NorthMet Project

Water Management Plan - Mine

Version 7

Issue Date: December 2017

This document was prepared for Poly Met Mining, Inc.
by Barr Engineering Co.

PART ONE: Applicant Information

If applicant is an entity (company, government entity, partnership, etc.), an authorized contact person must be identified. If the applicant is using an agent (consultant, lawyer, or other third party) and has authorized them to act on their behalf, the agent's contact information must also be provided.

Applicant/Landowner Name: Poly Met Mining, Inc.
Mailing Address: Poly Met Mining, Inc. Suite 2060, 444 Cedar Street, St. Paul, MN 55110
Phone: 651-389-4108
E-mail Address: jsaran@polymetmining.com

Authorized Contact (do not complete if same as above):
Mailing Address:
Phone:
E-mail Address:

Agent Name:
Mailing Address:
Phone:
E-mail Address:

PART TWO: Site Location Information

County: St. Louis **City/Township:**
Parcel ID and/or Address:
Legal Description (Section, Township, Range): Please see Section 3 of the Wetland Replacement Plan for location information
Lat/Long (decimal degrees):
Attach a map showing the location of the site in relation to local streets, roads, highways. Please see Large Figure 1 of the Wetland Replacement Plan
Approximate size of site (acres) or if a linear project, length (feet): 9,114 acres

If you know that your proposal will require an individual Permit from the U.S. Army Corps of Engineers, you must provide the names and addresses of all property owners adjacent to the project site. This information may be provided by attaching a list to your application [Please see Section 7 and Large Table 4 of the wetland replacement plan]
or by using block 25 of the Application for Department of the Army permit which can be obtained at:

http://www.mvp.usace.army.mil/Portals/57/docs/regulatory/RegulatoryDocs/engform_4345_2012oct.pdf

PART THREE: General Project/Site Information

If this application is related to a delineation approval, exemption determination, jurisdictional determination, or other correspondence submitted ***prior to*** this application then describe that here and provide the Corps of Engineers project number.
USACE File # 1999-5528-JKA

Describe the project that is being proposed, the project purpose and need, and schedule for implementation and completion. The project description must fully describe the nature and scope of the proposed activity including a description of all project elements that effect aquatic resources (wetland, lake, tributary, etc.) and must also include plans and cross section or profile drawings showing the location, character, and dimensions of all proposed activities and aquatic resource impacts.

Please see Sections 4, 5, and 11 of the Wetland Replacement Plan.

PART FOUR: Aquatic Resource Impact[1] Summary

If your proposed project involves a direct or indirect impact to an aquatic resource (wetland, lake, tributary, etc.) identify each impact in the table below. Include all anticipated impacts, including those expected to be temporary. Attach an overhead view map, aerial photo, and/or drawing showing all of the aquatic resources in the project area and the location(s) of the proposed impacts. Label each aquatic resource on the map with a reference number or letter and identify the impacts in the following table.

Please see Section 11 and Large Table 1 and Large Table 2 of the Wetland Replacement Plan.

Aquatic Resource ID (as noted on overhead view)	**Aquatic Resource Type** (wetland, lake, tributary etc.)	**Type of Impact** (fill, excavate, drain, or remove vegetation)	**Duration of Impact** Permanent (P) or Temporary (T)[1]	**Size of Impact**[2]	**Overall Size of Aquatic Resource** [3]	**Existing Plant Community Type(s)** in Impact Area[4]	**County, Major Watershed #, and Bank Service Area #** of Impact Area[5]

[1]If impacts are temporary; enter the duration of the impacts in days next to the "T". For example, a project with a temporary access fill that would be removed after 220 days would be entered "T (220)".
[2]Impacts less than 0.01 acre should be reported in square feet. Impacts 0.01 acre or greater should be reported as acres and rounded to the nearest 0.01 acre. Tributary impacts must be reported in linear feet of impact and an area of impact by indicating first the linear feet of impact along the flowline of the stream followed by the area impact in parentheses). For example, a project that impacts 50 feet of a stream that is 6 feet wide would be reported as 50 ft (300 square feet).
[3]This is generally only applicable if you are applying for a de minimis exemption under MN Rules 8420.0420 Subp. 8, otherwise enter "N/A".
[4]Use *Wetland Plants and Plant Community Types of Minnesota and Wisconsin* 3rd Ed. as modified in MN Rules 8420.0405 Subp. 2.
[5]Refer to Major Watershed and Bank Service Area maps in MN Rules 8420.0522 Subp. 7.

If any of the above identified impacts have already occurred, identify which impacts they are and the circumstances associated with each:

PART FIVE: Applicant Signature

☐ Check here if you are requesting a pre-application consultation with the Corps and LGU based on the information you have provided. Regulatory entities will not initiate a formal application review if this box is checked.

By signature below, I attest that the information in this application is complete and accurate. I further attest that I possess the authority to undertake the work described herein.

Applicant Name: Jennifer Saran Title: Director of Environmental Permitting

Signature: ______________ Date: 12/11/2017

I hereby authorize ______ to act on my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this application.

[1] **The term "impact" as used in this joint application form is a generic term used for disclosure purposes to identify activities that may require approval from one or more regulatory agencies. For purposes of this form it is not meant to indicate whether or not those activities may require mitigation/replacement.**

Attachment A
Request for Delineation Review, Wetland Type Determination, or Jurisdictional Determination

By submission of the enclosed wetland delineation report, I am requesting that the U.S. Army Corps of Engineers, St. Paul District (Corps) and/or the Wetland Conservation Act Local Government Unit (LGU) provide me with the following (check all that apply):

☒ **Wetland Type Confirmation**

☒ **Delineation Concurrence**. Concurrence with a delineation is a written notification from the Corps and a decision from the LGU concurring, not concurring, or commenting on the boundaries of the aquatic resources delineated on the property. Delineation concurrences are generally valid for five years unless site conditions change. Under this request alone, the Corps will not address the jurisdictional status of the aquatic resources on the property, only the boundaries of the resources within the review area (including wetlands, tributaries, lakes, etc.).

☐ **Preliminary Jurisdictional Determination**. A preliminary jurisdictional determination (PJD) is a non-binding written indication from the Corps that waters, including wetlands, identified on a parcel may be waters of the United States. For purposes of computation of impacts and compensatory mitigation requirements, a permit decision made on the basis of a PJD will treat all waters and wetlands in the review area as if they are jurisdictional waters of the U.S. PJDs are advisory in nature and may not be appealed.

☐ **Approved Jurisdictional Determination**. An approved jurisdictional determination (AJD) is an official Corps determination that jurisdictional waters of the United States are either present or absent on the property. AJDs can generally be relied upon by the affected party for five years. An AJD may be appealed through the Corps administrative appeal process.

In order for the Corps and LGU to process your request, the wetland delineation must be prepared in accordance with the 1987 Corps of Engineers Wetland Delineation Manual, any approved Regional Supplements to the 1987 Manual, and the *Guidelines for Submitting Wetland Delineations in Minnesota* (2013).
http://www.mvp.usace.army.mil/Missions/Regulatory/DelineationJDGuidance.aspx

Attachment B
Supporting Information for Applications Involving Exemptions, No Loss Determinations, and Activities Not Requiring Mitigation

Complete this part ***if*** you maintain that the identified aquatic resource impacts in Part Four do not require wetland replacement/compensatory mitigation OR ***if*** you are seeking verification that the proposed water resource impacts are either exempt from replacement or are not under CWA/WCA jurisdiction.

Identify the specific exemption or no-loss provision for which you believe your project or site qualifies:

Wetland located in the Cliffs Erie LLC (formerly LTVSMC) Permit to Mine permitted boundary of the Tailings Basin in the LTVSMC Coal Ash Landfill is proposed as an incidental wetland under Minnesota Rules, part 8420.0930, Subpt. 1 and Minnesota Rules, part 8420.0105, subpart 2, item D.

Provide a detailed explanation of how your project or site qualifies for the above. Be specific and provide and refer to attachments and exhibits that support your contention. Applicants should refer to rules (e.g. WCA rules), guidance documents (e.g. BWSR guidance, Corps guidance letters/public notices), and permit conditions (e.g. Corps General Permit conditions) to determine the necessary information to support the application. Applicants are strongly encouraged to contact the WCA LGU and Corps Project Manager prior to submitting an application if they are unsure of what type of information to provide:

Under 8420.0930 Mining, Subp. 1. Impacts from mining: Wetlands must not be impacted as part of a project for which a permit to mine is required by Minnesota Statutues, section 93.481, except as approved by the commissioner. Impacts to wetlands that the landowner can demonstrate, to the satisfaction of the local governmental unit, were created by pits, stockpiles, or tailings basins, and by action the purpose of which was not to create the wetland according to part 8420.0105, subpart 2, item D, are not regulated under this chapter."

The wetland was created as a drainage feature for the artificially-created landfill located in a tailings basin area. Under 8420.0105, subpart 2, item D, this area was created in a nonwetland area as a drainage feature for the purpose of drainage and not as part of a wetland replacement process.

Attachment C
Avoidance and Minimization

Project Purpose, Need, and Requirements. Clearly state the purpose of your project and need for your project. Also include a description of any specific requirements of the project as they relate to project location, project footprint, water management, and any other applicable requirements. Attach an overhead plan sheet showing all relevant features of the project (buildings, roads, etc.), aquatic resource features (impact areas noted) and construction details (grading plans, storm water management plans, etc.), referencing these as necessary:

Please see Sections 4 and 5 of the Wetland Replacement Plan.

Avoidance. Both the CWA and the WCA require that impacts to aquatic resources be avoided if practicable alternatives exist. Clearly describe all on-site measures considered to avoid impacts to aquatic resources and discuss at least two project alternatives that avoid all impacts to aquatic resources on the site. These alternatives may include alternative site plans, alternate sites, and/or not doing the project. Alternatives should be feasible and prudent (see MN Rules 8420.0520 Subp. 2 C). Applicants are encouraged to attach drawings and plans to support their analysis:

Please see Section 6 of the Wetland Replacement Plan.

Minimization. Both the CWA and the WCA require that all unavoidable impacts to aquatic resources be minimized to the greatest extent practicable. Discuss all features of the proposed project that have been modified to minimize the impacts to water resources (see MN Rules 8420.0520 Subp. 4):

Please see Section 6 of the Wetland Replacement Plan.

Off-Site Alternatives. An off-site alternatives analysis is not required for all permit applications. If you know that your proposal will require an individual permit (standard permit or letter of permission) from the U.S. Army Corps of Engineers, you may be required to provide an off-site alternatives analysis. The alternatives analysis is not required for a complete application but must be provided during the review process in order for the Corps to complete the evaluation of your application and reach a final decision. Applicants with questions about when an off-site alternatives analysis is required should contact their Corps Project Manager.

Please see Section 6 of the Wetland Replacement Plan.

Attachment D
Replacement/Compensatory Mitigation

Complete this part ***if*** your application involves wetland replacement/compensatory mitigation not associated with the local road wetland replacement program. Applicants should consult Corps mitigation guidelines and WCA rules for requirements.

Replacement/Compensatory Mitigation via Wetland Banking. Complete this section if you are proposing to use credits from an existing wetland bank (with an account number in the State wetland banking system) for all or part of your replacement/compensatory mitigation requirements.

Wetland Bank Account #	County	Major Watershed #	Bank Service Area #	Credit Type (if applicable)	Number of Credits
1609	St. Louis	3	1	NA	1,800

Applicants should attach documentation indicating that they have contacted the wetland bank account owner and reached at least a tentative agreement to utilize the identified credits for the project. This documentation could be a signed purchase agreement, signed application for withdrawal of credits or some other correspondence indicating an agreement between the applicant and the bank owner. *However, applicants are advised not to enter into a binding agreement to purchase credits until the mitigation plan is approved by the Corps and LGU.*

Please see Attachment C of the Wetland Replacement Plan for documentation.

Project-Specific Replacement/Permittee Responsible Mitigation. Complete this section if you are proposing to pursue actions (restoration, creation, preservation, etc.) to generate wetland replacement/compensatory mitigation credits for this proposed project.

WCA Action Eligible for Credit[1]	Corps Mitigation Compensation Technique[2]	Acres	Credit % Requested	Credits Anticipated[3]	County	Major Watershed #	Bank Service Area #

[1]Refer to the name and subpart number in MN Rule 8420.0526.
[2]Refer to the technique listed in *St. Paul District Policy for Wetland Compensatory Mitigation in Minnesota*.
[3]If WCA and Corps crediting differs, then enter both numbers and distinguish which is Corps and which is WCA.

Explain how each proposed action or technique will be completed (e.g. wetland hydrology will be restored by breaking the tile……) and how the proposal meets the crediting criteria associated with it. Applicants should refer to the Corps mitigation policy language, WCA rule language, and all associated Corps and WCA guidance related to the action or technique:

Attach a site location map, soils map, recent aerial photograph, and any other maps to show the location and other relevant features of each wetland replacement/mitigation site. Discuss in detail existing vegetation, existing landscape features, land use (on and surrounding the site), existing soils, drainage systems (if present), and water sources and movement. Include a topographic map showing key features related to hydrology and water flow (inlets, outlets, ditches, pumps, etc.):

Attach a map of the existing aquatic resources, associated delineation report, and any documentation of regulatory review or approval. Discuss as necessary:

For actions involving construction activities, attach construction plans and specifications with all relevant details. Discuss and provide documentation of a hydrologic and hydraulic analysis of the site to define existing conditions, predict project outcomes, identify specific project performance standards and avoid adverse offsite impacts. Plans and specifications should be prepared by a licensed engineer following standard engineering practices. Discuss anticipated construction sequence and timing:

For projects involving vegetation restoration, provide a vegetation establishment plan that includes information on site preparation, seed mixes and plant materials, seeding/planting plan (attach seeding/planting zone map), planting/seeding methods, vegetation maintenance, and an anticipated schedule of activities:

For projects involving construction or vegetation restoration, identify and discuss goals and specific outcomes that can be determined for credit allocation. Provide a proposed credit allocation table tied to outcomes:

Provide a five-year monitoring plan to address project outcomes and credit allocation:

Discuss and provide evidence of ownership or rights to conduct wetland replacement/mitigation on each site:

Quantify all proposed wetland credits and compare to wetland impacts to identify a proposed wetland replacement ratio. Discuss how this replacement ratio is consistent with Corps and WCA requirements:

By signature below, the applicant attests to the following (only required if application involves project-specific/permittee responsible replacement):

- All proposed replacement wetlands were not:
    - Previously restored or created under a prior approved replacement plan or permit
    - Drained or filled under an exemption during the previous 10 years
    - Restored with financial assistance from public conservation programs
    - Restored using private funds, other than landowner funds, unless the funds are paid back with interest to the individual or organization that funded the restoration and the individual or organization notifies the local government unit in writing that the restored wetland may be considered for replacement.
- The wetland will be replaced before or concurrent with the actual draining or filling of a wetland.
- An irrevocable bank letter of credit, performance bond, or other acceptable security will be provided to guarantee successful completion of the wetland replacement.
- Within 30 days of either receiving approval of this application or beginning work on the project, I will record the Declaration of Restrictions and Covenants on the deed for the property on which the replacement wetland(s) will be located and submit proof of such recording to the LGU and the Corps.

Applicant or Representative: Title:

Signature: ______________________________ Date:

I hereby certify that this report, with the exception of the sections listed below, was prepared by me or under my direct supervision and that I am a duly Licensed Professional Geologist under the laws of the state of Minnesota.

Tina Pint, PG — Date: 12/7/2017

PG #: 46154

I hereby certify that portions of this report were prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota, specifically the preliminary design of Mine Water Management Systems in Sections 2.1, 2.1.1, 2.1.3, 2.1.4, and 2.1.5 of this report.

Nancy Dent Johnson, P.E. — Date: 12/7/2017

PE #: 22740

I hereby certify that portions of this report were prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota, specifically the preliminary design of the mine water pumping stations in Sections 2.1.6, 2.1.7, 4.1.1, and 4.1.2 of this report.

Bryan T. Oakley, P.E. — Date: 12/7/2017

PE #: 24480

I hereby certify that portions of this report were prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota, specifically the preliminary design of the mine water pipelines and Sewage Management Systems in Sections 2.1.8, 2.3, 4.1.3, 4.1.4, 4.1.5, 4.1.6, and 4.4.1 of this report.

12/7/2017

Jon Minne, P.E. Date

PE #: 25080

I hereby certify that portions of this report were prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota, specifically the preliminary design of the Mine Site Stormwater Management Systems in Sections 2.2, 4.2, and 4.4.2 of this report.

12/7/2017

Paul T. Swenson, P.E. Date

PE #: 20533

Table of Contents

Acronyms, Abbreviations, and Units

Acronym	Stands For
AWMP	Adaptive Water Management Plan
BMPs	best management practice
cfs	cubic feet per second
CPS	Central Pumping Station
CRE	Contingency Reclamation Estimate
fps	feet per second
FSP	Field Sampling Plan
FTB	Flotation Tailings Basin
HCEQ	High Concentration Equalization Basin
HDPE	high-density polyethylene
HRC	haul road central
HRE	haul road east
HRN	haul road north
HRW	haul road west
LCEQ	Low Concentration Equalization Basins 1 and 2
LCRS	leak collection and recovery system
DNR	Minnesota Department of Natural Resources
mg/L	milligram per liter
mi^2	square mile
mm	millimeter
MPCA	Minnesota Pollution Control Agency
MPP	Mine to Plant Pipelines
MSFMF	Mine Site Fueling and Maintenance Facility
MSHA	Mine Safety and Health Administration

Acronym	Stands For
N/A	not applicable
NPDES	National Pollutant Discharge Elimination System
No.	Number
NWL	normal water level
OSLA	Overburden Storage and Laydown Area
OSP	Ore Surge Pile
PRB	Permeable Reactive Barrier
PTM	Permit to Mine
MW-	Mine water (prefix)
QAPP	Quality Assurance Project Plan
RTH	Rail Transfer Hopper
S	Mine water sump (prefix)
SAP	Sampling and Analysis Plan
SCS	Soil Conservation Service
SDS	State Disposal System
SOP	Standard Operating Procedure
SPCC	Spill Prevention Control and Countermeasures
SWPPP	Stormwater Pollution Prevention Plan
TSS	total suspended solids
USGS	United States Geological Survey
WWTS	Waste Water Treatment System
XP-SWMM	Software package used to model stormwater, sanitary water, and river systems

1.0 Introduction

This document presents the Water Management Plan - Mine for Poly Met Mining, Inc.'s (PolyMet's) NorthMet Project (Project) and describes the management of mine water (note this was formerly referred to as "process water" throughout the environmental review process and "mine drainage" during part of the permitting process) and stormwater at the Mine Site. It includes design of mine water, stormwater, and sewage infrastructure associated with the Mine Site, operating plans, water quality and quantity monitoring plans, reporting requirements, and adaptive management approaches. Information from this report is included in the Minnesota Department of Natural Resources (DNR) Permit to Mine (PTM) application and Consolidated Water Appropriation Permit application and Minnesota Pollution Control Agency (MPCA) National Pollutant Discharge Elimination System (NPDES) / State Disposal System (SDS) Permit application. This and other Management Plans have evolved through the environmental review and permitting phases of the Project.

In addition to the management of water at the Mine Site, this document also briefly references the quantity of water that the Project will remove from the upper reaches of the Partridge River and the quantity of water that will be discharged from the Mine Site in postclosure maintenance, as modeled in the Water Modeling Data Package Volume 1 – Mine Site (Reference (1)).

Several other Management Plans contain information that relates to the water management at the Mine Site. The NorthMet Project Rock and Overburden Management Plan (ROMP, Reference (2)) includes design details for stockpile drainage containment/liner systems. The NorthMet Project Adaptive Water Management Plan (AWMP, Reference (3)) contains details of adaptive engineering controls (Waste Water Treatment System (WWTS) and Category 1 Waste Rock Stockpile cover) to support compliance with applicable water quality standards at appropriate evaluation points.

Note that some terminology associated with the WWTS has changed since the environmental review process. Changes are associated with the relocation of the mine water treatment trains that were previously at the Mine Site Waste Water Treatment Facility (WWTF) to the Plant Site WWTS, and the relocation of the Mine Site equalization basins, Central Pumping Station, and Construction Mine Water Basin south of Dunka Road. To aid review of documents prepared for the Final Environmental Impact Statement (FEIS) which are referenced in this plan, Attachment A explains the WWTS terminology changes.

1.1 Objective and Overview

The objective of the Water Management Plan - Mine is to describe a safe and reliable system for managing the water at the Mine Site in a manner that results in compliance with applicable surface water and groundwater quality standards at appropriate Mine Site compliance points and is in accordance with conditions of Project NPDES/SDS Permits and Water Appropriation Permits.

As background to this water management plan, an understanding of the overall mine plan is necessary. Ore will be mined from the East Pit from Mine Years 1 to 11 and from the West Pit from Mine Years 2 to 11. During that period, the more potentially reactive waste rock (Category 2/3 and 4 waste rock) will be placed in temporary stockpiles, and the least potentially reactive waste rock (Category 1 waste rock) will be placed in a permanent stockpile. Ore will be mined from the West and Central Pits from Mine Years 11 to 16. As mining of the Central Pit progresses, it will be joined to the East Pit, and the combined pit (after Mine Year 13) will be referred to as the East Pit. From Mine Years 17 to 20, ore will be mined only from the West Pit. Beginning in Mine Year 11, after mining is completed in the East Pit, waste rock mined from the West and Central Pits will be placed directly in the East Pit. The waste rock in the temporary stockpiles will be relocated to the East Pit beginning in Mine Year 11. As the least potentially reactive waste rock (Category 1 waste rock) is mined, it will be placed in the permanent stockpile or the East Pit after Mine Year 11. As the East Pit is backfilled, water will be pumped to the pit from the WWTS and the Overburden Storage and Laydown Area to submerge the backfilled rock. By the end of operations (Mine Year 20), the East and Central Pits will be backfilled with waste rock mined from the West and Central Pits, waste rock and overburden from the temporary stockpiles, and water, resulting in permanent subaqueous disposal of these materials.

1.2 Outline

The outline of this document is:

Section 1.0	Introduction, objective and overview, and description of the Mine Site baseline data and existing conditions
Section 2.0	Description of the design of the mine water management systems and stormwater management infrastructure at the Mine Site
Section 3.0	Description of key outcomes of the design, including quantity of water pumped to the FTB, WWTS, or East Pit and estimated water quality
Section 4.0	Description of operational water management plans for mine water, stormwater, spills, and overflows
Section 5.0	Description of proposed water quantity and quality monitoring, including mine water internal to the Project, stormwater from the Mine Site, external groundwater, and external surface water. The specifics of monitoring, including specific locations, nomenclature, frequency, and parameters will be finalized upon completion of the NPDES/SDS and Water Appropriation permitting processes.
Section 6.0	Description of monthly and annual reporting requirements including comparison to modeled outcomes and compliance, adaptive management plans, and available mitigations

Because this document has evolved through the environmental review and permitting (NPDES/SDS, Water Appropriation, and PTM) phases of the Project, a Revision History is included at the end of the document.

1.3 Baseline Data

Section 4 of Reference (1) describes the baseline climate, land use, geology, surface water, and groundwater data used in water quantity and quality modeling at the Mine Site. This section provides a summary of the baseline surface water and groundwater data from Reference (1).

1.3.1 Surface Water Baseline Data

As described in Section 4.4 of Reference (1), the Mine Site is located within the Partridge River watershed, approximately 17 river miles upstream of Colby Lake (Large Figure 1). Above Colby Lake, the Partridge River watershed covers approximately 103 square miles. Tributaries to the Partridge River above Colby Lake and downstream of the Mine Site and Transportation and Utility Corridors include an Unnamed Creek downstream of the future West Pit Overflow, Wetlegs Creek, Longnose Creek, and Wyman Creek. Colvin Creek and the south branch of the Partridge River are also tributaries to the Partridge River; however, these streams will not be directly or indirectly impacted by the Project.

Daily flow data is available for the Partridge River from the U.S. Geological Survey (USGS) gaging station 04015475 – Partridge River above Colby Lake at Hoyt Lakes, Minnesota, from water years 1978 through 1987. During this period, hydrology was affected by the periodic and variable dewatering of the Peter Mitchell Pits located at the headwaters of the Partridge River. The hydrology data has been validated and adjusted for use on this Project, as described in Reference (1).

Recent (2011-present) daily flow data near the Mine Site is available from DNR gage H03155002, located on the Partridge River at the Dunka Road crossing (surface water monitoring station PM-3/SW003). This data is not directly comparable to the USGS gaging station 04015475 data due to the large difference in tributary watershed size and location. Based on its location, the DNR gage H03155002 is more heavily influenced by Peter Mitchell Pit dewatering than the USGS gaging station 04015475.

Several locations within the Partridge River watershed have been monitored for water quality beginning in 2004. These locations are shown in Large Figure 1 and include seven monitoring stations on the Partridge River above Colby Lake, two locations along Wyman Creek, three locations along tributaries to the Partridge River, and four locations in Colby Lake and Whitewater Reservoir. The results of baseline monitoring of the Partridge River, upstream of Colby Lake, and select tributaries from 2004 to 2013 is presented in Large Table 11 of Reference (1). Baseline monitoring data from water collected in Colby Lake and Whitewater Reservoir is presented in Large Table 10 of Reference (1). The frequency and extent (i.e., number of constituents) of monitoring varies by location. Monitoring conducted from 2004 through 2008 generally includes a wider list of constituents to characterize the baseline conditions within the watershed. Monitoring from 2008 through 2011 generally focused on a smaller list of constituents and locations to resolve specific issues (e.g., ratio of dissolved to total aluminum, inadequate thallium detection limits) with the data. More comprehensive baseline monitoring at select locations along the Partridge River and its tributaries was resumed in 2012 with a wider list of constituents.

1.3.2 Groundwater Baseline Data

As described in Sections 4.3 and 4.4 of Reference (1), baseflow in the Partridge River near the Mine Site can be considered a proxy for overall discharge through the surficial aquifer at the Mine Site because the river represents the primary sink for shallow groundwater flow. In the Mine Site area, the average 30-day low flow (considered a proxy for baseflow) in the Partridge River is estimated to be 3.8 cubic feet per second (cfs), corresponding to a contributing watershed area of approximately 95 square miles (mi^2), which represents an estimated aquifer yield of 0.04 cfs/mi^2, or 0.55 inches per year.

Based on groundwater elevations at the Mine Site surficial aquifer monitoring wells (Reference (1)) and estimated Partridge River elevations downgradient of the wells, the average hydraulic gradient across the area is on the order of 0.01. Using the approximate geometric mean of the hydraulic conductivity estimates from slug tests completed at the Mine Site (0.3 feet/day; Reference (4)) and assuming a porosity of 0.3, a representative groundwater velocity in the unconsolidated aquifer at the Mine Site is approximately 0.01 feet/day. Locally, actual velocities likely range over several orders of magnitude, depending on the gradient and hydraulic conductivity of the aquifer material present.

