	Clean water demand from the concentrator process	RS13B, Attachment A-7, applying Plant_Uptime	Water Section 6.1.2 - *Beneficiation Plant*
Total_H2O_Demand	[gal/yr]	Deterministic	N/A	Constant	7.5901E+09	N/A	N/A	N/A	Total flow rate of water needed by the concentrator plant	Bateman Water Balance (June 2011)	Water Section 6.1.2 - *Beneficiation Plant*
Process_H2O_Discharge	[gal/yr]	Deterministic	N/A	Constant	7.9217E+09	N/A	N/A	N/A	Flow rate of water discharged from the concentrator process	Bateman Water Balance (June 2011)	Water Section 6.1.2 - *Beneficiation Plant*
Other_H2O_Discharge	[gpm]	Deterministic	N/A	Constant	26.3	N/A	N/A	N/A	Flow rate of water discharged to the FTB from other water uses	RS13B, Attachment A-7, applying Plant_Uptime	Water Section 6.1.2 - *Beneficiation Plant*
Solids_Discharge	[ton/yr]	Deterministic	N/A	Constant	1.235E+07	N/A	N/A	N/A	Flow rate of solids from the concentrator plant to the FTB	Flotation Tailings Management Plan	Water Section 6.1.2 - *Beneficiation Plant*
Reagant_Load	[g/ton]	Deterministic	N/A	Constant	55	N/A	N/A	N/A	Grams CuSO4 per ton of ore processed	RS46, July 2007	Waste Section 10.6.4 - *Process Water Loading to Pond*
Ore_Processing_Rate	[ton/day]	Deterministic	N/A	Constant	30,860	N/A	N/A	N/A	Tons per day of ore processed by the Beneficiation Plant	Mine Plan	Waste Section 10.6.4 - *Process Water Loading to Pond*
SO4_S_Regression	[mg/kg/week/%]	Uncertain	Realization	Normal	13.92	0.581	N/A	N/A	Sulfate release as a function of sulfur content (%S)	See Mine Site Work Plan Table 1-27	Waste Section 8.1.1.1.2 - *Correction for Non-Constant Variance*
OSP_Sulfur	[%]	Deterministic	N/A	Constant	0.608	N/A	N/A	N/A	Mass-weighted average sulfur content of stockpile	See Mine Site Work Plan Tables	Waste Section 4.3.2 - *Sulfur Content*
Ore_Storage_Time	[mon]	Uncertain	Realization	Uniform	N/A	N/A	1	6	Length of time that any unit of ore is stored in in-pit stockpiles	Assumed	Waste Section 10.6.3.1 *Ore Leaching Load*
Plant_Uptime	[%]	Deterministic	N/A	Constant	91.26	N/A	N/A	N/A	Annual average percent of time the plant is running	Bateman Water Balance (June 2011)	Water Section 6.1.2 - *Beneficiation Plant*
Hydrometallurgical Plant											
Clean_H2O_Demand	[gpm]	Deterministic	N/A	Constant	124.9	N/A	N/A	N/A	Clean water demand from the hydrometallurgical process	RS13B, Attachment A-7, applying Plant_Uptime	Water Section 6.1.4 - *Hydrometallurgical Plant*
Total_H2O_Demand	[gal/yr]	Deterministic	N/A	Constant	2.342E+08	N/A	N/A	N/A	Total flow rate of water needed by the hydromet plant	Bateman Water Balance (June 2011)	Water Section 6.1.4 - *Hydrometallurgical Plant*
Process_H2O_Discharge	[gal/yr]	Deterministic	N/A	Constant	1.144E+08	N/A	N/A	N/A	Flow rate of water discharged from the hydromet process	Bateman Water Balance (June 2011)	Water Section 6.1.4 - *Hydrometallurgical Plant*
Other_H2O_Discharge	[gpm]	Deterministic	N/A	Constant	26.3	N/A	N/A	N/A	Flow rate of water discharged to the HRF from other water uses	RS13B, Attachment A-7, applying Plant_Uptime	Water Section 6.1.4 - *Hydrometallurgical Plant*
Solids_Discharge	[ton/yr]	Deterministic	N/A	Constant	3.342E+05	N/A	N/A	N/A	Flow rate of solids from the hydrometallurgical plant to the HRF	Residue Management Plan	Water Section 6.1.4 - *Hydrometallurgical Plant*

Table 1-1 **Input Variables for the Plant Site Model**

Variable Name	*Units*	*Deterministic/ Uncertain*	*Sampling/ Calculation Frequency*	*Distribution*	*Mean or Mode*	*Standard Deviation*	*Minimum*	*Maximum*	*Description*	*Source of Input Data*	*Modeling Package Section*
Flotation Tailings Basin Waste Water Treatment Plant											
Effluent_Perc_Influent	[%]	Deterministic	N/A	Constant	85	N/A	N/A	N/A	Percent of the influent flow to the FTB WWTP that is discharged to SD026 and SD006	Barr Memo, NorthMet Tailings Basin Water Treatment, August 2011	Water Section 6.1.3.6 - *FTB WWTP*
MaxFlow_SD026	[gpm]	Deterministic	N/A	Constant	500	N/A	N/A	N/A	Maximum flow to existing outfall SD026 from the FTB WWTP	Refined Embarrass Lake Wild Rice Mitigation Memo, June 2011	Water Section 6.1.3.6 - *FTB WWTP*
Backwash_Perc_Influent	[%]	Deterministic	N/A	Constant	5	N/A	N/A	N/A	Percent of the influent flow required for backwashing the greensand filter	Barr Memo, NorthMet Tailings Basin Water Treatment, August 2011	Water Section 6.1.3.6 - *FTB WWTP*
Effluent_Conc	[mg/L]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-43				Quality of the discharge from the Flotation Tailings Basin WWTP	Barr Memo, NorthMet Tailings Basin Water Treatment, August 2011	Water Section 6.1.3.6 - *FTB WWTP*
Fe_Backwash_Conc	[mg/L]	Deterministic	N/A	Constant	4	N/A	N/A	N/A	Iron concentration in the greensand filter backwash	Barr Memo, NorthMet Tailings Basin Water Treatment, August 2011	Water Section 6.1.3.6 - *FTB WWTP*
Mn_Backwash_Conc	[mg/L]	Deterministic	N/A	Constant	30	N/A	N/A	N/A	Manganese concentration in the greensand filter backwash	Barr Memo, NorthMet Tailings Basin Water Treatment, August 2011	Water Section 6.1.3.6 - *FTB WWTP*
K_Backwash_Conc	[mg/L]	Deterministic	N/A	Constant	11	N/A	N/A	N/A	Potassium concentration in the greensand filter backwash	Barr Memo, NorthMet Tailings Basin Water Treatment, August 2011	Water Section 6.1.3.6 - *FTB WWTP*
Pond_Treatment_Flow	[gpm]	Deterministic	N/A	Constant	2000	N/A	N/A	N/A	Flow rate from the pond into the treatment plant in closure	AWMMP	
Babbitt WWTP											
Babbitt_Flow	[cfs]	Deterministic	N/A	Constant	0.33	N/A	N/A	N/A	Flow from the Babbitt WWTP	RS74B	Water Section 4.4.2.2 - *Babbitt WWTP*
Area 5NW											
Area5_Summer	[cfs]	Uncertain	Timestep	Lognormal	2.127	1.798	N/A	N/A	Flow from Area 5NW during summer months	Analysis of measured flow data at SD033	Water Section 5.5.4 - *Pit 5NW (SD033) Discharge*
Area5_Winter	[cfs]	Uncertain	Timestep	Lognormal	1.177	0.888	N/A	N/A	Flow from Area 5NW during winter months	Analysis of measured flow data at SD033	Water Section 5.5.4 - *Pit 5NW (SD033) Discharge*
Area5_Snowmelt	[cfs]	Uncertain	Timestep	Uniform	N/A	N/A	0.774	7.271	Flow from Area 5NW during snowmelt months	Analysis of measured flow data at SD033	Water Section 5.5.4 - *Pit 5NW (SD033) Discharge*
Area5NW_Conc	[mg/L]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-44				Concentration of water that discharges from the Area 5NW Pit	RS74B	Water Section 5.3.5 - *Pit 5NW (SD033) Discharge*
Permeable Reactive Barrier											
PRB_Efficiency	[%/day]	Deterministic	N/A	Constant	Vector by constituent. Reference Table 1-45				Percent of mass removed in a 5-day test, divided by 5 days	Permeable Reactive Barrier Bench Test Report - Tailings Basin, September 2011	None

Table 1-1 **Input Variables for the Plant Site Model**

Variable Name	*Units*	*Deterministic/ Uncertain*	*Sampling/ Calculation Frequency*	*Distribution*	*Mean or Mode*	*Standard Deviation*	*Minimum*	*Maximum*	*Description*	*Source of Input Data*	*Modeling Package Section*
Groundwater Flow Path Characteristics											
HD	[m]	Deterministic	N/A	Constant	Vector by flowpath. Reference Table 1-46				Downstream water table elevation	GIS data/calculations	Water Section 5.4.2 - *Modeled Groundwater Flow Paths*
D	[m]	Deterministic	N/A	Constant	7	N/A	N/A	N/A	Aquifer thickness	Average thickness of the saturated material	Water Section 5.4.2 - *Modeled Groundwater Flow Paths*
La	[m]	Deterministic	N/A	Constant	Vector by flowpath. Reference Table 1-46				Total flow path length	GIS data/calculations	Water Section 5.4.2 - *Modeled Groundwater Flow Paths*
w	[m]	Deterministic	N/A	Constant	Vector by flowpath. Reference Table 1-46				Average flow path width	GIS data/calculations	Water Section 5.4.2 - *Modeled Groundwater Flow Paths*
Init_Grad	[--]	Deterministic	N/A	Constant	Vector by flowpath. Reference Table 1-46				Initial hydraulic gradient (determines flow capacity)	GIS data/calculations	Water Section 5.4.1.2 - *Groundwater Flow Paths*
Eval_Loc1	[m]	Deterministic	N/A	Constant	Vector by flowpath. Reference Table 1-46				Length from the upstream end to the first evaluation location on the flow path	GIS data/calculations	Water Section 5.4.2 - *Modeled Groundwater Flow Paths*
Recharge	[in/yr]	Uncertain	Realization	Triangular	0.6	N/A	0.3	1.5	Uniformly distributed recharge rate to the flow path	Most likely based on baseflow estimates, bounds based on using 1/2 the mode and 2.5 times the mode	Water Section 5.4.4.1 - *Recharge*
Perc_Flow_to_PM12_4	[%]	Deterministic	N/A	Constant	7.21	N/A	N/A	N/A	Percent of the groundwater flow path discharge that goes to PM-12.4; 0.44 mi2 / 6.10 mi2	CDF051	
Groundwater Flow Variables											
Surficial_Porosity	[--]	Deterministic	N/A	Constant	0.3	N/A	N/A	N/A	Porosity of the surficial aquifer	Assumed value, e.g. Fetter, 2001	Water Section 4.5.1 - *Water Quantity*
K_Surficial	[m/d]	Uncertain	Realization	Lognormal	4.0	1.6	N/A	N/A	Hydraulic Conductivity of the surficial aquifer	Mean based on aquifer tests, minimum value based on the limits of the recharge distribution	Water Section 4.3.2.2 - *Surficial Aquifer* & Section 5.4.4.1 - *Recharge*
Surficial_Density	$[kg/m^3]$	Deterministic	N/A	Constant	1,500	N/A	N/A	N/A	Dry (bulk) Density of the surficial deposits	USDA St. Louis County Soil Survey Database	Water Section 5.4.3 - *Sorption*
As_Kd	[L/kg]	Deterministic	N/A	Constant	25	N/A	N/A	N/A	Sorption coefficients for As in the surficial aquifer	EPA screening-level values	Water Section 5.4.3 - *Sorption*
Cu_Kd	[L/kg]	Deterministic	N/A	Constant	22	N/A	N/A	N/A	Sorption coefficients for Cu in the surficial aquifer	EPA screening-level values	Water Section 5.4.3 - *Sorption*
Ni_Kd	[L/kg]	Deterministic	N/A	Constant	16	N/A	N/A	N/A	Sorption coefficients for Ni in the surficial aquifer	EPA screening-level values	Water Section 5.4.3 - *Sorption*
Sb_Kd	[L/kg]	Uncertain	Realization	Triangular	1.6	N/A	1.3	6.1	Sorption coefficients for Sb in the surficial aquifer	EPA screening-level values	Water Section 5.4.3 - *Sorption*

Table 1-1 **Input Variables for the Plant Site Model**

Variable Name	*Units*	*Deterministic/ Uncertain*	*Sampling/ Calculation Frequency*	*Distribution*	*Mean or Mode*	*Standard Deviation*	*Minimum*	*Maximum*	*Description*	*Source of Input Data*	*Modeling Package Section*
Stream Reach Characteristics											
Flow_Control	[--]	Deterministic	N/A	Constant	Matrix, location by location. Reference Table 1-47				Controls which nodes contribute flow to other nodes	Surface water layout and stream order	Water Section 5.5 - *Surface Water Modeling*
XS_Area	[m^2]	Deterministic	N/A	Constant	Vector by location. Reference Table 1-48				Cross sectional area of each river reach	RS26 geomorphic surveys	Water Section 5.5 - *Surface Water Modeling*
Lengths	[m]	Deterministic	N/A	Constant	Vector by location. Reference Table 1-48				Incremental length upstream of each model node	GIS data	Water Section 5.5 - *Surface Water Modeling*
GW_Contr_Areas	[mi^2]	Deterministic	N/A	Constant	Vector by location. Reference Table 1-49				Un-impacted area contributing groundwater to the surface water evaluation nodes	GIS subwatersheds	Water Section 5.5 - *Surface Water Modeling*
Flowpath_Area	[mi^2]	Deterministic	N/A	Constant	Vector by location. Reference Table 1-49				Area of the modeled flow paths	GIS subwatersheds	Water Section 5.5 - *Surface Water Modeling*
SW_Contr_Areas	[mi^2]	Deterministic	N/A	Constant	Vector by location. Reference Table 1-49				Runoff contributing watershed area to each model node	GIS subwatersheds	Water Section 5.5 - *Surface Water Modeling*
FTBRO_Area	[mi^2]	Deterministic	N/A	Constant	Vector by location. Reference Table 1-49				Area of the FTB that runs off to the adjacent tributaries	GIS subwatersheds	Water Section 5.5 - *Surface Water Modeling*
Perc_NToe_MLC3	[%]	Deterministic	N/A	Constant	25	N/A	N/A	N/A	Percentage of the north toe surface seepage that travels to MLC-3 (the remainder goes to TC-1)	CDF051	
Stream Flow Variables											
Watershed_Yield	[cfs/mi^2]	Deterministic	Monthly	User-defined	User-defined Look-up Table by month. Reference Table 1-50				Randomly sampled daily total watershed yield as a function of month	USGS gage data	Water Section 5.5.2 - *Developing Probabilistic Model Inputs (Flow Distributions)*
Embarrass_Baseflow	[cfs/mi^2]	Deterministic	N/A	Constant	0.045	N/A	N/A	N/A	Baseflow added to Embarrass River nodes	Watershed wide average minimum 30-day flow	Water Section 4.4.1.3 - *Estimating Embarrass River Watershed Baseflow*
Model Initiation											
Initial_Mass_LTVSMC_Basin	[tonne]	Deterministic	N/A	Constant	Matrix by constituent and location. Reference Table 1-52				Initial mass of each constituent in each zone of existing Tailings Basin features	Average, steady-state results of the existing conditions GoldSim model	Water Section 5.9.1 - *Tailings Basin Initiation*
Initial_Mass_Rate	[kg/day]	Deterministic	N/A	Constant	Matrix by constituent and location. Reference Table 1-53				Initial rate at which constituent load is leaving areas of the existing Tailings Basin	Average, steady-state results of the existing conditions GoldSim model	Water Section 5.9.1 - *Tailings Basin Initiation*
Expected_Toe_Conc	[ug/L]	Deterministic	N/A	Constant	Matrix by constituent and location. Reference Table 1-54				Expected existing concentrations at the toes of the Tailings Basin to initiate groundwater concentrations	Average, steady-state results of the existing conditions GoldSim model	Water Section 5.9.2 - *Groundwater Flow Path Initiation*
AWMMP Mitigation Measures											
Mitigation_Evap_Cell2W	[--]	Uncertain	Annually	Normal	0.65	0.065	N/A	N/A	Fraction of precipitation that evaporates from the LTVSMC tailings in Cells 2W when the planted trees are fully mature	AWMMP	

Table 1-2 **Constant Surface Water Quality Standards (modeled constituents only)**

Constituent	*Surface_Constant_Standards (mg/L)*
Ag	0.001
Al	0.125
Alk	*999999*
As*	0.053
B	0.5
Ba	*999999*
Be	*999999*
Ca	*999999*
Cd†	*999999*
Cl	230
Co	0.005
Cr*	0.011
Cu†	*999999*
F	*999999*
Fe	*999999*
K	*999999*
Mg	*999999*
Mn	*999999*
Na	*999999*
Ni†	*999999*
Pb†	*999999*
Sb	0.031
Se*	0.005
SO_4 (non-wild rice areas)	*999999*
Tl	0.00056
V	*999999*
Zn†	*999999*

Notes

* From MN Rules 7052; all others from MN Rules 7050

** A value of 999999 indicates that there is no applicable standard

† See Table 1-4 for hardness-based standards

Table 1-3 Coefficients for Hardness-Dependent Surface Water Quality Standards (modeled constituents only)

Constituent	***A***	***B***
Cd*	0.7852	-2.715
Cu*	0.8545	-1.702
Ni*	0.846	0.0584
Pb	1.273	-4.705
Zn*	0.8473	0.884

<u>Notes</u>

Standard [mg/L] = exp(A*ln(total hardness [mg/L])+B)/1000

* From MN Rules 7052; all others from MN Rules 7050

$$Std\left({}^{mg}/_{L}\right) = \frac{e^{A\cdot\ln\left(Hardness\left({}^{mg}/_{L}\right)\right)+B}}{1000}$$

Table 1-4 Groundwater Quality Standards (modeled constituents only)

Constituent	*Ground_Primary_Standards** (mg/L)*	*Ground_Secondary_Standards** (mg/L)*
Ag*	0.03	0.1
Al†	*999999*	0.2
Alk	*999999*	*999999*
As	0.01	*999999*
B*	1	*999999*
Ba	2	*999999*
Be*	0.00008	*999999*
Ca	*999999*	*999999*
Cd*	0.004	*999999*
Cl	*999999*	250
Co	*999999*	*999999*
Cr	0.1	*999999*
Cu	*999999*	999999
F	4	2
Fe†	*999999*	0.3
K	*999999*	*999999*
Mg	*999999*	*999999*
Mn*†	0.1	0.05
Na	*999999*	*999999*
Ni*	0.1	*999999*
Pb	999999	*999999*
Sb	0.006	*999999*
Se*	0.03	*999999*
SO_4	*999999*	250
Tl*	0.0006	*999999*
V*	0.05	*999999*
Zn*	2	*5*

Notes

* Primary standard from MN Rules 4717 (HRLs); all others from MN Rules 7050 (EPA MCLs)

** A value of 999999 indicates that there is no applicable standard

† Secondary standards presented for reference but not used for impact assessment

Table 1-5 Average Background Groundwater Quality Distributions

Constituent	Source	Surficial Aquifer		
		GW_Alpha_Mean	GW_Beta	GW_Alpha_Stdev
Ag	All	-3.446	1.081	0.127
Al	All	2.859	1.673	0.208
Alk	All	11.170	0.774	0.093
As	Polymet	-0.788	0.485	0.111
B	Polymet	3.358	0.400	0.080
Ba	PolyMet	3.090	1.295	0.374
Be	Polymet	-1.832	0.886	0.177
Ca	All	9.876	0.976	0.116
Cd	Polymet*	-2.179	0.632	0.126
Cl	All	7.141	1.090	0.130
Co	Polymet	-1.952	0.876	0.253
Cr	All	-0.706	1.195	0.140
Cu	Polymet*	0.590	1.067	0.213
F	All	4.838	0.779	0.097
Fe	Polymet	3.682	0.740	0.174
K	All	7.188	0.974	0.116
Mg	All	9.023	0.937	0.111
Mn	Polymet*	4.898	1.581	0.316
Na	All	8.319	0.692	0.082
Ni	All	1.110	1.090	0.127
Pb	Polymet	-1.595	0.646	0.187
Sb	All	-2.878	1.761	0.260
Se	All	-0.344	0.853	0.126
SO_4	Polymet*	8.799	0.597	0.120
Tl	Polymet	-1.995	0.459	0.092
V	All	1.660	0.239	0.046
Zn	All	2.222	1.214	0.142

Notes

* Initially, the distribution (PolyMet Data or All Data) with the highest Mean was chosen. After further review, comparing the distribution to surfac runoff calibrations, the PolyMet groundwater data was chosen IF it provided a better calibration to surface water data. The distribution from All D chosen if the Mean from All data was lower than the Mean from the PolyMet data.

Table 1-6 Existing Surface Runoff Concentrations

Constituent	*RO_Mean (ug/L)*	*RO_StDev (ug/L)*
Ag	1.30E-01	1.3E-03
Al	1.11E+02	4.1E+01
Alk	3.24E+04	3.5E+04
As	1.04E+00	1.0E-02
B	1.56E+01	1.6E-01
Ba	1.77E+00	7.9E-01
Be	5.12E-02	5.1E-04
Ca	6.22E+03	2.2E+03
Cd	6.82E-02	1.6E-02
Cl	5.15E+03	3.3E+03
Co	6.19E-01	2.0E-01
Cr	9.81E-01	9.8E-01
Cu	5.65E-01	7.5E-01
F	7.66E+01	7.4E+01
Fe	2.32E+03	9.6E+02
K	2.86E+02	1.9E+02
Mg	3.34E+03	7.7E+02
Mn	4.22E+01	2.7E+02
Na	2.34E+03	9.5E+01
Ni	2.53E-01	2.5E-03
Pb	2.74E-01	3.8E-01
Sb	2.42E-01	2.4E-03
Se	6.09E-01	4.5E-01
SO_4	3.08E+03	1.6E+04
Tl	1.78E-01	5.0E-02
V	5.41E+00	5.4E-02
Zn	8.92E+00	5.9E+00

Notes

Surface water data not available for V; mean groundwater value assumed

Table 1-7 Initial Concentrations in the Embarrass River (mg/L)

Constituent	Embarrass River Evaluation Point (including tributaries of concern)										
	PM-12	*PM-12.2*	*PM-12.3*	*PM-12.4*	*PM-13*	*MLC-3*	*MLC-2*	*TC-1*	*PM-19*	*UC-1*	*PM-11*
Ag	**0.0001**	*0.0001*	*0.0001*	*0.0001*	**0.0001**	*0.0001*	**0.0001**	*0.0001*	**0.0001**	*0.0001*	**0.0001**
Al	**0.107**	*0.328*	*0.328*	*0.328*	**0.328**	*0.0125*	**0.0125**	*0.328*	*0.328*	*0.328*	*0.328*
Alk	**50.3**	*57.2*	*57.2*	*57.2*	**57.2**	*246*	**246**	*291*	**291**	*341*	**341**
As	**0.005**	*0.001*	*0.001*	*0.001*	**0.001**	*0.0008*	**0.0008**	*0.0013*	**0.0013**	*0.0005*	**0.0005**
B	**0.025**	*0.0443*	*0.0443*	*0.0443*	**0.0443**	*0.048*	**0.048**	*0.146*	**0.146**	*0.2605*	**0.2605**
Ba	**0.018**	*0.0304*	*0.0304*	*0.0304*	**0.0304**	*0.023*	**0.023**	*0.071*	**0.071**	*0.036*	**0.036**
Be	**0.0001**	*0.0001*	*0.0001*	*0.0001*	**0.0001**	*0.0001*	**0.0001**	*0.0001*	**0.0001**	*0.0001*	**0.0001**
Ca	**13.8**	*14.8*	*14.8*	*14.8*	**14.8**	*36.6*	**36.6**	*42.6*	**42.6**	*46.9*	**46.9**
Cd	**0.00001**	*0.00008*	*0.00008*	*0.00008*	**0.00008**	*0.00002*	**0.00002**	*0.00006*	**0.00006**	*0.00007*	**0.00007**
Cl	**3.84**	**3.28**	**3.8**	**4.07**	**4.57**	*11.3*	**11.3**	*12.56*	**12.56**	*18.2*	**18.2**
Co	**0.0005**	*0.0004*	*0.0004*	*0.0004*	**0.0004**	*0.0001*	**0.0001**	*0.0002*	**0.0002**	*0.0001*	**0.0001**
Cr	**0.0005**	*0.0007*	*0.0007*	*0.0007*	**0.0007**	*0.0005*	**0.0005**	*0.0005*	**0.0005**	*0.0005*	**0.0005**
Cu	**0.0006**	*0.001*	*0.001*	*0.001*	**0.001**	*0.0005*	**0.0005**	*0.0008*	**0.0008**	*0.0008*	**0.0008**
F	*0.724*	*0.724*	*0.724*	*0.724*	**0.724**	*0.23*	**0.23**	*0.724*	*0.724*	*0.724*	*0.724*
Fe	**2.15**	*1.29*	*1.29*	*1.29*	**1.29**	*1.3*	**1.3**	*1.123*	**1.123**	*0.276*	**0.276**
K	**1.11**	*2.12*	*2.12*	*2.12*	**2.12**	*2.53*	**2.53**	*2.99*	**2.99**	*7.23*	**7.23**
Mg	**5.4**	*11.52*	*11.52*	*11.52*	**11.52**	*35.6*	**35.6**	*36.15*	**36.15**	*75.8*	**75.8**
Mn	**0.184**	*0.107*	*0.107*	*0.107*	**0.107**	*0.157*	**0.157**	*0.14*	**0.14**	*0.102*	**0.102**
Na	**4.07**	*10.2*	*10.2*	*10.2*	**10.2**	*36.45*	**36.45**	*44.4*	**44.4**	*51*	**51**
Ni	**0.0012**	*0.0014*	*0.0014*	*0.0014*	**0.0014**	*0.0003*	**0.0003**	*0.0013*	**0.0013**	*0.0014*	**0.0014**
Pb	**0.00008**	*0.00022*	*0.00022*	*0.00022*	**0.00022**	*0.00006*	**0.00006**	*0.00015*	**0.00015**	*0.00016*	**0.00016**
Sb	*0.0015*	*0.0015*	*0.0015*	*0.0015*	**0.0015**	*0.0015*	*0.0015*	*0.0015*	*0.0015*	*0.0015*	*0.0015*
Se	**0.00009**	*0.0005*	*0.0005*	*0.0005*	**0.0005**	*0.0003*	**0.0003**	*0.0006*	**0.0006**	*0.0006*	**0.0006**
SO_4	**1.05**	**87.5**	**20.4**	**17.6**	**16.5**	*23.5*	**23.5**	*10.7*	**10.7**	*138.8*	**138.8**
Tl	**0.0001**	*0.0002*	*0.0002*	*0.0002*	**0.0002**	*0.000001*	**0.000001**	*0.0001*	**0.0001**	*0.0001*	**0.0001**
V*	*0.0054*	*0.0054*	*0.0054*	*0.0054*	*0.0054*	*0.0054*	*0.0054*	*0.0054*	*0.0054*	*0.0054*	*0.0054*
Zn	**0.003**	*0.0033*	*0.0033*	*0.0033*	**0.0033**	*0.003*	**0.003**	*0.003*	**0.003**	*0.003*	**0.003**

Notes

Source: Surface water monitoring, mean values from the most recent year of available data (bold values)

* Surface water data not available for V, mean groundwater value assumed

For unavailable data (data in italics), the nearest downstream value was assumed

Table 1-8 Flow Rates from the Mine Site WWTF (Results Pending)

Time (yrs)	*MineSite_Flow_Mean (gpm)*	*MineSite_Flow_StDev (gpm)*
0	419	69
1	513	80
2	599	95
3	716	114
4	810	119
5	943	149
6	1002	156
7	1024	163
8	1080	164
9	1162	186
10	1221	190
11	344	176
12	913	179
13	1208	189
14	1217	186
15	106	19
16	0	0
17	5	0
18	26	27
19	79	103
20	0	0
500	0	0

Notes

Source: Mine Site probabilistic water quality model

Table 1-9 MineSite_Mean_Conc, Mean Concentration in the Water from the Mine Site WWTF (mg/L), (Pending Model Results)

	Time (yrs)																					
Constituent	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***	***14***	***15***	***16***	***17***	***18***	***19***	***20***	***500***
Ag	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Al	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
Alk	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
As	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
B	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Ba	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Be	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Ca	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Cd	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Cl	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230
Co	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Cr	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
Cu	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
F	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Fe	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
K	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Mg	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Mn	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Na	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Ni	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Pb	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
Sb	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
Se	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
SO_4	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
Tl	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056	0.00056
V	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Zn	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388

Notes

Source: Mine Site probabilistic water quality model
Input Name in Model: MineSite_Mean_Conc

Table 1-10 MineSite_StDev_Conc, Standard Deviation of the Concentration in the Water from the Mine Site CPS (mg/L), (Pending Model Results)

	Time (yrs)																					
Constituent	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***	***14***	***15***	***16***	***17***	***18***	***19***	***20***	***500***
Ag	0.0000882	0.000136	0.000116	0.0000905	0.000107	0.000126	0.0000968	0.0000234	0	0	0	0	0	0	0	0	0	0	0	0.000014	0.0000968	0
Al	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alk	3550	7.73	7.73	7.57	7.57	7.73	7.41	7.33	7.41	7.49	7.49	6.01	6.63	7.73	7.65	6.01	6.16	6.24	6.48	6.71	11000	0
As	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	0.0476	0.0447	0.0488	0.0557	0.0501	0.0422	0.039	0.0378	0.0367	0.0339	0.0324	0.0289	0.0156	0.0117	0.012	0.0139	0.0179	0.0164	0.0148	0.0115	0.0975	0
Ba	0.0133	0.0115	0.013	0.015	0.0133	0.0115	0.0107	0.0106	0.0101	0.0096	0.00936	0.0078	0.00218	0.00195	0.00195	0.00211	0.00265	0.00258	0.00258	0.00289	0	0
Be	0.000759	0.000872	0.0009	0.000939	0.000916	0.000876	0.000895	0.000942	0.000919	0.000932	0.000923	0.000577	0.000414	0.000367	0.00039	0.000492	0.000468	0.000421	0.000359	0.000235	0.000929	0
Ca	13.2	12.3	12.1	12.2	11.7	11.2	10.7	10.3	9.83	9.6	9.44	10.1	10.5	11.1	11.2	11.6	11.7	11.8	11.8	11.9	12.2	0
Cd	0.0000234	0.0000312	0.0000156	0.0000078	0.0000156	0.0000156	0.0000156	0	0	0	0	0.000039	0.0000468	0.0000468	0.0000546	0.000078	0.0000936	0.000125	0.000211	0.000484	0	0
Cl	13.2	30.1	29.4	22.5	19.1	19.6	14.2	17.7	15.1	12.9	10.1	22.1	12.5	0	0	5.23	6.78	7.02	7.06	3.27	0.057	0
Co	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cr	0.00223	0.00229	0.0022	0.00204	0.002	0.00211	0.00197	0.00198	0.002	0.00204	0.00205	0.000991	0.000538	0.000406	0.000382	0.000554	0.000609	0.000593	0.000601	0.000609	0	0
Cu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	0.101	0.195	0.179	0.179	0.172	0.161	0.147	0.143	0.12	0.13	0.119	0.0858	0.0936	0.0702	0.0702	0.101	0.0858	0.0858	0.078	0.0858	0.226	0
Fe	0.00078	0.00156	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	2980	5.93	5.85	5.31	4.92	4.53	4.53	4.45	4.21	3.9	3.9	3.75	4.68	4.21	4.21	3.75	4.21	4.29	4.29	4.45	26.8	0
Mg	8.12	7.57	7.41	7.49	7.1	6.79	6.48	6.24	6.01	5.77	5.77	6.16	6.4	6.79	6.79	7.02	7.1	7.1	7.18	7.26	7.45	0
Mn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Na	12600	36.2	38.4	38.8	40	38.8	40.1	38.9	33.9	31.4	29.3	40.6	46	52.3	49.2	41.4	47.1	46	46	48.4	108	0
Ni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pb	0.00164	0.00289	0.00242	0.00179	0.00211	0.00273	0.0025	0.00133	0.000624	0.000468	0.00039	0.000546	0.000702	0.000858	0.00078	0.00039	0.000312	0.000468	0.00101	0.00336	0.00495	0
Sb	0.00039	0.000234	0.000156	0.000078	0.000156	0.000156	0	0	0	0	0	0	0	0	0	0	0	0.000234	0.000858	0.00187	0.00078	0
Se	0.0000078	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0000234	0.0000546	0.0000936	0.000226	0.000679	0.00136	0
SO_4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.34	4.68	0	0
Tl	0.000101	0.000122	0.000119	0.000128	0.000131	0.000124	0.000137	0.000115	0.0000991	0.0000929	0.0000874	0.0001	0.000108	0.00011	0.000108	0.000112	0.000101	0.0000975	0.0000858	0.0000741	0.0000799	0
V	0.00398	0.00384	0.00413	0.00414	0.00375	0.00322	0.00332	0.00339	0.00289	0.00273	0.00265	0.00179	0.00101	0.000858	0.000936	0.000936	0.000936	0.000858	0.00078	0.000702	0.0112	0
Zn	0.00234	0.0039	0.00234	0.00156	0.00234	0.00312	0.00234	0.00078	0	0	0	0.00468	0.00312	0.0039	0.0039	0.00936	0.0117	0.0164	0.0297	0.0616	0	0

Notes

Source: Mine Site probabilistic water quality model

Input Name in Model: MineSite_StDev_Conc

Table 1-11 **Function Coefficients to Determine Van Genuchten Parameters**

	Coefficient			
Parameter	***mm***	***bm***	***mb***	***bb***
Ksat_Coeff (cm/s)	2.793	2.4585	-3.6293	-3.1175
ResMoist_Coeff (cm^3/cm^3)	-0.2417	0.0543	0.1173	-0.0155
AirSuct_Coeff (1/cm)	0.002036	0.008121	-0.015927	0.010728
VGBeta_Coeff (--)	-31.3442	8.6015	14.6871	-1.4748

Notes

Source: NorthMet Project, Waste Characterization Data Package, Section 10.3 Saturation and Oxygen Diffusion

$$\log(K_{sat}) = m_m(F)(\theta) + b_m(\theta) + m_b(F) + b_b$$

$$\alpha, \beta, \theta_r = m_m(F)(\theta) + b_m(\theta) + m_b(F) + b_b$$

Table 1-12a Hydraulic Properties of Different Classes of the LTVSMC Tailings

		Tailings Class		
Parameter	***Units***	***Coarse***	***Fine***	***Bulk (Other)***
LTVSMC_SG*	*(--)*	2.80	2.90	2.85
LTVSMC_Porosity*	*(cm^3/cm^3)*	0.412	0.493	0.440
LTVSMC_Ksat*	*(cm/s)*	SEE TABLE 1-12b	SEE TABLE 1-12b	8.02E-05
LTVSMC_ResMoist*	*(cm^3/cm^3)*	0.041	0.059	0.048
LTVSMC_AirSuct†	*(1/cm)*	0.024	0.001	0.011
LTVSMC_VGBeta†	*(--)*	2.0	1.6	2.0

Notes

* Source: Unsaturated modeling by the geotechnical group

† Source: Fit to data from the geotechnical group

Table 1-12b Saturated Conductivity of LTVSMC Tailings in Each Cell*

		Tailings Class		
Cell	***Units***	***Coarse***	***Fine***	***Bulk (Other)***
Cell 1E	*(cm/s)*	2.40E-03	2.75E-05	SEE TABLE 1-12a
Cell 2E	*(cm/s)*	2.24E-03	8.71E-05	SEE TABLE 1-12a
Cell 2W	*(cm/s)*	1.17E-03	1.10E-04	SEE TABLE 1-12a

Notes

* Source: Calibrated MODFLOW model of existing conditions

Table 1-13 Distribution Parameters for Flotation Fine Tailings Release

Distribution Fit to Humidity Cell Data

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Ca	SO_4 rate ratio	HCT	mg Ca / mg SO_4	Beta	1.18E+00	3.03E-01	8.17E-01	3.46E+00
K	SO_4 rate ratio	HCT	mg K / mg SO_4	Beta	2.63E-01	6.37E-02	1.71E-01	7.51E-01
Mg	SO_4 rate ratio	HCT	mg Mg / mg SO_4	Beta	2.18E-01	4.69E-02	1.62E-01	7.94E-01
Mn	Ni rate ratio	HCT	mg Mn / mg Ni	Beta	4.68E+00	2.08E+00	2.07E+00	9.31E+00
Na	SO_4 rate ratio	HCT	mg Na / mg SO_4	Beta	8.20E-02	1.77E-02	6.03E-02	2.64E-01
Se	SO_4 rate ratio	HCT	mg Se / mg SO_4	Beta	1.79E-05	5.29E-06	1.29E-05	6.09E-05
SO_4	Rate	HCT	mg SO_4/kg/week	Beta	5.97E+00	2.09E+00	3.57E+00	1.96E+01

Distribution Fit to Aqua Regia Data

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Ag	S ratio	Aqua Regia	mg Ag / mg S	Beta	1.54E-04	1.49E-05	1.35E-04	2.54E-04
As	S ratio	Aqua Regia	mg As / mg S	Beta	1.96E-03	2.53E-04	1.67E-03	4.89E-03
Ba	K ratio	Aqua Regia	mg Ba / mg K	Beta	2.66E-02	1.27E-03	1.83E-02	3.06E-02
Be	K ratio	Aqua Regia	mg Be / mg K	Beta	1.03E-04	1.51E-05	8.13E-05	2.32E-04
Cu	S ratio	Aqua Regia	mg Cu / mg S	Beta	9.30E-02	1.46E-02	5.29E-02	1.46E-01
Pb	S ratio	Aqua Regia	mg Pb / mg S	Beta	2.67E-03	6.16E-04	1.93E-03	9.32E-03
Sb	S ratio	Aqua Regia	mg Sb / mg S	Beta	1.08E-04	3.50E-05	6.67E-05	1.99E-04
Tl	S ratio	Aqua Regia	mg Tl / mg S	Beta	7.15E-05	7.35E-06	5.97E-05	1.41E-04
V	K ratio	Aqua Regia	mg V / mg K	Beta	2.53E-02	2.61E-03	7.01E-03	3.17E-02

Distribution Fit to Waste Rock Humidity Cell Data

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Cd	Zn rate ratio	2/3 HCT (2)	mg Cd / mg Zn	Beta	1.65E-02	1.20E-02	1.01E-03	5.84E-02
Co	Ni rate ratio	2/3 HCT (2)	mg Co / mg Ni	Beta	8.29E-02	3.91E-02	2.24E-02	2.06E-01
Zn	Ni rate ratio	2/3 HCT (2)	mg Zn / mg Ni	Beta	3.35E-01	3.70E-01	3.31E-02	1.60E+00

Distribution Fit to Microprobe Data or Mineral Formula

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Al	Ca ratio	Anorthite Formula	mg Al / mg Ca	Constant	1.35E+00	--	--	--
	Na ratio	Albite Formula	mg Al / mg Na	Constant	1.17E+00	--	--	--
Fe	S ratio	Pyrrhotite microprobe	mg Fe / mg S	Beta	1.62E+00	8.72E-02	1.49E+00	1.92E+00
	Mg ratio	Olivine microprobe	mg Fe / mg Mg	Beta	1.87E+00	6.75E-01	1.19E+00	4.51E+00
Ni	S ratio	Pyrrhotite microprobe	mg Ni / mg S	Beta	5.63E-03	6.65E-03	5.65E-04	4.00E-02

Distribution From Defined Concentration Cap

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Cl	No release	N/A	mg/L	Constant	0	--	--	--
B	Cap	Whistle Mine	mg/L	Constant	1.00E-01	--	--	--
Cr	Cap	Whistle Mine	mg/L	Constant	1.00E-02	--	--	--

Notes

- HCT indicates average rates from tailings humidity cells over the entire testing period.
- Aqua Regia indicates ratios from whole tailings testing.
- Cat 2/3 HCT (2) indicates average rates from Category 2/3 humidity cells over Condition 2, as defined in Large Table 1.
- All distributions from humidity cell data and aqua regia data represent the full range of the observed values, with no weighting. Distributions are shown in Large Figure 42 to Large Figure 45.
- Distributions from microprobe data represent the full range of the observed ratios for each mineral, with no weighting. Distributions are shown in Large Figure 21 and Large Figure 22.
- Constituents not shown above are modeled according to the mineral solubility methods described in Section 10.1.1.