As described in Section 4.3 of Reference (1), there are 33 existing monitoring wells at the Mine Site, including:

- 24 wells located in the surficial deposits (identified on Large Figure 2 with the prefix "MW")
- 5 wells within the upper 100 feet of bedrock (identified on Large Figure 2 with the prefix "OB")
- 4 wells in bedrock at depths ranging from 485 to 610 feet below grade (identified on Large Figure 2 with the prefix "P")

The locations of these wells are shown on Large Figure 2. Three of the monitoring wells in the surficial deposits were installed in 2005 and have been sampled intermittently since installation. The additional 21 wells in the surficial deposits were installed between October 2011 and February 2012. A monthly groundwater sampling program of these surficial monitoring wells was initiated in November 2011 and continued through August 2012.

Quarterly (excluding first quarter) sampling has been conducted since October 2012. The five monitoring wells within the upper 100 feet of the bedrock have each been sampled intermittently since installation in 2006 until 2010 and annually starting in 2010. The four larger diameter deep bedrock wells were installed in 2006 and have been sampled during aquifer testing in 2006 and 2007. Groundwater monitoring data from the monitoring wells in the surficial deposits and bedrock wells are summarized in Large Table 3 through Large Table 6 in Reference (1).

1.4 Existing Conditions

Existing subwatersheds at and near the Mine Site are shown on Large Figure 3. Under existing conditions, runoff from the northernmost area of the Mine Site generally drains north into the One Hundred Mile Swamp and associated wetlands along the Partridge River. These wetlands form the headwaters of the Partridge River, which meanders around the east end of the Mine Site before turning southwest. Runoff from the majority of the Mine Site naturally drains to the south through culverts under Dunka Road and the adjacent rail line, into the Partridge River downstream of the Dunka Road crossing.

In addition to subwatershed boundaries, Large Figure 3 shows the 100-year flood levels and average water levels at selected locations along the Partridge River. The flood boundary was developed for the 24-hour storm event, which was the critical event for the Partridge River. The 100-year, 10-day snowmelt event was previously modeled to evaluate the peak flows in the Partridge River, but the 24-hour storm event produced higher flows and flood levels due to the quick runoff delivery in the upper watershed.

As shown by these flood levels, the Partridge River is very flat in the upstream reach in the vicinity of the One Hundred Mile Swamp; however, there is still an increase of over 10 feet in normal and flood water levels through the wetland from the east end of the Mine Site to the west end. Between the headwaters and Dunka Road, the Partridge River has a maximum slope of approximately 0.6%. The flood levels downstream of Dunka Road are more than 20 feet lower than most of the adjacent Mine Site perimeter ground elevations. There is very little risk from Partridge River flooding on the east and south sides of the Mine Site.

The increase in flood elevation from the 100-year event to the 500-year event on the Partridge River is relatively minor, varying from 0.1 to 0.5 feet on the north and east sides of the Mine Site to 1.0 foot upstream of the railroad crossing in the southeast corner of the Mine Site.

2.0 Mine Water and Stormwater Management Systems Design

The water at the Mine Site will be managed by keeping the stormwater separate from the mine water through a system of ditches, dikes, and ponds. Each of these terms is defined specifically for this Project, as follows:

- Stormwater is the result of precipitation and runoff that has contacted natural, stabilized, or reclaimed surfaces and has not been exposed to mining activities. The term stormwater includes non-contact stormwater, construction stormwater[1], and industrial stormwater[2] and is expected to meet the requirements of the NPDES/SDS permits for the Project prior to being discharged off-site.

- Mine water includes precipitation, runoff, and collected groundwater (pit dewatering water) that has contacted surfaces disturbed by mining activities, such as drainage collected on stockpile liners, pit dewatering, and runoff contacting ore, waste rock, and Mine Site haul road surfaces. Runoff from the Overburden Storage and Laydown Area (OSLA) and saturated mineral overburden will also be managed as construction mine water, a subset of mine water.

Construction water will be managed as either mine water or stormwater depending on its anticipated water quality, using the following guidelines:

- runoff from construction areas with no excavation will be managed as construction stormwater

- runoff and groundwater from construction areas where 75% or more of the exposed material is saturated mineral overburden (i.e., dewatering) will be managed as construction mine water

- runoff and groundwater from construction areas with less than 75% of the exposed material being saturated mineral overburden (i.e., dewatering) will be managed as construction stormwater

These guidelines for water management were based on results from the Mine Site overburden characterization work for the Project. Construction excavations are short-term, temporary phases of the Project. Therefore, these water management guidelines are distinct from the management practices for the different types of overburden during operations (see Section 2.2.4 of the Rock and Overburden Management Plan (Reference (2)). However, if an excavation is open for an extended period of time, dewatered saturated mineral overburden will have the potential to oxidize, which could result in washdown of the oxidized

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[1] Stormwater associated with construction activities, as defined in Minnesota Rules, part 7090.0080, subpart 4

[2] Stormwater associated with industrial activities, as defined in Minnesota Rules, part 7090.0080, subpart 6

constituents affecting the water quality within the excavation. These water management guidelines have been developed to be conservative (i.e., protective) in managing water potentially impacted by dewatered saturated mineral overburden as construction mine water.

Construction stormwater will be managed in accordance with the requirements of the Minnesota NPDES/SDS Construction Stormwater General Permit. This will include controls and best management practices (BMPs), including erosion and sediment control measures, construction water management control measures, dust control measures, and construction site restoration practices. Prior to the start of each phase of construction activities, these management measures will be incorporated into a Construction Stormwater Pollution Prevention Plan (SWPPP) based on detailed construction plans and in accordance with Construction Stormwater General Permit requirements. Construction mine water will be collected in temporary sumps or in the excavation and pumped to the Construction Mine Water Basin at the Equalization Basin Area.

Two examples of how these guidelines would be used is as follows:

- If a 10-foot excavation of the mine water pond is needed, consisting of 2.5 feet (25%) of unsaturated mineral overburden and 7.5 feet (75%) of saturated mineral overburden, the excavation water would be handled as construction mine water.

- If an 8.5-foot excavation of a stockpile foundation includes 6.5 feet (76%) of unsaturated mineral overburden and 2 feet (24%) of saturated mineral overburden, the excavation water would be handled as construction stormwater.

The mine water system including sumps, ponds, and the piping network for Mine Years 1, 11, and 20 are shown on Large Figure 4 to Large Figure 6. The stormwater system including dikes, ditches, culverts, and sedimentation ponds for Mine Years 1, 11, and 20 are shown on Large Figure 7 to Large Figure 9.

2.1 Mine Water

Mine water includes precipitation, runoff[3], and groundwater that has contacted surfaces disturbed by mining activities, such as drainage collected from stockpile liners, pit dewatering, and runoff contacting ore, waste rock, and Mine Site haul roads. This water may not meet water quality discharge limits for metals or other constituents and as a result, may require treatment. Mine water requiring treatment will be pumped to the Equalization Basin Area[4] where it will be pumped through either the High Concentration Mine Water Pipeline or the Low Concentration Mine Water Pipeline to the WWTS. Mine water that does not require treatment besides settling for total suspended solids (construction mine water and OSLA runoff) will be pumped to the Construction Mine Water Basin at the Equalization Basin Area where settling will occur and it will be pumped through the Construction Mine Water Pipeline to the FTB for use as plant make-up water or to the East or Central Pit for flooding in later years. These three pipelines (the Low Concentration Mine Water Pipeline, High Concentration Mine Water Pipeline, and Construction Mine Water Pipeline) are collectively referred to as the Mine to Plant Pipelines (MPP). Mine water will be intercepted throughout the Mine Site by ditches, dikes, and stockpile foundation liners/containment system to keep it separate from the stormwater collection and conveyance systems. Design drawings and flow diagrams of the mechanical infrastructure, which include the MPP and mine water systems, are provided in Attachment B.

Drawing ME-003 of the Mechanical Infrastructure Permit Application Support Drawings (Attachment B) provides a flow diagram of the mine water collection and conveyance system from each source to the Equalization Basin Area, and then to the FTB or WWTS at the Plant Site, or to the East Pit. Mine water sources include mine pits, waste rock and ore stockpiles, the OSLA, and other mine infrastructure such as haul roads and the Rail Transfer Hopper (RTH).

There are three types of stockpiles that will generate mine water:

- overburden stockpiles in the OSLA
- waste rock stockpiles (Category 1, 2/3, and 4)

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[3] Runoff is defined in this document as the total volume of stormwater or mine water that collects above ground. According to this definition, runoff from active stockpiles is mine water and runoff from reclaimed stockpiles is stormwater. Runoff from active stockpiles includes the total yield from surface runoff, liner drainage, and leakage through the liner. Runoff from reclaimed stockpiles includes flows from the top of the cover and interflow that infiltrates into the cover and exits the stockpile without contacting the waste rock.

[4] The Equalization Basin Area is the pond area at the Mine Site (south of Dunka Road) that contains the High Concentration Equalization Basin, the Low Concentration Equalization Basins 1 and 2, the Construction Mine Water Basin, the Central Pumping Station, and the Construction Mine Water Pumping Station.

- the Ore Surge Pile (OSP)

Precipitation coming in contact with each of these stockpiles will be managed as mine water until the stockpiles are reclaimed. Runoff from the OSLA will be considered mine water due to the concern regarding peat drainage potentially containing elevated levels of mercury. The Category 1 Waste Rock Stockpile is the only permanent stockpile and will be reclaimed. Once reclaimed, surface runoff from the Category 1 Waste Rock Stockpile will be managed as stormwater. The Category 2/3 and 4 Waste Rock Stockpiles are temporary, and the footprints will be reclaimed after the material is relocated to the mined-out East Pit for subaqueous disposal and the liner systems are removed. The ore in the OSP will be removed by the end of Mine Year 20, at which time the liner will be removed and the footprint will be reclaimed.

Incremental reclamation of the Category 1 Waste Rock Stockpile is planned beginning in Mine Year 14. The timing of cover placement will have a large impact on the water flows. The total flow from the reclaimed stockpile will include:

- Infiltration through the cover that drains through the waste rock and is stored in the stockpile. This mine water will not report to any collection system.

- Infiltration through the cover that drains through the waste rock and is collected by the groundwater containment system and routed to the WWTS. Design of the groundwater containment system is provided in Section 2.1.2 of Reference (2).

- Infiltration through the cover that drains through the waste rock, bypasses the containment system, and flows via groundwater to the pits for collection as mine water during operations or to the West Pit lake or backfilled East Pit during reclamation, closure, and postclosure maintenance. Modeling and capture efficiency of the groundwater containment system is provided in Section 2.1.2.2 and 2.1.2.3 of Reference (2).

- Infiltration through the cover that drains through the waste rock, bypasses the groundwater containment system, and is not captured in the groundwater containment system or the pits. Modeling and capture efficiency of the groundwater containment system is provided in Section 2.1.2.2 and 2.1.2.3 of Reference (2).

- Surface runoff from the stockpile cover (stormwater) that will be collected by the stormwater ditch surrounding the stockpile and routed through sedimentation ponds prior to off-site discharge or routed to the West Pit lake during reclamation.

2.1.1 Design Criteria for the Mine Water Systems

Design criteria for the mine water components are provided in Table 2-1 with preliminary sizing of the components listed on Drawing ME-004 of Mechanical Infrastructure Drawings in Attachment B. Mine water system components at the Mine Site have been designed to route mine water by gravity flow to sumps or mine water ponds that are designed to contain water from a component-specific “design event”. The design event chosen for each component was based on the expected quality of water handled by the component and the overflow potential of the component. This allows matching the level of protection applied to the component to the expected water quality handled by the component and the potential for overflows by choosing larger design events as necessary.

The mine water infrastructure that was designed using the 10-year and 100-year, 24 hour events assumed the Soil Conservation Service (SCS) Type II storm events with rainfall depths for the mine location obtained from Technical Paper No. 40 (TP-40; Reference (5)). In 2013, the National Oceanic and Atmospheric Administration published Atlas 14, which revised the rainfall/precipitation frequency estimates for design storms previously published in 1961 by the U.S. Weather Bureau’s TP-40. The change in the 10-year and 100-year, 24 hour design storms were evaluated between TP-40 and Atlas 14, and it was found that Atlas 14 increased the amount of precipitation for these two frequency events. As a result, PolyMet will update the precipitation amounts to reflect Atlas 14 during final design of the mine water system. There may be minor modifications to portions of the mine water system described in this section to reflect the increased capacity required for the Atlas 14 precipitation. The design constraints will not be modified from those listed.

Water from the sumps and mine water ponds will be pumped to the Equalization Basin Area. The Central Pumping Station (CPS) will pump water from the Equalization Basin Area through the MPP to the WWTS or FTB at the Plant Site, or to the East or Central Pit during pit flooding.

The following sections describe the design of the major components of the Mine Water System, which includes the collection and conveyance of water from the pits, the waste rock stockpiles, the OSLA, the OSP, and applicable construction areas.

Table 2-1 Design Criteria for Mine Water Infrastructure

Infrastructure Draining	Mine Water Component Name(1)	Design Event	Overflow Pond Design Event
Category 1 Waste Rock Stockpile	groundwater containment system (Section 2.1.2 of Reference (2)	100-year, 24-hour	Not applicable (N/A); overflow to mine pits
Category 2/3 Waste Rock Stockpile	S23-1, S23-2, S23-3; MW-S23-1, MW-S23-3	Sump: 10-year, 24-hour(2)	100-year, 24-hour less sump capacity(2)
Category 4 Waste Rock Stockpile	S4; MW-S4	Sump: 10-year, 24-hour2	100-year, 24-hour less sump capacity(2)

Infrastructure Draining	Mine Water Component Name(1)	Design Event	Overflow Pond Design Event
Ore Surge Pile	SOSP; MW-SOSP	Sump: 10-year, 24-hour(2)	100-year, 24-hour less sump capacity(2)
Rail Transfer Hopper	MW-RTH	Pond: 100-year, 24-hour(2), (3)	N/A
Haul Roads	MW-HRE, MW-HRN, MW-HRC, MW-HRW	Pond: 100-year, 24-hour(2)	N/A
Overburden Storage and Laydown Area	MW-OSLA	25-year, 24-hour(2)	N/A
Pit Pumps and Pipes	Varies	Annual snowmelt event (removal within 3 days)	N/A
Other Pumps / Pipes	Varies	Annual snowmelt event (removal within 30 days)	N/A

(1) Mine water sumps are named with the prefix S followed by an abbreviation of the infrastructure the drainage is coming from. Mine water ponds are named with the prefix MW followed by an abbreviation of the infrastructure the drainage is coming from.
(2) Mine water sumps and ponds include a safety factor in the form of freeboard (typically three feet) in addition to the design storm volume.
(3) MW-RTH was sized based on available area with a larger pump capacity to meet the design storm volume.

2.1.2 Mine Site Water Balance

The Project water balance can be found in Section 6.1 of Reference (1). The details include quantification and breakdown of stormwater, groundwater, and mine water, including the water balance associated with the stockpiles.

2.1.3 Pit Dewatering

The estimated average annual inflow rates and peak inflow rates for the three pits were estimated using results of probabilistic modeling conducted for the FEIS (Reference (1)) and for pit pre-stripping, engineering estimates were based on the area to be dewatered, the depth to the water table, typical soil properties, and pumping duration. Estimated pumping rates and quantities for pit dewatering are shown in Table 2-2 for estimated pit inflows and Table 2-3 for maximum pumping rates, which take into account the associated pre-stripping activities, as required for the Water Appropriation Permit application. Mine pit inflows will be directed to sumps within the pits where the water will be collected and pumped to the Equalization Basin Area. The mine pit pump capacities have been designed to minimize delay to mining operations during the typical spring snowmelt event.

Table 2-2 Mine Pit Inflows

Mine Pit	Inflow Component	Mine Year 1 Inflows(1)		Mine Year 11 Inflows(1),(2)		Mine Year 20 Inflows(1)	
		Average Annual (gallons per minute [gpm])	90th Percentile (gpm)	Average Annual (gpm)	90th Percentile (gpm)	Average Annual (gpm)	90th Percentile (gpm)
West Pit	Groundwater(3)	Not Applicable		81	104	44	58
	Runoff			224	278	236	298
	Total(4)			303	367	280	346
Central Pit	Groundwater	Not Applicable		30	40	4.9	6.4
	Runoff			7.2	8.9	68	81
	Total(4)			37	47	73	86
East Pit	Groundwater(3),(5)	101	134	738	977	161	210
	Runoff	114	144	124	153	217	258
	Total(4)	205	252	863	1,096	378	448

(1) Source of data: Section 6.1 of Reference (1)
(2) The Central Pit exists for only a portion of Mine Year 11; the values shown are for the latter third of the year when the pit is operational. The East Pit begins to be backfilled in Mine Year 11, but backfilling does not significantly change the natural inflows to the pit; the values shown are for the entire year.
(3) Groundwater flows to the West and East Pits include seepage from the Category 1 Waste Rock Stockpile. See Section 2.1.2 of Reference (2).
(4) Groundwater and runoff values do not sum to totals due to probabilistic model (i.e., high groundwater and high runoff conditions do not necessarily occur simultaneously).
(5) East Pit groundwater inflows are significantly higher than the West and Central Pit inflows due to its proximity to the Virginia Formation. The hydraulic conductivity of the Virginia Formation is almost 3 orders of magnitude higher than the Duluth Complex. The East Pit intersects the Virginia Formation, and the West and Central Pits do not.

Table 2-3 Mine Pit Estimated Pumping Summary

Mine Pit	Maximum Daily Rate(1) (gpm)	Maximum Monthly Rate(1) (gpm)	Maximum Annual Rate(1)(2) (gpm)	Maximum Annual Volume(3) (MG)	Average Annual Rate(4) (gpm)
East Pit	2,340(5)	1,900	1,900	1,000	200 – 800
Central Pit	1,300(5)	1,300	1,300	700	50 – 250
West Pit	2,640(5)	1,500	1,500	800	150 – 550

(1) Maximum daily, monthly, and annual pumping rates from the mine pits occur in different time periods. Rates cannot be summed.

(2) To be conservative, maximum annual rate is set equal to maximum monthly rate.

(3) Maximum annual volume is calculated from the maximum annual rate, rounded up to the nearest 25 MG.

(4) Range of the average monthly P50 values, on an annual basis, over the years of the appropriation, plus any appropriations associated with scheduled overburden stripping, rounded up to the nearest 50 gpm. This information is provided for context.

(5) Maximum daily rate based on the design pump capacity.

Water management within the pit will occur as part of mine development, with the pit floors sloped toward collection sumps. The sumps will be excavated as part of mine operations. Pumps in the sumps will either be submersible pumps or pumps on a raft floating in the sump. These pumping systems could include one single large pump or several smaller pumps, depending on an optimization analysis that will be done in final design. Hoses will connect the pumps to pipes which may connect to additional pumps at the rim of the pits, which will be determined in final design. The pipes will convey the water to the Equalization Basin Area. The current alignment of the pit dewatering system is based on the future pit development, thus minimizing the need to frequently move the pipes. In locations where a pipe will intersect a road, the pipes will be placed inside a culvert or a larger pipe buried under the road. Hoses may be used in some places, where design allows, providing operational flexibility and simplicity.

Inflows to the pits include contributions from groundwater and runoff within the pit, which includes direct precipitation. The size and location of the sumps and pumps will change as the pits expand in size and depth, requiring periodic evaluation of the pumping system. Pump capacities are based on peak annual flows from the snowmelt event, assuming a rapid spring snowmelt (40% of the snowmelt occurring within one day). The pumping systems are designed to handle groundwater inflows and the average annual runoff volumes from a snowmelt event, removing approximately 100% of the groundwater inflows and 40% of the annual snowmelt runoff (1.28 inches) within 3 days; the volume from this snowmelt event is approximately equivalent to the runoff volume expected in the pits during the 5-year, 24-hour storm event. The sumps are designed with capacity to hold the remaining volume from this snowmelt runoff event.

In the event that a storm exceeds the sump and pump capacity, the lowest level of the pit will be used to store the excess water, with mining operations relocated to higher levels or delayed until water levels are pumped down. During extreme storm events, pit dewatering may temporarily be stopped to allow the Equalization Basin Area to handle the increased volumes from other mine water facilities to minimize overflow of mine water sumps and ponds across the Mine Site.

The pipes associated with these pumps are sized to maintain average velocities less than 5 feet per second to minimize friction losses and surge pressures (i.e., water hammer) in the pipes. The pump sizes were evaluated for each Mine Year, because, as the pits deepen, larger pumps will be needed to overcome the change in static head.

The number and size of pumps will be evaluated on a regular basis due to changes in head, pumping distances, and availability of electrical power sources.

The preliminary pit sump, pump, and pipe sizes for pit dewatering are listed on Drawing ME-004 of the Mechanical Infrastructure Drawings in Attachment B. Pipe configurations for pit dewatering are shown on Drawings MW-001, MW-002, and ME-003 of this drawing set for Mine Years 1 and 11 (Attachment B).

2.1.4 Stockpile Drainage

The design of the stockpile liner and underdrain system for the Category 2/3 and Category 4 waste rock stockpiles and the OSP, and the design of the Category 1 Stockpile Groundwater Containment System are described in Section 2.1 of Reference (2). This section discusses the evaluation of leakage through the liners, the collection of water on top of the liners, the routing of the mine water away from the temporary stockpiles, and the containment system for collection of drainage from the Category 1 Waste Rock Stockpile.

Table 2-4 presents the range of total annual mine drainage volumes and flow rates estimated from the temporary stockpiles based on modeling results. These annual volumes assume that mine drainage from the stockpiles will begin within the first year and that all mine drainage is conveyed to the sumps.

Table 2-4 Temporary Stockpile Drainage

Stockpile	Mine Year 1(1)		Mine Year 11(1),(2)		Mine Year 20(1),(3)	
	Average Annual Inflow (gpm)	90th Percentile Inflow (gpm)	Average Annual Inflow (gpm)	90th Percentile Inflow (gpm)	Average Annual Inflow (gpm)	90th Percentile Inflow (gpm)
Category 2/3 Waste Rock	44	53	120	140	9.9	12
Category 4 Waste Rock	20	24	34	41	Not Applicable	
Ore Surge Pile	20	24	20	24	20	24

(1) Source of data: Section 6.1 of Reference (1)
(2) The Category 4 Waste Rock Stockpile exists through the first half of Mine Year 11; the stockpile is removed in the latter half of the year.
(3) All mass is removed from the Category 2/3 Waste Rock Stockpile by the end of Mine Year 19. The Mine Year 20 values represent the water collected on the liner as it is being removed and the stockpile is being reclaimed.

2.1.4.1 Temporary Stockpile Drainage Collection Systems

As described in Section 2.1.3 of Reference (2), the temporary stockpiles, which include the Category 2/3 and 4 Waste Rock Stockpiles and the OSP, will have stockpile liner drainage systems that will flow by gravity to mine water sumps and overflow ponds. In areas where elevated groundwater is encountered at or near the liner grades, they will also have foundation underdrain systems to alleviate excess pore water pressure that may subsequently develop in foundation soils as load is placed during stockpile development. If underdrains are needed, the water collected will flow by gravity to underdrain sumps. Water collected in the stockpile underdrain sumps is expected to be the same as groundwater quality. If the underdrains are needed, resultant water quality will be monitored as part of the groundwater performance monitoring program (see Section 5.1).

Any water collected in the underdrain sumps will be pumped to the mine water sumps, and the water will be pumped from the mine water sumps to the Equalization Basin Area. From the Equalization Basin Area, the water will be pumped to the WWTS for treatment via the MPP.

This section describes the design of the stockpile sumps and the overflow ponds that collect the water from the temporary stockpile liner system. See Section 2.1.3 of Reference (2) for design of the foundation underdrain sumps.

2.1.4.1.1 Temporary Stockpile Overliner Sump and Overflow Pond Design

Mine water sumps will be located along the perimeter of the temporary stockpiles to collect stockpile drainage, as shown in Large Figure 4 to Large Figure 6. The number of mine water sumps associated with each stockpile depends on the stockpile foundation design, as follows:

- The Category 2/3 Waste Rock Stockpile will have 3 sumps, S23-1, S23-2, and S23-3, located on the south side of the stockpile, between the stockpile and Dunka Road. Overflow mine water ponds include MW-S23-1, which provides overflow capacity for S23-1 and S23-2, and MW-S23-3, which provides overflow capacity for S23-3.

- The Category 4 Waste Rock Stockpile will have one sump, S4, located on the south side of the stockpile, with one overflow pond MW-S4.

- The OSP will have one sump, SOSP, located on the southwest side of the OSP, with one overflow pond MW-SOSP.

The sumps will be designed to contain mine water from active stockpiles during a 10-year, 24-hour rainfall event with the flood level below the stockpile liner discharge pipe elevation. To minimize uncontrolled overflows from the sumps, the volume generated by the 100-year 24-hour storm event in excess of the sump capacity will flow by gravity to overflow ponds adjacent to each sump. Dikes will be constructed around the perimeter of each sump and pond with a combined capacity for the 100-year, 24-hour mine water yield plus a safety factor in the form of freeboard (typically three feet). Further discussion of overflows is included in Section 4.4. Preliminary sump and pond footprints for the temporary stockpiles are listed in Table 2-5. The temporary stockpile overliner sumps have been designed with access for maintenance and cleanout, as needed. Frequency of cleanout will be based on annual inspection of the depth of sediment at the pump location (lowest point in each sump).

The temporary stockpile mine water sumps will be constructed with a double composite liner system consisting of an upper high-density polyethylene (HDPE) primary liner underlain by a geonet leak collection and recovery system (LCRS) which is underlain by a secondary HDPE liner that overlies a one-foot thick soil liner as shown in Detail 2 of Drawing MW-014 (Attachment B) or a composite liner (without LCRS) but using leak location liner for equivalent protection. Overflow ponds will be constructed with a single liner system overlying a one-foot thick soil liner as shown on Detail 1 of Drawing MW-014 in Attachment B. of the Mechanical Infrastructure Drawings. Temporary stockpile mine water sumps and ponds are designed with an average depth between 6 and 12 feet depending on the depth to bedrock, depth to groundwater, and stockpile outlet pipe elevation. Drawings MW-003 to MW-007 in Attachment B show the layout of each of these sumps and associated overflow ponds.

The sump and pond dikes and slopes will be vegetated or riprapped to limit erosion. The design will be finalized once the foundation grading design is completed and the liner elevation is established, and maximum sump and pond elevations can be established. This will be dependent on site-specific investigations of depth to bedrock and depth to groundwater. The design elevations will allow runoff from the temporary stockpiles to be conveyed by gravity into the sumps with gravity overflow into the overflow ponds. The outlet for both the sumps and ponds will be a pump and piping system to convey this mine water to the Equalization Basin Area and then to the WWTS via the MPP.

Table 2-5 Stockpile Sump and Pond Dimensions – Approximate

Stockpile	Sump/Pond Name	Area (acres)	Required Capacity (acre-feet)	Design Volume (acre-feet)(1)
Category 2/3 Waste Rock	S23-1	2.4	14.9	14.9
	S23-2	2.5	11.9	12.0
	S23-3	1.5	6.6	6.6
	MW-S23-1	4.3	21.4	21.5
	MW-S23-3	1.5	5.3	5.3
Category 4 Waste Rock	S4	2.5	10.1	12.5
	MW-S4	2.0	8.1	9.9
Ore Surge Pile	SOSP	2.1	8.5	8.7
	MW-SOSP	1.6	4.8	5.3

(1) The design volume does not account for the freeboard (typically three feet) planned as part of the design.