Table 1-14 Distribution Parameters for Flotation Coarse Tailings Release

Distribution Fit to Humidity Cell Data

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Ca	SO_4 rate ratio	HCT	mg Ca / mg SO_4	Beta	9.58E-01	3.34E-01	3.00E-01	1.60E+00
K	SO_4 rate ratio	HCT	mg K / mg SO_4	Beta	2.60E-01	8.16E-02	0.00E+00	4.91E-01
Mg	SO_4 rate ratio	HCT	mg Mg / mg SO_4	Beta	1.82E-01	3.32E-02	9.68E-02	5.46E-01
Mn	Ni rate ratio	HCT	mg Mn / mg Ni	Beta	3.37E+00	1.32E+00	1.80E+00	1.00E+01
Na	SO_4 rate ratio	HCT	mg Na / mg SO_4	Beta	6.86E-02	2.40E-02	3.58E-02	2.57E-01
Se	SO_4 rate ratio	HCT	mg Se / mg SO_4	Beta	1.75E-05	3.51E-06	0.00E+00	2.41E-05
SO_4	Rate	HCT	mg SO_4/kg/week	Beta	5.47E+00	1.44E+00	3.71E+00	2.41E+01

Distribution Fit to Aqua Regia Data

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Ag	S ratio	Aqua Regia	mg Ag / mg S	Beta	2.05E-04	3.41E-05	1.42E-04	5.45E-04
As	S ratio	Aqua Regia	mg As / mg S	Beta	1.82E-03	3.31E-04	9.17E-04	5.09E-03
Ba	K ratio	Aqua Regia	mg Ba / mg K	Beta	2.74E-02	1.81E-03	2.01E-02	4.02E-02
Be	K ratio	Aqua Regia	mg Be / mg K	Beta	9.77E-05	9.41E-06	5.71E-05	1.53E-04
Cu	S ratio	Aqua Regia	mg Cu / mg S	Beta	2.11E-01	5.25E-02	2.95E-03	7.00E-01
Pb	S ratio	Aqua Regia	mg Pb / mg S	Beta	2.88E-03	7.68E-04	1.18E-03	1.08E-02
Sb	S ratio	Aqua Regia	mg Sb / mg S	Beta	1.10E-04	3.06E-05	5.45E-05	2.50E-04
Tl	S ratio	Aqua Regia	mg Tl / mg S	Beta	9.44E-05	1.27E-05	6.67E-05	1.86E-04
V	K ratio	Aqua Regia	mg V / mg K	Beta	1.81E-02	2.66E-03	1.81E-03	3.00E-02

Distribution Fit to Waste Rock Humidity Cell Data

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Cd	Zn rate ratio	2/3 HCT (2)	mg Cd / mg Zn	Beta	1.65E-02	1.20E-02	1.01E-03	5.84E-02
Co	Ni rate ratio	2/3 HCT (2)	mg Co / mg Ni	Beta	8.29E-02	3.91E-02	2.24E-02	2.06E-01
Zn	Ni rate ratio	2/3 HCT (2)	mg Zn / mg Ni	Beta	3.35E-01	3.70E-01	3.31E-02	1.60E+00

Distribution Fit to Microprobe Data or Mineral Formula

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Al	Ca ratio	Anorthite Formula	mg Al / mg Ca	Constant	1.35E+00	--	--	--
	Na ratio	Albite Formula	mg Al / mg Na	Constant	1.17E+00	--	--	--
Fe	S ratio	Pyrrhotite microprobe	mg Fe / mg S	Beta	1.62E+00	8.72E-02	1.49E+00	1.92E+00
	Mg ratio	Olivine microprobe	mg Fe / mg Mg	Beta	1.87E+00	6.75E-01	1.19E+00	4.51E+00
Ni	S ratio	Pyrrhotite microprobe	mg Ni / mg S	Beta	5.63E-03	6.65E-03	5.65E-04	4.00E-02

Distribution From Defined Concentration Cap

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Cl	No release	N/A	mg/L	Constant	0	--	--	--
B	Cap	Whistle Mine	mg/L	Constant	1.00E-01	--	--	--
Cr	Cap	Whistle Mine	mg/L	Constant	1.00E-02	--	--	--

Notes
- HCT indicates average rates from tailings humidity cells over the entire testing period.
- Aqua Regia indicates ratios from whole tailings testing.
- Cat 2/3 HCT (2) indicates average rates from Category 2/3 humidity cells over Condition 2, as defined in Large Table 1.
- All distributions from humidity cell data and aqua regia data represent the full range of the observed values, with no weighting. Distributions are shown in Large Figure 46 to Large Figure 49.
- Distributions from microprobe data represent the full range of the observed ratios for each mineral, with no weighting. Distributions are shown in Large Figure 21 and Large Figure 22.
- Constituents not shown above are modeled according to the mineral solubility methods described in Section 10.1.1.

Table 1-15 **Category 1 Concentration Cap Distributions (Applied to the NorthMet Flotation Tailings and Buttress)**

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Ag	Limit	Dunka Seep	mg/L	Constant	0.0002	N/A	N/A	N/A
Al	Function pH (Solubility equation)		mg/L		N/A	N/A	N/A	N/A
Alkalinity	Function pH (AMAX data)		mg/L		N/A	N/A	N/A	N/A
As	Limit	Whistle Mine	mg/L	Constant	0.1	N/A	N/A	N/A
B	Limit	Whistle Mine	mg/L	Constant	0.1	N/A	N/A	N/A
Ba	Solubility equation				N/A	N/A	N/A	N/A
Be	Limit	Dunka Seep	mg/L	Constant	0.0004	N/A	N/A	N/A
Ca	Solubility equation				N/A	N/A	N/A	N/A
Cd	Function Zn limit, Cd/Zn release ratio				N/A	N/A	N/A	N/A
Cl	No limit				N/A	N/A	N/A	N/A
Co	Function pH (AMAX data)				N/A	N/A	N/A	N/A
Cr	Limit	Whistle Mine	mg/L	Constant	0.01	N/A	N/A	N/A
Cu	Function pH (AMAX data)				N/A	N/A	N/A	N/A
F	Solubility equation				N/A	N/A	N/A	N/A
Fe	Function pH (AMAX data)		mg/L		N/A	N/A	N/A	N/A
K	Function pH (AMAX data)		mg/L		N/A	N/A	N/A	N/A
Mg	Function Ca limit, Mg/Ca release ratio				N/A	N/A	N/A	N/A
Mn	Function pH (AMAX data)		mg/L		N/A	N/A	N/A	N/A
Na	Function pH (AMAX data)		mg/L		N/A	N/A	N/A	N/A
Ni	Function pH (AMAX data)		mg/L		N/A	N/A	N/A	N/A
Pb	Limit	Whistle Mine	mg/L	Constant	0.1	N/A	N/A	N/A
Sb	Limit	NorthMet Lab	mg/L	Uniform	N/A	N/A	0.0083	0.1
Se	Function SO4 limit, Se/SO4 release ratio				N/A	N/A	N/A	N/A
SO4	Solubility equation				N/A	N/A	N/A	N/A
Tl	Limit	Dunka Seep	mg/L	Constant	0.0002	N/A	N/A	N/A
V	Limit	Whistle Mine	mg/L	Constant	0.01	N/A	N/A	N/A
Zn	Function pH (AMAX data)		mg/L		N/A	N/A	N/A	N/A

N/A = not used

pH-based Range from AMAX Data
(95th percentile values, all units mg/L)

pH	Alkalinity	Co	Cu	Fe	K	Mn	Na	Ni	Zn
7.0	2.60E+01	2.80E-01	5.20E-01	4.00E-02	3.99E+01	3.08E-01	1.32E+02	5.91E+00	4.05E-01
7.1	3.45E+01	2.33E-01	2.85E-01	7.50E-02	4.61E+01	3.86E-01	1.38E+02	4.31E+00	2.93E-01
7.2	3.55E+01	1.36E-01	1.78E-01	1.01E-01	4.28E+01	1.75E-01	1.73E+02	2.08E+00	1.70E-01
7.3	3.59E+01	9.30E-02	2.00E-01	5.00E-02	5.04E+01	2.00E-01	2.31E+02	1.62E+00	1.33E-01
7.4	4.92E+01	7.00E-02	9.68E-02	4.20E-02	4.28E+01	1.72E-01	2.19E+02	1.28E+00	7.00E-02
7.5	4.82E+01	5.00E-02	1.00E-01	4.00E-02	4.60E+01	2.27E-01	2.18E+02	9.05E-01	9.64E-02
7.6	5.07E+01	4.00E-02	1.54E-01	7.75E-02	4.72E+01	2.10E-01	3.10E+02	4.55E-01	1.19E-01
7.7	4.50E+01	4.36E-02	1.23E-01	6.35E-02	4.37E+01	3.19E-01	4.68E+02	4.85E-01	1.15E-01
7.8	4.20E+01	6.00E-02	1.31E-01	5.50E-02	3.95E+01	2.05E-01	3.70E+02	3.75E-01	6.50E-02
7.9	4.00E+01	7.58E-02	5.73E-02	3.80E-02	4.80E+01	2.88E-01	3.90E+02	5.26E-01	8.88E-02
8.0	4.50E+01	1.00E-02	2.00E-02	2.00E-02	4.30E+01	1.40E-01	1.15E+02	2.00E-01	5.20E-02
8.1	5.00E+01	3.00E-02	3.00E-02	2.00E-02	4.00E+01	1.40E-01	2.40E+02	3.60E-01	2.00E-02

pH-based Range from AMAX Data
(maximum values, all units mg/L)

pH	Alkalinity	Co	Cu	Fe	K	Mn	Na	Ni	Zn
7.0	4.30E+01	6.20E-01	2.30E+00	4.00E-02	4.30E+01	3.80E-01	2.60E+02	1.30E+01	5.50E-01
7.1	4.10E+01	3.10E-01	7.50E-01	8.00E-02	4.80E+01	9.70E-01	5.91E+02	7.02E+00	3.70E-01
7.2	4.50E+01	1.50E-01	3.40E-01	7.00E-01	4.43E+01	2.40E-01	2.00E+02	3.42E+00	2.30E-01
7.3	3.60E+01	1.20E-01	2.60E-01	6.00E-02	5.90E+01	3.00E-01	2.60E+02	2.29E+00	2.30E-01
7.4	5.40E+01	8.00E-02	1.80E-01	6.00E-02	5.32E+01	1.90E-01	3.22E+02	1.35E+00	1.12E-01
7.5	5.27E+01	5.00E-02	1.30E-01	7.00E-02	6.00E+01	2.40E-01	3.13E+02	1.70E+00	1.00E-01
7.6	5.90E+01	6.00E-02	1.90E-01	2.10E-01	5.20E+01	2.30E-01	3.39E+02	1.07E+00	1.34E-01
7.7	5.10E+01	5.20E-02	1.31E-01	7.00E-02	5.00E+01	3.40E-01	5.55E+02	5.90E-01	1.20E-01
7.8	5.90E+01	7.00E-02	1.70E-01	6.00E-02	4.00E+01	2.40E-01	3.72E+02	4.20E-01	7.00E-02
7.9	4.00E+01	9.00E-02	6.00E-02	4.00E-02	4.90E+01	2.90E-01	3.95E+02	5.65E-01	9.00E-02
8.0	5.50E+01	1.00E-02	2.00E-02	2.00E-02	4.30E+01	1.40E-01	1.15E+02	2.00E-01	5.20E-02
8.1	7.00E+01	4.00E-02	4.00E-02	6.00E-02	4.60E+01	1.60E-01	3.17E+02	4.60E-01	2.50E-02

Notes
- All distributions from Whistle Mine data represent the detection limit used for nonacidic conditions.
- All distributions from Vangorda Mine data represent the highest observed concentration under acidic conditions.
- All distributions from AMAX data represent a uniform distribution between the 95th percentile and maximum observed value at the referenced pH for AMAX piles with 0.64% S. Data for pH values above 7.5 are used for Flotation Tailings as discussed in Section 10.4 (not for Category 1 waste rock).
- Concentration caps for all constituents not shown are calculated from the equations shown in Section 8.3.1.
- Distributions shown as constant indicate zero detections in the referenced data set, the detection limit is set as the concentration cap.

Table 1-16 Flotation Tailings Constituent Content

Constituent	***Units***	***NM_Content.Coarse_Content***	***NM_Content.Fine_Content***	***Buttress_Content***
Ag	mg/kg	1.86E-01	2.13E-01	1.35E-01
Al	mg/kg	3.56E+04	3.60E+04	4.07E+04
Alkalinity*	mg/kg	1.00E+20	1.00E+20	1.00E+20
As	mg/kg	2.43E+00	2.19E+00	2.47E+00
B	mg/kg	5.00E+00	5.00E+00	7.94E+00
Ba	mg/kg	4.86E+01	5.36E+01	4.07E+01
Be	mg/kg	1.87E-01	1.84E-01	2.43E-01
Ca	mg/kg	2.04E+04	1.98E+04	2.22E+04
Cd	mg/kg	6.29E-02	6.50E-02	4.19E-01
Cl*	mg/kg	1.00E+20	1.00E+20	1.00E+20
Co	mg/kg	5.51E+01	4.56E+01	4.83E+01
Cr	mg/kg	1.08E+02	9.89E+01	1.01E+02
Cu	mg/kg	1.10E+02	2.22E+02	2.15E+02
F*	mg/kg	1.00E+20	1.00E+20	1.00E+20
Fe	mg/kg	6.78E+04	5.39E+04	6.17E+04
K	mg/kg	1.83E+03	1.94E+03	1.40E+03
Mg	mg/kg	4.08E+04	3.30E+04	4.00E+04
Mn	mg/kg	7.52E+02	6.02E+02	7.01E+02
Na	mg/kg	4.53E+03	4.69E+03	5.80E+03
Ni	mg/kg	2.89E+02	2.46E+02	2.55E+02
Pb	mg/kg	3.39E+00	3.21E+00	2.45E+00
Sb	mg/kg	1.29E-01	1.21E-01	1.34E+00
Se	mg/kg	5.20E-01	4.30E-01	1.00E+20
S	mg/kg	1.21E+03	1.05E+03	1.90E+03
Tl	mg/kg	8.86E-02	1.00E-01	4.78E+00
V	mg/kg	4.54E+01	3.47E+01	3.32E+01
Zn	mg/kg	7.04E+01	5.79E+01	6.83E+01

Notes

* Whole tailings content data not available. A high value of 1e20 ppm is used.