2.1.4.1.2 Ore Surge Pile (OSP) Sump and Sump Liner

The temporary OSP is different from the temporary waste rock stockpiles because it will likely have periods with very little material on the liner throughout the mine operations. Due to the potential for small quantities of material to be on the liner of the OSP, the sump SOSP has been designed with more overall capacity than the temporary waste rock stockpile sumps. This was achieved by increasing the yield coefficients used in sizing the sumps to 100% of precipitation for the OSP in order to reflect the potential for these periods of small quantities of cover material, which will increase the quantity and timing of runoff within the footprint. This sump was designed to contain the entire precipitation volume from an open liner during the 10-year 24-hour event. The combined capacity of the sump and overflow pond MW-SOSP will contain the 100-year 24-hour precipitation volume. The OSP sump has been designed with access for maintenance and cleanout, as needed. Frequency of cleanout will be based on annual inspection of the depth of sediment at the pump location (lowest point in each sump).

2.1.4.1.3 Construction of Lined Sumps and Ponds

In general, sumps and overflow ponds will be excavated below the natural ground, designed to optimize the pond bottom with the expected groundwater and bedrock while draining the stockpile liners by gravity. Construction of a lined sump or pond requires adequate foundation drainage to prevent excessive pore pressure from developing under the liner. Due to the difference in elevation between the elevated groundwater and high bedrock outcrops in this area and low elevation of the overliner discharge pipes from the stockpiles, the lined sumps and overflow ponds may have to be designed with the pond bottom below the groundwater level. Additional geotechnical and hydrologic investigation is needed to determine the actual depth of groundwater and bedrock in these locations prior to final design. If the sumps and ponds must be constructed with the pond bottom below the groundwater level, the following options will be evaluated to prevent excessive pore pressures from building up below the liners:

- The stockpile underdrain sumps could be extended below the sump and pond bottom to allow for pumping to maintain dry foundations. The advantage of this is that it would minimize the number of pumps on-site; however, the disadvantage is that it would increase the amount of water pumped and managed.

- A separate underdrain system could be installed below the sump and pond bottom to allow for pumping to maintain dry foundations. The advantage of this is that it is separate from the stockpile underdrain system and could potentially be discharged off-site (clean groundwater); however, this would increase the number of pumps required, increasing capital and maintenance costs.

- A clay liner could be used instead of the geomembrane liners. The advantage of this would be that an underdrain system with a separate pump and piping system would not be needed below the sumps and ponds; however, use of a clay liner would increase the amount of water pumped due to increased leakage rates <u>into</u> the sump and pond to maintain inward drainage to prevent leakage out of the sumps and ponds to groundwater. The disadvantage of this is that it would increase the amount of mine water pumped from the sumps and ponds.

- The ballast, or weight on top of the liner, in the sump and pond could be increased to counteract the buoyancy forces of groundwater. The advantage of this option is that there would be no additional pumping or piping systems required and no extra water to manage and treat. However, the ballast used to hold down the liner would reduce the capacity of the sumps/ponds, so increased volumes and potentially larger sump and pond footprints would be required.

These options will be evaluated after the additional geotechnical and hydrologic investigation are performed, which will provide more precise information on the actual depths to bedrock and the water table.

2.1.4.2 Category 1 Stockpile Groundwater Containment System

A groundwater containment system will be constructed to capture stockpile drainage from below the Category 1 Waste Rock Stockpile and convey this water to sumps for collection and pumping to the Equalization Basin Area and then to the WWTS via the MPP. Drainage through the stockpile is significantly reduced once portions of the stockpile are reclaimed. See Section 2.1.2 of Reference (2) for more details of this design.

2.1.5 Mine Water Ponds for Other Infrastructure

Mine water ponds provide storage for gravity flow of mine water volumes during large rainfall or snowmelt events and during short power outages. Apart from the temporary stockpile ponds, there will be six other mine water ponds constructed at the Mine Site, as shown on Large Figure 4 to Large Figure 6 and Drawings MW-001 and MW-002 in Attachment B. These include:

- MW-OSLA, the OSLA pond, will collect runoff from the OSLA
- MW-HRE, MW-HRW, MW-HRN, and MW-HRC, the haul road ponds, will collect mine water from the haul roads
- MW-RTH, the RTH pond, will collect mine water from the RTH

The mine water ponds for the haul roads and RTH are designed to contain runoff volumes from the 100-year, 24-hour storm. The mine water pond for the OSLA is designed to handle the 25-year, 24-hour storm. Preliminary sizing for the mine water ponds is listed in Table 2-6. The mine water ponds will have the added benefit of reducing TSS, which will limit the amount of sediment in the pumping and piping system. These mine water ponds have been designed with access for maintenance and cleanout, as needed. Frequency of cleanout will be based on annual inspection of the depth of sediment at the pump location (lowest point in each pond).

Table 2-6 Mine Water Pond Dimensions – Approximate

Infrastructure	Sump/Pond Name	Area (acres)	Required Capacity (acre-feet)	Design Volume (acre-feet)
Overburden Storage and Laydown Area	MW-OSLA	7.1[(1)]	10.7	14.5[(1)]
Haul Road	MW-HRE	2.2	10.7	10.7
	MW-HRN	1.4	4.4	4.6
	MW-HRC	1.7	6.1	6.9
	MW-HRW	1.7	3.7	4.0
Rail Transfer Hopper	MW-RTH[(2)]	0.4	0.7	0.7

(1) MW-OSLA was oversized to allow for storage of peat within the pond, as described in Section 2.1.5.1.
(2) MW-RTH was sized based on available area with a larger pump capacity to meet the design storm volume.

Table 2-7 presents the range of annual average and 90th percentile flow rates for the ponds associated with the OSLA, haul roads, and RTH, based on modeling results.

Table 2-7 Mine Water Pond Drainage

Infrastructure	Mine Year 1(1)		Mine Year 11(1)		Mine Year 20(1)	
	Average Annual Inflow (gpm)	90th Percentile Inflow (gpm)	Average Annual Inflow (gpm)	90th Percentile Inflow (gpm)	Average Annual Inflow (gpm)	90th Percentile Inflow (gpm)
Overburden Storage and Laydown Area(2)	5.4	6.6	5.4	6.6	5.4	6.6
Haul Roads(3)	53	67	53	67	53	67
Ore Surge Pile(4)	20	24	20	24	20	24

(1) Source of data: Section 6.1 of Reference (1)
(2) The OSLA footprint will be fully developed in Mine Year 1 and not reclaimed until after Mine Year 20.
(3) Haul roads were modeled at their largest extent; inflows represent maximum extent with no change over time.
(4) The Ore Surge Pile was modeled as fully developed in Mine Year 1 and not reclaimed until after Mine Year 20.

The liner systems for these mine water ponds have been chosen based on the quality of the water that they will be collecting. The MW-RTH drainage is expected to be similar to that collected from the OSP or Category 4 Waste Rock Stockpile; therefore it will be constructed with the same liner as designed for the Category 4 Waste Rock Stockpile sumps, as described in Section 2.1.4.1. The haul road mine water ponds will be constructed with a single HDPE geomembrane over a one-foot thick soil liner, and the OSLA pond will be constructed without a liner.

In general, ponds will be excavated below the natural ground level in the center of the ponds with the perimeter of the ponds partially built up above the natural ground level to allow for storage and containment, designed to optimize the bottom of the pond with the expected groundwater and bedrock information. As described in Section 2.1.4, construction of a lined pond requires adequate foundation drainage to prevent excessive pore pressure from developing under the liner. The pond dikes and slopes will be vegetated or riprapped to limit erosion. The pond dike design will be finalized once the foundation grading design is completed, the liner elevation is established, and maximum pond elevations can be established. The pond elevations will allow runoff from disturbed surfaces to be conveyed by gravity into the ponds. The outlet for the haul road ponds and the RTH pond will be a pump and piping system to convey this mine water to the Equalization Basin Area. The outlet for the OSLA pond will be a pump and piping system to convey the mine water directly to the Construction Mine Water Basin and on to the FTB via the Construction Mine Water Pipeline or to the East Pit starting in Mine Year 11.

2.1.5.1 Overburden Storage and Laydown Area (OSLA) Runoff

This section describes the collection and conveyance of runoff from the OSLA including design of the mine water pond.

The OSLA is a temporary storage area used to screen, sort, and temporarily store unsaturated mineral overburden and peat that may be used for future construction or reclamation purposes. As described in Section 7.4.2.3 of Reference (2), the area will be graded to provide a well drained site that directs surface runoff to a mine water pond in the southwest corner of the area (the OSLA Pond). The OSLA Pond was designed to accommodate runoff from the 25-year, 24-hour storm event with three feet of freeboard. As shown on Table 2-6, this pond was oversized to allow for storage of peat within the pond.

Surface runoff from the OSLA is managed as mine water because there is concern about the potential release of mercury from peat storage. Surface runoff from the OSLA will drain to a mine water pond for storage and reduction of TSS. The water in the OSLA Pond is expected to exhibit water quality similar to construction stormwater and is not expected to require treatment for dissolved substances; however, water quality will be monitored throughout the life of the mine, as described in Section 5.0. The water will be pumped from the OSLA Pond directly to the Construction Mine Water Basin and on to the FTB via the Construction Mine Water Pipeline or to the East or Central Pit to aid in pit flooding.

Storage of peat in the OSLA begins prior to the start of mining when peat is removed from stockpile foundation areas and stripped during the development of the East Pit. Peat removal from the West and Central Pits will be completed between Mine Years 2 and 11; additions of peat to the OSLA are not expected to occur after Mine Year 11.

2.1.5.2 Haul Road Runoff

The quality of the water coming off the haul roads will be related to the amount and type of waste rock and ore spillage occurring on the roadways and is considered mine water. Runoff from the haul roads will be collected in mine water ditches and directed to one of four lined haul road ponds. Haul roads will generally be kept clear of material for safe travel of the vehicles and as part of best management practices at the Mine Site.

As shown on Table 2-6, haul road runoff will be directed to four separate mine water ponds, MW-HRE, MW-HRN, MW-HRC and MW-HRW, as shown on Large Figure 4 to Large Figure 6 and on Drawings MW-001 and MW-002 in Attachment B. MW-HRE is located on the south side of the haul road leading to the Category 2/3 Waste Rock Stockpile, west of the OSP. MW-HRW is located along the haul road to the West Pit, between the haul road and the OSLA. MW-HRN is located south of the Category 4 Waste Rock Stockpile and Central Pit, east of the West Pit, at the intersection of two haul roads. MW-HRC is located on the south side of the haul road leading to the OSP. MW-HRC and MW-HRE will be needed in Mine Year 1, while MW-HRW and MW-HRN will be constructed as the haul roads are expanded to those areas.

Haul road ponds have been designed to contain runoff from the 100-year, 24-hour storm event with three feet of freeboard with design capacities as listed on Table 2-6. Runoff from the haul roads will be directed to these mine water ponds prior to being pumped to the Equalization Basin Area and then to WWTS via the MPP. In some cases, haul road runoff may be directed to a mine pit and included in mine water from pit dewatering rather than routed to these ponds. The haul road layout and design is shown on the Mine Site and Dunka Road Earthwork Application Support Drawings (the Earthwork Drawings). Drawing EW-005 of that drawing set shows the overall haul road layout.

The haul roads will be constructed with a cross slope to direct surface runoff to one side of the road, as shown on Sections 1 and 2 on Drawing EW-006 of the Earthwork Drawings. Drawing EW-007 of the Earthwork Drawings provides two additional typical sections for the haul roads and the entrance road construction. Ditches will be built adjacent to the road, as shown on Sections 1 and 2 on Drawing EW-006 of the Earthwork Drawings. These mine water ditches will only collect surface runoff from the road surface. Stormwater runoff from areas adjacent to the roads will flow through the rock base of the haul roads and will be routed to the Mine Site stormwater system. Managing runoff in this manner will minimize the size of the mine water ditches and the amount of water requiring treatment from haul road runoff.

The haul roads will be constructed with safety berms as required by the Mine Safety and Health Administration (MSHA) and as shown on Sections 1 and 2 on Drawing EW-006 of the Earthwork Drawings. Several construction methods may be used to allow surface runoff from the haul roads to flow past the safety berms into the mine water ditches. Such methods include:

- constructing safety berms of coarse, free-draining rock
- installing culverts under safety berms
- constructing safety berms of boulders with gaps between them allowing road runoff to drain
- leaving a small gap in the safety berm, as allowed by MSHA rules

2.1.5.3 Rail Transfer Hopper (RTH) Area Runoff

The RTH is used for loading ore into rail cars. Due to the nature of the work and potential for ore spillage, surface runoff from the RTH active areas will be considered mine water. The layout of the RTH consists of a raised platform on which haul trucks enter and exit the area and from which they dump ore into a hopper over a pan feeder, which conveys the ore into rail cars. There will be a sloped concrete floor within the RTH, directing runoff to the south. The runoff will cross the railroad on sloped concrete panels to a small swale along the south side of the railroad track to pond MW-RTH. Water from MW-RTH will get pumped to the Equalization Basin Area and then to the WWTS via the MPP.

Pond MW-RTH will be designed to accommodate runoff volumes from the 100-year, 24-hour storm event from the RTH with one foot of freeboard with design capacities as listed on Table 2-6.

2.1.6 Equalization Basin Area

In the Equalization Basin Area, PolyMet will combine mine water streams into the following three waste streams:

- construction mine water and OSLA runoff
- mine water with low volume and relatively high concentrations of dissolved constituents
- mine water with high volume and relatively low concentrations of dissolved constituents

PolyMet will route mine water containing relatively high concentrations of dissolved constituents to the High Concentration Equalization (HCEQ) Basin. PolyMet will route mine water containing relatively low concentrations of dissolved constituents to Low Concentration Equalization (LCEQ) Basin 1 and LCEQ Basin 2. Construction mine water and runoff from the OSLA will be routed to the Construction Mine Water Basin or to the East or Central Pit during pit flooding after Mine Year 11.

2.1.7 Pumping Stations

2.1.7.1 Central Pumping Station (CPS)

The CPS will receive mine water and construction mine water from numerous sources within the Mine Site (Attachment B). Upon entering the CPS Building, these flows will be conveyed by gravity to the LCEQ Basins, HCEQ Basin, or the Construction Mine Water Basin. Water from the LCEQ and HCEQ Basins will flow by gravity back to the lift stations (described below) in the CPS Building, and then be conveyed to the WWTS.

During normal operation, it is anticipated that LCEQ Basins 1 and 2 flow will be pumped to the membrane treatment train at the WWTS via the same lift station within the CPS Building. This lift station will be capable of meeting the minimum pumping requirements to prevent the Basins from overfilling during a spring snowmelt event with one pump out of service.

The lift station within the CPS Building for pumping mine water from the HCEQ Basin into the chemical precipitation system at the WWTS will be capable of meeting the minimum pumping requirements to prevent the Basins from overfilling during the 30-day spring snowmelt event followed by 30 days of the mean summer flow conditions with one pump out of service.

Each lift station within the CPS Building will initially be provided with two pumps, each capable of pumping 100% of the initial flow. Both lift stations can be upgraded to three pumps, with each pump capable of pumping 50% of the Mine Year 10 design flow.

The equalization basins will serve to decrease the variability of mine water influent streams in terms of flow rate and water quality. The pumping rate from the equalization basins to the WWTS mine water treatment trains will vary depending upon the volume of water in the basins. When the equalization basins are nearly full, pumping to the WWTS will be at a faster rate, and when they are nearly empty, pumping to the WWTS will be at a slower rate. The WWTS operators will be responsible for managing the operation of the equalization basins including initial flooding, normal operations, emergency procedures, and responding to warning systems. The equalization basins will have a water level control system to automatically shut off incoming flow before they reach full capacity. In addition, a high-water-level alarm will alert the operators so that overfilling does not occur. The control room at the WWTS will have water level monitoring of the equalization basins, and the Equalization Basin Area will be visually inspected at least once per shift.

2.1.7.2 Construction Mine Water Pumping Station

The Construction Mine Water Pumping Station will be located in the Equalization Basin area and will pump construction mine water and OSLA runoff from the Construction Mine Water Basin to the FTB via the Construction Mine Water Pipeline through Mine Year 11. When East Pit backfill begins in Mine Year 11, runoff from the OSLA, which reports to the Construction Mine Water Basin, will be routed directly to the East Pit and therefore no longer pumped to the FTB. This will make the Construction Mine Water Pipeline available to transport treated water from the WWTS to the Mine Site. These two operating scenarios will not occur simultaneously. No construction mine water will be managed after Mine Year 11 because all of the mine feature construction will be completed.

2.1.8 Mine to Plant Pipelines (MPP)

Three pipelines (collectively referred to as the Mine to Plant Pipelines or MPP) will convey water between the Mine Site and the Plant Site.

- The Low Concentration Mine Water Pipeline will transport water from the LCEQ Basins to membrane separation units at the WWTS.

- The High Concentration Mine Water Pipeline will transport water from the HCEQ Basin to the chemical precipitation treatment train at the WWTS (with the exception of the construction phase through Mine Year 1 when the High Concentration Mine Water Pipeline will temporarily be used to transport Construction Mine Water to the FTB). The WWTS design is discussed in Reference (3).

- The Construction Mine Water Pipeline will transport water from the Construction Mine Water Basin to the FTB through Mine Year 11. The Construction Mine Water Pipeline will be designed so that it safely discharges into the FTB to prevent any potential erosion of tailings or the FTB dams. Starting in the middle of Mine Year 11, no construction mine water will be generated at the Mine Site, so the Construction Mine Water Pipeline will be used to transport treated water from the WWTS to the Mine Site to aid in flooding of the East and Central Pits.

The MPP will be used continuously throughout the year and will be designed and constructed to prevent freezing in the winter. The MPP will consist of the pipelines, air/vacuum relief valves, drain valves, and in-line flow meters on each end of the pipelines. The MPP alignment is parallel to the existing Dunka Road alignment. The alignment of the three pipelines diverges within the Plant Site where the Construction Mine Water Pipeline heads north toward the FTB and the Low Concentration Mine Water Pipeline and High Concentration Mine Water Pipeline go the WWTS. The exception to this alignment is during the construction phase when the High Concentration Mine Water Pipeline will be routed to the FTB when it transports construction mine water to the FTB.

The following criteria were used in selecting the MPP alignment:

- The MPP will be next to Dunka Road, which will be utilized for daily mine traffic. This means that the MPP corridor will be under regular observation by mine personnel. In the unlikely event that a leak should develop, it can be quickly identified and repaired. In addition, flow meters at both ends of the MPP will allow for quick detection of a leak.

- Wetland impacts along this established route are minimized compared to the other alignments considered.

- The alignment crosses under Dunka Road once within the Mine Site through a box culvert; otherwise the alignment does not cross a major road planned for regular mine traffic or a rail line, minimizing the risk of structural failure due to surface loads from heavy mine vehicles or trains.

- The majority of the alignment is in areas already disturbed by previous activities.

- This alignment provides easy access for operations, inspections, maintenance, and repairs of the MPP.

- Preliminary review of the alignment did not identify any major constructability concerns.

The MPP will be designed to handle flow rates from the corresponding operating CPS pumps and Construction Mine Water Pumping Station. The total design head (static plus dynamic) is estimated at approximately 300 to 400 feet at the design flows of 400, 1,600, and 2,600 gallons per minute. The nominal pipe diameter of each pipeline, using HDPE SDR 11 pipe material for the respective design flows are:

- High Concentration Mine Water – 8 inch

- Construction Mine Water – 12 inch
- Low Concentration Mine Water – 18 inch

Smaller pipe diameters would result in a significant increase in pumping head at higher flows, and larger pipe diameters would result in increased pipeline cost with no significant reduction in pump horsepower. Larger pipe diameters would also result in slower water velocities, which would not suitably scour settled particles. Pipeline velocities ranging from approximately 1foot per second (fps) to 10 fps at the selected pump capacity will be used to help select the final MPP diameters for construction.

The majority of the MPP will be installed above grade to minimize bedrock excavation, minimize installation costs and facilitate ease of maintenance (refer to Drawing MPP-010 in the Mechanical Infrastructure Drawings). To protect the above grade sections from freezing during winter operations, the pipelines will be covered with approximately eight feet of material. Side slopes of this cover will be approximately 1.5 (horizontal) to 1 (vertical), resulting in a footprint that will be approximately 26 feet in width. Sections of the MPP will be buried to allow for access over the MPP: the depth of cover of these sections will be determined based on bedrock elevation. In sections where available coverage is not adequate between the existing grade and bedrock, insulation will be added to protect the MPP from freezing.

The material used for bedding and cover will consist of overburden from the MPP construction or from the Plant Site or Mine Site, and/or LTV Steel Mining Company tailings from the Plant Site. The MPP cover material will be protected from erosion with topsoil where needed and seeded to establish vegetation.

The MPP drawings included in the Mechanical Infrastructure Drawings include the general layout (Drawing MPP-001), plan and profile sheets (Drawing MPP-002 to MPP-009), typical sections (Drawing MPP-010), and details of the installation (Drawing MPP-011). The MPP drawings are provided in Attachment B.Because varying topographic conditions along the MPP corridor will require different installation methods, five typical cross-sections have been developed to illustrate the methods of construction. Although it is anticipated that the five standard cross-sections shown on Drawing MPP-010 will address most conditions encountered, variations and modifications to these standard arrangements may occasionally be necessary, and will be addressed during the final design of the MPP prior to construction. As shown, the MPP generally follows the surface profile of the Dunka Road corridor with sufficient cut and backfill to avoid abrupt changes in elevation. The MPP layout also avoids abrupt changes in horizontal direction minimizing the need for pipeline fittings. Automatic air/vacuum relief valves will be placed along the alignment at the high points as shown on the plan and profile sheets. Likewise, manually operated drain valves will be provided at the low points to allow drainage of pipeline sections for maintenance. Drainage of the pipeline sections would be accomplished by connecting the manual drain valve to a portable tank, opening the valve to transfer the pipeline contents to the tank. Water from the tank would be treated at the WWTS.

The Construction Mine Water Pipeline will be extended to the WWTS in Mine Year 11 to deliver treated water back to the Mine Site. This extension will follow the same route as the other two pipelines.

East Pit water level management starts in Mine Year 12, as the Category 4 waste rock is placed in the pit. At that time, the Construction Mine Water Pipeline flow will be reversed and used to send water from the WWTS to the East Pit. No construction mine water will be generated after this time. The Construction Mine Water Pipeline will continue to be used to convey treated water from the WWTS to the East Pit during reclamation and closure (during West Pit flooding and East Pit flushing).

2.2 Stormwater Management

Three types of stormwater will be managed at the Mine Site:

- Non-contact stormwater is precipitation and runoff that contacts natural, stabilized, or reclaimed surfaces and has not been exposed to mining activities, construction activities (as defined in Minnesota Rules, part 7090.0080, subpart 4) or industrial activities (as defined in Minnesota Rules, part 7090.0080, subpart 6). Non-contact stormwater includes runoff from natural areas, from on-site features constructed of overburden (unsaturated mineral overburden or peat) once stabilized with permanent cover, and from the reclaimed portions of the permanent Category 1 Waste Rock Stockpile.

- Construction stormwater is associated with construction activities (as defined in Minnesota Rules, part 7090.0080, subpart 4). Construction stormwater includes precipitation, runoff, and dewatering water from construction areas with the exception of dewatering water from saturated mineral overburden (which is managed as construction mine water).

- Industrial stormwater is associated with industrial activities (as defined in Minnesota Rules, part 7090.0080, subpart 6). Industrial stormwater includes precipitation and runoff from the industrial areas at the Mine Site that is composed entirely of stormwater and not combined with mine water.

These three categories of stormwater will be comingled and will be kept separate from mine water through a system of ditches, dikes, and ponds. For the purpose of this chapter, these three categories of stormwater will be referred to collectively as stormwater.

Runoff from the Transportation and Utility Corridors, including the Dunka Road and utility corridor and the adjacent railroad corridor (which will generally remain in its existing condition), will contribute to the stormwater runoff volumes from the Project. Stormwater runoff from the

Transportation and Utility Corridors north of Dunka Road flows to the south through culverts under Dunka Road and the railroad to Wetlegs Creek, Longnose Creek, and Wyman Creek. To maintain existing flow patterns to the extent practical, stormwater ditches and culverts along the railroad corridor and Dunka Road and utility corridor will be retained. A few culverts through Dunka Road will be extended. Culverts will be installed through the MPP embankment where necessary to maintain existing flow patterns. The Railroad Connection Track will include culverts in at least two locations and ditching to facilitate drainage around and through the new track, while maintaining existing drainage patterns to the extent practical.

The Mine Site stormwater management system will be developed as required throughout the mining operation to control site stormwater flows and volumes that would result from the 100-year, 24-hour storm event, at minimum. The overall system capacity will be based on the Mine Site configuration, and the individual segments will be installed when needed, as shown on Large Figure 7 to Large Figure 9. Mine Site permit application support drawings (Attachment C) are included in the relevant permit applications. Stormwater management will be modified during reclamation, closure, and postclosure maintenance, including filling of some ditches, construction of new ditches, and reclamation of the sedimentation ponds into wetlands or uplands.

Stormwater in and around the Mine Site will be managed in a manner that reduces potential impacts to mining activities, protects the environment, and maintains existing flow patterns to the extent practicable. The volume and rate of stormwater flows will be altered by construction of stockpiles, pits, and mine infrastructure (e.g., haul roads, RTH, OSLA), because the majority of the runoff from these areas will be captured and treated as mine water.

Stormwater flowing on and off the Mine Site will be controlled by natural watershed divides and a series of dikes and ditches constructed around the perimeter of the Mine Site, along the pit rims, and around the interior of the Mine Site. Sedimentation ponds will be constructed along the perimeter of the Mine Site to reduce TSS from these stormwater ditches prior to discharging off-site to tributaries to the Partridge River.

2.2.1 Stormwater Modeling

The flows and volumes from stormwater ditches and sedimentation ponds were modeled using XP-SWMM, Version 10.6, which is a software package used to model stormwater, sanitary water, and river systems. The design for the stormwater ditches and sedimentation ponds was based on the critical year for each feature, determined by identifying the Mine Year producing the highest quantity of runoff for each ditch and pond network. Once the critical year was established, the sedimentation ponds and stormwater ditches were designed using the 10-year and 100-year, 24 hour Soil Conservation Service (SCS) Type II storm events with rainfall depths for the mine location obtained from Technical Paper No. 40 (TP-40; Reference (5)). In 2013, the National Oceanic and Atmospheric Administration published Atlas 14, which revised the rainfall/precipitation frequency estimates for design storms previously published in 1961 by the U.S. Weather Bureau’s TP-40. The change in the 10-year and 100-year, 24 hour design storms were evaluated between TP-40 and Atlas 14, and it was found that Atlas 14 increased the amount of precipitation for these two frequency events. As a result, PolyMet will update the precipitation amounts to reflect Atlas 14 during final design of the stormwater system. There may be minor modifications to the stormwater system described in this section to reflect the increased capacity required for the Atlas 14 precipitation. The design constraints will not be modified from those listed.

For the sedimentation ponds, the design goal was to control, at a minimum, the 10-year, 24-hour storm event through the outlet pipe(s). A secondary spillway is included in the design for each pond to control the discharges that occur during storm events greater than the 10-year, 24-hour storm. See Section 2.2.4.2 for detailed information regarding design of the ponds and outlets.

The following sections describe the major components of the stormwater management system.

2.2.2 Exclusion Dikes

Dikes will be placed at strategic locations around the perimeter of the Mine Site and around the pit rims as described in the following sections.

2.2.2.1 Perimeter Dikes

The purpose of constructing dikes and ditches at or near the perimeter of the Mine Site is to:

- minimize the amount of surface water flowing on to the Mine Site
- minimize Project impacts to wetlands outside the perimeter of the Mine Site
- eliminate mine water flowing uncontrolled off the Mine Site
- manage the rate and location of stormwater flowing off the Mine Site

The criteria used to select dike alignments include:

- as close to the Project boundary as practicable to avoid obstructing mining operations
- where needed to facilitate construction of subsurface flow cutoff to prevent shallow groundwater flow from entering the Mine Site
- where the ground surface at the Project boundary is lower than flood levels in surrounding water bodies, and flood levels are high enough to flow onto the Mine Site if not controlled
- where stormwater from construction areas or other surfaces disturbed by mining activities will otherwise discharge off the site and where ditches will not adequately control the runoff

- where needed to ensure that stormwater runoff is detained and discharged in a manner that will meet stormwater quality requirements

Dikes will be constructed of the silty sands or glacial till material excavated during construction of ditches and removal of overburden. Side slopes will be vegetated to control erosion. Small dikes will also be constructed, as needed, along interior stormwater ditches and around stockpile construction areas to separate stormwater and mine water around the Mine Site.

In order to convey stormwater adjacent to the dikes, prevent surface runoff from entering the mine pits, intercept stormwater prior to reaching mine water areas, and prevent water from pooling in areas where the dikes cut across low areas, ditches will be constructed along the interior of most of the perimeter dike system. In addition, there will be some areas along the site perimeter where the existing ground is already relatively high so that a ditch will be able to capture the site surface runoff without a dike. Stormwater captured by the ditches will be directed to sedimentation ponds and then routed into a natural drainage system. Where glacial till is present in the dike foundation zone below the water table and where inspection trenching (conducted at the time of construction) indicates potential for high-permeability conditions or where peat is present, seepage control measures may be installed to restrict groundwater movement. Test trenches will be excavated along the perimeter dike alignments during construction to determine the underlying soil conditions. The test trenches will be used to evaluate the need for construction of cutoff trenches.

In areas where glacial till is present, seepage control measures may include soil cut-off trenches constructed of compacted silty sand or compacted glacial till, or slurry trenches. The decision on which design to use will depend on depth to bedrock and soil type on which the dike will be built. In areas where peat is present, seepage will be prevented by placing earthen dike materials over the surface of the peat, which will compress and reduce the permeability of the peat. If a sand seam or other high-permeability material is found in the dike foundation zone below the peat deposit, a soil cutoff trench, slurry wall, or sheet pile wall will be installed (depending on depth to bedrock) to cut off seepage. Geotechnical testing has indicated that silty sand soils found at the Mine Site are a relatively low-permeability material in their natural state, as discussed in Section 4.1 of Reference (6). Therefore, seepage cutoffs are generally not planned to be used in areas where dike foundation soils are silty sand.

The alignment of the perimeter dikes for the various years of mine operation are shown on Large Figure 7 to Large Figure 9 and on Drawings SW-003, SW-004, and SW-005 in Attachment C. Typical design sections for the perimeter dikes are shown on Drawing SW-007 of the Mine Site Stormwater Drawings.

2.2.2.2 Pit Exclusion Dikes

Pit exclusion dikes will be constructed in areas where surface water might otherwise drain into the mine pits. The pit exclusion dikes are temporary in nature, intended to be in place only as long as the mine pit overburden excavation limit is at a specific location. Dikes will be constructed by pushing up a ridge of soil where needed around the limits of overburden excavation at the pit rim during overburden stripping operations. Pit exclusion dikes do not require as rigorous control of construction materials and procedures (compaction and moisture content control) as the perimeter dikes need. They can be constructed quickly and economically to cut off surface water flow into the pits. Dikes will be removed and reconstructed in new locations as the mine pit expands. These dikes are intended only to intercept and direct surface runoff, not to impede movement of groundwater flow. The dikes will also serve as safety berms for mining operations at some locations and will need to remain in place until mining operations are terminated at those locations. The typical design section for the pit exclusion dikes is shown on Drawing EW-008 of the Mine Site Stormwater Drawings.

2.2.3 Stormwater Ditches

The purpose of stormwater ditches throughout the Mine Site is to:

- route stormwater away from the areas of mining activity to minimize the amount of mine water created on the Mine Site
- convey collected stormwater to perimeter ditches and sedimentation ponds prior to controlled discharge from the Mine Site
- minimize the impacts of mining operations on the Partridge River system

The layout of the proposed stormwater system was designed to maintain existing sub-watershed boundaries and discharge locations at the Mine Site to the extent practical while still maintaining the objectives of the system. The primary strategy is to intercept stormwater before it contacts areas that have been disturbed by mining activities, which will minimize the amount of mine water and the overall impacts to the Partridge River.

Large Figure 7 to Large Figure 9 show the layout of the stormwater ditches, dikes, and ponds for Mine Years 1, 11, and 20, respectively. Ditch plan and profile views are shown on Drawings SW-013 through SW-030 in Attachment C. Typical cross-sections and details for stormwater ditches are shown on Drawing SW-007 in Attachment C.

2.2.4 Sedimentation Ponds and Outlets

Sedimentation ponds will be constructed to reduce TSS from stormwater runoff and allow for controlled discharge of stormwater from the Mine Site. Based on preliminary design, five stormwater sedimentation ponds are planned for the Mine Site, as shown on Large Figure 7 to Large Figure 9 (the final number and configuration of stormwater ponds will be determined in final design). Pond A is located near the northeastern corner of the Category 1 Waste Rock Stockpile and directs stormwater from the north and west sides of the stockpile off-site. Pond B is located between the East Pit and northern border of the Mine Site. Pond C-West is located west of the West Pit and was designed to provide additional flood storage and reduction of peak discharge rates prior to Pond C-East, which is located west of the OSLA and downstream of Pond C-West. Pond D is located west of the OSP, on the north side of Dunka Road.

Stormwater will be routed from the Mine Site to these five locations around the perimeter of the site. These locations were selected to discharge stormwater into existing flow paths outside of the Mine Site boundary to mimic existing conditions to the extent possible and to minimize the overall hydrologic impacts to the Partridge River. Some existing culvert locations along Dunka Road will be consolidated through diking and ditching to limit the number of outlets from the site to simplify management, monitoring, and operations. All five of the sedimentation ponds (shown on Large Figure 7) will be constructed prior to the end of Mine Year 1, with the remaining pond, Pond C-West, constructed in Mine Year 2 (shown on Drawing SW-004 in Attachment C).

2.2.4.1 General Design Criteria

The stormwater sedimentation ponds will be designed to limit TSS outflow concentrations into natural flow paths to meet the TSS benchmark values established in the Minnesota NPDES/SDS Industrial Stormwater General Permit (Permit No. MNR050000). Design capacity was evaluated using methodolgy described in Section 2.2.1.

The inflow TSS concentrations may fluctuate over time and can only be estimated for this design. The design assumes inflow TSS concentrations of 50 milligram per liter (mg/L) during baseflow conditions and 100 mg/L during storm events. These TSS estimates are believed to overestimate the actual concentrations that will occur, although the inflow concentrations used in the design will need to be confirmed once water quality sampling can be conducted.

Sediment removal in the sedimentation ponds is sensitive to the grain size distribution of the sediments in the stormwater entering the pond. The grain size distribution of the inflow sediments used in the design will need to be confirmed once water quality sampling can be conducted at the site and additional geotechnical data can be obtained. The ponds and outlet configuration will be modified as necessary according to any new data as necessary to meet the permit requirements. The pond surface areas were designed to remove 70% of sediment during the 10-year and 100-year storm events. The baseflow and the 10-year storm event assumes a larger percentage of fines using a design gradation of 0.0363 millimeters (mm), of which 70% of the expected sediment will be larger than this according to the reference gradations. The 100-year storm event uses a design gradation of 0.05 mm, of which 70% of the expected sediment will be larger than this according to the reference gradations. However, a small change in the grain size distribution could result in a large change in the required surface area of the pond for sediment removal.

Additionally, stormwater permitting has been taken into account in the design of these ponds. PolyMet has requested coverage of Mine Site industrial stormwater discharges under the Minnesota NPDES/SDS Industrial Stormwater General Permit (Permit No. MNR050000), which includes a TSS benchmark value of 100 mg/L. Compliance with this benchmark value was used in the design criteria.

The annual average flow was used to size the ponds for the baseflow condition, for which a lower TSS concentration but higher percent of finer sediments is expected. The peak flows from the SCS Type II, 10-year and 100-year, 24-hour storm events determined from the XP-SWMM model were used to size the ponds for storm event flows, for which a higher TSS concentration but lower percent of finer sediments is expected. The 100-year, 24-hour storm event flow was the driving factor in determining the required pond surface area. The pond, culvert, and weir sizes were designed to slow the flow through the stormwater ponds long enough to allow the required settling within each pond. TSS removal was estimated using the assumption of a steady-state plug flow reactor and computing sediment settling velocity (in still water) according to Dietrich (Reference (7)).

In general, the storage volumes available in the sedimentation ponds will result partially from excavation and partially due to construction of dikes above natural ground. The planned 3 (horizontal) to 1 (vertical) side slopes of the pond dikes will provide a stable cross-section that will provide sufficient flow path length to control leakage. Side slopes will be covered with soil and seeded to control erosion. With this design, the diversion ditches will flow by gravity from the channels into the sedimentation ponds, and additional storage can be provided above the ground. This also allows better control of the pond outflows and increases their sedimentation efficiency.

2.2.4.2 Sedimentation Pond Sizing and Outlet Design

The sizes of the sedimentation ponds have been designed and will be constructed to meet the objectives of the Minnesota NPDES/SDS Industrial Stormwater General Permit (Permit No. MNR050000). The primary design objective is reduction of sediment in runoff from storms up to the 100-year, 24-hour storm event.

The primary outlet structures for the ponds will be designed and constructed to accommodate flows up to the 10-year, 24-hour storm without overtopping the secondary spillway. Detention storage will be provided to accommodate runoff volumes up to the 10-year storm event. An earthen weir and secondary spillway will also be constructed through the pond embankment to accommodate flows from storms larger than the 10-year storm event without overtopping the dikes or roads, except for Pond C-West and Pond D. The downstream side of these overflow structures will include erosion control measures such as riprap. Accumulated sediment will be removed from sedimentation ponds by pumping or dredging, as required.

Pond C-West is intended primarily for attenuation of peak discharge into Pond C-East. The flow from Pond C-West will discharge through the primary spillway, which is adequately sized to accommodate the 100-year storm event runoff; a secondary spillway is not necsssary in the design.

Due to its outlet under Dunka Road, Pond D outlets through culverts (with no secondary spillway), which are designed to accommodate the 100-year, 24-hour storm and convey stormwater discharge from the pond to an existing wetland south of Dunka Road.

Due to the proximity to the Partridge River, and the estimated elevations of the Partridge River flood flows, each of the outlet culverts on Pond A and Pond B will be fitted with check valves to prevent water from flowing from off-site into the ponds. Both the primary outlet and an emergency outlet were designed for conditions specific to each pond's design needs, with the primary outlet designed to provide flood attenuation and the secondary outlet designed to pass flows larger than the design values used to size the sedimentation pond and primary outlet. The pond outlet configuration showing the primary outlet culverts and secondary overflow earthen weirs are illustrated on Drawings SW-008 to SW-012 in Attachment C. Similar to all long-term infrastructure at the Mine Site, the outlet designs for the ponds were chosen to provide reliable service and to minimize maintenance.

The ponds will be excavated to provide 8 to 10 feet of dead storage below the primary outlet invert to provide capacity for the sedimentation and to prevent resuspension of sediment. As required under both the Minnesota NPDES/SDS Construction Stormwater General Permit (Permit No. MN R100001) and the Minnesota NPDES/SDS Industrial Stormwater General Permit (Permit No. MNR050000), these ponds will have depths no greater than 10 feet. The ponds were sized to achieve a length-to-width ratio that will range from about 2 to 3 to reduce the probability of short-circuiting and allow adequate sedimentation for flows up to the 100-year storm event.

In many proposed pond locations, groundwater is near or at the existing ground surface. The normal water level of the ponds in such locations will be based on the expected groundwater elevations.

The minimum surface area of the ponds were computed to achieve the required TSS removal efficiencies; the preliminary surface area of the ponds range from 1.7 to 6.0 acres (meeting or exceeding the minimum surface area required to achieve the required TSS removal efficiencies). For all ponds, with the exception of Pond C-West, the primary outlet of each pond will consist of between one and six reinforced concrete pipe culverts with diameters ranging from 24 to 60 inches. The culvert inverts will be set at the normal water level (NWL) in each pond. Culverts will have a positive slope discharging to the downstream side of the dike or road embankment. With the exception of Pond C-West and Pond D, each pond will also have a secondary overflow structure to allow flows above the capacity of the primary outlet to discharge without overtopping the dikes or road embankments. The spillway will be an earthen spillway with an elevation set between 0.5 feet and one foot below the dike elevation and will vary in length from 6 to 200 feet. The downstream side of these spillways will include erosion control measures, such as riprap, as needed. The riprap will be Minnesota Department of Transportation Standard Specification 3601 Random Riprap Class III, IV, or V, depending on the size of riprap required for the calculated discharge velocity for the spillway.

Existing culvert invert elevations under Dunka Road were maintained where they will be replaced so that existing flows will not be impeded. Therefore, culverts to or from ponds located adjacent to Dunka Road, including culverts directing flow from Pond C-East and Pond D, are designed to maintain the surveyed grades of the existing corrugated metal pipe culverts under the road. The culverts under Dunka Road for Pond C-East and Pond D have been designed to convey the 100-year, 24-hour storm event.

2.3 Sewage Management and Infrastructure

The Mine Site will have portable sanitary facilities to manage sewage. Sewage collected from Mine Site portable sanitary facilities will be transported via truck to the Plant Site for treatment at the Plant Site Sewage Treatment System.

3.0 Key Outcomes

Through modeling (described in detail in Reference (1)), water quantity and quality estimates have been determined and used in the design of these water management systems. The modeling also includes the expected water quantity and quality outcomes resulting from these water management systems which are summarized in this section.

3.1 Water Quantity

The quantity of water that the Project will remove from the upper reaches of the Partridge River and the quantity of water that will be discharged from the Mine Site in postclosure maintenance were modeled, as described in Reference (8)). The overall Project water balance determines the quantity of water that will be removed from the Upper Partridge River watershed and the disposition of that water. Mine water will be recycled to the extent possible, which will reduce the amount of water withdrawn from Colby Lake, or used to flood the mine pits.

Groundwater appropriation will be needed for both construction and operations at the Mine Site. Estimated water appropriation flows are provided in the Project's Consolidated Water Appropriation Permit application.

3.2 Water Quality

Reference (1) describes the water quality modeling with key outcomes summarized as follows:

- estimated West Pit lake water quality in Large Table 1
- estimated groundwater quality in Large Table 2 and Large Table 3 along two surficial groundwater flow paths downstream of the Mine Site
- estimated surface water quality in Large Table 4 and Large Table 5 at two surface water locations downstream of the Mine Site
- estimated stockpile drainage water quality in Large Table 6

4.0 Operating Plan

During the construction and operations phases, water at the Mine Site must be continually channeled, monitored, and pumped for treatment as necessary to allow the mine to function efficiently and to protect the environment. This section describes the steps and processes planned at the Mine Site during the construction and operating phases.

4.1 Mine Water

Mine water may not meet water quality limits for metals or other constituents for discharge off-site. With the exception of water from the OSLA and from construction dewatering of saturated mineral overburden (i.e., construction mine water), all mine water will be routed via the MPP to the WWTS, then to the FTB or back to the Mine Site for pit flooding in later years. Mine water will be intercepted by ditches, dikes, the Category 1 Stockpile Groundwater Containment System, and stockpile foundation liners to keep it separate from the stormwater conveyance systems. The operation of the mine water system is detailed below.

4.1.1 Central Pumping Station (CPS)

Under normal conditions, the CPS pumps will be operated automatically by liquid level sensing equipment. The pumps will be started in sequence, one at a time, as required to maintain the water level in the corresponding pond at safe levels. Start pump and stop pump levels will be based on the depth of water in the relevant equalization basin. As the water level in the pond rises, the first pump will be started at reduced speed. If the water level continues to rise, a second pump will be started at reduced speed. Likewise, when available, the third pump will be started should the inflow to the corresponding pond exceed the capacity of two pumps operating at maximum speed to maintain the desired water level in the basin. During normal operations, the third pump is considered redundant.

The design flow rate of the low concentration pumps is listed on Table 4-1.

Table 4-1 Design Flow Rate of the Low Concentration Pumps

	Pump Capacity	Capacity required
1 Pump	1700 gpm	Mine Year 5 = 1460 gpm
2 Pumps	2600 gpm	Mine Year 10 = 2561 gpm
3 Pumps	3000 gpm	3rd pump is installed for redundancy

The design flow rate of the high concentration pumps is listed on Table 4-2.

Table 4-2 Design Flow Rate of the High Concentration Pumps

	Pump Capacity	Capacity required
1 Pump	290 gpm	Mine Year 5 = 261 gpm
2 Pumps	400 gpm	Mine Year 10 = 368 gpm
3 Pumps	440 gpm	3rd pump is installed for redundancy

Preventive maintenance will be an integral part of the operation of the CPS. Preventive maintenance will be focused on keeping equipment operable under the expected range of operating conditions. Preventive maintenance tasks include, but are not limited to:

- daily observation of pump operation and review of alarm conditions, if any, that have occurred
- daily verification that the flow meters at the CPS and the end of the MPP are properly sending data and that data appears to be valid over the previous 24-hour period
- weekly inspection of the intake screens; clearing debris as required
- inspection of any ice control measures at the intake, prior to winter, to confirm that they are operational; during winter, daily inspection of the pump station intake to confirm that ice is not forming to the extent that could damage the intake and/or restrict flow to the pumps
- annual inspection of instrumentation, controls, and electrical components and replacement of worn or damaged parts
- annual cleaning of intake well, as required, to remove any solids that may have collected
- inspection of pumps and valves, with rebuilding, as required, at intervals recommended by the pump manufacturer, which is typically approximately one billion gallons of water pumped for each pump; valve lubrication as required
- regular inspection of building services, such as heating and ventilation; service as required

4.1.2 Construction Mine Water Pumping Station

Under normal conditions, the construction mine water pumps will be operated automatically by liquid level sensing equipment in the Construction Mine Water Basin. The pumping station will be provided with three pumps each sized to deliver 50% of the required flow capacity. The pumps will be started in sequence, one at a time, as required to maintain the water level in the basin at safe levels. Start pump and stop pump levels will be based on the depth of water in the basin. As the water level in the basin rises, the first pump will be started. If the water level continues to rise, a second pump will be started. The third pump will be started should the inflow to the basin exceed the capacity of two pumps operating at maximum speed to maintain the desired water level in the basin. During normal operations, the third pump is considered redundant, with the design flow provided by two pumps operating in parallel, as listed in Table 4-3.

Table 4-3 Design Flow Rate of the Construction Mine Water Pumps

	Pump Capacity	Capacity required
1 Pump	1600 gpm	Mine Year 5 = 1600 gpm
2 Pumps	2600 gpm	Mine Year -1 = 2600 gpm
3 Pumps	3000 gpm	3rd pump is installed for redundancy

When the construction mine water flows decrease below 50% of the initial capacity requirement, it will be possible to remove one of the construction mine water pumps from service.

4.1.3 Mine to Plant Pipelines (MPP)

Monitoring of the MPP will occur by routine visual inspections and with flow meters on each end of each pipeline. Visual inspections of the MPP alignment will be completed on a regular basis for early identification of any potential leaks. Final design and construction may affect specific details of the monitoring and insection plan. Once final design and construction of the MPP is completed, PolyMet will include its monitoring and inspection protocols in a spill response plan. Currently, PolyMet anticipates the following elements will be included in its plan: Visual inspections of the MPP will be completed daily at each manhole location, which will include a walk-around inspection. Additionally, monthly visual inspections will occur along the entire MPP alignment (berms, in most cases).

Each pipeline of the MPP contains in-line flow meters at both the origin and terminus, which will be monitored in the control room at the WWTS. Having the flow meters on each end of the pipe will allow for continuous monitoring of flow differentials; if a differential suggests that a leak might have occurred, an alarm will be triggered and the pumps will automatically stop. Further details on flow differentials will be determined during final engineering design. Once final design and construction of the MPP is completed, PolyMet will include its monitoring and inspection protocols in a monitoring plan, and its spill response procedures in a spill response plan.

4.1.4 Mine Water Pipes

The mine water pipes will carry the water from the mine water sumps and ponds, located around the Mine Site, to the Equalization Basin Area. The mine water piping system will expand as the mine expands, connecting the pits, stockpiles, and ore handling areas with the Equalization Basin Area. The condition of the pipes will be monitored during each shift, and maintenance will be performed as necessary.

4.1.5 Mine Site Sumps and Pumps

Sumps are located throughout the Mine Site in the pits, around the edge of the temporary waste rock stockpiles, and along the edge of the OSP, as described in Section 2.1.4.1. The water that collects in these sumps will be pumped to the Equalization Basin Area via the mine water pipes. The condition of the pumps and sumps will be monitored during each shift, and maintenance or replacement of the pumps will be performed, as necessary.

4.1.6 Mine Site Mine Water Ponds

If a storm event, snowmelt, or power outage creates more water than a stockpile sump can contain, the excess water from the sumps will overflow to adjacent mine water ponds.

Mine water ponds without sumps are located in six locations to collect runoff from the haul roads, RTH, and OSLA. In these cases, mine water runoff will flow by gravity from these areas to the appropriate ponds. Water in the mine water ponds will be pumped to the Equalization Basin Area via the mine water pipes.

The condition of the ponds and pumps will be monitored once per shift, and maintenance or replacement of the pumps will be performed as necessary. Mine water ponds have been designed with access for maintenance cleanout, as needed. The need for and frequency of sediment cleanout will be assessed during annual pond inspections.

4.2 Stormwater

Stormwater ponds will be inspected annually to determine the depth of sedimentation within the ponds. These ponds will be dredged if the depth of sedimentation reduces the required storage capacity below what is needed based on the pond design.

Stormwater dikes and ditches will be monitored after construction as part of standard operation and maintenance activities to detect excessive seepage. Should a zone of excessive seepage be identified, sheet pile, grouting, or other seepage control technologies can be installed with the dike in place. Alternatively, a low-permeability material could be compacted in a trench excavated near the toe of the dike without disturbing the dike.

The stormwater management infrastructure will be operated in accordance with the Construction SWPPP, which will be developed prior to construction, and the Industrial SWPPP, which will be developed prior to the start of operations. These SWPPPs will be designed to meet the requirements of the Minnesota NPDES/SDS Construction Stormwater General Permit (Permit No. MN R100001) and the Minnesota NPDES/SDS Industrial Stormwater General Permit (Permit No. MNR050000), respectively.

A SWPPP is a “living” document that evolves with changes at a site. PolyMet will amend these SWPPPs whenever there is:

- a change in Mine Site facilities
- a change in the operating procedures of the facility
- a change that may impact the potential for pollutants to be discharged via stormwater

The intent of these SWPPPs is to protect water quality by preventing pollution from stormwater associated with construction and industrial activities. These SWPPPs will identify and describe controls and BMPs proposed for the Mine Site; these controls and BMPs are designed to minimize the discharge of potential pollutants in stormwater runoff.

Inspections and recording activities are important parts of the continued success of these SWPPPs. The frequency and extent of the inspections will be defined in each SWPPP. Associated recordkeeping forms will be included in each SWPPP.

4.3 Spills

This section is a summary of the Mine Site Spill Prevention Control and Countermeasures (SPCC) Plan which will be developed prior to the threshold for need being met in accordance with 40 CFR 112.3. The SPCC Plan provides the procedures for response to spills. These procedures apply to all PolyMet employees, contractors, and vendors delivering, dispensing, or using petroleum products at the Mine Site. It is the policy of PolyMet to promote a long-term, continuous effort towards spill prevention first, and control and countermeasures where necessary. An SPCC Plan Administrator will be designated and is responsible for developing, implementing, and maintaining the SPCC Plan. In the case of a spill, the procedures for emergency contacts and a spill contingency plan will be further described in the SPCC Plan. Training sessions and spill prevention briefings for operating personnel will review the requirements of the SPCC Plan and highlight and describe recently developed precautionary measures.

4.4 Overflows

This section includes discussion of what will occur in the event of an overflow of mine water and stormwater containment features. An overflow may occur when a storm event exceeds the design storm or an extended power outage occurs at the Mine Site. In order to prevent and mitigate the effects of possible overflows, the following operational plan will be used.

4.4.1 Mine Water

The storage capacities of the mine water sumps and ponds are provided on Table 2-5 and Table 2-6 and on Drawing ME-004 of the Mechanical Infrastructure Drawings. Where the sumps and ponds are next to each other, the sump volume only includes the volume before it will overflow into the pond, whereas the pond volume is the remaining volume apart from the sump. This is the storage capacity of the design and does not include the freeboard (typically three feet) or contingency response plans for removing or rerouting the water to prevent overtopping.

Mine water collection from the temporary stockpiles, haul roads, and ore handling areas (OSP and RTH) will likely require treatment to meet water quality standards. The design storm for these facilities, the 100-year, 24-hour event, only has a 1% chance of being exceeded in any given year, or an 18% chance of being exceeded during the 20-year life of the Mine Site. Although these facilities have been designed according to a significant design storm, there may be occasions during the life of the mine that the design storm is exceeded, resulting in runoff exceeding the capacity of the facilities. The design includes a factor of safety in the form of freeboard volume, and additional contingencies have been developed to minimize environmental impacts in the event the total volume available is exceeded.

For storm events in excess of the design storm, mine water from temporary stockpiles, haul roads, and the ore handling areas will continue to fill the ponds within the excess capacity (freeboard) included in the design of each pond. With the exception of the RTH pond, the sump and pond designs include three feet of freeboard based on the MPCA's *Recommended Pond Design Criteria* (Reference (9)). Due to the lack of room, the RTH pond has been designed with one foot of freeboard, but will include a larger pump that can pump the higher volumes. Use of freeboard in the design provides a significant factor of safety for these ponds, with a total excess capacity (design volume plus freeboard) ranging from approximately 30% to 170% over the required capacity, as shown in Table 4-4.