Table 1-17 Weathering Rates from the NorthMet Tailings

Constituent	*NM_Tailings_Weathering.Coarse_Weathering (mg/m^2/month)*	*NM_Tailings_Weathering.Fines_Weathering (mg/m^2/month)*
Ag	0.003	0.003
Al	7.1	7.5
Alk (as CaCO3)	2400	2500
As	2	0.096
B	2.1	1.8
Ba	0.12	0.14
Be	0.012	0.012
Ca	940	1100
Cd	0.0024	0.0024
Cl	26	25
Co	0.009	0.011
Cr	0.016	0.018
Cu	0.23	0.17
F	2.9	3
Fe	1.2	2
K	230	240
Mg	210	190
Mn	0.71	0.8
Na	75	67
Ni	0.16	0.15
Pb	0.012	0.0094
Sb	0.28	0.25
Se	0.014	0.013
SO_4	1000	1600
Tl	0.0016	0.0012
V*	0	0
Zn	0.11	0.11

Notes

Data is from RS-46 (Waste Water Modeling - Tailings NorthMet Project; July 20, 2007)

* No data available for V, weathering load assumed to be zero

Table 1-18 Dissolved Oxygen Concentration in the FTB Pond

Month	*Distribution*	*Pond_DO_Mean (mg/L)*	*Pond_DO_SD (mg/L)*
January	Normal	14.2	0
February	Normal	14.2	0
March	Normal	14.2	0
April	Normal	13.5	0.5
May	Normal	11.4	0.5
June	Normal	10.2	0.5
July	Normal	9.7	0.5
August	Normal	9.9	0.5
September	Normal	11	0.5
October	Normal	13.1	0.5
November	Normal	14.2	0
December	Normal	14.2	0

Table 1-19 Distribution Parameters for LTVSMC Tailings Release

Distribution Fit to Humidity Cell Data

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Se	SO_4 rate ratio	HCT	mg Se / mg SO_4	Beta	7.22E-05	4.63E-05	3.04E-05	3.04E-04
SO_4	Rate	HCT	mg SO_4/kg/week	Beta	1.87E+00	5.02E-01	8.13E-01	2.54E+00
Zn	SO_4 rate ratio	HCT	mg Zn / mg SO_4	Beta	5.32E-05	9.20E-06	4.28E-05	8.33E-05

Distribution Fit to Aqua Regia Data

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Ag	S ratio	Aqua Regia	mg Ag / mg S	Beta	1.85E-04	1.51E-04	3.47E-05	1.99E-03
As	S ratio	Aqua Regia	mg As / mg S	Beta	1.11E-01	5.43E-02	2.85E-02	8.75E-01
Cd	S ratio	Aqua Regia	mg Cd / mg S	Beta	7.69E-05	6.83E-05	8.21E-06	4.62E-03
Co	S ratio	Aqua Regia	mg Co / mg S	Beta	4.10E-02	3.17E-02	9.94E-03	3.75E-01
Cu	S ratio	Aqua Regia	mg Cu / mg S	Beta	4.26E-02	3.66E-02	7.95E-03	7.00E-01
Ni	S ratio	Aqua Regia	mg Ni / mg S	Beta	1.71E-02	1.10E-02	3.46E-03	1.92E-01
Pb	S ratio	Aqua Regia	mg Pb / mg S	Beta	6.66E-03	3.95E-03	1.12E-03	4.17E-02
Sb	S ratio	Aqua Regia	mg Sb / mg S	Beta	3.44E-04	2.34E-04	8.93E-05	2.92E-03
Tl	S ratio	Aqua Regia	mg Tl / mg S	Beta	9.04E-05	7.48E-05	1.95E-05	8.33E-04

Distribution Fit to Microprobe Data

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Fe	S ratio	Pyrite microprobe	mg Fe / mg S	Beta	8.85E-01	1.36E-02	8.50E-01	9.06E-01

Distribution Fit to Observed Seepage Data

Constituent	Method	Source	Units	Distribution	Mean/Mode	St. Dev.	Minimum	Maximum
Al	Cap	Well Data	mg/L	Uniform	--	--	5.00E-03	2.50E-02
B	Cap	Well Data	mg/L	Trunc. Normal	5.14E-01	7.0E-02	0.00E+00	1.00E+10
Be	Cap	Well Data	mg/L	Uniform	--	--	1.00E-04	2.50E-04
Ca	Cap	Well Data	mg/L	Trunc. Normal	1.17E+02	1.7E+01	0.00E+00	1.00E+10
Cl	Cap	Well Data	mg/L	Trunc. Normal	2.24E+01	1.8E+00	0.00E+00	1.00E+10
Cr	Cap	Well Data	mg/L	Trunc. Normal	5.99E-04	1.4E-04	0.00E+00	1.00E+10
K	Cap	Well Data	mg/L	Trunc. Normal	1.03E+01	2.1E+00	0.00E+00	1.00E+10
Mg	Ca ratio	Well Data	mg Mg / mg Ca	Trunc. Normal	1.63E+00	3.1E-01	0.00E+00	1.00E+10
Mn	Cap	Well Data	mg/L	Trunc. Normal	1.54E+00	3.9E-01	0.00E+00	1.00E+10
Na	Cap	Well Data	mg/L	Trunc. Normal	4.96E+01	1.1E+01	0.00E+00	1.00E+10
V	Cap	Well Data	mg/L	Uniform	--	--	5.00E-04	1.00E-03

Notes
- HCT indicates average rates from tailings humidity cells over the entire testing period.
- Aqua Regia indicates ratios from whole tailings testing.
- Cat 2/3 HCT (2) indicates average rates from Category 2/3 humidity cells over Condition 2, as defined in Large Table 1.
- All distributions from humidity cell data, aqua regia and microprobe data represent the full range of the observed values, with no weighting. Distributions are shown in Large Figure 50 to Large Figure 52.
- All distributions from well data represent calibrated distributions so that modeled concentrations at the Tailings Basin toes are best fits to observed data in GW001, GW006, GW007, GW012, SD004, and SD026. Distributions are shown in Large Figure 53 to Large Figure 55.
- Constituents not shown above are modeled according to the mineral solubility methods described in Section 10.1.2.

Table 1-20 Distribution Parameters for LTVSMC Tailings Disturbed Flushing Load

Distribution Fit to Leach Extraction Test Data

Constituent	*Method*	*Source*	*Units*	*Distribution*	*Mean/Mode*	*St. Dev.*	*Minimum*	*Maximum*
Ag	Load	Leach tests	mg/kg tailings	Beta	2.09E-05	4.85E-06	1.16E-05	3.73E-05
Al	Load	Leach tests	mg/kg tailings	Beta	2.16E-03	1.25E-03	1.26E-04	7.43E-03
Alkalinity	Load	Leach tests	mg/kg tailings	Beta	9.88E+01	2.62E+01	0.00E+00	1.27E+02
As	Load	Leach tests	mg/kg tailings	Beta	2.10E-03	2.96E-03	1.56E-04	2.15E-02
B	Load	Leach tests	mg/kg tailings	Beta	5.51E-02	1.98E-02	3.04E-02	1.90E-01
Ba	Load	Leach tests	mg/kg tailings	Beta	1.86E-03	2.96E-03	5.00E-05	2.00E-02
Be	Load	Leach tests	mg/kg tailings	Beta	7.50E-05	1.44E-05	5.00E-05	1.00E-04
Ca	Load	Leach tests	mg/kg tailings	Beta	1.79E+01	6.21E+00	9.30E+00	4.21E+01
Cd	Load	Leach tests	mg/kg tailings	Beta	1.50E-05	2.89E-06	1.00E-05	2.00E-05
Cl	Leach Load of Chloride is assumed to be 0 mg/kg			Beta	-1.00E+00	5.90E-02	-1.10E+00	-9.00E-01
Co	Load	Leach tests	mg/kg tailings	Beta	1.38E-04	1.00E-04	3.95E-05	4.97E-04
Cr	Load	Leach tests	mg/kg tailings	Beta	6.08E-04	6.87E-04	6.56E-05	4.00E-03
Cu	Load	Leach tests	mg/kg tailings	Beta	1.77E-03	1.13E-03	6.61E-04	8.00E-03
F	Load	Leach tests	mg/kg tailings	Beta	2.52E-01	2.08E-01	5.40E-02	1.53E+00
Fe	Load	Leach tests	mg/kg tailings	Beta	1.66E-02	1.20E-02	2.12E-03	4.88E-02
K	Load	Leach tests	mg/kg tailings	Beta	2.02E+00	2.15E+00	4.17E-01	1.00E+01
Mg	Load	Leach tests	mg/kg tailings	Beta	1.64E+01	8.20E+00	1.56E+00	6.28E+01
Mn	Load	Leach tests	mg/kg tailings	Beta	2.43E-02	3.33E-02	4.72E-04	2.51E-01
Na	Load	Leach tests	mg/kg tailings	Beta	3.67E+00	6.70E+00	2.33E-01	4.03E+01
Ni	Load	Leach tests	mg/kg tailings	Beta	5.98E-04	3.61E-04	1.91E-04	1.70E-03
Pb	Load	Leach tests	mg/kg tailings	Beta	3.75E-05	2.82E-05	1.67E-05	2.00E-04
Sb	Load	Leach tests	mg/kg tailings	Beta	7.50E-05	5.52E-05	3.33E-05	3.19E-04
Se	Load	Leach tests	mg/kg tailings	Beta	6.61E-04	6.73E-04	9.70E-05	4.93E-03
SO_4	Load	Leach tests	mg/kg tailings	Beta	2.14E+01	3.09E+01	1.27E+00	1.92E+02
Tl	Load	Leach tests	mg/kg tailings	Beta	7.50E-06	1.44E-06	5.00E-06	1.00E-05
V	Load	Leach tests	mg/kg tailings	Beta	8.01E-05	1.51E-05	3.74E-05	1.02E-04
Zn	Load	Leach tests	mg/kg tailings	Beta	1.08E-03	8.48E-05	4.00E-04	4.00E-03

Notes

- All distributions from leach extraction testing represent the full range of observed data.
- Distributions for constituents with no detections range from LOD/2 to LOD with a uniform distribution.
- Distributions are shown in Large Figure 56 to Large Figure 60.

Table 1-21 **Calibration Factor for LTVSMC Metal Release Ratios**

Constituent	*LTVSMC_Calib_Factor (--)*	*Ratio_or_Conc_LTV (--)*
Ag	0.0035	1
Al	1	0
Alk	1	0
As	0.0001	1
B	1	0
Ba	1	0
Be	1	0
Ca	1	0
Cd	0.0116	1
Cl	1	0
Co	0.0006	1
Cr	1	0
Cu	0.0005	1
F	1	0
Fe	0.0469	1
K	1	0
Mg	1	0
Mn	1	0
Na	1	0
Ni	0.0027	1
Pb	0.0003	1
Sb	0.0047	1
Se	0.015	1
SO_4	1	1
Tl	0.0107	1
V	1	0
Zn	0.2596	1

Notes

If the value is 1, the method of release is not by a release ratio to S (see Table 1-19).

Table 1-22 **LTVSMC Tailings Constituent Content**

Constituent	*Units*	*LTVSMC_Content*
Ag	mg/kg	7.33E-02
Al	mg/kg	1.92E+02
Alkalinity*	mg/kg	1.00E+20
As	mg/kg	2.82E+01
B	mg/kg	5.15E+00
Ba	mg/kg	1.03E+01
Be	mg/kg	6.92E-01
Ca	mg/kg	1.45E+03
Cd	mg/kg	5.74E-02
Cl*	mg/kg	1.00E+20
Co	mg/kg	8.22E+00
Cr	mg/kg	8.50E+01
Cu	mg/kg	9.72E+00
F*	mg/kg	1.00E+20
Fe	mg/kg	9.88E+03
K	mg/kg	6.24E+01
Mg	mg/kg	8.09E+02
Mn	mg/kg	4.61E+03
Na	mg/kg	1.11E+01
Ni	mg/kg	4.23E+00
Pb	mg/kg	1.54E+00
Sb	mg/kg	8.08E-02
Se	mg/kg	4.94E-01
S†	mg/kg	4.64E+01
Tl	mg/kg	2.00E-02
V	mg/kg	1.00E+01
Zn	mg/kg	9.67E+00

Notes

* Data not available. A high value of 1e20 ppm is assumed.

Table 1-23 Flotation Tailings Basin Dam Construction

Time (yrs)	North Dam		East Dam		South Dam		North Buttress		South Buttress	
	Cumulative Volume (CY)	Outer Area (acres)	Cumulative Volume (CY)	Outer Area (acres)	Cumulative Volume (CY)	Outer Area (acres)	Volume (CY)	Area (acres)	Volume (CY)	Area (acres)
0	0	0	0	0	0	0	0	0	0	0
0.001	2,480	55	0	0	0	0	573	45	0	0
1	2,480,000	55	0	0	0	0	572,950	45	0	0
2	3,330,000	55	0	0	0	0	1,145,900	45	0	0
3	4,180,000	69	0	0	0	0	1,145,900	45	0	0
4	5,010,000	82	0	0	0	0	1,145,900	45	0	0
5	5,840,000	95	0	0	0	0	1,145,900	45	0	0
6	6,640,000	108	0	0	0	0	1,145,900	45	0	0
7	7,440,000	133	0	0	0	0	1,145,900	45	0	0
7.001	7,440,679	147	64	15	64	15	1,145,900	45	109	15
8	8,119,298	160	63,684	15	63,684	15	1,145,900	45	108,500	15
9	8,807,046	174	123,144	15	123,144	15	1,145,900	45	217,000	15
10	9,502,192	187	178,904	15	178,904	15	1,145,900	45	325,500	15
11	10,122,932	193	234,529	17	249,040	22	1,145,900	45	325,500	15
12	10,723,773	198	293,703	20	335,524	29	1,145,900	45	325,500	15
13	11,306,931	204	356,030	22	436,538	35	1,145,900	45	325,500	15
14	11,874,271	209	421,179	24	550,549	42	1,145,900	45	325,500	15
15	12,532,555	215	501,645	26	703,050	50	1,145,900	45	325,500	15
16	13,173,732	221	584,518	29	870,250	58	1,145,900	45	325,500	15
17	13,799,473	226	669,564	31	1,050,713	65	1,145,900	45	325,500	15
18	14,411,219	232	756,579	33	1,243,202	73	1,145,900	45	325,500	15
18.001	14,411,793	232	756,666	33	1,243,398	73	1,145,900	45	325,500	15
19	14,985,672	241	843,762	37	1,439,065	82	1,145,900	45	325,500	15
20	15,547,561	249	934,025	40	1,644,414	91	1,145,900	45	325,500	15
20.001	15,547,561	249	934,025	40	1,644,414	91	1,145,900	45	325,500	15
21	15,547,561	249	934,025	40	1,644,414	91	1,145,900	45	325,500	15
22	15,547,561	249	934,025	40	1,644,414	91	1,145,900	45	325,500	15
23	15,547,561	249	934,025	40	1,644,414	91	1,145,900	45	325,500	15
24	15,547,561	249	934,025	40	1,644,414	91	1,145,900	45	325,500	15
25	15,547,561	249	934,025	40	1,644,414	91	1,145,900	45	325,500	15
30	15,547,561	249	934,025	40	1,644,414	91	1,145,900	45	325,500	15
35	15,547,561	249	934,025	40	1,644,414	91	1,145,900	45	325,500	15
40	15,547,561	249	934,025	40	1,644,414	91	1,145,900	45	325,500	15
45	15,547,561	249	934,025	40	1,644,414	91	1,145,900	45	325,500	15
50	15,547,561	249	934,025	40	1,644,414	91	1,145,900	45	325,500	15
500	15,547,561	249	934,025	40	1,644,414	91	1,145,900	45	325,500	15

Table 1-24 Flotation Tailings Basin Dam Elevations and Areas

Time (yrs)	Crest Elevation* (feet)	Crest Area † (acres)	Beach Elevation ‡ (feet)	North Beach Area (acres)	East Beach Area (acres)	South Beach Area (acres)	Closure Beach (acres)
0	1588.0	516.9	1570.0	0.00	0.00	0.00	0.00
0.001	1588.0	516.9	1570.0	96.06	0.00	0.00	0.00
1	1588.0	516.9	1585.0	95.40	0.00	0.00	0.00
2	1600.0	518.5	1597.0	94.73	0.00	0.00	0.00
3	1612.0	520.1	1609.0	93.40	0.00	0.00	0.00
4	1625.0	521.7	1622.0	92.07	0.00	0.00	0.00
5	1636.0	522.5	1633.0	90.57	0.00	0.00	0.00
6	1649.0	523.4	1646.0	89.07	0.00	0.00	0.00
7	1661.0	529.4	1658.0	86.82	0.00	0.00	0.00
7.001	1661.0	1271.2	1658.0	86.81	20.78	103.34	0.00
8	1669.0	1271.2	1666.0	78.62	20.78	103.34	0.00
9	1677.0	1300.2	1674.0	80.10	23.43	103.50	0.00
10	1681.5	1329.2	1678.5	81.58	26.07	103.65	0.00
11	1686.5	1335.6	1683.5	82.24	26.68	102.66	0.00
12	1691.5	1341.9	1688.5	82.91	27.29	101.67	0.00
13	1696.0	1348.2	1693.0	83.57	27.89	100.67	0.00
14	1700.5	1354.5	1697.5	84.23	28.50	99.68	0.00
15	1705.5	1351.1	1702.5	84.83	30.50	100.17	0.00
16	1710.0	1347.6	1707.0	85.42	32.51	100.67	0.00
17	1715.0	1344.1	1712.0	86.02	34.51	101.16	0.00
18	1719.5	1340.7	1716.5	86.61	36.51	101.65	0.00
18.001	1719.5	1340.7	1716.5	86.61	36.51	101.65	188.64
19	1723.0	1331.6	1720.0	88.42	41.06	102.37	188.64
20	1727.0	1322.5	1724.0	90.23	45.61	103.08	188.64
20.001	1727.0	1322.5	1724.0	90.23	45.61	103.08	188.64
21	1727.0	1322.5	1724.0	90.23	45.61	103.08	188.64
22	1727.0	1322.5	1724.0	90.23	45.61	103.08	188.64
23	1727.0	1322.5	1724.0	90.23	45.61	103.08	188.64
24	1727.0	1322.5	1724.0	90.23	45.61	103.08	188.64
25	1727.0	1322.5	1724.0	90.23	45.61	103.08	188.64
30	1727.0	1322.5	1724.0	90.23	45.61	103.08	188.64
35	1727.0	1322.5	1724.0	90.23	45.61	103.08	188.64
40	1727.0	1322.5	1724.0	90.23	45.61	103.08	188.64
45	1727.0	1322.5	1724.0	90.23	45.61	103.08	188.64
50	1727.0	1322.5	1724.0	90.23	45.61	103.08	188.64
500	1727.0	1322.5	1724.0	90.23	45.61	103.08	188.64

Notes

* Elevation of the top of the dams (maximum water surface elevation)

† Plan view area created by a closed contour at the crest elevation

‡ Elevation at the point where the NorthMet tailings beaches meet the FTB dams

Table 1-25 Percentage of Seepage from Each Dam that Flows to Each Toe of the Tailings Basin

	North Dam				*East Dam*				*South Dam*			
Time (yrs)	*North*	*North-West*	*West*	*South*	*North*	*North-West*	*West*	*South*	*North*	*North-West*	*West*	*South*
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.001	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
8	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
9	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
10	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
11	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
12	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
13	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
14	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
15	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
16	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
17	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
18	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
18.001	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
19	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
20	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
20.001	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
21	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
22	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
23	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
24	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
25	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
30	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
35	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
40	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
45	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
50	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
500	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0

Notes

Year 0 represents existing conditions, Year 7 is the year before Cell 1E and Cell 2E merge, Year 18 represents the beginning of closure activities, Year 20 represents final closure.

Gray cells indicate that the feature does not exist at that time.

Table 1-26 **Volume of saturated tailings within the Flotation Tailings Basin Dams**

Time (yrs)	North Dam (acre-ft)				East Dam (acre-ft)				South Dam (acre-ft)			
	North	North-West	West	South	North	North-West	West	South	North	North-West	West	South
0	0	0	0	0	0	0	0	0	0	0	0	0
0.001	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	194	0	0	0	0	0	0	0	0	0	0	0
7	532	0	0	0	0	0	0	0	0	0	0	0
7.001	588	0	0	0	0	0	0	0	0	0	0	0
8	768	0	0	0	38	0	0	0	0	0	0	0
9	966	0	0	0	98	0	0	0	0	0	0	0
10	860	0	0	0	131	0	0	0	0	0	0	0
11	1255	0	0	0	191	0	0	0	0	0	0	0
12	1663	0	0	0	275	0	0	0	0	0	0	0
13	2050	0	0	0	352	0	0	0	0	0	0	0
14	2445	0	0	0	438	0	0	0	0	0	0	0
15	2924	0	0	0	540	0	0	0	0	0	0	0
16	3370	0	0	0	667	0	0	0	0	0	0	0
17	3876	0	0	0	791	0	0	0	0	0	0	0
18	4362	0	0	0	916	0	0	0	0	0	0	0
18.001	4362	0	0	0	916	0	0	0	0	0	0	0
19	4880	0	0	0	1092	0	0	0	0	0	0	0
20	5453	0	0	0	1260	0	0	0	0	0	0	0
20.001	5453	0	0	0	1260	0	0	0	0	0	0	0
21	5304	0	0	0	1260	0	0	0	0	0	0	0
22	5154	0	0	0	1260	0	0	0	0	0	0	0
23	5005	0	0	0	1260	0	0	0	0	0	0	0
24	4868	0	0	0	1260	0	0	0	0	0	0	0
25	4719	0	0	0	1260	0	0	0	0	0	0	0
30	3972	0	0	0	1260	0	0	0	0	0	0	0
35	3237	0	0	0	1260	0	0	0	0	0	0	0
40	2502	0	0	0	1260	0	0	0	0	0	0	0
45	1755	0	0	0	1260	0	0	0	0	0	0	0
50	1021	0	0	0	1260	0	0	0	0	0	0	0
500	1021	0	0	0	1260	0	0	0	0	0	0	0

Notes

The top of the LTVSMC tailings in Cell 2W is approximated as 1727 feet

The base of the LTVSMC Tailings Basin is approximated as 1500 feet.

Table 1-27 Percentage of Seepage from Each NorthMet Tailings Beach that Flows to Each Toe of the Tailings Basin

	North Beach				*East Beach*				*South Beach*				*Closure Beach*			
Time (yrs)	*North*	*North-West*	*West*	*South*	*North*	*North-West*	*West*	*South*	*North*	*North-West*	*West*	*South*	*North*	*North-West*	*West*	*South*
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.001	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	1.2	4.9	93.9	0.0	0.0	0.0	0.0
8	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	1.2	4.9	93.9	0.0	0.0	0.0	0.0
9	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	1.2	4.9	93.9	0.0	0.0	0.0	0.0
10	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	1.2	4.9	93.9	0.0	0.0	0.0	0.0
11	99.9	0.1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	1.1	4.3	94.7	0.0	0.0	0.0	0.0
12	99.7	0.3	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.9	3.7	95.4	0.0	0.0	0.0	0.0
13	99.6	0.4	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.8	3.1	96.2	0.0	0.0	0.0	0.0
14	99.4	0.6	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.6	2.5	96.9	0.0	0.0	0.0	0.0
15	99.3	0.7	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.5	1.8	97.7	0.0	0.0	0.0	0.0
16	99.1	0.9	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.3	1.2	98.5	0.0	0.0	0.0	0.0
17	99.0	1.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.2	0.6	99.2	0.0	0.0	0.0	0.0
18	98.8	1.2	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
18.001	98.8	1.2	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	29.3	40.8	24.5	5.4
19	98.8	1.2	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	29.0	41.4	23.9	5.7
20	98.8	1.2	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	28.7	42.0	23.3	6.0
20.001	98.8	1.2	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	28.7	42.0	23.3	6.0
21	98.8	1.2	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	30.0	40.9	22.5	6.5
22	98.9	1.1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	31.4	39.8	21.7	7.0
23	~~98.9~~	~~1.1~~	~~0.0~~	~~0.0~~	~~100.0~~	~~0.0~~	~~0.0~~	~~0.0~~	~~0.0~~	~~0.0~~	~~0.0~~	~~100.0~~	~~32.7~~	~~38.8~~	~~21.0~~	~~7.6~~
24	99.0	1.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	34.1	37.7	20.2	8.1
25	99.0	1.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	35.4	36.6	19.4	8.6
30	99.2	0.8	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	42.1	31.2	15.5	11.2
35	99.4	0.6	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	48.8	25.8	11.7	13.8
40	99.6	0.4	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	55.5	20.3	7.8	16.4
45	99.8	0.2	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	62.2	14.9	3.9	19.0
50	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	68.9	9.5	0.0	21.6
500	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	68.9	9.5	0.0	21.6

Notes

Year 0 represents existing conditions, Year 7 is the year before Cell 1E and Cell 2E merge, Year 18 represents the beginning of closure activities, Year 20 represents final closure.

Gray cells indicate that the feature (unsaturated fine tailings, dams, and the existing pond in Cell 1E) does not exist at that time.

Table 1-28 **Volume of saturated tailings within the Flotation Tailings Basin Beaches**

Time (yrs)	North Beach (acre-ft)				East Beach (acre-ft)				South Beach (acre-ft)				Closure Beach (acre-ft)			
	North	North-West	West	South	North	North-West	West	South	North	North-West	West	South	North	North-West	West	South
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1049	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	2179	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	3017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	3913	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	4601	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	5433	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	6103	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.001	6103	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	6022	0	0	0	104	0	0	0	0	0	0	0	0	0	0	0
9	6632	0	0	0	305	0	0	0	0	0	0	0	0	0	0	0
10	6983	0	0	0	456	0	0	0	0	5	21	409	0	0	0	0
11	7435	7	0	0	600	0	0	0	0	10	38	846	0	0	0	0
12	7894	24	0	0	750	0	0	0	0	12	50	1290	0	0	0	0
13	8315	33	0	0	892	0	0	0	0	14	54	1675	0	0	0	0
14	8732	53	0	0	1040	0	0	0	0	13	53	2067	0	0	0	0
15	9199	65	0	0	1266	0	0	0	0	13	47	2535	0	0	0	0
16	9625	87	0	0	1495	0	0	0	0	9	36	2965	0	0	0	0
17	10100	102	0	0	1760	0	0	0	0	7	21	3462	0	0	0	0
18	10525	128	0	0	2026	0	0	0	0	0	0	3914	0	0	0	0
18.001	10525	128	0	0	2026	0	0	0	0	0	0	3914	0	0	0	0
19	10824	131	0	0	2423	0	0	0	0	0	0	4136	0	0	0	0
20	11170	136	0	0	2873	0	0	0	0	0	0	4402	0	0	0	0
20.001	11170	136	0	0	2873	0	0	0	0	0	0	4402	0	0	0	0
21	10885	132	0	0	2873	0	0	0	0	0	0	4288	0	0	0	0
22	10601	118	0	0	2873	0	0	0	0	0	0	4164	0	0	0	0
23	10316	115	0	0	2873	0	0	0	0	0	0	4051	0	0	0	0
24	10040	101	0	0	2873	0	0	0	0	0	0	3938	0	0	0	0
25	9755	99	0	0	2873	0	0	0	0	0	0	3814	0	0	0	0
30	8324	67	0	0	2873	0	0	0	0	0	0	3226	0	0	0	0
35	6897	42	0	0	2873	0	0	0	0	0	0	2639	0	0	0	0
40	5464	22	0	0	2873	0	0	0	0	0	0	2062	0	0	0	0
45	4016	8	0	0	2873	0	0	0	0	0	0	1474	0	0	0	0
50	2572	0	0	0	2873	0	0	0	0	0	0	886	0	0	0	0
500	2572	0	0	0	2873	0	0	0	0	0	0	886	0	0	0	0

Notes

The top of the LTVSMC tailings in Cell 2E is approximated as 1570 feet

The top of the LTVSMC tailings in Cell 1E is approximated as 1658 feet

Table 1-29 Average Depth to the Phreatic Surface Within Unsaturated Areas

Time (yrs)	North Dam		East Dam		South Dam		Closure Beach (feet)
	Dam (feet)	Beach (feet)	Dam (feet)	Beach (feet)	Dam (feet)	Beach (feet)	
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.001	44.8	4.0	0.0	0.0	0.0	0.0	0.0
1	44.8	4.0	0.0	0.0	0.0	0.0	0.0
2	44.8	4.0	0.0	0.0	0.0	0.0	0.0
3	52.4	6.7	0.0	0.0	0.0	0.0	0.0
4	60.1	9.5	0.0	0.0	0.0	0.0	0.0
5	67.7	12.2	0.0	0.0	0.0	0.0	0.0
6	75.4	15.0	0.0	0.0	0.0	0.0	0.0
7	83.0	17.7	0.0	0.0	0.0	0.0	0.0
7.001	83.0	17.7	6.0	3.0	77.7	16.3	0.0
8	89.4	19.4	6.0	3.0	77.7	16.3	0.0
9	95.9	21.2	6.0	3.0	77.7	16.3	0.0
10	102.3	22.9	6.0	3.0	77.7	16.3	0.0
11	103.5	23.0	6.0	3.0	76.2	16.8	0.0
12	104.7	23.0	6.0	3.0	74.8	17.2	0.0
13	105.9	23.1	6.0	3.0	73.3	17.7	0.0
14	107.1	23.2	6.0	3.0	71.9	18.1	0.0
15	108.3	23.3	6.0	3.0	70.4	18.6	0.0
16	109.5	23.3	6.0	3.0	68.9	19.1	0.0
17	110.7	23.4	6.0	3.0	67.5	19.5	0.0
18	111.9	23.5	6.0	3.0	66.0	20.0	0.0
18.001	111.9	23.5	6.0	3.0	66.0	20.0	11.1
19	112.5	26.1	6.0	3.0	67.7	21.6	12.8
20	113.2	28.7	6.0	3.0	69.4	23.3	14.5
20.001	113.2	28.7	6.0	3.0	69.4	23.3	14.5
21	114.4	31.9	6.0	3.0	70.5	24.4	15.9
22	115.6	35.2	6.0	3.0	71.7	25.6	17.4
23	116.8	38.4	6.0	3.0	72.8	26.7	18.8
24	117.9	41.6	6.0	3.0	73.9	27.8	20.3
25	119.1	44.8	6.0	3.0	75.1	29.0	21.7
30	125.1	61.0	6.0	3.0	80.7	34.7	28.9
35	131.0	77.1	6.0	3.0	86.4	40.4	36.1
40	136.9	93.2	6.0	3.0	92.0	46.0	43.3
45	142.9	109.4	6.0	3.0	97.7	51.7	50.5
50	148.8	125.5	6.0	3.0	103.3	57.4	57.7
500	148.8	125.5	6.0	3.0	103.3	57.4	57.7

Notes

Year 0 represents existing conditions, Year 7 is the year before Cell 1E and Cell 2E merge, Year 18 represents the beginning of closure activities, Year 20 represents fi

Gray cells indicate that the feature (unsaturated fine tailings, dams, and the existing pond in Cell 1E) does not exist at that time.

A minimum value of 3 feet in the beaches and 6 feet in the dams was used

Table 1-30 Areas of the Flotation Tailings Pond

Time (yrs)	*Pond_Top_Area (acres)*	*Pond_Bottom_Area (acres)*
0	182.80	142.50
0.001	420.80	305.71
1	420.80	305.71
2	423.75	307.63
3	426.69	309.56
4	429.63	311.87
5	431.96	313.73
6	434.28	318.06
7	442.54	326.80
7.001	1068.44	883.55
8	1068.44	883.55
9	1093.19	908.45
10	1117.94	933.56
11	1123.99	943.18
12	1130.04	952.85
13	1136.09	957.62
14	1142.14	962.40
15	1135.58	956.55
16	1129.02	950.70
17	1122.47	943.84
18	1115.91	936.99
18.001	905.32	758.01
19	905.32	758.01
20	905.32	758.01
500	905.32	758.01

Notes

* Areas at Year 0 represent the areas of the existing pond in Cell 2E

Table 1-31 Seepage Quantity and Direction from the NorthMet Flotation Tailings Pond

Time (yrs)	*Pond_Seepage_Rate (in/yr)*	*Pond_Seepage_Direction[N] (%)*	*Pond_Seepage_Direction[NW] (%)*	*Pond_Seepage_Direction[W] (%)*	*Pond_Seepage_Direction[S] (%)*	*Pond_Saturated_Volume (acre-ft)*
0	46.0	100.0	0.0	0.0	0.0	12796
0.001	14.6	100.0	0.0	0.0	0.0	23460
1	14.6	93.1	7.0	0.0	0.0	29772
2	14.6	86.1	13.9	0.0	0.0	35065
3	19.3	82.4	17.6	0.0	0.0	40429
4	24.0	78.8	21.2	0.0	0.0	46293
5	28.7	75.1	24.9	0.0	0.0	51295
6	33.4	71.5	28.5	0.0	0.0	57216
7	38.1	67.8	32.2	0.0	0.0	63615
7.001	38.1	67.8	32.2	0.0	0.0	153589
8	33.7	62.7	29.2	3.0	5.1	162136
9	29.3	57.7	26.2	6.0	10.1	174637
10	24.9	52.6	23.2	9.0	15.2	183622
11	25.4	53.2	21.9	9.0	16.0	190235
12	25.9	53.7	20.5	8.9	16.8	196909
13	26.4	54.3	19.2	8.9	17.7	203076
14	26.9	54.8	17.8	8.9	18.5	209297
15	27.4	55.4	16.5	8.8	19.3	213773
16	27.9	56.0	15.1	8.8	20.1	217619
17	28.4	56.5	13.8	8.7	21.0	221968
18	28.9	57.1	12.4	8.7	21.8	225692
18.001	28.9	57.1	12.4	8.7	21.8	183101
19	27.1	58.5	11.8	8.4	21.3	186270
20	25.2	60.0	11.2	8.0	20.8	189891
20.001	6.5	60.0	11.2	8.0	20.8	189891
50	6.5	77.0	1.8	0.0	21.2	189891
500	6.5	77.0	1.8	0.0	21.2	189891

Notes

Values at year 0 represent the existing conditions of the pond in Cell 2E

Table 1-32 Areas Contributing Runoff to the Tailings Basin as it Develops

Time (yrs)	*Contr_Embank_Area_2E (acres)*	*Contr_Embank_Area_1E (acres)*	*Contr_Watershed_2E (acres)*	*Contr_Watershed_1E (acres)*
0	86.6	49.4	112.0	835.9
2	83.8	46.7	100.1	835.9
4	72.0	46.7	72.3	835.9
6	61.8	46.7	62.5	835.9
7	50.5	46.7	51.0	835.9
7.001	0.0	97.2	0.0	281.7
10	0.0	75.7	0.0	245.5
14	0.0	48.4	0.0	194.8
18	0.0	26.4	0.0	159.2
20	0.0	19.1	0.0	138.5
500	0.0	19.1	0.0	138.5

Notes

Year 0 represents existing conditions, Year 7 is the year before Cell 1E and Cell 2E merge,

Year 18 represents the beginning of closure activities, Year 20 represents final closure.

The area contributing runoff to Cell 2E is added to the area contributing to Cell 1E in years after the two cells have merged

Table 1-33 **Areas of the Existing LTVSMC Tailings Zones**

Time (yrs)	Cell 2W			Cell 1E			Cell 2E		
	Coarse Tailings (m^2)	Fine Tailings (m^2)	Other (m^2)	Coarse Tailings (m^2)	Fine Tailings (m^2)	Other (m^2)	Coarse Tailings (m^2)	Fine Tailings (m^2)	Other (m^2)
0	890,625	3,027,344	1,845,703	1,173,828	824,219	0	810,547	687,966	304,688
0.001	890,625	3,027,344	1,845,692	1,173,703	824,219	0	50,781	0	304,688
1	890,625	3,027,344	1,834,574	1,048,828	824,219	0	50,781	0	304,688
2	890,625	3,027,344	1,823,445	1,034,505	824,219	0	42,318	0	304,688
3	890,625	3,027,344	1,799,569	1,020,182	824,219	0	33,854	0	304,688
4	890,625	3,027,344	1,775,693	1,005,859	824,219	0	25,391	0	304,688
5	890,625	3,027,344	1,755,054	991,536	824,219	0	16,927	0	304,688
6	890,625	3,027,344	1,734,415	977,214	824,219	0	8,464	0	304,688
7	890,625	3,027,344	1,688,685	962,891	824,219	0	0	0	304,688
7.001	890,625	3,027,344	1,688,656	31,250	0	0	0	0	304,688
8	890,625	3,027,344	1,659,683	31,250	0	0	0	0	304,688
9	890,625	3,027,344	1,630,680	29,492	0	0	0	0	304,688
10	890,625	3,027,344	1,601,678	27,734	0	0	0	0	304,688
11	890,625	3,027,344	1,574,058	25,977	0	0	0	0	304,688
12	890,625	3,027,344	1,546,438	24,219	0	0	0	0	304,688
13	890,625	3,027,344	1,518,818	22,461	0	0	0	0	304,688
14	890,625	3,027,344	1,491,199	20,703	0	0	0	0	304,688
15	890,625	3,027,344	1,468,941	18,945	0	0	0	0	304,688
16	890,625	3,027,344	1,446,683	17,188	0	0	0	0	304,688
17	890,625	3,027,344	1,424,425	15,430	0	0	0	0	304,688
18	890,625	3,027,344	1,402,168	13,672	0	0	0	0	304,688
18.001	890,625	3,027,344	1,402,153	13,672	0	0	0	0	304,688
19	890,625	3,027,344	1,387,397	13,672	0	0	0	0	304,688
20	890,625	3,027,344	1,372,626	13,672	0	0	0	0	304,688
20.001	890,625	3,027,344	1,372,626	13,672	0	0	0	0	304,688
21	890,625	3,027,344	1,372,626	13,672	0	0	0	0	304,688
22	890,625	3,027,344	1,372,626	13,672	0	0	0	0	304,688
23	890,625	3,027,344	1,372,626	13,672	0	0	0	0	304,688
24	890,625	3,027,344	1,372,626	13,672	0	0	0	0	304,688
25	890,625	3,027,344	1,372,626	13,672	0	0	0	0	304,688
30	890,625	3,027,344	1,372,626	13,672	0	0	0	0	304,688
35	890,625	3,027,344	1,372,626	13,672	0	0	0	0	304,688
40	890,625	3,027,344	1,372,626	13,672	0	0	0	0	304,688
45	890,625	3,027,344	1,372,626	13,672	0	0	0	0	304,688
50	890,625	3,027,344	1,372,626	13,672	0	0	0	0	304,688
500	890,625	3,027,344	1,372,626	13,672	0	0	0	0	304,688

Notes

Gray cells indicate that the feature is not present.