Table 4-4 Sump and Pond Excess Volume

Infrastructure	Sump/Pond Name	Required Volume (acre-feet)	Design Volume (acre-feet)	Freeboard Volume (acre-feet)	Excess Volume (1)
Category 2/3 Waste Rock Stockpile	S23-1	14.9	14.9	15.7	33%
	S23-2	11.9	12.0		
	MW-S23-1	21.4	21.5		
	S23-3	6.6	6.6	6.4	54%
	MW-S23-3	5.3	5.3		
Category 4 Waste Rock Stockpile	S4	10.1	12.5	10.6	81%
	MW-S4	8.1	9.9		
Ore Surge Pile	SOSP	8.5	8.7	5.6	47%
	MW-SOSP	4.8	5.3		
Overburden Storage and Laydown Area	MW-OSLA	10.7	14.5(2)	14.1(2)	167%(2)
Haul Roads	MW-HRE	10.7	10.7	4.2	39%
	MW-HRN	4.4	4.6	2.8	69%
	MW-HRC	6.1	6.9	3.0	61%
	MW-HRW	3.7	4.0	2.6	77%
Rail Transfer Hopper	MW-RTH(3)	0.7	0.7	0.3	43%

(1) Excess capacity compares the total capacity (design volume plus freeboard volume) to required capacity.
(2) MW-OSLA was oversized to allow for storage of peat within the pond, as described in Section 2.1.5.1.
(3) MW-RTH was sized based on available area with a larger pump capacity.

Although the chance that the total design volume will be exceeded is small, an operational contingency plan has been developed in the event that this occurs. The pumping networks draining these sumps and ponds are sized for the snowmelt event; therefore any additional pumping capacity required must be increased through a second pump system. Although it will not be cost-effective to have a second permanent pump and pipeline network in place in the event of an extended power outage or storm event that causes the design volume to be exceeded, an emergency operating procedure has been developed to manage mine water under these circumstances. This operational contingency plan includes use of temporary portable pumps to operate during events greater than the design volume or under circumstances of extended power outages associated with heavy rainfall. This plan will maintain water levels below the total capacity of the sumps and ponds, pumping to the pits until mine water volumes are down to manageable levels.

Under circumstances of design events exceeding sump and pond capacity or extended power outages during heavy rainfall, it is likely that the equalization basins may also reach capacity and the pumping network leading to it will be shut down. In these circumstances, pumped mine water may be temporarily pumped into the pits, with mining operations in the lower levels temporarily shut down until water in the pit sumps are back to manageable levels. If the emergency operating procedure, as described above, is put into effect, mine water will be pumped to the pits, based on the level of reactivity of material stockpiled, following these priorities in descending order of reactivity and priority: OSP sump SOSP and overflow pond MW-SOSP; Category 4 Waste Rock stockpile sump S4 and overflow pond MW-S4; Category 2/3 Waste Rock Stockpile sumps and overflow ponds; RTH runoff pond MW-RTH; haul road runoff ponds MW-HRC, MW-HRE, MW-HRW, and MW-HRN; and OSLA runoff pond MW-OSLA. Pit dewatering may be temporarily stopped during these conditions to allow lowering of the water in these sumps and mine water ponds to manageable levels.

In the unlikely event of runoff exceeding the total design capacity of the sumps and ponds and containment under the emergency contingency plan is insufficient, overflows from the mine water areas will ultimately overflow into the Mine Site stormwater system, which ultimately flows off-site to the Partridge River.

Sump overflow ponds will contain sump overflow during events exceeding the 10-year, 24-hour storm up to the 100-year, 24-hour storm, but they will also receive direct precipitation during all rainfall events. Therefore these ponds will require periodic pumping because there is not a separate pumping system for these ponds. The pump system installed for the sumps will be used for periodic pumping of these overflow ponds to maintain capacity for the design storm.

After major storm events, stockpile sumps will be pumped down to their normal water levels to maintain storage volume for future storms, and then the overflow pond water will be conveyed to the Equalization Basin Area.

Overflow from the Category 1 Stockpile Groundwater Containment System is prevented by gravity overflow pipes from the system sumps directly to the East and West Pits (Section 2.1.2 of Reference (2)).

4.4.2 Stormwater

The design of the stormwater sedimentation ponds and outlets are described in Section 2.2.4, with pond sizing and outlet structure design described in Section 2.2.4.2.

The primary outlets from Stormwater Sedimentation Pond A and Pond B (on the north perimeter of the site) will be fitted with check valves to prevent water from the Partridge River from flowing onto the Mine Site under flood conditions on the river (shown on Drawing SW-008 and SW-009 in Attachment C). For each of the three stormwater sedimentation ponds on the south perimeter of the site, both the primary outlet and an emergency outlet were designed for each pond’s specific conditions, with the primary outlet designed to provide flood attenuation and the secondary outlet designed to pass flows larger than the design values used to size the primary outlet. If necessary, during large flood events in the headwaters of the Partridge River along the north side of the Mine Site, excess stormwater from Pond A and Pond B will be pumped to the stormwater ditch that flows south to Pond C-East or off-site using temporary portable pumps. If necessary, flood control pumping priorities will be given to the stormwater pond with potential to overflow into the mine water systems.

4.5 Dust Suppression

Water will be used to control fugitive dust emissions. The appropriate water sources will be determined depending on the location and runoff management for the road to be watered. At the Mine Site, fugitive emission control water could be drawn from multiple sources, including mine pit dewatering collection sumps with open pits, haul road drainage water ponds, the OSLA pond, and the Equalization Basin Area basins.

5.0 Water Quantity and Quality Monitoring

Proper long-term management of water quality and quantity at the Mine Site will depend, in part, on a systematic monitoring plan that will be finalized in NPDES/SDS and Water Appropriation permitting. As operations proceed, the monitoring plan will be updated as required. Monitoring will be used to determine project compliance with permits, improve model accuracy, identify potential causes of changes to water quality or quantity, and identify options, if necessary, to adapt the Project to result in short-term and long-term compliance.

In aggregate, the NPDES/SDS and Water Appropriation monitoring plans will provide a comprehensive and thorough evaluation of water flow rates, water levels, and water quality on a continuous, monthly, or quarterly basis, depending upon the component being monitored. Monitoring information provided in this document as well as the applicable permit applications include specific locations, nomenclature, frequency, and parameters; the specifics of monitoring for the Project will be finalized during each applicable permitting process.

The proposed monitoring stations are divided between the Mine Site and the Plant Site. In the proposed monitoring plans, the Transportation and Utility Corridors are grouped with the Mine Site. This document presents the Mine Site and Transportation and Utility Corridors monitoring plans as a series of figures and tables:

- Large Figure 10 through Large Figure 12 show the proposed monitoring stations for groundwater, surface water, stormwater, and internal waste streams.

- Large Table 7 through Large Table 10 describe the purpose for monitoring, the type of monitoring, the proposed parameter groups to be monitored, the proposed frequency of monitoring, and the proposed frequency and method of reporting. These tables also denote which permit(s) (NPDES/SDS and/or Water Appropriation) each monitoring station is associated with. Many monitoring stations are associated with both permits. Large Table 11 lists the proposed parameters to be monitored for each type of monitoring.

Information included on the large figures and large tables are described further in the following sections.

5.1 Monitoring Types

Monitoring for the Project is categorized by monitoring type (e.g., compliance monitoring, performance monitoring) and station type (i.e., groundwater, surface water, stormwater, and internal waste stream). Refer to the Mine Site and Transportation and Utility Corridors monitoring plan tables (Large Table 7 through Large Table 10) for additional information on associated parameters, frequency, and reporting.

- Compliance Monitoring (groundwater stations): Compliance monitoring will be conducted at locations where the Project will need to demonstrate compliance. These locations are downgradient of potential Project impacts. Groundwater compliance monitoring stations are typically at or near the property boundaries.

- Indicator Monitoring (groundwater stations): Indicator monitoring will be conducted at locations between the compliance stations and Project features to allow for early detection of potential Project impacts.

- Performance Monitoring (groundwater stations): Performance monitoring will be conducted to monitor the performance of engineering infrastructure (liners systems, containment systems, etc.). Performance monitoring stations will include monitoring wells, paired monitoring wells, paired piezometers, and stockpile underdrains.

- Background Monitoring (groundwater and surface water stations): Background monitoring will be conducted to document surface water quality upstream and groundwater quality upgradient of the Project. Background monitoring stations will be located upstream/upgradient of potential Project impacts.

- Benchmark Stormwater Monitoring (stormwater stations): Benchmark stormwater monitoring will be conducted at benchmark stormwater monitoring stations to evaluate the potential impact of industrial activities on stormwater runoff. Results will be compared to applicable benchmark values to determine whether additional stormwater control measures may be necessary. These stations are proposed at outfalls of industrial stormwater from the Mine Site and at locations where stormwater runoff along the Transportation and Utility Corridors flows to a stream.

- Monitor-Only (groundwater, surface water, and internal waste stream stations): PolyMet proposes to conduct some monitoring that is not required for NPDES/SDS compliance. At monitor-only stations, no limits or standards will apply; however, there may be triggers that will initiate further investigation. Monitor-only stations are proposed for groundwater monitoring stations downgradient of potential Project impacts, surface water stations downstream of potential Project impacts, and for Project internal waste streams.

    - The surface water monitor-only stations will evaluate long-term water quality to identify potential changes that may be attributed to the Project; however, they will not be considered compliance points. The intent of the surface water monitor-only stations is to allow for a more holistic (i.e., multi-media) monitoring approach. If water quality impacts attributable to the Project are found at these monitoring stations, further investigation will be conducted and the overall monitoring plan will be evaluated to determine the root cause of the impacts and whether adaptive engineering controls or contingency mitigations are needed.

- The internal waste stream monitor-only stations will evaluate the potential for off-site impacts and aid in design and operation of the WWTS.

- Water Appropriation Monitoring (groundwater, surface water, internal waste stream stations, and precipitation): Monitoring in connection with water appropriations will measure flow rates and water levels to document appropriation rates and monitor potential effects of permitted appropriations. Precipitation monitoring will also occur to correlate appropriated amounts with changes in precipitation. Water Appropriation Monitoring also serves to identify the effects of permitted appropriations and associated discharges on surface water flow downstream of the Mine Site.

  - Appropriation Groundwater Monitoring will measure the effects of permitted groundwater withdrawals on groundwater levels in the surficial aquifer and in bedrock at the Mine Site.

  - Appropriation Source Monitoring will measure flows from Mine Site infrastructure that will withdraw groundwater, surface water, and/or collected precipitation during operations, such as the mine pits and the Category 1 Stockpile Groundwater Containment System, and will document the water levels in the mine pits and groundwater wells.

  - Streamflow Monitoring will measure streamflow in the Partridge River watershed to assess potential hydrologic effects associated with permitted appropriations.

5.2 Groundwater Monitoring

Groundwater from the Mine Site generally flows south toward the property boundary. Large Table 7 presents the proposed Mine Site and Transportation and Utility Corridors groundwater monitoring plan, which will consist of compliance, indicator, performance, and appropriation groundwater monitoring, as shown on Large Figure 10.

Proposed monitoring parameters were selected based on consideration of baseline monitoring results, FEIS modeling results, the existing Cliffs Erie Hoyt Lakes Tailings Basin Area NPDES/SDS Permit (Permit No. MN0054089), and best professional judgment.

5.3 Surface Water Monitoring

Surface water from the Mine Site and the Transportation and Utility Corridors generally flows south toward the Partridge River and its tributaries (Wetlegs Creek, Longnose Creek, and Wyman Creek).

Large Table 8 presents the proposed Mine Site and Transportation and Utility Corridors surface water monitoring plan, which will consist of background, monitor-only, and streamflow monitoring stations, as shown on Large Figure 11.

Proposed monitoring parameters were selected based on consideration of baseline monitoring results, FEIS modeling results, the existing Cliffs Erie Hoyt Lakes Tailings Basin Area NPDES/SDS Permit (Permit No. MN0054089), the existing Cliffs Erie Hoyt Lakes Mining Area NPDES/SDS Permit (Permit No. MN0042536), 40 CFR part 440, and best professional judgment.

5.4 Benchmark Stormwater Monitoring

Large Table 9 presents the proposed benchmark stormwater monitoring plan for the Mine Site and the Transportation and Utility Corridors, and monitoring station locations are shown on Large Figure 11.

Proposed monitoring parameters were selected based on consideration of Minnesota NPDES/SDS Industrial Stormwater General Permit (Permit No. MNR050000) Sector G and Sector P requirements.

5.5 Internal Waste Stream Monitoring

Large Table 10 presents the proposed Mine Site and Transportation and Utility Corridors internal waste stream monitoring plan, which will consist of monitor only, internal flow, and appropriation source stations, as shown on Large Figure 12.

Proposed monitoring parameters were selected based on consideration of FEIS modeling results and best professional judgment.

5.6 Wetland Monitoring

In addition to the monitoring plan that will be done under the NPDES/SDS Permit and the Water Appropriation Permits, wetland hydrology monitoring will be developed as part of wetland permitting and is expected to be similar to the baseline wetland hydrology monitoring program currently underway; see Section 4 of Reference (10).

5.7 Sampling and Analysis Plan and Quality Assurance Project Plan

These monitoring plan components will be detailed in the Sampling and Analysis Plans (SAP) that will be prepared upon issuance of a NPDES/SDS permit or as required by other regulatory programs. Each SAP will detail the monitoring stations, sampling frequency, sample collection protocol, analytical methods and parameters, and quality assurance requirements. At a minimum, the SAP will consist of a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP). The FSP will detail the field activities and documentation requirements for the sample collection and management in the field. The field activities and documentation requirements will be organized as Standard Operating Procedures (SOP) specific to the various activities to be performed. The QAPP will detail the data quality objectives for the monitoring plans, list the monitoring stations, analytical methods, parameters, and quality control limits, data validation procedures, and data management practices.

The SAPs will incorporate analytical methods or standard practices approved by the U.S. Environmental Protection Agency or other agency, as appropriate. Sample collection frequency was selected based on conditions specified in permits for similar operations, and considered potential rate of transport where appropriate. Frequency of sampling will be finalized during the NPDES/SDS and Water Appropriations permitting processes.

6.0 Reporting and Adaptive Management

Adaptive management is a system of management practices based on clearly defined outcomes and monitoring requirements to determine if management actions are meeting the desired outcomes; and, if not, implementing changes that will best ensure that outcomes are met or re-evaluated. Adaptive management recognizes the uncertainty associated with estimates based on natural systems as a result of the baseline monitoring data, waste characterization, scale of plan, decisions on modeling inputs and other limiting factors. Adaptive management measures will continue to be developed through the operations, reclamation, closure, and postclosure maintenance phases of the Project.

A key component of adaptive management for water is the Adaptive Water Management Plan (Reference (3)) that describes adaptive engineering controls that manage water quality and quantity. Fixed engineering controls (liners, dikes, ditches, etc.) are described in this plan and other management plans. Contingency mitigations that could be applied if engineering controls do not manage water quality and quantity properly are also described in this document.

6.1 NPDES/SDS Permit and Water Appropriation Permit Reporting

The NPDES/SDS permit and the Water Appropriation permits will require and will define routine water quality and quantity reporting and annual reports.

As required by these permits, water quality reports will be submitted to the MPCA and water quantity reports will be submitted to the DNR.

The content required for these reports will be defined in the relevant permits. In addition to water quantity and quality monitoring described in Section 5.0, PolyMet anticipates that both of these permits will also require the following information be included in the reports:

- precipitation data
- water level data (for groundwater monitoring)
- identification and explanation of variations from permit requirements, if any

PolyMet anticipates additional information required in the NPDES/SDS reports will include:

- identification of any changes to the stockpile liners or groundwater containment system made during the last year
- a summary of any previously reported variations from permit requirements

- identification of any changes to the stockpile liners or groundwater containment system planned for the coming year

PolyMet anticipates additional information required in the Water Appropriations reports will include:

- water movement reporting, including flow rates and total monthly volumes for all water movement on-site or discharged off-site
- monthly and annual amounts of water appropriated, by installation
- stream flow data
- monthly records of augmentation flows from the WWTS and the drainage swale
- macroinvertebrate monitoring results
- stream flow data

6.2 Permit to Mine Reporting

A PTM Annual Report will be submitted to the DNR by March 31 of each year, in accordance with Minnesota Rules, part 6132.1300, subpart 1. A template for the Annual PTM Report is included in the PTM application. It includes:

- assessment of rock stability in the mine pit and slopes
- management of blasting in the pit
- monitoring of groundwater inflows into the pit
- transportation and utility corridors monitoring (ore car and track inspections)
- dust monitoring
- mining rates and production summary
- the total tons of overburden and waste rock by type placed in stockpiles or mine pits from the start of operations through the past year and the remaining planned capacity
- the average sulfur content (based on the most recent Block Model) of waste rock placed in stockpiles, placed in the East Pit from the West and Central Pits and, to the extent practical, from temporary stockpiles (recognizing that the rock placed in the

East Pit from temporary stockpiles will not be re-evaluated for sulfur content prior to pit disposal)

- a map showing where waste rock and overburden were placed and where vegetation was established for reclamation during the past year
- a map showing where overburden and waste rock are planned to be placed and where vegetation is planned to be established for reclamation during the coming year
- identification of any planned changes in operations that could impact final reclamation
- an update of the waste rock waste characterization program

6.3 Annual GoldSim Model Assessment

Each year, PolyMet will update the Mine Site GoldSim model based on observed conditions from the previous year. Modeled water quality and quantity from the updated GoldSim model will be compared to observed water quality and quantity at major Project features and at select groundwater wells. PolyMet will conduct an annual decision process to confirm that the model assumptions and construct are appropriate for continued use, propose model refinements if necessary, and determine whether adaptive management actions or contingency mitigation measures are necessary.

The annual GoldSim model assessment will be documented in a report to be submitted to MPCA for the NPDES/SDS Permits and DNR for the Water Appropriation Permits and the PTM. Additional detail regarding the annual model assessment and decision process for model refinements is provided in Reference (11).

6.4 Adaptive Management

If the annual GoldSim model assessment and decision process indicates that an unacceptable outcome could occur or the observed flows and concentrations exceed permit levels, adaptive management actions will be implemented. PolyMet will submit a work plan to initiate adaptive management actions to the MPCA and DNR to address the issue.

The work plan could include some or all of the following adaptive management actions:

1. Field studies that may be necessary to determine the root cause of the exceedance
2. Adjustments that can be made to the adaptive engineering controls described in Reference (3) that will remedy the root cause. Adjustments to the adaptive engineering controls include changing the scale or type of control and its design.

3. If the exceedances persist, implementation of contingency mitigation (Section 6.5) that will remedy the root cause and include that contingency mitigation as an adaptive engineering control in Reference (3).

PolyMet will monitor and model effects to the environment with the new or adjusted engineering control or contingency mitigation measure until the issue no longer persists.

6.5 Contingency Mitigations

If monitoring or refined model estimates with adaptive engineering controls show that water quantity or quality at compliance points are projected to not meet compliance parameters, mitigations are available that would address the following situations. The contingency mitigations described in the following paragraphs are feasible but depend on site-specific conditions and do not include modifications to adaptive engineering controls which are described in Reference (3). These mitigations would be developed and designed if needed and coordinated with the DNR and MPCA as appropriate.

A. A pattern of overflows of the mine water sumps or ponds develop.

   i. As described in Section 4.4, there is excess capacity designed as a safety factor in all the mine water sumps and ponds ranging from approximately 30 to 170% of required capacity. Additional capacity could be developed by expanding the pond areas.

B. Streams along the railroad corridor between the Mine Site and Plant Site show degradation in water quality as a result of material spilled from the rail cars.

   i. The PTM application includes details of the loading, unloading, and transport of ore and the engineering controls and procedures that will be used to minimize the potential of ore spillage along the railroad corridor. If degradation of water quality is found as a result of ore spillage, catchment areas could be developed adjacent to the tracks at stream crossings to further minimize the amount of spilled material that reaches the streams. Solids in the catchment areas would be removed and placed in the Process Plant, Category 4 Waste Rock Stockpile, or the East Pit.

C. Groundwater downgradient of lined infrastructure or the mine pits has compliance issues.

   i. Interception wells could collect groundwater flows impacted by a leak from one of the liner systems. Water collected by interception wells would be pumped to the WWTS or an approved non-mechanical treatment system for treatment. Because all liner systems at the Mine Site are for temporary infrastructure (temporary stockpiles, temporary ponds, etc.), the interception wells would only be needed while the liner is in use or until a liner repair could be performed.

ii. Interception wells could collect groundwater flows impacted by pit overflow into the surficial aquifer. Water collected by interception wells would be pumped to the WWTS or an approved non-mechanical treatment system for treatment.

iii. Groundwater outflows from the pits could be contained by the use of injection grouting or grout curtains, as described in PolyMet's conceptual plan for bedrock groundwater flow mitigation (Reference (12)).

D. West Pit water quality is worse than expected.

i. The contaminant load from the West Pit walls could be reduced by several methods:

   a. Once the West Pit reaches its full water level, dams could be constructed in the low areas of the pit rim to raise the water level, decreasing the amount of exposed wall rock.

   b. A low permeability soil barrier could be constructed along the Ore Grade Material portions of the exposed pit wall such that the groundwater level rises in that area to an elevation above the top of the exposed Ore Grade Material. This would effectively create a wetland over this material, holding water over the exposed material, and limiting groundwater flow through the material.

ii. The contaminant load to the West Pit from the East Pit could be reduced by several methods:

   a. A low permeability soil barrier could be constructed along the Virginia Formation portion of the exposed pit wall such that the groundwater level rises in that area to an elevation above the top of the exposed Virginia Formation. This would effectively create a wetland over this material, holding water over the exposed material, and limiting groundwater flow through the material.

   b. A Permeable Reactive Barrier (PRB) could be installed in the East Pit outlet channel to remove contaminates. Use of PRBs to remove sulfate, trace metals, and other dissolved or suspended constituents from water is described in detail in Section 6 of Reference (3).

   c. The water leaving the East Pit could be pumped to the WWTS.

iii. Injection grouting or grout curtains could be used to minimize groundwater inflows to the pits, as described in PolyMet's conceptual plan for bedrock groundwater flow mitigation (Reference (12)).

iv. The West Pit water could be diluted by routing additional stormwater to the West Pit.

v. The West Pit could be treated by several methods:

   a. The West Pit water could be pumped to the WWTS, treated, and returned to the West Pit.

   b. The West Pit lake could be treated in-situ with iron salts, fertilizer, or other methods tailored to the contaminant of concern. For example, Alexco is the industry leader for pit lake remediation and has technologies that have successfully treated billion gallon pit lakes for contaminants including selenium, zinc, uranium, and nitrate. Alexco's technologies have been successfully applied at numerous sites and locations and have demonstrated successful remediation.

6.6 Periodic Evaluation of Models

In addition to the annual model assessment described in Section 6.6, PolyMet will conduct a periodic assessment of the underlying conceptual models and other supporting mathematical models that are used as inputs to the GoldSim models. The periodic model evaluation will be conducted approximately every five years, and a separate work plan will be developed for each of the periodic model evaluations that will identify the specific data sets and models to be evaluated. Additional detail regarding the periodic model evaluation is provided in Reference (11).

Revision History

Date	Version	Description
11/30/2011	1	Initial release
01/09/2013	2	Significant changes to incorporate project changes related to the decisions made in the AWMP Version 4 and 5. These project changes include the extension of the groundwater containment system along the south side of the stockpile, the use of a geomembrane cover on the Category 1 Waste Rock Stockpile, the use of long-term mechanical treatment and the potential for non-mechanical treatment in long-term closure.
12/31/2014	3	Changes were made for clarification, to address agency comments (Sections 1.0, 1.1, 1.2, 1.3.2, 1.4, 2.1.1, 2.1.4.1.1, 2.1.4.1.2, 2.1.5.1, 2.1.7, 2.2.4.1, 4.0, 4.1, 4.2, 4.4.1, 4.4.2, 5.0, 5.1.6, 5.3, 6.0, 6.2, 6.3, 6.5, 6.6, 7.2.1), to incorporate minor design changes and project refinements (Sections 2 and 4), and to incorporate the results of water modeling (Section 3).
03/09/2015	4	Minor changes were made to address agency comments (Sections 1.0, 1.2, 1.3.1, 1.3.2, 2.1, 2.1.5.1, 2.1.6, 3.1, 5.0, 5.1.1, 5.1.2, 5.1.3, 5.1.3, 5.1.4, 5.1.5, 5.5.2, 6.1, 6.2, 6.6, and 7.2.3, Large Table 8, and Large Figure 12).
07/11/2016	5	Certification page added, minor changes made to Section 7 tables for clarity, minor changes made to Large Figures to account for changes to the WWTF footprint, permit application support drawings added to Attachments A and B, reference to Attachments C, D, and E were deleted from this document.
08/29/2017	6	Updated to reflect Project design at time of update (August 2017),. Changes included modifications to the Project designs, specifically to the Equalization Basin Area, re-insertion of the monitoring plan, updated periodic evaluation of models discussion, and updated reference list. Former Section 7 was deleted because this document is specific to the construction and operations phases. Attachment A was added to explain the WWTS terminology changes.
12/7/2017	7	Updated for inclusion in PTM v3 to reflect response to DNR comments received on PTM v2 submittal. Additionally, further clarity has been provided on construction stormwater (Section 2.0) and for the MPP (Section 4.1.3). Minor errors or omissions noted since v6 of the plan were also addressed.

References

1. **Poly Met Mining Inc.** NorthMet Project Water Modeling Data Package Volume 1 - Mine Site (v14). February 2015.

2. **Poly Met Mining, Inc.** NorthMet Project Rock and Overburden Management Plan (v10). December 2017.

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4. **Barr Engineering Co.** Hydrogeologic Investigation - Phase I, PolyMet NorthMet Mine Site, RS-02 Draft-02. November 2006.

5. **U.S. Department of Commerce, Weather Bureau.** Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years - Technical Paper No. 40. May 1961.

6. **Poly Met Mining Inc.** NorthMet Project Geotechnical Data Package Vol 3 - Mine Site Stockpiles (v5). July 2016.

7. **Dietrich, William E.** Settling velocity of natural particles. *Water Resources Research.* 1982, Vol. 18, 6, p. 1615.

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9. **Meyer, P., G. Erickson, D. Sahli, N. Groh, B. Smith, V. Sathyaseelan.** *Recommended Pond Design Criteria. Document wq-wwtp5-53.* s.l. : Minnesota Pollution Control Agency, December 2009.

10. **Poly Met Mining Inc.** NorthMet Project Wetland Management Plan (v7). January 2015.

11. **Barr Engineering Co.** GoldSim Model Assessment Work Plan - NorthMet Project. August 2017.

12. **Foth Infrastructure & Environment, LLC.** NorthMet Pit: Conceptual Plan for Bedrock Groundwater Flow Mitigation. August 2014.