Table 1-34 Depth to the Water Table in the Existing LTVSMC tailings

Time (yrs)	Cell 2W			Cell 1E			Cell 2E		
	Coarse Tailings (ft)	Fine Tailings (ft)	Other (ft)	Coarse Tailings (ft)	Fine Tailings (ft)	Other (ft)	Coarse Tailings (ft)	Fine Tailings (ft)	Other (ft)
0	125.4	114.9	96.4	42.6	39.0	0.0	28.3	36.8	42.4
0.001	125.4	114.9	96.4	42.6	39.0	0.0	28.3	36.8	42.4
1	121.9	106.1	92.7	39.0	37.6	0.0	27.8	18.4	35.1
2	118.3	97.4	89.0	35.5	36.2	0.0	27.4	0.0	27.8
3	119.0	92.1	89.5	34.9	35.9	0.0	21.9	0.0	28.0
4	119.8	86.8	90.0	34.3	35.5	0.0	16.4	0.0	28.3
5	120.5	81.5	90.4	33.8	35.2	0.0	11.0	0.0	28.5
6	121.3	76.2	90.9	33.2	34.8	0.0	5.5	0.0	28.8
7	122.0	70.9	91.4	32.6	34.5	0.0	0.0	0.0	29.0
7.001	122.0	70.9	91.4	32.6	34.5	0.0	0.0	0.0	29.0
8	120.8	70.8	91.1	25.0	23.0	0.0	0.0	0.0	32.2
9	119.6	70.7	90.9	17.5	11.5	0.0	0.0	0.0	35.5
10	118.4	70.6	90.6	9.9	0.0	0.0	0.0	0.0	38.7
11	118.0	69.3	90.9	9.4	0.0	0.0	0.0	0.0	39.0
12	117.5	67.9	91.2	9.0	0.0	0.0	0.0	0.0	39.2
13	117.1	66.6	91.5	8.5	0.0	0.0	0.0	0.0	39.5
14	116.6	65.2	91.7	8.1	0.0	0.0	0.0	0.0	39.8
15	116.2	63.9	92.0	7.6	0.0	0.0	0.0	0.0	40.1
16	115.7	62.5	92.3	7.1	0.0	0.0	0.0	0.0	40.3
17	115.3	61.2	92.6	6.7	0.0	0.0	0.0	0.0	40.6
18	114.8	59.8	92.9	6.2	0.0	0.0	0.0	0.0	40.9
18.001	114.8	59.8	92.9	6.2	0.0	0.0	0.0	0.0	40.9
19	116.3	60.7	93.4	4.9	0.0	0.0	0.0	0.0	41.1
20	117.8	61.7	93.9	3.6	0.0	0.0	0.0	0.0	41.4
20.001	117.8	61.7	93.9	3.6	0.0	0.0	0.0	0.0	41.4
21	118.9	62.5	94.3	7.3	0.0	0.0	0.0	0.0	41.7
22	120.0	63.3	94.7	11.1	0.0	0.0	0.0	0.0	42.0
23	121.1	64.1	95.2	14.8	0.0	0.0	0.0	0.0	42.4
24	122.1	64.9	95.6	18.5	0.0	0.0	0.0	0.0	42.7
25	123.2	65.7	96.0	22.3	0.0	0.0	0.0	0.0	43.0
30	128.6	69.6	98.1	40.9	0.0	0.0	0.0	0.0	44.6
35	134.1	73.6	100.2	59.6	0.0	0.0	0.0	0.0	46.2
40	139.5	77.6	102.2	78.2	0.0	0.0	0.0	0.0	47.8
45	144.9	81.5	104.3	96.9	0.0	0.0	0.0	0.0	49.4
50	150.3	85.5	106.4	115.5	0.0	0.0	0.0	0.0	51.0
500	150.3	85.5	106.4	115.5	0.0	0.0	0.0	0.0	51.0

Notes

Year 0 represents existing conditions, Year 7 is the year before Cell 1E and Cell 2E merge, Year 18 represents the beginning of closure activities, Year 20 represents final closure.

Gray cells indicate that the feature does not exist at that time.

Table 1-35 Seepage Direction from each zone in Cell 2W

Time (yrs)	Coarse Tailings (%)				Fine Tailings (%)				Other (%)			
	North	North-West	West	South	North	North-West	West	South	North	North-West	West	South
0	0.7	37.4	44.6	17.3	1.4	50.2	47.2	1.2	11.3	39.9	44.2	4.6
0.001	0.7	37.4	44.6	17.3	1.4	50.2	47.2	1.2	11.3	39.9	44.2	4.6
1	0.4	36.1	45.9	17.7	0.7	49.5	48.8	1.1	6.5	45.4	42.6	5.6
2	0.0	34.8	47.2	18.0	0.0	48.7	50.4	0.9	1.7	50.8	41.0	6.5
3	0.0	32.7	49.8	17.5	0.0	47.6	51.5	0.8	1.5	49.7	42.1	6.6
4	0.0	30.6	52.4	17.0	0.0	46.5	52.7	0.8	1.4	48.6	43.2	6.7
5	0.0	28.5	55.0	16.5	0.0	45.5	53.8	0.7	1.2	47.6	44.4	6.9
6	0.0	26.4	57.6	16.0	0.0	44.4	55.0	0.7	1.1	46.5	45.5	7.0
7	0.0	24.3	60.2	15.5	0.0	43.3	56.1	0.6	0.9	45.4	46.6	7.1
7.001	0.0	24.3	60.2	15.5	0.0	43.3	56.1	0.6	0.9	45.4	46.6	7.1
8	0.0	25.2	59.5	15.3	0.0	43.7	55.8	0.5	1.2	45.2	46.8	6.8
9	0.0	26.2	58.8	15.0	0.0	44.2	55.4	0.4	1.5	45.1	47.0	6.4
10	0.0	27.1	58.1	14.8	0.0	44.6	55.1	0.3	1.8	44.9	47.2	6.1
11	0.0	26.8	58.4	14.8	0.0	44.4	55.3	0.3	1.9	44.5	47.4	6.2
12	0.1	26.6	58.6	14.7	0.0	44.2	55.5	0.2	2.0	44.0	47.6	6.3
13	0.1	26.3	58.9	14.7	0.0	44.0	55.8	0.2	2.1	43.6	47.8	6.5
14	0.2	26.1	59.2	14.6	0.0	43.8	56.0	0.2	2.2	43.2	48.0	6.6
15	0.2	25.8	59.5	14.6	0.1	43.6	56.2	0.1	2.4	42.7	48.2	6.7
16	0.3	25.5	59.7	14.5	0.1	43.4	56.4	0.1	2.5	42.3	48.4	6.8
17	0.3	25.3	60.0	14.5	0.1	43.2	56.7	0.0	2.6	41.8	48.6	7.0
18	0.4	25.0	60.3	14.4	0.1	43.0	56.9	0.0	2.7	41.4	48.8	7.1
18.001	0.4	25.0	60.3	14.4	0.1	43.0	56.9	0.0	2.7	41.4	48.8	7.1
19	0.4	25.0	59.9	14.7	0.1	43.2	56.7	0.0	2.7	41.4	48.6	7.3
20	0.4	25.0	59.5	15.1	0.1	43.5	56.4	0.0	2.7	41.4	48.4	7.5
20.001	0.4	25.0	59.5	15.1	0.1	43.5	56.4	0.0	2.7	41.4	48.4	7.5
21	0.4	25.6	58.9	15.1	0.2	43.9	55.9	0.0	2.9	41.3	48.2	7.6
22	0.5	26.1	58.3	15.2	0.2	44.3	55.4	0.0	3.1	41.2	48.0	7.7
23	0.5	26.7	57.6	15.2	0.3	44.8	54.9	0.0	3.3	41.1	47.8	7.8
24	0.5	27.2	57.0	15.2	0.3	45.2	54.5	0.0	3.5	40.9	47.6	7.9
25	0.6	27.8	56.4	15.3	0.4	45.6	54.0	0.0	3.7	40.8	47.4	8.1
30	0.7	30.6	53.3	15.5	0.7	47.7	51.5	0.0	4.7	40.3	46.4	8.6
35	0.9	33.4	50.2	15.7	1.0	49.9	49.1	0.1	5.7	39.7	45.4	9.2
40	1.0	36.2	47.0	15.8	1.2	52.0	46.7	0.1	6.7	39.1	44.4	9.7
45	1.2	39.0	43.9	16.0	1.5	54.1	44.2	0.1	7.7	38.6	43.4	10.3
50	1.3	41.8	40.8	16.2	1.8	56.2	41.8	0.1	8.7	38.0	42.4	10.8
500	1.3	41.8	40.8	16.2	1.8	56.2	41.8	0.1	8.7	38.0	42.4	10.8

Notes

Year 0 represents existing conditions, Year 7 is the year before Cell 1E and Cell 2E merge, Year 18 represents the beginning of closure activities, Year 20 represents final closure.

Table 1-36 Volume of saturated tailings under each zone of Cell 2W

Time (yrs)	*Coarse Tailings (acre-ft)*				*Fine Tailings (acre-ft)*				*Other (acre-ft)*			
	North	***North-West***	***West***	***South***	***North***	***North-West***	***West***	***South***	***North***	***North-West***	***West***	***South***
0	157	8363	9973	3868	1174	42097	39581	1006	3365	11883	13164	1370
0.001	157	8363	9973	3868	1174	42097	39581	1006	3365	11883	13164	1370
1	93	8350	10617	4094	633	44769	44136	995	1999	13962	13101	1722
2	0	8325	11291	4306	0	47215	48863	873	539	16111	13003	2061
3	0	7772	11837	4159	0	48036	51971	807	478	15837	13416	2103
4	0	7219	12362	4011	0	48769	55272	839	448	15562	13833	2145
5	0	6680	12891	3867	0	49524	58558	762	386	15310	14280	2219
6	0	6141	13399	3722	0	50087	62045	790	355	15013	14690	2260
7	0	5615	13911	3582	0	50563	65510	701	294	14844	15236	2321
7.001	0	5615	13911	3582	0	50563	65510	701	294	14844	15236	2321
8	0	5890	13907	3576	0	51063	65202	584	397	14954	15484	2250
9	0	6193	13898	3545	0	51680	64776	468	502	15087	15722	2141
10	0	6477	13886	3537	0	52181	64466	351	609	15193	15971	2064
11	0	6429	14009	3550	0	52379	65238	354	648	15169	16157	2113
12	24	6410	14122	3542	0	52606	66055	238	687	15110	16346	2163
13	24	6361	14246	3555	0	52796	66955	240	726	15083	16536	2249
14	49	6341	14384	3547	0	53015	67781	242	767	15064	16738	2301
15	49	6291	14509	3560	122	53197	68570	122	842	14974	16903	2350
16	73	6246	14623	3552	123	53407	69405	123	882	14918	17070	2398
17	74	6219	14750	3564	124	53581	70325	0	922	14826	17238	2483
18	99	6173	14890	3556	125	53783	71169	0	963	14768	17408	2533
18.001	99	6173	14890	3556	125	53783	71169	0	963	14768	17408	2533
19	97	6091	14593	3581	124	53743	70537	0	965	14803	17377	2610
20	96	6008	14299	3629	124	53791	69742	0	968	14838	17347	2688
20.001	96	6008	14299	3629	124	53791	69742	0	968	14838	17347	2688
21	95	6090	14013	3592	246	54022	68789	0	1037	14774	17243	2719
22	118	6146	13729	3579	245	54250	67843	0	1107	14711	17138	2749
23	117	6223	13424	3543	366	54594	66902	0	1175	14640	17027	2778
24	115	6279	13159	3509	364	54811	66088	0	1244	14541	16923	2809
25	137	6351	12884	3495	483	55023	65159	0	1313	14478	16820	2874
30	152	6627	11542	3357	824	56165	60640	0	1651	14157	16300	3021
35	184	6829	10264	3210	1148	57262	56344	115	1982	13805	15787	3199
40	193	6971	9051	3043	1341	58116	52193	112	2307	13463	15288	3340
45	217	7047	7932	2891	1633	58885	48109	109	2624	13154	14789	3510
50	219	7056	6887	2735	1905	59489	44246	106	2934	12814	14298	3642
500	219	7056	6887	2735	1905	59489	44246	106	2934	12814	14298	3642

Notes

The top of the LTVSMC tailings in Cell 2W is approximated as 1727 feet

The base of the LTVSMC Tailings Basin is approximated as 1500 feet.

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Table 1-37 Seepage Direction from each zone in Cell 2E

Time (yrs)	Coarse Tailings (%)				Fine Tailings (%)				Other (%)			
	North	North-West	West	South	North	North-West	West	South	North	North-West	West	South
0	94.6	5.4	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
0.001	94.6	5.4	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
1	48.1	52.0	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
2	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
3	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
4	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
5	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
6	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
7	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
7.001	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
8	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
9	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
10	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
11	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
12	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
13	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
14	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
15	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
16	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
17	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
18	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
18.001	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
19	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
20	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
20.001	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
21	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
22	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
23	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
24	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
25	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
30	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
35	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
40	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
45	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
50	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0
500	1.5	98.5	0.0	0.0	100.0	0.0	0.0	0.0	98.6	1.4	0.0	0.0

Notes

Year 0 represents existing conditions, Year 7 is the year before Cell 1E and Cell 2E merge, Year 18 represents the beginning of closure activities, Year 20 represents final closure.

Table 1-38 Volume of saturated tailings under each zone of Cell 2E

Time (yrs)	Coarse Tailings (acre-ft)				Fine Tailings (acre-ft)				Other (acre-ft)			
	North	North-West	West	South	North	North-West	West	South	North	North-West	West	South
0	11179	638	0	0	14020	0	0	0	8196	116	0	0
0.001	13198	753	0	0	14020	0	0	0	13468	191	0	0
1	6744	7291	0	0	14020	0	0	0	13465	191	0	0
2	210	13810	0	0	14020	0	0	0	13525	192	0	0
3	210	13810	0	0	14020	0	0	0	13558	193	0	0
4	210	13810	0	0	14020	0	0	0	13604	193	0	0
5	210	13810	0	0	14020	0	0	0	13664	194	0	0
6	210	13810	0	0	14020	0	0	0	13744	195	0	0
7	210	13810	0	0	14020	0	0	0	13824	196	0	0
7.001	210	13810	0	0	14020	0	0	0	13824	196	0	0
8	210	13810	0	0	14020	0	0	0	13824	196	0	0
9	210	13810	0	0	14020	0	0	0	13824	196	0	0
10	210	13810	0	0	14020	0	0	0	13824	196	0	0
11	210	13810	0	0	14020	0	0	0	13824	196	0	0
12	210	13810	0	0	14020	0	0	0	13824	196	0	0
13	210	13810	0	0	14020	0	0	0	13824	196	0	0
14	210	13810	0	0	14020	0	0	0	13824	196	0	0
15	210	13810	0	0	14020	0	0	0	13824	196	0	0
16	210	13810	0	0	14020	0	0	0	13824	196	0	0
17	210	13810	0	0	14020	0	0	0	13824	196	0	0
18	210	13810	0	0	14020	0	0	0	13824	196	0	0
18.001	210	13810	0	0	14020	0	0	0	13824	196	0	0
19	210	13810	0	0	14020	0	0	0	13824	196	0	0
20	210	13810	0	0	14020	0	0	0	13824	196	0	0
20.001	210	13810	0	0	14020	0	0	0	13824	196	0	0
21	210	13810	0	0	14020	0	0	0	13824	196	0	0
22	210	13810	0	0	14020	0	0	0	13824	196	0	0
23	210	13810	0	0	14020	0	0	0	13824	196	0	0
24	210	13810	0	0	14020	0	0	0	13824	196	0	0
25	210	13810	0	0	14020	0	0	0	13824	196	0	0
30	210	13810	0	0	14020	0	0	0	13824	196	0	0
35	210	13810	0	0	14020	0	0	0	13824	196	0	0
40	210	13810	0	0	14020	0	0	0	13824	196	0	0
45	210	13810	0	0	14020	0	0	0	13824	196	0	0
50	210	13810	0	0	14020	0	0	0	13824	196	0	0
500	210	13810	0	0	14020	0	0	0	13824	196	0	0

Notes

The top of the LTVSMC tailings in Cell 2E is approximated as 1570 feet

The base of the LTVSMC Tailings Basin is approximated as 1500 feet.

Table 1-39 **Seepage Direction from each zone in Cell 1E**

	Coarse Tailings (%)				*Fine Tailings (%)*				*Other (%)*				*Pond (%)*			
Time (yrs)	*North*	*North-West*	*West*	*South*	*North*	*North-West*	*West*	*South*	*North*	*North-West*	*West*	*South*	*North*	*North-West*	*West*	*South*
0	62.7	4.5	0.0	32.8	41.1	16.3	0.0	42.6	0.0	0.0	0.0	0.0	27.4	16.6	10.4	45.6
0.001	62.7	4.5	0.0	32.8	41.1	16.3	0.0	42.6	0.0	0.0	0.0	0.0	27.4	16.6	10.4	45.6
1	33.1	18.6	0.0	48.3	28.1	24.3	0.0	47.7	0.0	0.0	0.0	0.0	21.0	20.3	10.4	48.5
2	3.5	32.7	0.0	63.8	15.1	32.2	0.0	52.7	0.0	0.0	0.0	0.0	14.5	23.9	10.3	51.3
3	2.8	37.0	0.7	59.5	12.4	32.1	1.4	54.1	0.0	0.0	0.0	0.0	12.0	22.1	12.5	53.4
4	2.1	41.3	1.3	55.2	9.7	32.0	2.8	55.5	0.0	0.0	0.0	0.0	9.5	20.2	14.8	55.5
5	1.5	45.7	2.0	50.9	6.9	31.9	4.2	57.0	0.0	0.0	0.0	0.0	7.0	18.4	17.0	57.6
6	0.8	50.0	2.6	46.6	4.2	31.8	5.6	58.4	0.0	0.0	0.0	0.0	4.5	16.5	19.3	59.7
7	0.1	54.3	3.3	42.3	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
7.001	0.1	54.3	3.3	42.3	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
8	0.1	45.9	5.4	48.7	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
9	0.0	37.4	7.4	55.1	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
10	0.0	29.0	9.5	61.5	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
11	0.0	25.4	8.3	66.3	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
12	0.0	21.8	7.1	71.1	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
13	0.0	18.1	5.9	75.9	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
14	0.0	14.5	4.8	80.7	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
15	0.0	10.9	3.6	85.6	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
16	0.0	7.3	2.4	90.4	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
17	0.0	3.6	1.2	95.2	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
18	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
18.001	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
19	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
20	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
20.001	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
21	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
22	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
23	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
24	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
25	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
30	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
35	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
40	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
45	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
50	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8
500	0.0	0.0	0.0	100.0	1.5	31.7	7.0	59.8	0.0	0.0	0.0	0.0	2.0	14.7	21.5	61.8

Notes

Year 0 represents existing conditions, Year 7 is the year before Cell 1E and Cell 2E merge, Year 18 represents the beginning of closure activities, Year 20 represents final closure.

Gray cells indicate that the feature (unsaturated fine tailings, dams, and the existing pond in Cell 1E) does not exist at that time.