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Large Table 1 Estimated West Pit Lake Water Quality

Constituent	Mine Year / Percentile / Units	Surface Water Quality Standard(1)	Mine Year 25(1) Average P10(2)	Mine Year 25(1) Average P50(2)	Mine Year 25(1) Average P90(2)	Mine Year 55(1), (3) Average P10(2)	Mine Year 55(1), (3) Average P50(2)	Mine Year 55(1), (3) Average P90(2)	Mine Year 75(1), (4) Average P10(2)	Mine Year 75(1), (4) Average P50(2)	Mine Year 75(1), (4) Average P90(2)
Ag (Silver)	µg/L	1	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Al (Aluminum)	µg/L	125	0.93	1.41	2.15	0.93	1.41	2.15	0.93	1.41	2.15
Alkalinity	mg/L	--	34.82	39.69	51.12	34.82	39.69	51.12	34.82	39.69	51.12
As (Arsenic)	µg/L	53	10.88	13.59	18.77	8.88	10.81	14.88	7.98	9.72	13.32
B (Boron)	µg/L	500	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Ba (Barium)	µg/L	--	28.13	30.30	31.29	28.12	36.05	38.22	26.95	36.88	39.50
Be (Beryllium)	µg/L	--	0.40	0.40	0.40	0.35	0.40	0.40	0.32	0.40	0.40
Ca (Calcium)	mg/L	--	49.34	54.98	70.72	34.31	38.74	49.46	30.80	34.72	44.77
Cd (Cadmium)(5)	µg/L	2.6	1.16	1.89	4.72	0.77	1.50	**3.88**	0.68	1.41	**3.63**
Cl (Chloride)	mg/L	230	12.53	13.42	15.41	8.16	10.64	14.99	7.29	9.54	13.35
Co (Cobalt)	µg/L	5	21.90	52.83	113.41	**17.21**	**38.25**	**80.09**	**15.47**	**33.99**	**73.49**
Cr (Chromium)	µg/L	11	3.86	4.00	4.14	2.37	2.57	2.91	2.10	2.29	2.59
Cu (Copper)(5)	µg/L	9.8	118.98	236.74	656.69	**118.98**	**236.74**	**654.58**	**118.98**	**236.74**	**654.58**
F (Fluoride)	mg/L	--	0.28	0.32	0.35	0.20	0.25	0.31	0.18	0.22	0.27
Fe (Iron)	µg/L	--	45.83	59.87	199.13	45.83	59.87	199.13	45.83	59.87	199.13
K (Potassium)	mg/L	--	12.83	14.19	17.31	7.96	10.00	13.71	7.06	8.85	12.05
Mg (Magnesium)	mg/L	--	32.72	35.27	39.74	14.42	15.84	18.88	12.98	14.27	16.94
Mn (Manganese)	µg/L	--	191.36	232.02	311.95	126.32	146.00	198.30	121.08	139.69	188.04
Na (Sodium)	mg/L	--	43.69	50.32	63.67	25.82	34.11	52.18	23.12	30.32	46.09
Ni (Nickel)(5)	µg/L	54.6	330.95	683.53	1466.24	**269.24**	**488.73**	**902.46**	**241.09**	**433.22**	**801.56**
Pb (Lead)(5)	µg/L	3.4	7.62	11.46	20.93	**5.61**	**7.87**	**11.89**	**5.10**	**7.06**	**10.55**
Sb (Antimony)	µg/L	31	9.90	11.21	13.67	6.37	7.68	9.56	5.64	6.83	8.50
Se (Selenium)	µg/L	5	0.25	2.71	3.40	0.25	1.78	2.41	0.25	1.61	2.17
SO_4 (Sulfate)	mg/L	--	95.11	104.71	124.55	48.35	56.77	68.54	43.15	50.86	61.90
Tl (Thallium)	µg/L	0.56	0.11	0.12	0.13	0.08	0.08	0.09	0.07	0.08	0.09
V (Vanadium)	µg/L	--	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Zn (Zinc)(5)	µg/L	125.4	86.02	115.60	274.24	63.58	98.58	**229.45**	57.38	95.73	**221.91**

(1) Surface water quality standard only applies at overflow, and therefore is only compared to Mine Years 55 and 75; values for those years above the applicable water quality standard are shown in bold with light red shading.
(2) Values shown are the average of the monthly P10, P50, and P90 values, as indicated, for the referenced Mine Year; see Section 6.2 of Reference (1).
(3) Flooding of the West Pit has a 90% probability of being complete by the end of Mine Year 55.
(4) Concentrations in the West Pit are typically stable or trending downward in postclosure maintenance.
(5) Standard is hardness-based and evaluated at a hardness of 105.5 mg/L; see Section 6.5.3 Reference (1) for surface water monitoring station SW004a, which is downstream of the West Pit discharge.

Large Table 2 Estimated Surficial Groundwater Quality along the East Pit-Category 2/3 Waste Rock Stockpile Flow Path at the Property Boundary

Constituent	Mine Year / Percentile / Units	Water Quality Standard	Mine Year 10 Average P10(1)	Mine Year 10 Average P50(1)	Mine Year 10 Average P90(1)	Mine Year 30 Average P10(1)	Mine Year 30 Average P50(1)	Mine Year 30 Average P90(1)	Mine Year 75 Average P10(1)	Mine Year 75 Average P50(1)	Mine Year 75 Average P90(1)	Mine Year 150 Average P10(1)	Mine Year 150 Average P50(1)	Mine Year 150 Average P90(1)	Mine Year 200(2) Average P10(1)	Mine Year 200(2) Average P50(1)	Mine Year 200(2) Average P90(1)
Ag (Silver)	µg/L	30	0.11	0.11	0.11	0.11	0.12	0.14	0.11	0.11	0.11	0.11	0.12	0.13	0.11	0.12	0.13
Al (Aluminum)(3)	µg/L	--	49.64	54.05	58.90	72.17	134.72	335.31	49.89	55.17	70.97	43.76	49.95	56.02	42.94	47.52	53.35
Alkalinity	mg/L	--	61.71	64.55	67.52	61.69	64.53	67.51	61.57	64.45	67.49	57.04	61.87	65.82	55.70	60.17	64.50
As (Arsenic)	µg/L	10	0.67	0.72	0.76	0.67	0.72	0.76	0.67	0.72	0.76	0.67	0.72	0.76	0.67	0.72	0.76
B (Boron)	µg/L	1,000	26.60	27.03	27.47	26.67	27.12	27.59	26.63	27.10	27.71	26.92	27.95	29.74	26.96	27.69	28.89
Ba (Barium)	µg/L	2,000	29.41	31.36	33.44	29.38	31.35	33.43	29.41	31.35	33.43	28.71	31.60	34.69	26.57	30.32	34.59
Be (Beryllium)(4)	µg/L	0.45	0.12	0.12	0.12	0.12	0.12	0.13	0.12	0.12	0.12	0.12	0.13	0.15	0.12	0.13	0.15
Ca (Calcium)	mg/L	--	14.84	15.45	16.09	15.09	15.80	16.65	14.89	15.56	16.37	14.35	15.63	17.21	13.96	14.91	16.29
Cd (Cadmium)	µg/L	4	0.10	0.10	0.10	0.11	0.12	0.19	0.10	0.10	0.13	0.10	0.14	0.28	0.11	0.13	0.20
Cl (Chloride)	mg/L	250	0.62	0.65	0.69	0.62	0.66	0.70	0.62	0.66	0.98	0.69	1.34	2.71	0.82	0.99	2.13
Co (Cobalt)	µg/L	--	0.79	0.87	0.98	1.19	2.76	10.42	0.80	0.92	2.20	0.94	1.78	3.48	1.06	1.52	2.73
Cr (Chromium)	µg/L	100	0.89	0.93	0.98	0.90	0.94	0.99	0.89	0.94	0.99	0.84	0.94	1.03	0.81	0.89	0.99
Cu (Copper)	µg/L	--	2.30	2.49	2.69	2.30	2.49	2.69	2.30	2.49	2.69	2.31	2.49	2.69	2.32	2.51	2.70
F (Fluoride)	mg/L	2	0.07	0.07	0.08	0.07	0.07	0.08	0.07	0.07	0.08	0.07	0.08	0.11	0.07	0.07	0.10
Fe (Iron)(3)	µg/L	--	1,217.80	1,427.00	1,673.30	1,235.30	1,451.00	1,714.00	1,215.80	1,423.70	1,674.80	1,109.20	1,318.10	1,562.20	1,077.80	1,273.30	1,496.40
K (Potassium)	mg/L	--	1.63	1.69	1.74	1.66	1.72	1.78	1.64	1.70	1.98	1.64	2.33	3.75	1.55	1.81	3.03
Mg (Magnesium)	mg/L	--	6.67	6.96	7.26	6.82	7.14	7.70	6.71	7.00	7.36	6.49	7.01	7.63	6.33	6.72	7.27
Mn (Manganese)(3),(4)	µg/L	1,002	477.87	551.07	635.44	485.10	558.64	644.69	477.65	550.89	635.37	436.35	516.97	599.18	423.87	497.62	576.79
Na (Sodium)	mg/L	--	5.12	5.35	5.57	5.20	5.44	5.70	5.16	5.40	6.42	5.19	7.50	12.75	4.88	5.71	10.06
Ni (Nickel)	µg/L	100	1.86	2.01	2.18	1.86	2.01	2.18	1.86	2.02	2.18	1.88	2.04	2.23	1.91	2.08	2.35
Pb (Lead)	µg/L	--	0.57	0.61	0.65	0.62	0.68	0.85	0.57	0.62	0.66	0.60	0.72	0.85	0.64	0.78	0.86
Sb (Antimony)	µg/L	6	0.25	0.25	0.25	0.25	0.25	0.26	0.25	0.26	0.32	0.26	0.28	0.35	0.26	0.27	0.33
Se (Selenium)	µg/L	30	0.52	0.52	0.53	0.53	0.56	0.64	0.52	0.53	0.56	0.50	0.55	0.65	0.49	0.51	0.61
SO_4 (Sulfate)	mg/L	250	9.15	9.62	10.15	10.01	11.30	15.84	9.19	9.83	11.37	9.39	11.35	15.76	9.17	10.09	13.71
Tl (Thallium)	µg/L	0.6	0.12	0.12	0.13	0.12	0.12	0.13	0.12	0.12	0.13	0.11	0.12	0.13	0.11	0.12	0.12
V (Vanadium)	µg/L	50	3.50	3.62	3.75	3.52	3.64	3.77	3.50	3.64	3.78	3.59	4.08	4.61	3.49	4.20	4.66
Zn (Zinc)	µg/L	2,000	4.21	4.36	4.54	4.72	6.22	12.06	4.24	4.46	6.62	4.55	9.19	18.24	5.81	8.49	14.68

NOTE: Values above the applicable water quality standard are shown in bold with light red shading.
(1) Values shown are the average of the monthly P10, P50, and P90 values, as indicated, for the referenced Mine Year; see Section 6.3 of Reference (1).
(2) Model runs evaluated through Mine Year 200.
(3) Not evaluated against the secondary groundwater standard.
(4) Evaluated against the site-specific evaluation criteria shown.

Large Table 3 Estimated Surficial Groundwater Quality along the West Pit Flow Path at the Property Boundary

Constituent	Mine Year / Percentile / Units	Water Quality Standard	Mine Year 50			Mine Year 75			Mine Year 150			Mine Year 200(2)		
			Average P10(1)	Average P50(1)	Average P90(1)	Average P10(1)	Average P50(1)	Average P90(1)	Average P10(1)	Average P50(1)	Average P90(1)	Average P10(1)	Average P50(1)	Average P90(1)
Ag (Silver)	µg/L	30	0.11	0.11	0.11	0.11	0.11	0.13	0.14	0.15	0.16	0.15	0.16	0.16
Al (Aluminum)(3)	µg/L	--	49.54	53.99	58.87	43.07	52.63	58.21	25.16	28.14	36.09	24.85	27.62	30.69
Alkalinity	mg/L	--	61.71	64.55	67.52	59.57	63.79	67.09	49.38	53.01	59.06	49.10	52.33	57.77
As (Arsenic)	µg/L	10	0.67	0.72	0.76	0.67	0.72	0.76	0.67	0.72	0.76	0.67	0.72	0.76
B (Boron)	µg/L	1,000	26.59	27.03	27.47	26.70	27.41	44.44	52.40	63.08	65.67	55.42	61.52	65.13
Ba (Barium)	µg/L	2,000	29.41	31.36	33.44	29.55	31.62	33.62	27.25	33.67	36.60	24.74	33.32	38.14
Be (Beryllium)(4)	µg/L	0.45	0.12	0.12	0.12	0.12	0.12	0.18	0.19	0.24	0.27	0.17	0.22	0.26
Ca (Calcium)	mg/L	--	14.82	15.43	16.07	14.98	15.81	21.26	20.35	22.60	27.00	17.80	20.03	24.11
Cd (Cadmium)	µg/L	4	0.10	0.10	0.10	0.10	0.11	0.47	0.32	0.64	1.73	0.28	0.56	1.73
Cl (Chloride)	mg/L	250	0.62	0.65	0.69	0.63	0.68	3.26	3.08	4.27	5.80	2.70	3.55	5.06
Co (Cobalt)	µg/L	--	0.77	0.85	0.94	0.80	0.96	10.40	6.34	14.11	30.82	5.80	11.40	26.67
Cr (Chromium)	µg/L	100	0.89	0.93	0.98	0.90	0.96	1.35	1.29	1.44	1.60	1.12	1.23	1.47
Cu (Copper)	µg/L	--	2.30	2.49	2.69	2.30	2.49	2.69	2.30	2.49	2.69	2.30	2.49	2.69
F (Fluoride)	mg/L	2	0.07	0.07	0.08	0.07	0.07	0.12	0.11	0.13	0.16	0.10	0.11	0.14
Fe (Iron)(3)	µg/L	--	1,217.80	1,427.10	1,673.30	1,089.10	1,376.70	1,652.40	642.89	778.48	1,029.80	634.53	753.62	913.80
K (Potassium)	mg/L	--	1.63	1.69	1.74	1.65	1.73	3.70	3.62	4.53	5.82	3.06	3.82	5.11
Mg (Magnesium)	mg/L	--	6.67	6.95	7.25	6.72	7.11	9.39	8.77	9.68	10.96	7.76	8.52	9.94
Mn (Manganese)(3),(4)	µg/L	1,002	477.78	551.04	635.42	446.63	532.35	621.33	307.76	350.13	429.52	297.51	337.82	387.57
Na (Sodium)	mg/L	--	5.12	5.34	5.57	5.18	5.49	12.72	11.68	15.12	22.23	10.00	12.80	18.37
Ni (Nickel)	µg/L	100	1.86	2.01	2.18	1.86	2.01	2.18	1.86	2.01	2.18	1.86	2.01	2.18
Pb (Lead)	µg/L	--	0.57	0.61	0.65	0.58	0.65	2.35	2.34	3.23	4.88	2.10	2.76	4.07
Sb (Antimony)	µg/L	6	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.27
Se (Selenium)	µg/L	30	0.51	0.52	0.53	0.51	0.53	0.77	0.41	0.94	1.18	0.39	0.82	1.07
SO_4 (Sulfate)	mg/L	250	9.11	9.58	10.08	9.25	10.00	21.62	21.60	26.19	31.65	18.74	22.15	28.46
Tl (Thallium)	µg/L	0.6	0.12	0.12	0.13	0.11	0.12	0.13	0.09	0.10	0.11	0.09	0.09	0.10
V (Vanadium)	µg/L	50	3.50	3.62	3.75	3.53	3.69	5.17	5.79	6.77	7.02	6.57	6.82	7.03
Zn (Zinc)	µg/L	2,000	4.18	4.34	4.50	4.26	4.57	29.09	25.42	45.04	105.51	22.13	42.11	106.05

NOTE: Values above the applicable water quality standard are shown in bold with light red shading.
(1) Values shown are the average of the monthly P10, P50, and P90 values, as indicated, for the referenced Mine Year; see Section 6.3 of Reference (1).
(2) Model runs evaluated through Mine Year 200.
(3) Not evaluated against the secondary groundwater standard.
(4) Evaluated against the site-specific evaluation criteria shown.

Large Table 4 Estimated Surface Water Quality for the Partridge River at SW004

Constituent	Mine Year / Percentile / Units	Water Quality Standard	Mine Year 20 Average P10[1]	Mine Year 20 Average P50[1]	Mine Year 20 Average P90[1]	Mine Year 55 Average P10[1]	Mine Year 55 Average P50[1]	Mine Year 55 Average P90[1]	Mine Year 75 Average P10[1]	Mine Year 75 Average P50[1]	Mine Year 75 Average P90[1]	Mine Year 125 Average P10[1]	Mine Year 125 Average P50[1]	Mine Year 125 Average P90[1]	Mine Year 200[2] Average P10[1]	Mine Year 200[2] Average P50[1]	Mine Year 200[2] Average P90[1]
Ag (Silver)	µg/L	1	0.10	0.11	0.11	0.10	0.11	0.11	0.10	0.10	0.11	0.10	0.10	0.11	0.10	0.10	0.11
Al (Aluminum)	µg/L	125	30.09	70.35	**244.71**	30.78	70.81	**246.21**	44.88	96.38	**254.55**	41.59	95.87	**257.23**	43.47	94.89	**270.05**
Alkalinity	mg/L	--	25.47	73.28	129.93	24.53	72.90	128.45	19.11	54.26	145.87	18.43	53.13	129.76	19.06	52.69	130.10
As (Arsenic)	µg/L	53	0.20	0.88	2.36	0.20	0.88	2.13	0.13	0.56	2.17	0.12	0.56	2.50	0.12	0.56	2.19
B (Boron)	µg/L	500	18.86	81.35	162.27	17.75	81.37	195.40	9.95	36.47	158.70	9.89	35.92	161.46	10.71	36.56	192.83
Ba (Barium)	µg/L	--	2.67	9.54	18.12	2.66	9.68	18.30	2.09	9.30	27.59	2.12	9.39	27.91	2.01	9.30	27.85
Be (Beryllium)	µg/L	--	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.12	0.10	0.10	0.12	0.10	0.10	0.12
Ca (Calcium)	mg/L	--	6.99	19.94	33.58	6.76	20.03	33.39	5.10	13.71	33.37	5.01	13.50	33.05	5.18	13.77	31.95
Cd (Cadmium)[3]	µg/L	2.5	0.03	0.08	0.14	0.03	0.08	0.14	0.02	0.07	0.15	0.02	0.07	0.15	0.02	0.07	0.15
Cl (Chloride)	mg/L	230	1.69	8.29	15.00	1.72	8.33	16.26	0.64	2.45	13.68	0.61	2.51	15.06	0.59	2.37	13.58
Co (Cobalt)	µg/L	5	0.06	0.32	0.89	0.06	0.33	0.83	0.04	0.38	1.27	0.05	0.38	1.09	0.05	0.38	0.98
Cr (Chromium)	µg/L	11	0.23	0.57	1.15	0.24	0.57	1.20	0.20	0.63	1.25	0.20	0.63	1.29	0.23	0.63	1.34
Cu (Copper)[3]	µg/L	9.5	0.44	1.15	2.68	0.41	1.17	2.79	0.41	1.43	3.11	0.43	1.43	3.15	0.39	1.42	3.20
F (Fluoride)	mg/L	--	0.03	0.09	0.18	0.03	0.09	0.18	0.02	0.07	0.20	0.02	0.07	0.19	0.02	0.06	0.18
Fe (Iron)	µg/L	--	549.50	1,838.05	4,718.10	551.61	1,844.31	4,406.60	441.44	1,467.87	5,267.90	396.27	1,453.83	4,813.50	461.71	1,433.34	4,737.80
K (Potassium)	mg/L	--	0.59	2.05	3.59	0.58	2.03	3.63	0.37	1.32	3.83	0.40	1.38	5.03	0.43	1.35	3.96
Mg (Magnesium)	mg/L	--	4.19	10.27	14.56	4.31	10.17	14.50	3.23	6.64	14.15	3.28	6.72	12.77	3.32	6.73	13.82
Mn (Manganese)	µg/L	--	13.94	131.67	277.54	15.31	132.79	281.62	9.24	141.46	498.47	8.45	141.73	504.29	8.53	141.72	502.25
Na (Sodium)	mg/L	--	1.31	6.69	12.17	1.24	6.73	11.45	0.56	3.23	10.53	0.62	3.30	13.07	0.62	3.25	11.29
Ni (Nickel)[3]	µg/L	53.3	0.24	0.93	2.56	0.25	0.95	2.97	0.20	1.12	3.28	0.19	1.13	3.37	0.22	1.14	3.28
Pb (Lead)[3]	µg/L	3.3	0.03	0.23	0.58	0.03	0.23	0.61	0.02	0.23	0.79	0.02	0.23	0.74	0.02	0.24	0.77
Sb (Antimony)	µg/L	31	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.26	0.25	0.25	0.26	0.25	0.25	0.26
Se (Selenium)	µg/L	5	0.23	0.65	1.20	0.23	0.65	1.19	0.17	0.48	1.44	0.18	0.49	1.30	0.18	0.48	1.25
SO_4 (Sulfate)	mg/L	--	3.86	15.11	26.25	4.03	15.03	26.24	1.95	7.02	15.90	2.35	6.94	16.49	2.21	6.92	14.80
Tl (Thallium)	µg/L	0.56	0.00	0.03	0.06	0.00	0.03	0.06	0.00	0.03	0.11	0.00	0.03	0.11	0.00	0.03	0.11
V (Vanadium)	µg/L	--	1.01	1.41	2.01	1.01	1.41	2.03	0.99	1.59	3.26	1.00	1.60	3.32	1.00	1.60	3.33
Zn (Zinc)[3]	µg/L	122.3	1.31	5.03	19.41	1.37	5.08	17.34	1.06	4.30	20.97	0.91	4.40	21.88	1.04	4.28	19.31
Hardness	mg/L	500	43.57	93.40	128.18	41.55	93.89	128.38	35.42	65.27	121.94	34.64	64.59	121.91	36.63	65.25	119.64

NOTE: Values above the applicable water quality standard are shown in bold with light red shading.
(1) Values shown are the average of the monthly P10, P50, and P90 values, as indicated, for the referenced Mine Year; see Section 6.5 of Reference (1).
(2) Model runs evaluated through Mine Year 200.
(3) Standard is hardness-based and evaluated at a hardness of 102.5 mg/L; see Section 6.5.3 of Reference (1).

Large Table 5 Estimated Surface Water Quality for the Partridge River at SW004a

Constituent	Mine Year / Percentile / Units	Water Quality Standard	Mine Year 20 Average P10[1]	Mine Year 20 Average P50[1]	Mine Year 20 Average P90[1]	Mine Year 55 Average P10[1]	Mine Year 55 Average P50[1]	Mine Year 55 Average P90[1]	Mine Year 75 Average P10[1]	Mine Year 75 Average P50[1]	Mine Year 75 Average P90[1]	Mine Year 125 Average P10[1]	Mine Year 125 Average P50[1]	Mine Year 125 Average P90[1]	Mine Year 200[2] Average P10[1]	Mine Year 200[2] Average P50[1]	Mine Year 200[2] Average P90[1]
Ag (Silver)	µg/L	1	0.10	0.10	0.11	0.10	0.11	0.12	0.10	0.11	0.15	0.10	0.11	0.15	0.10	0.11	0.15
Al (Aluminum)	µg/L	125	32.96	79.13	**267.93**	29.20	75.87	**254.52**	33.05	82.98	**250.45**	31.88	83.07	**256.89**	32.03	82.77	**263.34**
Alkalinity	mg/L	--	21.32	65.79	137.96	21.49	64.01	132.84	18.68	52.34	145.05	17.39	51.32	128.21	18.52	50.96	127.26
As (Arsenic)	µg/L	53	0.15	0.76	2.61	0.16	0.90	2.23	0.16	0.92	2.43	0.15	0.93	2.47	0.14	0.92	2.45
B (Boron)	µg/L	500	12.92	64.04	168.74	13.75	64.83	199.71	10.19	43.53	159.36	10.39	43.24	163.91	10.90	40.59	195.10
Ba (Barium)	µg/L	--	2.27	9.31	21.80	2.33	10.37	23.01	2.23	11.39	32.48	2.25	11.14	33.31	2.10	10.54	34.76
Be (Beryllium)	µg/L	--	0.10	0.10	0.11	0.10	0.11	0.15	0.10	0.12	0.24	0.10	0.12	0.24	0.10	0.11	0.23
Ca (Calcium)	mg/L	--	5.72	17.49	34.03	5.65	17.88	34.65	5.09	15.02	33.78	5.09	14.76	33.55	5.34	14.70	31.81
Cd (Cadmium)[3]	µg/L	2.6	0.03	0.08	0.14	0.03	0.13	0.39	0.03	0.17	0.89	0.03	0.15	0.91	0.03	0.13	0.77
Cl (Chloride)	mg/L	230	1.12	6.05	13.62	1.21	6.23	16.37	0.75	3.23	13.37	0.66	2.95	15.30	0.62	2.58	13.64
Co (Cobalt)	µg/L	5	0.05	0.33	0.91	0.07	0.54	1.22	0.06	0.78	2.91	0.07	0.83	3.03	0.08	0.81	2.93
Cr (Chromium)	µg/L	11	0.21	0.59	1.20	0.24	0.70	1.26	0.21	0.81	1.63	0.22	0.76	1.39	0.24	0.70	1.34
Cu (Copper)[3]	µg/L	9.8	0.40	1.25	2.91	0.43	1.65	3.08	0.44	2.15	5.57	0.46	2.15	5.57	0.44	2.12	5.59
F (Fluoride)	mg/L	--	0.02	0.08	0.18	0.03	0.09	0.20	0.02	0.08	0.20	0.02	0.08	0.19	0.02	0.07	0.19
Fe (Iron)	µg/L	--	464.80	1,682.78	5,123.50	477.17	1,578.39	4,539.00	415.39	1,259.69	5,259.70	373.14	1,257.83	4,524.60	434.73	1,236.18	4,679.40
K (Potassium)	mg/L	--	0.46	1.79	3.77	0.48	1.68	3.67	0.36	1.20	3.80	0.39	1.24	4.98	0.40	1.23	3.96
Mg (Magnesium)	mg/L	--	3.71	8.96	13.72	3.80	8.82	13.83	3.27	6.99	14.33	3.29	7.03	12.84	3.29	6.93	13.91
Mn (Manganese)	µg/L	--	10.01	132.57	357.08	11.43	126.31	334.87	8.68	125.66	417.39	8.03	126.21	424.46	8.02	125.81	421.94
Na (Sodium)	mg/L	--	0.87	5.34	12.21	1.00	6.67	16.08	0.79	5.99	20.72	0.75	5.39	17.77	0.72	4.57	12.41
Ni (Nickel)[3]	µg/L	54.6	0.20	0.98	2.80	0.39	3.07	9.03	0.40	5.11	24.61	0.46	5.38	25.14	0.47	5.11	24.90
Pb (Lead)[3]	µg/L	3.4	0.02	0.23	0.63	0.03	0.35	0.79	0.03	0.48	1.79	0.04	0.49	1.79	0.03	0.48	1.78
Sb (Antimony)	µg/L	31	0.25	0.25	0.25	0.25	0.53	1.63	0.27	0.76	3.60	0.26	0.64	2.87	0.26	0.49	1.87
Se (Selenium)	µg/L	5	0.19	0.58	1.25	0.20	0.63	1.25	0.18	0.58	1.46	0.18	0.57	1.32	0.18	0.53	1.26
SO_4 (Sulfate)	mg/L	--	2.92	11.96	24.17	3.12	11.57	22.04	2.00	7.22	15.94	2.35	7.22	16.53	2.21	7.18	14.54
Tl (Thallium)	µg/L	0.56	0.00	0.03	0.08	0.00	0.03	0.08	0.00	0.03	0.11	0.00	0.03	0.11	0.00	0.03	0.10
V (Vanadium)	µg/L	--	1.00	1.46	2.46	1.02	1.81	3.31	1.02	2.24	6.47	1.02	2.29	6.48	1.02	2.21	6.51
Zn (Zinc)[3]	µg/L	125.4	1.10	4.64	21.80	1.52	8.64	20.83	1.54	11.74	46.39	1.48	10.92	48.09	1.39	9.49	45.35
Hardness	mg/L	500	39.07	82.56	124.06	37.88	83.30	128.16	35.38	69.56	122.73	34.54	68.75	122.42	37.02	68.11	119.28