Table 1-40 **Volume of saturated tailings under each zone of Cell 1E**

Time (yrs)	Coarse Tailings (acre-ft)				Fine Tailings (acre-ft)				Other (acre-ft)			
	North	North-West	West	South	North	North-West	West	South	North	North-West	West	South
0	22588	1621	0	11816	14640	5806	0	15174	0	0	0	0
0.001	22698	1629	0	11874	14688	5825	0	15224	0	0	0	0
1	12373	6953	0	18055	10366	8964	0	17596	0	0	0	0
2	1312	12261	0	23922	5589	11917	0	19504	0	0	0	0
3	1107	14625	277	23519	4964	12850	560	21657	0	0	0	0
4	871	17131	539	22897	4168	13751	1203	23849	0	0	0	0
5	651	19835	868	22092	3162	14620	1925	26123	0	0	0	0
6	348	21780	1133	20299	1925	14574	2566	26764	0	0	0	0
7	44	23723	1442	18480	687	14528	3208	27406	0	0	0	0
7.001	46	24850	1510	19358	687	14528	3208	27406	0	0	0	0
8	46	21007	2471	22288	687	14528	3208	27406	0	0	0	0
9	0	17119	3387	25221	687	14528	3208	27406	0	0	0	0
10	0	13276	4349	28155	687	14528	3208	27406	0	0	0	0
11	0	11630	3800	30356	687	14528	3208	27406	0	0	0	0
12	0	9983	3251	32558	687	14528	3208	27406	0	0	0	0
13	0	8289	2702	34758	687	14528	3208	27406	0	0	0	0
14	0	6642	2199	36964	687	14528	3208	27406	0	0	0	0
15	0	4994	1649	39216	687	14528	3208	27406	0	0	0	0
16	0	3344	1100	41416	687	14528	3208	27406	0	0	0	0
17	0	1649	550	43603	687	14528	3208	27406	0	0	0	0
18	0	0	0	45792	687	14528	3208	27406	0	0	0	0
18.001	0	0	0	45779	687	14528	3208	27406	0	0	0	0
19	0	0	0	45767	687	14528	3208	27406	0	0	0	0
20	0	0	0	45754	687	14528	3208	27406	0	0	0	0
20.001	0	0	0	45691	687	14528	3208	27406	0	0	0	0
21	0	0	0	45628	687	14528	3208	27406	0	0	0	0
22	0	0	0	45565	687	14528	3208	27406	0	0	0	0
23	0	0	0	45502	687	14528	3208	27406	0	0	0	0
24	0	0	0	45439	687	14528	3208	27406	0	0	0	0
25	0	0	0	45439	687	14528	3208	27406	0	0	0	0
30	0	0	0	45829	687	14528	3208	27406	0	0	0	0
35	0	0	0	45829	687	14528	3208	27406	0	0	0	0
40	0	0	0	45829	687	14528	3208	27406	0	0	0	0
45	0	0	0	45829	687	14528	3208	27406	0	0	0	0
50	0	0	0	45829	687	14528	3208	27406	0	0	0	0
500	0	0	0	45829	687	14528	3208	27406	0	0	0	0

Notes

The top of the LTVSMC tailings in Cell 1E is approximated as 1658 feet

The base of the LTVSMC Tailings Basin is approximated as 1500 feet.

Table 1-41 Stage-Area-Storage Relationship in the HRF

Elevation (ft)	*Area (acres)*	*Volume (acre-ft)*
1570	34.07	0.00
1572	35.06	69.13
1574	36.04	140.23
1576	37.02	213.29
1578	38.01	288.32
1580	38.99	365.33
1582	39.98	444.29
1584	40.96	525.23
1586	41.94	608.13
1588	42.93	693.01
1590	43.91	779.85
1592	44.90	868.66
1594	45.88	959.43
1596	46.86	1052.18
1598	47.85	1146.89
1600	53.05	1244.83
1602	54.33	1352.22
1604	55.61	1462.16
1606	56.89	1574.66
1608	58.17	1689.71
1610	59.45	1807.33
1612	60.73	1927.50
1614	62.00	2050.23
1616	63.28	2175.52
1618	64.56	2303.37
1620	65.84	2433.77
1622	67.12	2566.73
1624	68.40	2702.25
1626	69.68	2840.33
1628	70.96	2980.97
1630	77.08	3125.62
1632	78.49	3281.19
1634	79.91	3439.59
1636	81.32	3600.82
1638	82.74	3764.88
1640	84.15	3931.77
1642	85.57	4101.50
1644	86.99	4274.06
1646	88.40	4449.44
1648	89.82	4627.66
1650	96.54	4810.30

Table 1-42 Hydrometallurgical Residue Facility Evolution

Time (yrs)	*Crest_El (ft)*	*Forest_WS_Area (acres)*	*Cell2W_WS_Area (acres)*
0	1570	0.0	0.0
3	1600	42.0	14.9
6	1630	24.1	0.0
13	1650	25.3	0.0
500	1650	25.3	0.0

Table 1-43 FTB WWTP Effluent Concentration

Constituent	*Effluent_Conc (mg/L)*
Ag	0.001
Al	0.125
Alk (as CaCO3)	100
As	0.01
B	0.4
Ba	0
Be	0.004
Ca	75
Cd	0.004
Cl	1.3
Co	0.005
Cr	0.011
Cu	0.03
F	0.05
Fe	0.3
K	0.4
Mg	70
Mn	0.05
Na	1.6
Ni	0.1
Pb	0.019
Sb	0.031
Se	0.005
SO_4	0.7
Tl	0.00056
V	0.05
Zn	0.388

Notes

Effluent concentrations are based on the expected effluent of the chosen RO system

Table 1-44 Other Surface Water Quality Inputs

Constituent	*Area5NW_Conc* (mg/L)*	*Initial_Pond_Concs_1E** (mg/L)*	*Initial_Pond_Concs_2E** (mg/L)*	*CL_Quality (mg/L)*
Ag	0.0001	0.0001	0.0001	0.0001
Al	0.0125	0.01	0.01	0.078
Alk (as CaCO3)	96	260	340	27.8
As	0.0013	0.0047	0.0054	0.00075
B	0.16	0.25	0.3	0.042
Ba	0.0036	0.25	0.25	0.007
Be	0.0001	0.0002	0.0002	0.0001
Ca	85.7	26	34	19.8
Cd	0.0001	0.0001	0.0001	0.0001
Cl	4.33	23	23	2.17
Co	0.0004	0.0006	0.0006	0.00016
Cr	0.0005	0.0005	0.0005	0.0005
Cu	0.0018	0.0013	0.001	0.0027
F	0.17	5.9	4.4	0.088
Fe	0.116	0.025	0.03	0.86
K	51.9	8.7	12	0.94
Mg	243	47	66	8.5
Mn	0.804	0.048	0.079	0.066
Na	89.2	78	77	3.25
Ni	0.0036	0.0013	0.001	0.0021
Pb	0.00015	0.0016	0.0016	0.00025
Sb	0.00025	0.00025	0.00025	0.00025
Se	0.00079	0.0005	0.0005	0.0005
SO_4	1042	95	130	33.8
Tl	0.0001	0.00017	0.00017	0.0001
V	0.00541	0.00541	0.00541	0.00541
Zn	0.003	0.013	0.013	0.003

Notes

Source: Surface Water Samples for Area_5NW_Effluent_Conc from SD-033 through 08/23/2011

* Data not available for Alkalinity, Fluoride and Vanadium; GW values assumed

** Data not available for Ag, Al, Ba, Be, Cd, Cr, Pb, Sb, Se, Tl, V, & Zn; average concentrations at the North Toe (GW001 & GW012) assumed

Table 1-45 Removal Efficiency of the Permeable Reactive Barrier

Constituent	***PRB_Efficiency (% / day)***
Ag	0
Al	0
Alk	2
As	18
B	4
Ba	0
Be	0
Ca	14
Cd	0
Cl	0
Co	18
Cr	0
Cu	18
F	0
Fe	16
K	0
Mg	3
Mn	18
Na	0
Ni	18
Pb	15
Sb	0
Se	10
SO_4	10
Tl	0
V	0
Zn	18

Notes

First the total % removed was estimated using the PRB bench study, and the total % removed was divided by 5-days (HRT) to estimate the removal rate (% removed / day)

Table 1-46 Groundwater Flow Path Characteristics

Variable Name	*Units*	*Description*	*Groundwater Flow Path*			
			[N]	*[NW]*	*[W]*	*[S]**
HD	[m]	Downstream water table elevation	443.2	438.6	430	0
La	[m]	Total flow path length	3260	3715	5410	1
w	[m]	Average flow path width	1920	2090	2920	0
Init_Grad	[--]	Initial hydraulic gradient (determines flow capacity)	-0.00444	-0.00514	-0.00736	0
Eval_Loc1	[m]	Length from the upstream end (basin toe) to the first evaluation location on the flow path	1205	1325	3110	0

Notes

* South [S] flow path not actually modeled.

Table 1-47 Flow_Control, 1 if the SW location in the row contributes flow to the SW location in the column

Location	*PM12*	*PM12_2*	*PM12_3*	*PM12_4*	*PM13*	*MLC3*	*MLC2*	*TC1*	*PM19*	*UC1*	*PM11*
PM12	1	1	1	1	1	0	0	0	0	0	0
PM12_2	0	1	1	1	1	0	0	0	0	0	0
PM12_3	0	0	1	1	1	0	0	0	0	0	0
PM12_4	0	0	0	1	1	0	0	0	0	0	0
PM13	0	0	0	0	1	0	0	0	0	0	0
MLC3	0	0	1	1	1	1	1	0	0	0	0
MLC2	0	0	1	1	1	0	1	0	0	0	0
TC1	0	0	1	1	1	0	0	1	1	0	0
PM19	0	0	1	1	1	0	0	0	1	0	0
UC1	0	0	0	0	1	0	0	0	0	1	1
PM11	0	0	0	0	1	0	0	0	0	0	1

Table 1-48 **Surface Water Characteristics**

Surface Water Evaluation Point	*Lengths (m)*	*XS_Area (m^2)*
PM-12	6381	10
PM-12.2	6324	30
PM-12.3	14343	30
PM-12.4	5865	30
PM-13	5892	30
MLC-3	1210	5
MLC-2	2575	5
TC-1	1325	5
PM-19	2554	5
UC-1	10	5
PM-11	3300	5

Notes

Lengh based on GIS data

Area based on modeling assumptions

Table 1-49 Contributing Areas to each Surface Water Evaluation Point

Surface Water Evaluation Point	*Incremental Tributary Area (sq mi)**			
	Surface Water		*Groundwater*	
	SW_Contr_Areas (mi^2)	*FTBRO_Area (mi^2)*	*GW_Contr_Areas (mi^2)*	*Flowpath_Area (mi^2)*
PM-12	18.97	0	18.97	0
PM-12.2	14.12	0	14.12	0
PM-12.3	41.28	0	41.28	0
PM-12.4	11.38	0	10.94	0.44
PM-13	8.91	0	6.22	5.66
MLC-3	1.36	0.04	0.73	0
MLC-2	2.17	0	1.08	2.42
TC-1	1.94	0.24	0	0
PM-19	1.76	0	0	3
UC-1	0	0.03	0	0
PM-11	2.97	0.37	0	0

Notes

* Surface runoff areas are equal to or greater than the sum of groundwater areas. This is due to runoff from the Tailings Basin, where recharge is not applied because it is accounted for in seepage.

Table 1-50 **Distribution of Watershed Yield by Month**

Percentile	Watershed_Yield (cfs per square mile)											
	January	*February*	*March*	*April*	*May*	*June*	*July*	*August*	*September*	*October*	*November*	*December*
MIN	0.010	0.010	0.016	0.029	0.238	0.040	0.041	0.020	0.025	0.029	0.055	0.039
1%	0.012	0.010	0.016	0.040	0.306	0.043	0.045	0.023	0.029	0.033	0.062	0.040
5%	0.036	0.017	0.025	0.057	0.464	0.099	0.062	0.036	0.036	0.062	0.106	0.052
10%	0.041	0.027	0.032	0.113	0.578	0.204	0.077	0.045	0.050	0.094	0.136	0.062
20%	0.046	0.034	0.041	0.433	0.759	0.340	0.113	0.066	0.087	0.147	0.159	0.084
35%	0.057	0.045	0.051	0.838	1.099	0.555	0.204	0.101	0.170	0.215	0.215	0.108
50%	0.069	0.054	0.057	1.501	1.529	0.832	0.340	0.159	0.272	0.306	0.283	0.125
65%	0.084	0.062	0.071	2.197	2.069	1.268	0.540	0.249	0.430	0.408	0.385	0.170
80%	0.100	0.070	0.113	3.237	3.024	1.989	0.883	0.498	0.725	0.634	0.510	0.227
90%	0.109	0.085	0.249	4.470	4.222	2.797	1.785	0.861	1.373	1.119	0.736	0.294
95%	0.147	0.102	0.860	6.288	5.956	3.487	3.030	1.443	1.789	1.669	0.963	0.362
99%	0.227	0.113	4.596	10.622	14.760	6.320	5.443	2.660	5.614	4.417	1.538	0.530
MAX	0.249	0.159	8.766	16.874	19.479	12.344	8.947	3.216	8.935	5.130	1.880	0.566

Notes

* Based on USGS gage 04017000 data and 88.3 sq. mile drainage area

Table 1-51 Variation in Precipitation and Evaporation Throughout Each Year

Month	***Annual_P_Variation (yr/mon)***	***Annual_E_Variation (yr/mon)***
January	0.028	0.000
February	0.023	0.000
March	0.034	0.033
April	0.062	0.093
May	0.112	0.136
June	0.146	0.145
July	0.139	0.165
August	0.134	0.164
September	0.139	0.134
October	0.097	0.093
November	0.052	0.037
December	0.034	0.000

Notes

* Based on National Weather Service (NWS) sites closest to the Plant Site using the

Table 1-52 Initial_Mass_LTVSMC_Basin, Initial Mass in the LTVSMC Tailings Basin

Constituent	Toes[N] (tonnes)	Toes[NW] (tonnes)	Toes[W] (tonnes)	Toes[S] (tonnes)	UnsatFine2W (tonnes)	UnsatCoarse2W (tonnes)	UnsatBanks2W (tonnes)	UnsatFine1E (tonnes)	UnsatCoarse1E (tonnes)	UnsatFine2E (tonnes)	UnsatCoarse2E (tonnes)	UnsatBanks2E (tonnes)
Ag	5.59E-07	5.65E-07	7.76E-07	1.21E-06	1.84E-03	2.58E-04	4.88E-04	3.59E-04	1.28E-04	1.40E-04	2.49E-05	1.89E-05
Al	6.10E-05	8.23E-05	1.18E-04	1.23E-04	3.15E-01	4.77E-02	6.95E-02	2.83E-02	1.58E-02	1.92E-02	7.66E-03	4.37E-03
Alkalinity	1.69E+00	1.67E+00	2.34E+00	3.04E+00	5.96E+03	9.01E+02	1.31E+03	5.35E+02	2.99E+02	3.64E+02	1.45E+02	8.25E+01
As	2.49E-05	1.53E-05	1.94E-05	5.09E-05	3.60E-02	5.07E-03	9.55E-03	6.96E-03	2.51E-03	2.76E-03	4.93E-04	3.70E-04
B	1.82E-03	2.68E-03	3.91E-03	3.31E-03	1.08E+01	1.63E+00	2.38E+00	9.70E-01	5.41E-01	6.59E-01	2.62E-01	1.50E-01
Ba	1.13E-03	4.81E-04	5.24E-04	2.52E-03	4.36E-01	6.75E-02	9.14E-02	3.53E-02	2.21E-02	2.66E-02	1.33E-02	6.92E-03
Be	1.08E-06	1.09E-06	1.51E-06	2.27E-06	3.68E-03	5.57E-04	8.12E-04	3.31E-04	1.84E-04	2.25E-04	8.95E-05	5.10E-05
Ca	2.69E-01	5.62E-01	8.43E-01	4.45E-01	2.46E+03	3.72E+02	5.42E+02	2.21E+02	1.23E+02	1.50E+02	5.98E+01	3.41E+01
Cd	6.14E-07	7.58E-07	1.07E-06	1.30E-06	2.73E-03	3.81E-04	7.22E-04	5.22E-04	1.90E-04	2.07E-04	3.70E-05	2.79E-05
Cl	1.27E-01	1.36E-01	1.89E-01	2.65E-01	4.71E+02	7.13E+01	1.04E+02	4.23E+01	2.36E+01	2.88E+01	1.15E+01	6.53E+00
Co	7.38E-06	1.73E-05	2.58E-05	1.44E-05	7.37E-02	1.03E-02	1.95E-02	1.42E-02	5.10E-03	5.66E-03	1.00E-03	7.57E-04
Cr	2.88E-06	3.44E-06	4.87E-06	5.94E-06	1.26E-02	1.90E-03	2.77E-03	1.13E-03	6.30E-04	7.67E-04	3.05E-04	1.74E-04
Cu	9.30E-06	1.74E-05	2.54E-05	2.08E-05	6.91E-02	9.72E-03	1.84E-02	1.33E-02	4.83E-03	5.30E-03	9.38E-04	7.09E-04
F	2.56E-02	2.41E-02	3.20E-02	6.41E-02	7.04E+01	1.06E+01	1.55E+01	6.32E+00	3.53E+00	4.30E+00	1.71E+00	9.75E-01
Fe	8.06E-03	2.75E-02	4.19E-02	1.43E-02	1.24E+02	1.74E+01	3.29E+01	2.39E+01	8.61E+00	9.45E+00	1.68E+00	1.27E+00
K	5.90E-02	5.93E-02	8.38E-02	1.03E-01	2.16E+02	3.27E+01	4.76E+01	1.94E+01	1.08E+01	1.32E+01	5.25E+00	2.99E+00
Mg	4.75E-01	9.23E-01	1.38E+00	7.72E-01	4.01E+03	6.06E+02	8.84E+02	3.60E+02	2.01E+02	2.45E+02	9.75E+01	5.55E+01
Mn	2.03E-03	6.92E-03	1.06E-02	2.92E-03	3.23E+01	4.88E+00	7.12E+00	2.90E+00	1.62E+00	1.97E+00	7.85E-01	4.47E-01
Na	3.97E-01	3.42E-01	4.60E-01	8.56E-01	1.04E+03	1.58E+02	2.30E+02	9.36E+01	5.22E+01	6.37E+01	2.53E+01	1.44E+01
Ni	1.34E-05	3.13E-05	4.66E-05	2.80E-05	1.32E-01	1.85E-02	3.50E-02	2.55E-02	9.09E-03	1.01E-02	1.79E-03	1.37E-03
Pb	7.45E-06	3.91E-06	4.62E-06	1.67E-05	6.41E-03	9.00E-04	1.71E-03	1.24E-03	4.44E-04	4.89E-04	8.70E-05	6.62E-05
Sb	1.43E-06	1.53E-06	2.12E-06	3.08E-06	5.13E-03	7.20E-04	1.36E-03	9.85E-04	3.56E-04	3.90E-04	6.94E-05	5.26E-05
Se	2.82E-06	2.92E-06	4.03E-06	6.08E-06	9.69E-03	1.35E-03	2.57E-03	1.85E-03	6.71E-04	7.39E-04	1.31E-04	9.93E-05
SO4	1.11E+00	2.20E+00	3.27E+00	2.00E+00	9.26E+03	1.30E+03	2.45E+03	1.79E+03	6.43E+02	7.06E+02	1.25E+02	9.52E+01
Tl	9.38E-07	9.24E-07	1.27E-06	2.03E-06	2.98E-03	4.18E-04	7.89E-04	5.74E-04	2.08E-04	2.29E-04	4.02E-05	3.07E-05
V	2.47E-05	1.17E-05	1.34E-05	5.51E-05	1.58E-02	2.38E-03	3.47E-03	1.42E-03	7.90E-04	9.62E-04	3.83E-04	2.18E-04
Zn	6.51E-05	4.74E-05	6.13E-05	1.44E-04	1.23E-01	1.72E-02	3.25E-02	2.37E-02	8.50E-03	9.35E-03	1.66E-03	1.26E-03

Notes

* The values presented in this table are subject to change upon refinement or further development of the existing conditions Plant Site model

Table 1-53 Initial_Mass_Rate, Initial Mass Transport Rate in the LTVSMC Tailings Basin