NOTE: Values above the applicable water quality standard are shown in bold with light red shading.
(1) Values shown are the average of the monthly P10, P50, and P90 values, as indicated, for the referenced Mine Year; see Section 6.5 of Reference (1).
(2) Model runs evaluated through Mine Year 200.
(3) Standard is hardness-based and evaluated at a hardness of 105.5 mg/L; see Section 6.5.3 of Reference (1)

Large Table 6   Estimated Water Quality from Stockpile Drainage

Constituent[1]	Stockpile	Category 2/3 Waste Rock Stockpile (Temporary)			Category 4 Waste Rock Stockpile (Temporary)		Ore Surge Pile (Temporary)			Category 1 Waste Rock Stockpile (Permanent)				
	Mine Year / Units	Mine Year 1	Mine Year 11	Mine Year 19[2]	Mine Year 1	Mine Year 11[2]	Mine Year 1	Mine Year 11	Mine Year 20[2]	Mine Year 1	Mine Year 11	Mine Year 20	Mine Year 30[3]	Mine Year 75[3]
Ag (Silver)	µg/L	0.18	16.30	41.87	21.43	32.89	0.16	39.13	40.54	0.000	0.003	0.01	0.19	0.20
Al (Aluminum)	µg/L	0.44	150,188.33	378,285.83	253,425.83	404,926.67	0.40	351,548.33	345,180.00	1.14	1.41	1.41	1.41	1.41
Alkalinity	mg/L	25.03	16.65	0.00	0.00	0.00	21.19	1.17	0.14	32.13	39.69	39.68	39.69	39.69
As (Arsenic)	µg/L	89.42	100.00	100.08	122.93	159.34	79.47	99.83	97.32	17.53	100.00	99.98	100.00	100.00
B (Boron)	µg/L	89.46	138.35	200.40	617.68	1,247.21	81.00	193.41	194.70	80.77	100.00	99.98	100.00	100.00
Ba (Barium)	µg/L	28.18	10.27	11.32	73.24	91.62	25.52	7.78	11.72	31.96	14.96	14.50	10.79	10.67
Be (Beryllium)	µg/L	0.36	6.66	16.61	11.30	14.94	0.32	15.69	13.84	0.12	0.40	0.40	0.40	0.40
Ca (Calcium)	mg/L	215.42	577.78	405.76	294.51	434.49	80.20	422.61	387.71	144.00	682.43	683.98	683.89	684.28
Cd (Cadmium)	µg/L	4.23	45.66	64.31	90.65	125.67	2.33	82.88	24.41	1.06	3.48	3.59	3.67	3.67
Cl (Chloride)	mg/L	44.57	10.18	0.00	21.82	3.98	12.83	0.00	0.00	37.48	9.52	0.00	0.00	0.00
Co (Cobalt)	µg/L	261.85	5457.81	2881.22	6,449.77	15,151.08	662.06	28,145.75	8,023.15	83.27	122.65	122.62	122.65	122.65
Cr (Chromium)	µg/L	6.19	12.28	15.96	8.35	17.16	4.56	15.57	15.29	5.92	10.00	10.00	10.00	10.00
Cu (Copper)	µg/L	4,751.60	61,553.42	149,495.83	1,437.46	11,040.08	4,300.46	140,653.33	145,123.33	191.18	236.74	236.69	236.73	236.74
F (Fluoride)	mg/L	1.81	1.53	1.78	1.83	1.90	1.07	1.75	1.75	1.84	1.37	1.37	1.37	1.37
Fe (Iron)	µg/L	86.86	32,754.25	86,679.25	194,950.00	317,081.67	78.62	80,801.83	84,178.58	48.52	59.87	59.86	59.87	59.87
K (Potassium)	mg/L	31.92	42.03	27.98	9.41	13.29	13.84	29.22	27.03	23.74	46.90	46.89	46.90	46.90
Mg (Magnesium)	mg/L	35.77	389.22	303.89	276.57	1,059.48	25.80	732.48	226.73	32.95	146.90	150.97	150.76	151.06
Mn (Manganese)	µg/L	583.62	11212.28	7176.27	8,960.25	61,068.75	1,386.01	45,722.58	17,019.33	150.96	232.11	232.06	232.10	232.11
Na (Sodium)	mg/L	40.55	154.53	62.91	11.32	20.20	34.07	77.90	59.26	35.56	219.15	225.86	234.82	235.37
Ni (Nickel)	µg/L	3,669.22	83,192.58	42,749.81	9,183.46	31,350.58	12,158.82	588,671.67	146,079.33	1,062.53	2,226.35	2,227.61	2,230.10	2,230.10
Pb (Lead)	µg/L	1.79	137.15	360.09	288.10	385.96	1.62	337.01	341.77	0.62	7.35	10.77	99.93	100.00
Sb (Antimony)	µg/L	40.93	691.01	702.75	414.47	1,714.23	28.02	1,557.98	359.45	22.68	52.61	53.26	54.15	54.15
Se (Selenium)	µg/L	12.85	81.09	99.86	39.08	109.64	15.17	99.25	96.78	0.19	1.68	2.02	4.28	4.46
SO_4 (Sulfate)	mg/L	394.16	4,251.70	2,978.15	4,225.02	11,551.67	369.83	7,846.88	2,728.82	119.90	1,265.19	1,393.40	2,727.05	2,793.10
Tl (Thallium)	µg/L	0.10	1.03	2.07	1.07	2.75	0.16	2.14	1.95	0.01	0.08	0.08	0.20	0.20
V (Vanadium)	µg/L	8.94	27.53	55.00	9.78	15.42	8.09	52.29	53.17	8.08	10.00	10.00	10.00	10.00
Zn (Zinc)	µg/L	305.46	3,640.50	6,322.72	7,779.83	10,721.28	346.31	7,991.74	3,635.80	55.38	181.17	187.68	192.16	192.16

(1) Values shown are the average of the monthly P50 values for the referenced Mine Year; see Section 6.2 of Reference (1).
(2) Temporary stockpiles are shown through the years they are active: Category 2/3 Waste Rock Stockpile through Mine Year 19, Category 4 Waste Rock Stockpile through Mine Year 11, and Ore Surge Pile through Mine Year 20.
(3) Concentrations in the Category 1 Waste Rock Stockpile seepage are typically stable from approximately Mine Year 30 through postclosure maintenance.

Large Table 7 Mine Site Proposed Groundwater Monitoring

Existing Station ID	Proposed Station ID	Bedrock or Surficial Aquifer	Description	Parameter Group(s)	Frequency	Reporting	Monitoring Type	Permit(s)
Compliance Monitoring								
MW-3	GW403	Surficial Aquifer	Monitor groundwater to show compliance downgradient of Category 2/3 Waste Rock Stockpile and the East Pit.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly Discharge Monitoring Reports (DMRs); Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
MW-7	GW407	Surficial Aquifer	Monitor groundwater along the property boundary for compliance downgradient of the Ore Surge Pile (OSP), the Category 2/3 Waste Rock Stockpile, and the East Pit.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
MW-8S	GW408	Surficial Aquifer	Monitor groundwater to show compliance south of Category 1 Stockpile Groundwater Containment System and southwest of the West Pit.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
MW-10S	GW409	Surficial Aquifer	Monitor groundwater along the property boundary for compliance downgradient of the Equalization Basin Area, Overburden Storage and Laydown Area (OSLA), Category 4 Waste Rock Stockpile, and the Central Pit.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
MW-12	GW412	Surficial Aquifer	Monitor groundwater downgradient and northeast of the Category 1 Stockpile Groundwater Containment System.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
MW-14	GW414	Surficial Aquifer	Monitor groundwater downgradient and west of the Category 1 Stockpile Groundwater Containment System.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
MW-15	GW415	Surficial Aquifer	Monitor groundwater downgradient and north of the Category 1 Stockpile Groundwater Containment System.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
MW-16	GW416	Surficial Aquifer	Monitor groundwater for compliance along the property boundary downgradient of the West Pit and the Category 1 Stockpile Groundwater Containment System.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
MW-17	GW417	Surficial Aquifer	Monitor groundwater downgradient of the Category 2/3 Waste Rock Stockpile.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation

Existing Station ID	Proposed Station ID	Bedrock or Surficial Aquifer	Description	Parameter Group(s)	Frequency	Reporting	Monitoring Type	Permit(s)
(New Station)	GW422	Surficial Aquifer	Monitor groundwater for compliance along the property boundary, south of the Category 2/3 Waste Rock Stockpile.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance	NPDES/SDS
BR-1	GW501	Bedrock	Monitor groundwater for compliance along the property boundary downgradient and southeast of the Category 2/3 Waste Rock Stockpile.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
BR-6	GW506	Bedrock	Monitor groundwater for compliance along the property boundary downgradient and south of the Category 2/3 Waste Rock Stockpile.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW512	Bedrock	Monitor groundwater downgradient and northeast of the Category 1 Stockpile Groundwater Containment System.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW514	Bedrock	Monitor groundwater downgradient and west of the Category 1 Stockpile Groundwater Containment System.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW515	Bedrock	Monitor groundwater downgradient and north of the Category 1 Stockpile Groundwater Containment System.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW516	Bedrock	Monitor groundwater for compliance along the property boundary downgradient of the West Pit and the Category 1 Stockpile Groundwater Containment System.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW524	Bedrock	Monitor groundwater along the property boundary for compliance downgradient of the Equalization Basin Area, Overburden Storage and Laydown Area (OSLA), Category 4 Waste Rock Stockpile, and the Central Pit.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Compliance; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
Indicator Monitoring								
MW-2	GW402	Surficial Aquifer	Monitor groundwater downgradient of West Pit to provide information prior to compliance point. This well may become dry in later years due to pit dewatering.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
MW-11	GW411	Surficial Aquifer	Monitor groundwater downgradient of the OSLA to provide information prior to compliance point.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Indicator	NPDES/SDS

Existing Station ID	Proposed Station ID	Bedrock or Surficial Aquifer	Description	Parameter Group(s)	Frequency	Reporting	Monitoring Type	Permit(s)
MW-18	GW418	Surficial Aquifer	Monitor groundwater downgradient of Category 1 Stockpile Groundwater Containment System and west of the West Pit to provide information prior to compliance point.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
GW-M001	GW419	Surficial Aquifer	Monitor groundwater downgradient of the Category 4 Waste Rock Stockpile and the Central Pit to provide information prior to compliance point.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
GW-M002	GW420	Surficial Aquifer	Monitor groundwater downgradient of the Rail Transfer Hopper (RTH)/Ore Loading Area to provide information prior to compliance point.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Indicator	NPDES/SDS
GW-M003	GW421	Surficial Aquifer	Monitor groundwater downgradient of the OSP to provide information prior to compliance point.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Indicator	NPDES/SDS
(New Station)	GW468	Surficial Aquifer	Monitor groundwater between the West Pit and the Category 1 Stockpile Groundwater Containment System.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW470	Surficial Aquifer	Monitor groundwater north of the East Pit and north of the Mine Site boundary.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW471	Surficial Aquifer	Monitor groundwater north of the East Pit and north of the Mine Site boundary.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW472	Surficial Aquifer	Monitor groundwater north of the East Pit and north of the Mine Site boundary.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW473	Surficial Aquifer	Monitor groundwater north of the East Pit and north of the Mine Site boundary.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW477	Surficial Aquifer	Monitor groundwater downgradient of the Category 1 Stockpile Groundwater Containment System.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator	NPDES/SDS

Existing Station ID	Proposed Station ID	Bedrock or Surficial Aquifer	Description	Parameter Group(s)	Frequency	Reporting	Monitoring Type	Permit(s)
(New Station)	GW478	Surficial Aquifer	Monitor groundwater north of the West Pit and north of the Mine Site boundary.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW479	Surficial Aquifer	Monitor groundwater north of the West Pit and north of the Mine Site boundary.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW499	Surficial Aquifer	Monitor groundwater north of the East Pit.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW502	Bedrock	Monitor groundwater downgradient of the West Pit to provide information prior to compliance point.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
OB-4	GW504	Bedrock	Monitor groundwater adjacent to and north of the East Pit.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
OB-5	GW505	Bedrock	Monitor groundwater adjacent to and northeast of the East Pit. Monitor potential drawdown from East Pit.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
OB-1	GW507	Bedrock	Monitor groundwater between the West Pit and the Category 1 Stockpile Groundwater Containment System to provide information prior to compliance point.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW508	Bedrock	Monitor groundwater between the West Pit and the Category 1 Stockpile Groundwater Containment System.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW509	Bedrock	Monitor groundwater north of the East Pit. Monitor potential drawdown from East Pit.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW510	Bedrock	Monitor groundwater north of the East Pit and north of the Mine Site boundary.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation

Existing Station ID	Proposed Station ID	Bedrock or Surficial Aquifer	Description	Parameter Group(s)	Frequency	Reporting	Monitoring Type	Permit(s)
(New Station)	GW517	Bedrock	Monitor groundwater downgradient of the Category 1 Stockpile Groundwater Containment System.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator	NPDES/SDS
(New Station)	GW518	Bedrock	Monitor groundwater north of the West Pit and north of the Mine Site boundary.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW519	Bedrock	Monitor groundwater north of the West Pit and north of the Mine Site boundary.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW521	Bedrock	Monitor groundwater north of the East Pit and north of the Mine Site boundary.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW522	Bedrock	Monitor groundwater north of the East Pit and north of the Mine Site boundary.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW523	Bedrock	Monitor groundwater north of the East Pit and north of the Mine Site boundary.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
(New Station)	GW525	Bedrock	Monitor groundwater downgradient of the Category 4 Waste Rock Stockpile and the Central Pit to provide information prior to compliance point.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Indicator; Water Appropriation Groundwater	NPDES/SDS; Water Appropriation
Performance Monitoring								
MW-5	GW405	Surficial Aquifer	Monitor groundwater downstream of the Equalization Basin Area for comparison with baseline data. Data will provide information on the performance of the Equalization Basin Area liner system.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Water Levels; Year-round	Quarterly DMRs; Annual Report	Performance	NPDES/SDS
(New Station)	GW491	Surficial Aquifer	Monitor groundwater collected by underdrain system (if underdrain is installed). Data collected will document performance of the stockpile liner system by comparing underdrain groundwater quality with the overliner drainage quality.	Mine Site Groundwater Quality Parameter List; Continuous Flow Monitoring	Quarterly Water Quality; Continuous Flow Monitoring; Year-round	Quarterly DMRs; Annual Report	Performance; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	GW492	Surficial Aquifer	Monitor groundwater collected by underdrain system (if underdrain is installed). Data collected will document performance of the stockpile liner system by comparing underdrain groundwater quality with the overliner drainage quality.	Mine Site Groundwater Quality Parameter List; Continuous Flow Monitoring	Quarterly Water Quality; Continuous Flow Monitoring; Year-round	Quarterly DMRs; Annual Report	Performance; Appropriation Source	NPDES/SDS; Water Appropriation

Existing Station ID	Proposed Station ID	Bedrock or Surficial Aquifer	Description	Parameter Group(s)	Frequency	Reporting	Monitoring Type	Permit(s)
(New Station)	GW493	Surficial Aquifer	Monitor groundwater collected by underdrain system (if underdrain is installed). Data collected will document performance of the stockpile liner system by comparing underdrain groundwater quality with the overliner drainage quality.	Mine Site Groundwater Quality Parameter List; Continuous Flow Monitoring	Quarterly Water Quality; Continuous Flow Monitoring; Year-round	Quarterly DMRs; Annual Report	Performance; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	GW494	Surficial Aquifer	Monitor groundwater collected by underdrain system (if underdrain is installed). Data collected will document performance of the stockpile liner system by comparing underdrain groundwater quality with the overliner drainage quality.	Mine Site Groundwater Quality Parameter List; Continuous Flow Monitoring	Quarterly Water Quality; Continuous Flow Monitoring; Year-round	Quarterly DMRs; Annual Report	Performance; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	GW495	Surficial Aquifer	Monitor groundwater collected by underdrain system (if underdrain is installed). Data collected will document performance of the stockpile liner system by comparing underdrain groundwater quality with the overliner drainage quality.	Mine Site Groundwater Quality Parameter List; Continuous Flow Monitoring	Quarterly Water Quality; Continuous Flow Monitoring; Year-round	Quarterly DMRs; Annual Report	Performance; Appropriation Source	NPDES/SDS; Water Appropriation
(New Stations)	GW600-GW601	Surficial Aquifer	Monitor water levels for hydraulic head with paired piezometers to evaluate the performance of the Category 1 Stockpile Groundwater Containment System.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Performance	NPDES/SDS
(New Stations)	GW602-GW603	Surficial Aquifer	Monitor water quality downstream of barrier and monitor water levels for hydraulic head with paired wells to evaluate the performance of the Category 1 Stockpile Groundwater Containment System.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Hydraulic Head and Water Levels; Year-round	Monthly DMRs; Annual Report	Performance	NPDES/SDS
(New Stations)	GW604-GW605	Surficial Aquifer	Monitor water levels for hydraulic head with paired piezometers to evaluate the performance of the Category 1 Stockpile Groundwater Containment System.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Performance	NPDES/SDS
(New Stations)	GW606-GW607	Surficial Aquifer	Monitor water quality downstream of barrier and monitor water levels for hydraulic head with paired wells to evaluate the performance of the Category 1 Stockpile Groundwater Containment System.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Hydraulic Head and Water Levels; Year-round	Quarterly DMRs; Annual Report	Performance	NPDES/SDS
(New Stations)	GW608-GW609	Surficial Aquifer	Monitor water levels for hydraulic head with paired piezometers to evaluate the performance of the Category 1 Stockpile Groundwater Containment System.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Performance	NPDES/SDS
(New Stations)	GW610-GW611	Surficial Aquifer	Monitor water quality downstream of barrier and monitor water levels for hydraulic head with paired wells to evaluate the performance of the Category 1 Stockpile Groundwater Containment System.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Hydraulic Head and Water Levels; Year-round	Quarterly DMRs; Annual Report	Performance	NPDES/SDS
(New Stations)	GW612-GW613	Surficial Aquifer	Monitor water levels for hydraulic head with paired piezometers to evaluate the performance of the Category 1 Stockpile Groundwater Containment System.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Performance	NPDES/SDS

Existing Station ID	Proposed Station ID	Bedrock or Surficial Aquifer	Description	Parameter Group(s)	Frequency	Reporting	Monitoring Type	Permit(s)
(New Stations)	GW614-GW615	Surficial Aquifer	Monitor water quality downstream of barrier and monitor water levels for hydraulic head with paired wells to evaluate the performance of the Category 1 Stockpile Groundwater Containment System.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Hydraulic Head and Water Levels; Year-round	Quarterly DMRs; Annual Report	Performance	NPDES/SDS
(New Stations)	GW616-GW617	Surficial Aquifer	Monitor water levels for hydraulic head with paired piezometers to evaluate the performance of the Category 1 Stockpile Groundwater Containment System.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Performance	NPDES/SDS
(New Stations)	GW618-GW619	Surficial Aquifer	Monitor water quality downstream of barrier and monitor water levels for hydraulic head with paired wells to evaluate the performance of the Category 1 Stockpile Groundwater Containment System.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Hydraulic Head and Water Levels; Year-round	Quarterly DMRs; Annual Report	Performance	NPDES/SDS
(New Stations)	GW620-GW621	Surficial Aquifer	Monitor water levels for hydraulic head with paired piezometers to evaluate the performance of the Category 1 Stockpile Groundwater Containment System.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Performance	NPDES/SDS
(New Stations)	GW622-GW623	Surficial Aquifer	Monitor water quality downstream of barrier and monitor water levels for hydraulic head with paired wells to evaluate the performance of the Category 1 Stockpile Groundwater Containment System.	Mine Site Groundwater Quality Parameter List; Water Levels	Quarterly Water Quality; Monthly Hydraulic Head and Water Levels; Year-round	Quarterly DMRs; Annual Report	Performance	NPDES/SDS
(New Stations)	GW624-GW625	Surficial Aquifer	Monitor water levels for hydraulic head with paired piezometers to evaluate the performance of the Category 1 Stockpile Groundwater Containment System.	Water Levels	Monthly; Year-round	Monthly DMRs; Annual Report	Performance	NPDES/SDS
Water Appropriation Groundwater								
(New Station)	GW430	Surficial Aquifer	Monitor groundwater downgradient from the East Pit.	Water Levels	Monthly; Year-round	Annual Report	Water Appropriation Groundwater	Water Appropriation
(New Station)	GW431	Surficial Aquifer	Monitor potential drawdown from East Pit.	Water Levels	Monthly; Year-round	Annual Report	Water Appropriation Groundwater	Water Appropriation
(New Station)	GW530	Bedrock	Monitor groundwater downgradient from the East Pit.	Water Levels	Monthly; Year-round	Annual Report	Water Appropriation Groundwater	Water Appropriation
(New Station)	GW531	Bedrock	Monitor groundwater adjacent to the Category 2/3 Waste Rock Stockpile.	Water Levels	Monthly; Year-round	Annual Report	Water Appropriation Groundwater	Water Appropriation
(New Station)	GW532	Bedrock	Monitor groundwater adjacent to the West Pit.	Water Levels	Monthly; Year-round	Annual Report	Water Appropriation Groundwater	Water Appropriation

Large Table 8 Mine Site Proposed Surface Water Monitoring

Existing Station ID	Proposed Station ID	Water Body	Description	Parameter Group(s)	Frequency	Reporting	Monitoring Type	Permit(s)
Background Monitoring								
PM-2 / SW002	SW402	Partridge River	Monitor Partridge River upstream of the Mine Site.	Mine Site Surface Water Quality Parameter List; Continuous Flow Monitoring	Monthly Water Quality; Continuous flow monitoring Year-round	Monthly Discharge Monitoring Reports (DMRs); Annual Report	Background; Streamflow	NPDES/SDS; Water Appropriation
PM-6	SW410	Wyman Creek	Monitor Wyman Creek headwaters upstream of Transportation and Utility Corridors impacts.	Mine Site Surface Water Quality Parameter List	Monthly; Year-round	Monthly DMRs; Annual Report	Background	NPDES/SDS
LN-2	SW411	Longnose Creek	Monitor Longnose Creek headwaters upstream of Transportation and Utility Corridors impacts.	Mine Site Surface Water Quality Parameter List	Monthly; Year-round	Monthly DMRs; Annual Report	Background	NPDES/SDS
WL-2	SW412	Wetlegs Creek	Monitor Wetlegs Creek headwaters upstream of Transportation and Utility Corridors impacts.	Mine Site Surface Water Quality Parameter List	Monthly; Year-round	Monthly DMRs; Annual Report	Background	NPDES/SDS
Monitor Only								
WL-1	SW407	Wetlegs Creek	Monitor Wetlegs Creek downstream of the Transportation and Utility Corridors.	Mine Site Surface Water Quality Parameter List	Monthly; Year-round	Monthly DMRs; Annual Report	Monitor Only	NPDES/SDS
LN-1	SW408	Longnose Creek	Monitor Longnose Creek downstream of the Transportation and Utility Corridors.	Mine Site Surface Water Quality Parameter List	Monthly; Year-round	Monthly DMRs; Annual Report	Monitor Only	NPDES/SDS
PM-5	SW409	Wyman Creek	Monitor Wyman Creek downstream of the Transportation and Utility Corridors.	Mine Site Surface Water Quality Parameter List	Monthly; Year-round	Monthly DMRs; Annual Report	Monitor Only	NPDES/SDS
SW004c	SW413	Partridge River	Monitor Partridge River upstream of the South Branch and downstream of Unnamed Creek, which is the future West Pit overflow.	Mine Site Surface Water Quality Parameter List	Monthly; Year-round	Monthly DMRs; Annual Report	Monitor Only	NPDES/SDS
Streamflow								
(New Station)	SW431	Partridge River	Monitor Partridge River downstream of the confluence with the South Branch of the Partridge River and downstream of the Mine Site.	Continuous Flow Monitoring	Continuous flow monitoring; Year-round	Annual Report	Streamflow	Water Appropriation
(New Station)	SW432	South Branch of Partridge River	Monitor South Branch of Partridge River downstream of the Mine Site.	Continuous Flow Monitoring	Continuous flow monitoring; Year-round	Annual Report	Streamflow	Water Appropriation
(New Station)	SW433	Unnamed (West Pit Overflow) Creek	Monitor Unnamed (West Pit Overflow) Creek	Continuous Flow Monitoring	Continuous flow monitoring; Year-round for two years	Annual Report	Streamflow	Water Appropriation

Large Table 9 Mine Site Proposed Benchmark Stormwater Monitoring

Existing Station ID	Proposed Station ID	Water Body	Description	Parameter Group(s)	Frequency	Reporting	Monitoring Type	Permit(s)
Benchmark Stormwater Monitoring								
(New Station)	BML40	Partridge River	Monitor industrial stormwater discharge from Sedimentation Pond A to Partridge River to show compliance with benchmark monitoring requirements.	Mine Site Benchmark Stormwater Parameter List	Quarterly during Storm Event; Year-round	Quarterly Stormwater Discharge Monitoring Reports (DMRs); Annual Report	Benchmark Stormwater	NPDES/SDS
(New Station)	BML41	Partridge River	Monitor industrial stormwater discharge from Sedimentation Pond B to Partridge River to show compliance with benchmark monitoring requirements.	Mine Site Benchmark Stormwater Parameter List	Quarterly during Storm Event; Year-round	Quarterly Stormwater Discharge Monitoring Reports (DMRs); Annual Report	Benchmark Stormwater	NPDES/SDS
(New Station)	BML42	Partridge River Tributaries	Monitor industrial stormwater discharge from Sedimentation Pond C to a Partridge River tributary to show compliance with benchmark monitoring requirements.	Mine Site Benchmark Stormwater Parameter List	Quarterly during Storm Event; Year-round	Quarterly Stormwater DMRs; Annual Report	Benchmark Stormwater	NPDES/SDS
(New Station)	BML43	Partridge River Tributaries	Monitor industrial stormwater discharge from Sedimentation Pond D to a Partridge River tributary to show compliance with benchmark monitoring requirements.	Mine Site Benchmark Stormwater Parameter List	Quarterly during Storm Event; Year-round	Quarterly Stormwater DMRs; Annual Report	Benchmark Stormwater	NPDES/SDS
(New Station)	BML44	Partridge River Tributaries	Monitor industrial stormwater discharge southeast of the Rail Transfer Hopper to a ditch tributary to the Partridge River to show compliance with benchmark monitoring requirements.	Mine Site Benchmark Stormwater Parameter List	Quarterly during Storm Event; Year-round	Quarterly Stormwater DMRs; Annual Report	Benchmark Stormwater	NPDES/SDS
(New Station)	BML47	Wetlegs Creek	Monitor Wetlegs Creek downstream of the Transportation and Utility Corridors to show compliance with benchmark monitoring requirements.	Transportation and Utility Corridors Benchmark Stormwater Parameter List	Quarterly during Storm Event; Year-round	Quarterly Stormwater DMRs; Annual Report	Benchmark Stormwater	NPDES/SDS
(New Station)	BML48	Longnose Creek	Monitor Longnose Creek downstream of the Transportation and Utility Corridors to show compliance with benchmark monitoring requirements.	Transportation and Utility Corridors Benchmark Stormwater Parameter List	Quarterly during Storm Event; Year-round	Quarterly Stormwater DMRs; Annual Report	Benchmark Stormwater	NPDES/SDS
(New Station)	BML49	Wyman Creek	Monitor Wyman Creek downstream of the Transportation and Utility Corridors to show compliance with benchmark monitoring requirements.	Transportation and Utility Corridors Benchmark Stormwater Parameter List	Quarterly during Storm Event; Year-round	Quarterly Stormwater DMRs; Annual Report	Benchmark Stormwater	NPDES/SDS