Constituent	Cell2W_Fines (kg/day)	Cell2W_Coarse (kg/day)	Cell2W_Banks (kg/day)	Cell1E_Fines (kg/day)	Cell1E_Coarse (kg/day)	Cell1E_Pond (kg/day)	Cell2E_Fines (kg/day)	Cell2E_Coarses (kg/day)	Cell2E_Banks (kg/day)	Cell2E_Pond (kg/day)
Ag	2.96E-04	6.71E-05	1.07E-04	2.69E-05	3.01E-05	5.13E-04	2.17E-05	1.38E-05	7.73E-06	2.37E-04
Al	5.06E-02	1.24E-02	1.52E-02	2.16E-03	3.77E-03	5.13E-02	2.99E-03	4.28E-03	1.80E-03	2.37E-02
Alkalinity	9.57E+02	2.35E+02	2.88E+02	4.06E+01	7.12E+01	1.33E+03	5.64E+01	8.14E+01	3.40E+01	8.05E+02
As	5.78E-03	1.31E-03	2.10E-03	5.29E-04	5.87E-04	2.41E-02	4.24E-04	2.69E-04	1.52E-04	1.28E-02
B	1.74E+00	4.25E-01	5.22E-01	7.38E-02	1.29E-01	1.28E+00	1.02E-01	1.47E-01	6.17E-02	7.10E-01
Ba	7.01E-02	1.76E-02	2.00E-02	2.68E-03	5.28E-03	1.28E+00	4.13E-03	7.52E-03	2.86E-03	5.92E-01
Be	5.92E-04	1.45E-04	1.78E-04	2.51E-05	4.39E-05	1.03E-03	3.49E-05	5.03E-05	2.11E-05	4.73E-04
Ca	3.95E+02	9.69E+01	1.19E+02	1.68E+01	2.94E+01	1.33E+02	2.33E+01	3.36E+01	1.40E+01	8.05E+01
Cd	4.38E-04	9.94E-05	1.58E-04	3.89E-05	4.46E-05	5.13E-04	3.22E-05	2.04E-05	1.15E-05	2.37E-04
Cl	7.57E+01	1.86E+01	2.28E+01	3.21E+00	5.62E+00	1.18E+02	4.46E+00	6.43E+00	2.69E+00	5.44E+01
Co	1.18E-02	2.69E-03	4.29E-03	1.09E-03	1.21E-03	3.08E-03	8.66E-04	5.51E-04	3.11E-04	1.42E-03
Cr	2.02E-03	4.95E-04	6.07E-04	8.55E-05	1.50E-04	2.56E-03	1.19E-04	1.72E-04	7.17E-05	1.18E-03
Cu	1.11E-02	2.53E-03	4.03E-03	1.01E-03	1.13E-03	6.66E-03	8.09E-04	5.18E-04	2.93E-04	2.37E-03
F	1.13E+01	2.77E+00	3.40E+00	4.80E-01	8.40E-01	3.02E+01	6.67E-01	9.59E-01	4.02E-01	1.04E+01
Fe	1.99E+01	4.52E+00	7.20E+00	1.81E+00	2.02E+00	1.28E-01	1.46E+00	9.27E-01	5.23E-01	7.10E-02
K	3.47E+01	8.51E+00	1.04E+01	1.48E+00	2.59E+00	4.46E+01	2.05E+00	2.95E+00	1.23E+00	2.84E+01
Mg	6.45E+02	1.58E+02	1.94E+02	2.73E+01	4.81E+01	2.41E+02	3.79E+01	5.49E+01	2.29E+01	1.56E+02
Mn	5.19E+00	1.27E+00	1.56E+00	2.21E-01	3.85E-01	2.46E-01	3.06E-01	4.41E-01	1.85E-01	1.87E-01
Na	1.67E+02	4.10E+01	5.03E+01	7.06E+00	1.24E+01	4.00E+02	9.89E+00	1.42E+01	5.95E+00	1.82E+02
Ni	2.13E-02	4.82E-03	7.67E-03	1.90E-03	2.16E-03	6.66E-03	1.56E-03	9.89E-04	5.58E-04	2.37E-03
Pb	1.03E-03	2.34E-04	3.72E-04	9.25E-05	1.05E-04	8.20E-03	7.55E-05	4.80E-05	2.70E-05	3.79E-03
Sb	8.24E-04	1.88E-04	2.99E-04	7.49E-05	8.35E-05	1.28E-03	6.03E-05	3.84E-05	2.17E-05	5.92E-04
Se	1.56E-03	3.53E-04	5.62E-04	1.42E-04	1.58E-04	2.56E-03	1.14E-04	7.25E-05	4.07E-05	1.18E-03
SO4	1.49E+03	3.37E+02	5.37E+02	1.35E+02	1.51E+02	4.87E+02	1.09E+02	6.92E+01	3.90E+01	3.08E+02
Tl	4.79E-04	1.09E-04	1.73E-04	4.33E-05	4.88E-05	8.71E-04	3.50E-05	2.23E-05	1.26E-05	4.02E-04
V	2.53E-03	6.21E-04	7.61E-04	1.08E-04	1.88E-04	2.77E-02	1.49E-04	2.15E-04	9.00E-05	1.28E-02
Zn	1.97E-02	4.47E-03	7.12E-03	1.79E-03	2.00E-03	6.66E-02	1.44E-03	9.17E-04	5.17E-04	3.08E-02

Notes

* The values presented in this table are subject to change upon refinement or further development of the existing conditions Plant Site model

Table 1-54 Expected_Toe_Conc, Expected Existing Constituent Concentrations at the Toes of the Tailings Basin

Constituent	**Expected_Toe_Conc[N] (ug/L)**	**Expected_Toe_Conc[NW] (ug/L)**	**Expected_Toe_Conc[W] (ug/L)**	**Expected_Toe_Conc[S] (ug/L)**
Ag	0.11	0.09	0.09	0.11
Al	10	10	10	10
Alkalinity	305000	277100	278900	262900
As	4.7	2.3	2.1	4.6
B	325	425	465	280
Ba	200	80	62	220
Be	0.2	0.18	0.18	0.2
Ca	47380	93000	99950	37200
Cd	0.13	0.11	0.12	0.12
Cl	22900	22650	22600	22950
Co	1.8	2.8	3	1.6
Cr	0.52	0.56	0.57	0.51
Cu	1.9	2.3	2.4	1.9
F	5000	5000	5000	6000
Fe	2100	4140	4540	1710
K	10720	10020	10160	8920
Mg	84200	153700	165000	64770
Mn	345	1140	1250	230
Na	72200	57500	55400	74600
Ni	3.2	5	5.3	3
Pb	1.4	0.6	0.5	1.5
Sb	0.28	0.23	0.22	0.29
Se	0.57	0.45	0.45	0.57
SO4	244000	323000	344000	205000
Tl	0.19	0.14	0.14	0.19
V	5.4	5.4	5.4	5.4
Zn	12.6	7.5	6.9	13.1

Notes

* The values presented in this table are subject to change upon refinement or further development of the existing conditions Plant Site model

Table 2-1 Output Constituents for the Plant Site Model

Constituent
Ag
Al
Alk
As
B
Ba
Be
Ca
Cd
Cl
Co
Cr
Cu
F
Fe
Hardness
K
Mg
Mn
Na
Ni
Pb
Sb
Se
SO_4
Tl
V
Zn

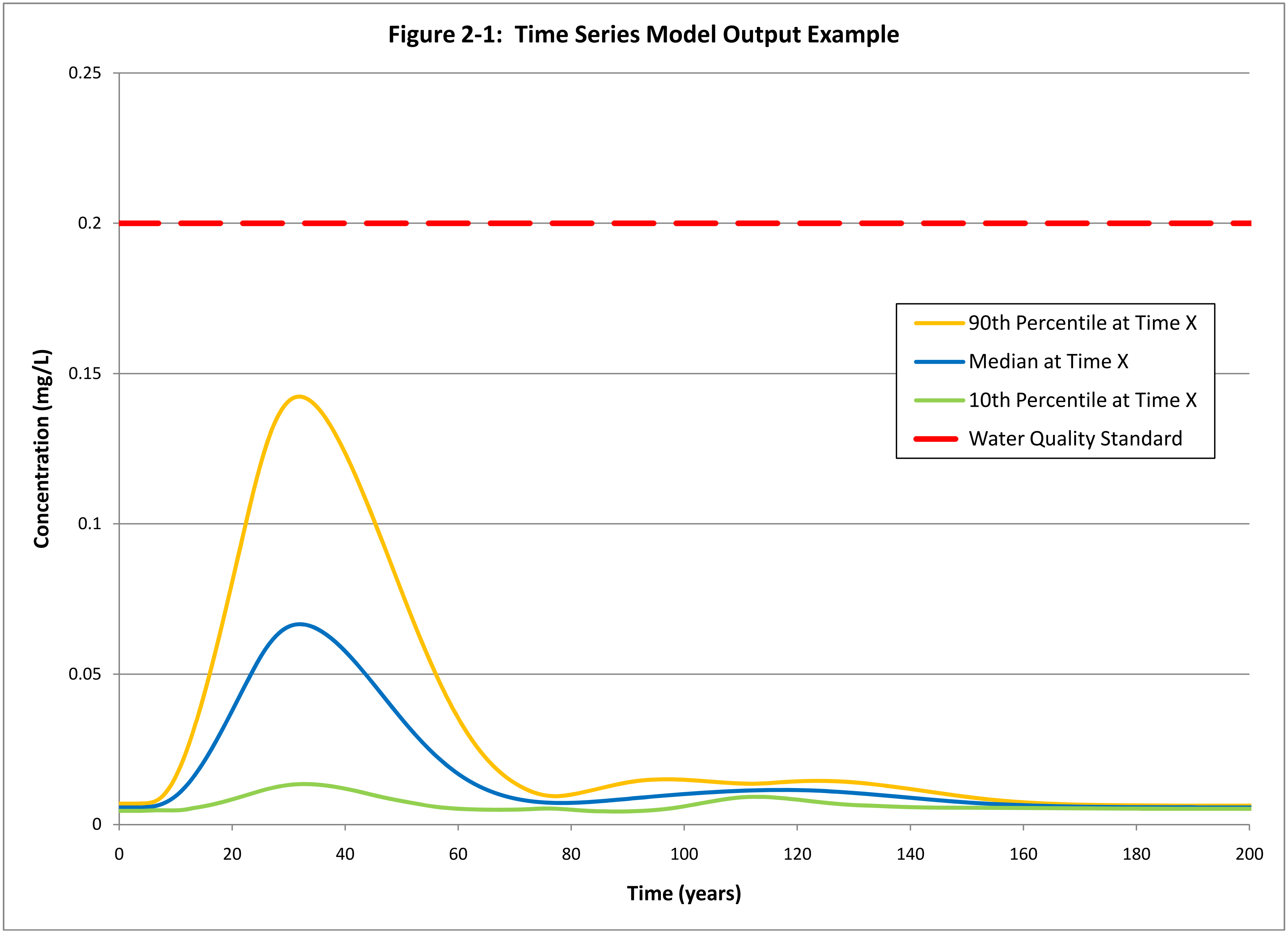
Table 2-2 Output Locations for the Plant Site Model

Surface Water Evaluation Locations

Evaluation Location	*Applicable Standards*
PM-12	SW
PM-12.2	SW
PM-12.3	SW
PM-12.4	SW
PM-13	SW
MLC-3	SW
MLC-2	SW
TC-1	SW
PM-19	SW
UC-1	SW
PM-11	SW

Groundwater Evaluation Locations

Flowpath	*Evaluation Locations*	*Applicable Standards*	*Receiving Surface Water Node*
North	Prop. Bound.	GW	MLC-2
North-West	Prop. Bound.	GW	PM-19
West	Prop. Bound.	GW	PM-13



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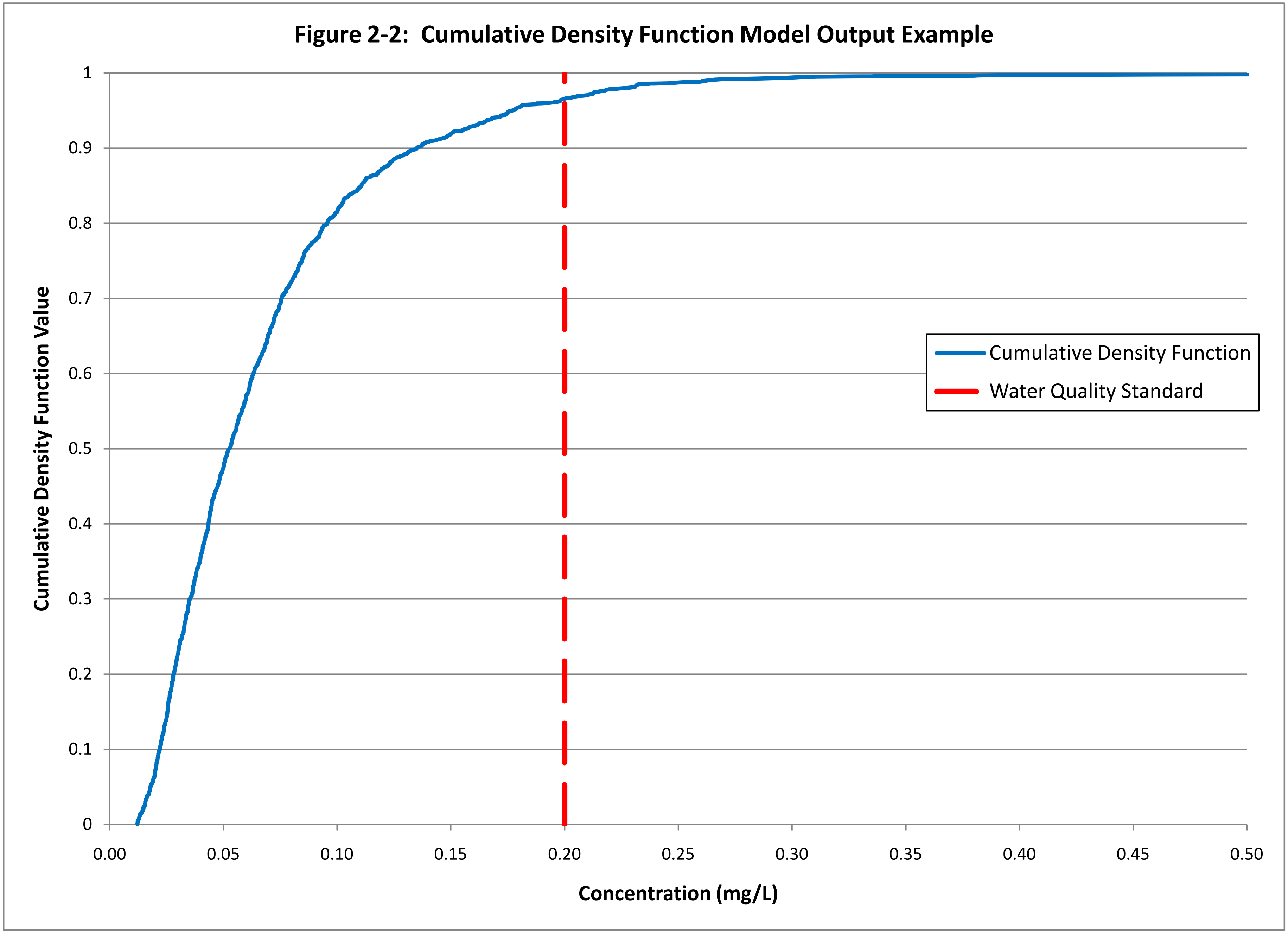

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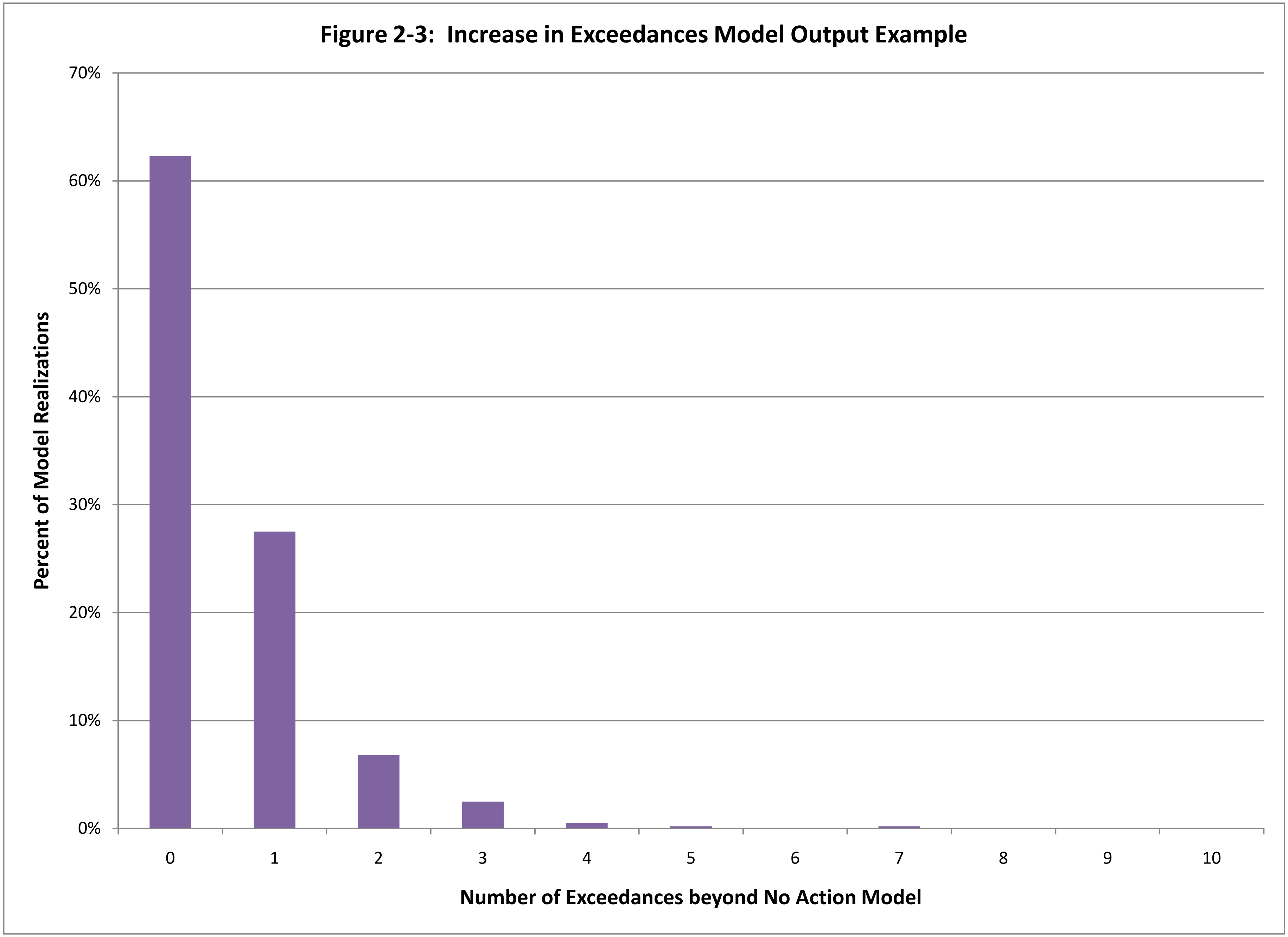

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