Large Table 10 Mine Site Proposed Internal Waste Stream Monitoring

Existing Station ID	Proposed Station ID	Internal Stream	Description	Parameter Group(s)	Frequency	Reporting	Monitoring Type	Permit(s)
Monitor Only								
(New Station)	WS401	East Pit Dewatering	Monitor waste stream from East Pit dewatering.	Internal Waste Stream Parameter List; Continuous Flow Monitoring; Water Levels	Twice per Month Water Quality; Continuous Flow Monitoring; Year-round	Monthly Discharge Monitoring Reports (DMRs); Annual Report	Monitor Only; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	WS402	West Pit Dewatering	Monitor waste stream from West Pit dewatering.	Internal Waste Stream Parameter List; Continuous Flow Monitoring; Water Levels	Twice per Month Water Quality; Continuous Flow Monitoring; Year-round	Monthly DMRs; Annual Report	Monitor Only; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	WS403	West Pit Dewatering	Monitor waste stream from West Pit dewatering.	Internal Waste Stream Parameter List; Continuous Flow Monitoring; Water Levels	Twice per Month Water Quality; Continuous Flow Monitoring; Year-round	Monthly DMRs; Annual Report	Monitor Only; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	WS404	Central Pit Dewatering	Monitor waste stream from Central Pit dewatering.	Internal Waste Stream Parameter List; Continuous Flow Monitoring; Water Levels	Twice per Month Water Quality; Continuous Flow Monitoring; Year-round	Monthly DMRs; Annual Report	Monitor Only; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	WS411	Category 1 Stockpile Groundwater Containment System	Monitor waste stream from Category 1 Stockpile Groundwater Containment System sump.	Internal Waste Stream Parameter List; Continuous Flow Monitoring	Monthly Water Quality; Continuous Flow Monitoring; Year-round	Monthly DMRs; Annual Report	Monitor Only; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	WS412	Category 1 Stockpile Groundwater Containment System	Monitor waste stream from Category 1 Stockpile Groundwater Containment System sump.	Internal Waste Stream Parameter List; Continuous Flow Monitoring	Monthly Water Quality; Continuous Flow Monitoring; Year-round	Monthly DMRs; Annual Report	Monitor Only; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	WS413	OSLA Runoff	Monitor waste stream from Overburden Storage and Laydown Area (OSLA) runoff (from OSLA Pond).	Internal Waste Stream Parameter List; Continuous Flow Monitoring	Monthly Water Quality; Continuous Flow Monitoring; Year-round	Monthly DMRs; Annual Report	Monitor Only; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	WS414	Construction Mine Water Basin	Monitor waste stream from the Construction Mine Water Basin. This is the combined flow of construction mine water and OSLA drainage that goes to the FTB via the Construction Mine Water Pipeline.	Mine Site Equalization Basin Area Internal Waste Stream Parameter List; Continuous Flow Monitoring	Monthly Water Quality; Continuous Flow Monitoring; Year-round	Monthly DMRs; Annual Report	Monitor Only; Internal Flow	NPDES/SDS; Water Appropriation
(New Station)	WS415	Low Concentration Mine Water	Monitor waste stream from the Low Concentration Equalization Basins (LCEQ Basins) that goes to the Waste Water Treatment System (WWTS) via the Low Concentration Pipeline.	Mine Site Equalization Basin Area Internal Waste Stream Parameter List; Continuous Flow Monitoring	Monthly Water Quality; Continuous Flow Monitoring; Year-round	Monthly DMRs; Annual Report	Monitor Only; Internal Flow	NPDES/SDS; Water Appropriation

Existing Station ID	Proposed Station ID	Internal Stream	Description	Parameter Group(s)	Frequency	Reporting	Monitoring Type	Permit(s)
(New Station)	WS416	High Concentration Mine Water	Monitor waste stream from the High Concentration Equalization Basin (HCEQ Basin) that goes to the WWTS via the High Concentration Pipeline.	Mine Site Equalization Basin Area Internal Waste Stream Parameter List; Continuous Flow Monitoring	Monthly Water Quality; Continuous Flow Monitoring; Year-round	Monthly DMRs; Annual Report	Monitor Only; Internal Flow	NPDES/SDS; Water Appropriation
(New Station)	WS421	Category 2/3 Waste Rock Stockpile Mine Water Drainage	Monitor waste stream collected on the Category 2/3 Waste Rock Stockpile liner.	Internal Waste Stream Parameter List; Continuous Flow Monitoring	Monthly Water Quality; Continuous Flow Monitoring; Year-round	Monthly DMRs; Annual Report	Monitor Only; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	WS422	Category 2/3 Waste Rock Stockpile Mine Water Drainage	Monitor waste stream collected on the Category 2/3 Waste Rock Stockpile liner.	Internal Waste Stream Parameter List; Continuous Flow Monitoring	Monthly Water Quality; Continuous Flow Monitoring; Year-round	Monthly DMRs; Annual Report	Monitor Only; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	WS423	Category 2/3 Waste Rock Stockpile Mine Water Drainage	Monitor waste stream collected on the Category 2/3 Waste Rock Stockpile liner.	Internal Waste Stream Parameter List; Continuous Flow Monitoring	Monthly Water Quality; Continuous Flow Monitoring; Year-round	Monthly DMRs; Annual Report	Monitor Only; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	WS424	Category 4 Waste Rock Stockpile Mine Water Drainage	Monitor waste stream collected on the Category 4 Waste Rock Stockpile liner.	Internal Waste Stream Parameter List; Continuous Flow Monitoring	Monthly Water Quality; Continuous Flow Monitoring; Year-round	Monthly DMRs; Annual Report	Monitor Only; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	WS425	Ore Surge Pile Mine Water Drainage	Monitor waste stream collected on the Ore Surge Pile liner.	Internal Waste Stream Parameter List; Continuous Flow Monitoring	Monthly Water Quality; Continuous Flow Monitoring; Year-round	Monthly DMRs; Annual Report	Monitor Only; Appropriation Source	NPDES/SDS; Water Appropriation
(New Station)	WS441	Construction Mine Water and OSLA Runoff	Monitor waste stream into the Construction Mine Water Basin.	Continuous Flow Monitoring	Continuous Flow Monitoring; Year-round	Annual Report	Appropriation Source	Water Appropriation
(New Station)	WS442	Low Concentration Mine Water	Monitor waste stream into LCEQ Basin 1.	Continuous Flow Monitoring	Continuous Flow Monitoring; Year-round	Annual Report	Appropriation Source	Water Appropriation
(New Station)	WS443	Low Concentration Mine Water	Monitor waste stream into LCEQ Basin 2.	Continuous Flow Monitoring	Continuous Flow Monitoring; Year-round	Annual Report	Appropriation Source	Water Appropriation
(New Station)	WS444	High Concentration Mine Water	Monitor waste stream into the HCEQ Basin.	Continuous Flow Monitoring	Continuous Flow Monitoring; Year-round	Annual Report	Appropriation Source	Water Appropriation
(New Station)	WS900	East Pit Water	Monitor overflow from East Pit to West Pit	Continuous Flow Monitoring	Continuous Flow Monitoring; Year-round	Annual Report	Internal Flow	Water Appropriation

Large Table 11 Mine Site Proposed Parameter List

List Name	Parameters	
Mine Site Groundwater Quality Parameter List	-Alkalinity -Aluminum -Arsenic -Copper -Hardness -Lead	-Manganese -pH -Specific Conductance -Sulfate -Total Dissolved Solids (TDS) -Zinc
Mine Site Surface Water Quality Parameter List	-Alkalinity -Aluminum -Arsenic -Cadmium -Cobalt -Copper -Hardness -Lead -Mercury	-Nickel -pH -Specific Conductance -Sulfate -TDS -Total Suspended Solids (TSS) -Temperature -Zinc
Mine Site Benchmark Stormwater Monitoring Parameter List (Industrial Stormwater Requirements for Sub-Sectors G1 and G2)	-Antimony -Arsenic -Cadmium -Chemical Oxygen Demand (COD) -Copper -Hardness -Iron -Lead	-Nickel -Nitrite plus Nitrate-Nitrogen -pH -Selenium -Silver -TSS -Zinc
Transportation and Utility Corridors Benchmark Stormwater Monitoring Parameter List(Industrial Stormwater Requirements for Sector P)	-TSS	
Internal Waste Stream Parameter List	-Arsenic -Cadmium -Copper -Lead	-Mercury -pH -TSS -Zinc

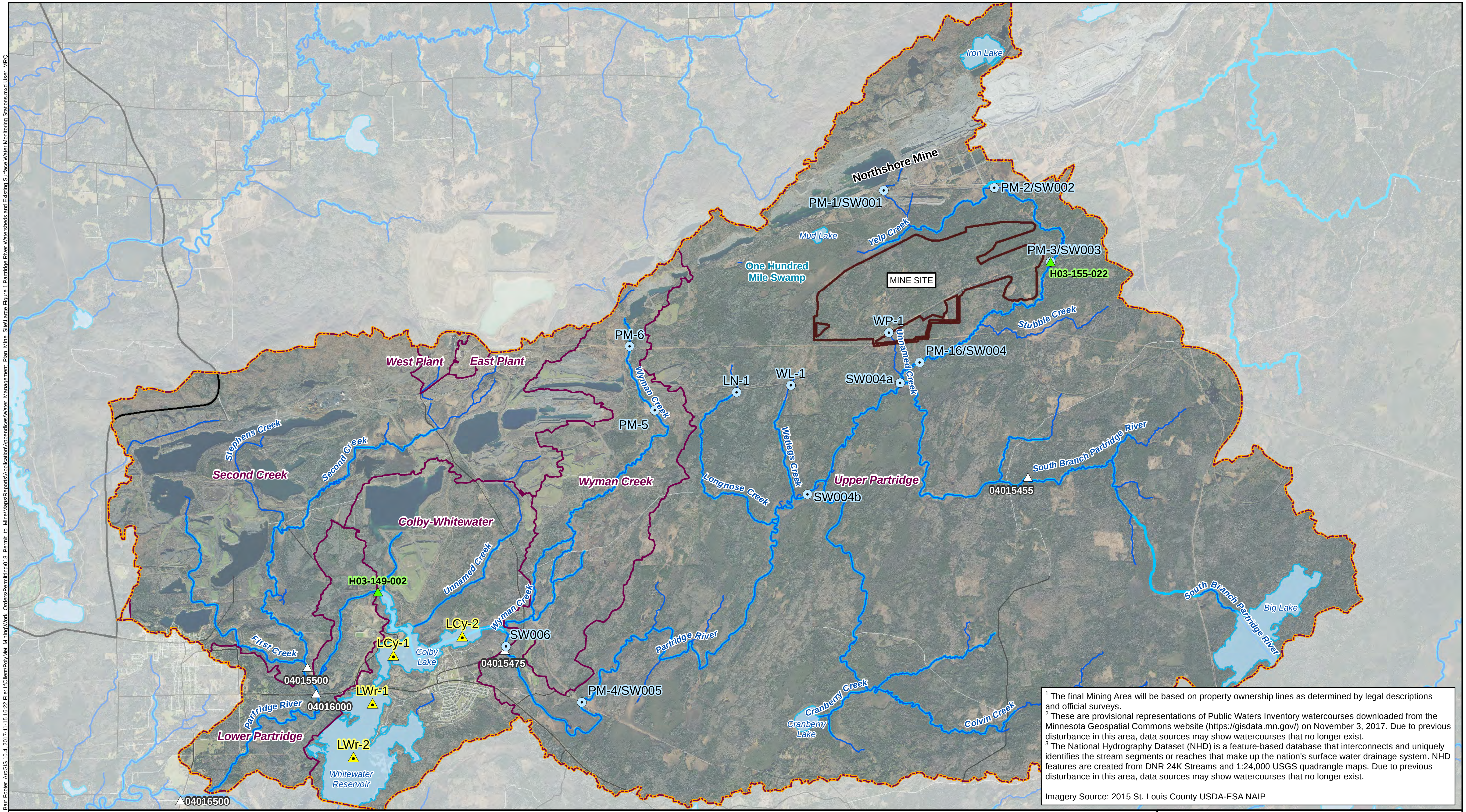
List Name	Parameters	
Mine Site Equalization Basin Area Internal Waste Stream Parameter List	Metals/Inorganics -Aluminum -Antimony -Arsenic -Barium -Beryllium -Boron -Cadmium -Chromium -Cobalt -Copper -Iron -Lead -Manganese -Nickel -Selenium -Silver -Thallium -Zinc	General Parameters -Chloride -Fluoride -Hardness -Sodium (%) -Sulfate

Large Table 12 Estimated Mine to Plant Pipelines Water Quality

Constituent	Mine Year	Mine Year 1			Mine Year 11			Mine Year 20		
	Percentile / Units	Average P10(2)	Average P50(2)	Average P90(2)	Average P10(2)	Average P50(2)	Average P90(2)	Average P10(2)	Average P50(2)	Average P90(2)
Ag (Silver)	μg/L	0.34	0.76	0.84	0.98	1.00	1.00	0.97	0.98	1.00
Al (Aluminum)	μg/L	104.42	104.45	104.48	125.00	125.00	125.00	125.00	125.00	125.00
Alkalinity	mg/L	602.17	674.52	758.37	24.33	33.74	42.91	30.90	36.62	43.63
As (Arsenic)	μg/L	8.62	8.74	8.92	10.00	10.00	10.00	10.00	10.00	10.00
B (Boron)	μg/L	107.64	135.82	170.18	80.00	103.63	136.54	69.67	82.93	101.98
Ba (Barium)	μg/L	668.86	746.93	836.44	47.60	63.13	81.98	87.42	97.84	109.22
Be (Beryllium)	μg/L	0.42	0.69	3.07	0.90	1.34	3.08	0.42	0.84	1.13
Ca (Calcium)	mg/L	16.99	22.13	28.70	37.26	44.29	51.62	50.19	59.18	66.16
Cd (Cadmium)	μg/L	3.05	3.35	3.38	3.88	4.00	4.00	1.74	3.00	3.89
Cl (Chloride)	mg/L	78.60	98.38	135.09	31.63	47.47	70.84	111.16	129.11	140.68
Co (Cobalt)	μg/L	4.58	4.58	4.58	5.00	5.00	5.00	5.00	5.00	5.00
Cr (Chromium)	μg/L	2.57	3.83	5.03	4.28	5.04	6.21	4.60	5.29	5.95
Cu (Copper)	μg/L	26.19	27.50	27.50	30.00	30.00	30.00	30.00	30.00	30.00
F (Fluoride)	mg/L	1.83	1.83	1.83	1.90	1.99	2.00	2.00	2.00	2.00
Fe (Iron)	μg/L	275.00	275.00	275.00	300.00	300.00	300.00	300.00	300.00	300.00
K (Potassium)	mg/L	42.30	50.13	58.64	42.14	56.04	72.34	183.79	210.93	240.25
Mg (Magnesium)	mg/L	38.39	42.40	45.53	29.50	33.97	38.25	20.63	24.89	30.37
Mn (Manganese)	μg/L	45.83	45.83	45.83	50.00	50.00	50.00	50.00	50.00	50.00
Na (Sodium)	mg/L	247.70	285.64	334.89	140.14	192.87	248.75	502.24	589.61	686.07
Ni (Nickel)	μg/L	91.67	91.67	91.67	100.00	100.00	100.00	100.00	100.00	100.00
Pb (Lead)	μg/L	6.79	11.72	14.30	19.00	19.00	19.00	19.00	19.00	19.00
Sb (Antimony)	μg/L	18.95	25.94	26.23	31.00	31.00	31.00	17.89	24.64	31.00
Se (Selenium)	μg/L	2.74	4.08	4.24	5.00	5.00	5.00	3.61	4.78	5.00
SO_4 (Sulfate)	mg/L	229.17	229.17	229.17	250.00	250.00	250.00	250.00	250.00	250.00
Tl (Thallium)	μg/L	0.10	0.13	0.18	0.23	0.32	0.56	0.12	0.17	0.23
V (Vanadium)	μg/L	6.31	8.00	13.76	9.95	11.06	14.37	9.79	10.68	11.56
Zn (Zinc)	μg/L	282.98	322.86	326.37	380.37	388.00	388.00	249.70	351.99	388.00

(1) Values shown are the average of the monthly P10, P50, and P90 values, as indicated, for the referenced Mine Year; see Section 6.2 of Reference (1).

Large Figures



[1] The final Mining Area will be based on property ownership lines as determined by legal descriptions and official surveys.
[2] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[3] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

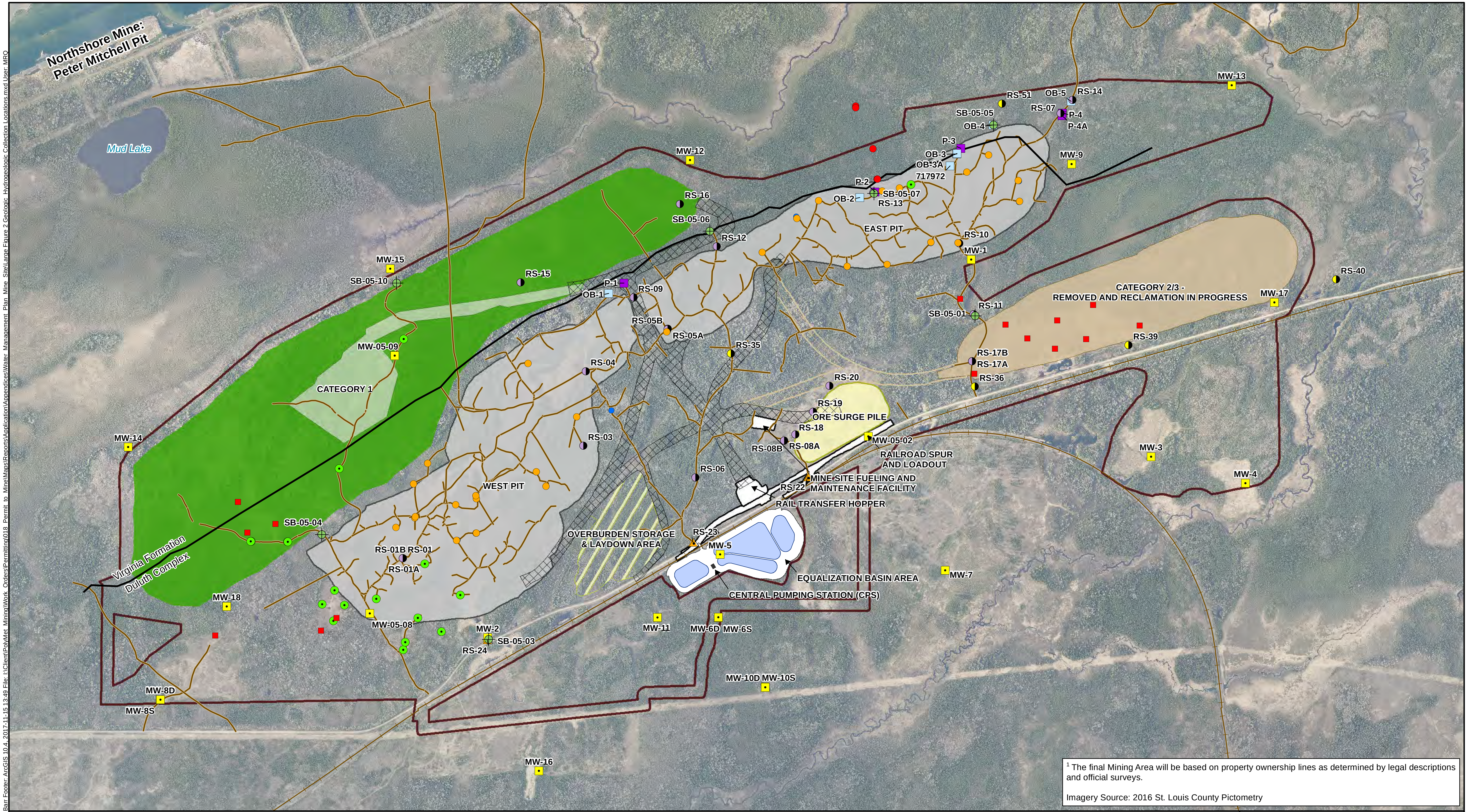
Imagery Source: 2015 St. Louis County USDA-FSA NAIP

- Mine Site[1]
- USGS Gage Station
- MDNR Gage Station
- Surface Water Monitoring Stations - Colby Lake, Whitewater Reservoir
- Surface Water Monitoring Stations - Stream
- Partridge River Watershed Boundary
- Partridge River Subwatersheds
- Public Waters Inventory (PWI) Basins
- Public Waters Inventory (PWI) Watercourses[2]
- National Hydrography Dataset (NHD) Rivers & Streams[3]

0 1.5 3
Miles

PARTRIDGE RIVER WATERSHEDS AND EXISTING SURFACE WATER MONITORING STATIONS
NorthMet Project
Poly Met Mining, Inc.

Large Figure 1
Water Management Plan - Mine

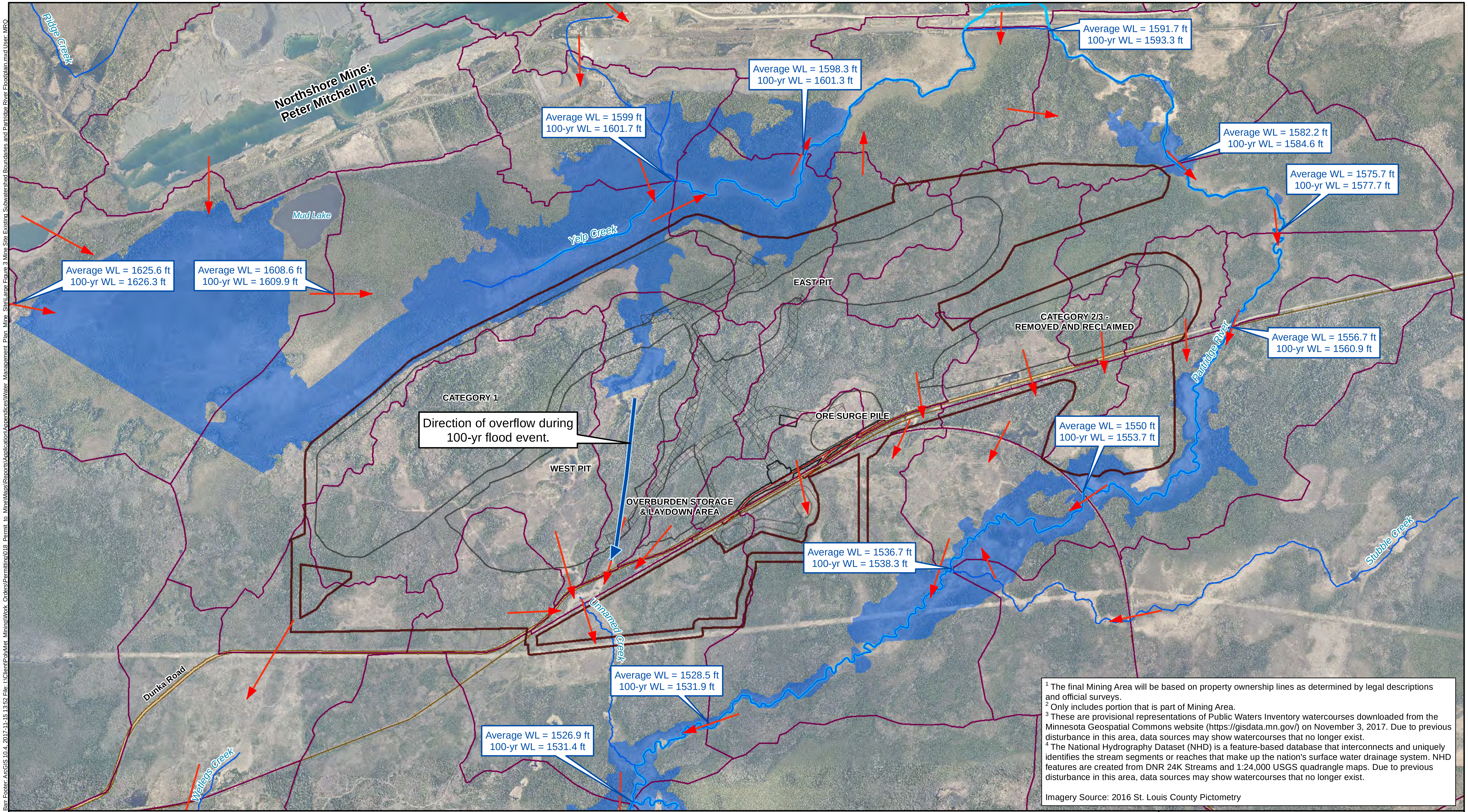


- Mine Site[1]
- Mine Year 20 Footprints
  - Mine Pits
  - Open Stockpile
  - Covered Stockpile
  - Active Stockpile
  - Storage & Laydown Area
  - Removed and Reclaimed Stockpiles
  - Haul Roads
  - Reclaimed Haul Roads
- Phase I
  - Bedrock Aquifer Testing Location - 2005
  - Soil Boring - 2005
- Phase II
  - Observation Wells - 2005/2006
  - Pumping Test Wells - 2005/2006
  - Phase III - Wetland Piezometer - 2006
  - Overburden Geochem/Geotech Boring - 2008
  - 2011/2012 Rotasonic Borings
  - Exploratory Borehole Sump Logging Location - 2010
- Sorption Sampling Location - 2009
- Bedrock Groundwater Elevation Measurement - 2006
- Golder Test Trench - 2006
- Monitoring Well
- Unit Boundaries
- Existing Trails and Roads
- Existing Private Railroad

0 750 1,500
Feet

GEOLOGIC/HYDROGEOLOGIC DATA COLLECTION LOCATIONS
NorthMet Project
Poly Met Mining, Inc.

Large Figure 2
Water Management Plan - Mine



[1] The final Mining Area will be based on property ownership lines as determined by legal descriptions and official surveys.
[2] Only includes portion that is part of Mining Area.
[3] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[4] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

Imagery Source: 2016 St. Louis County Pictometry

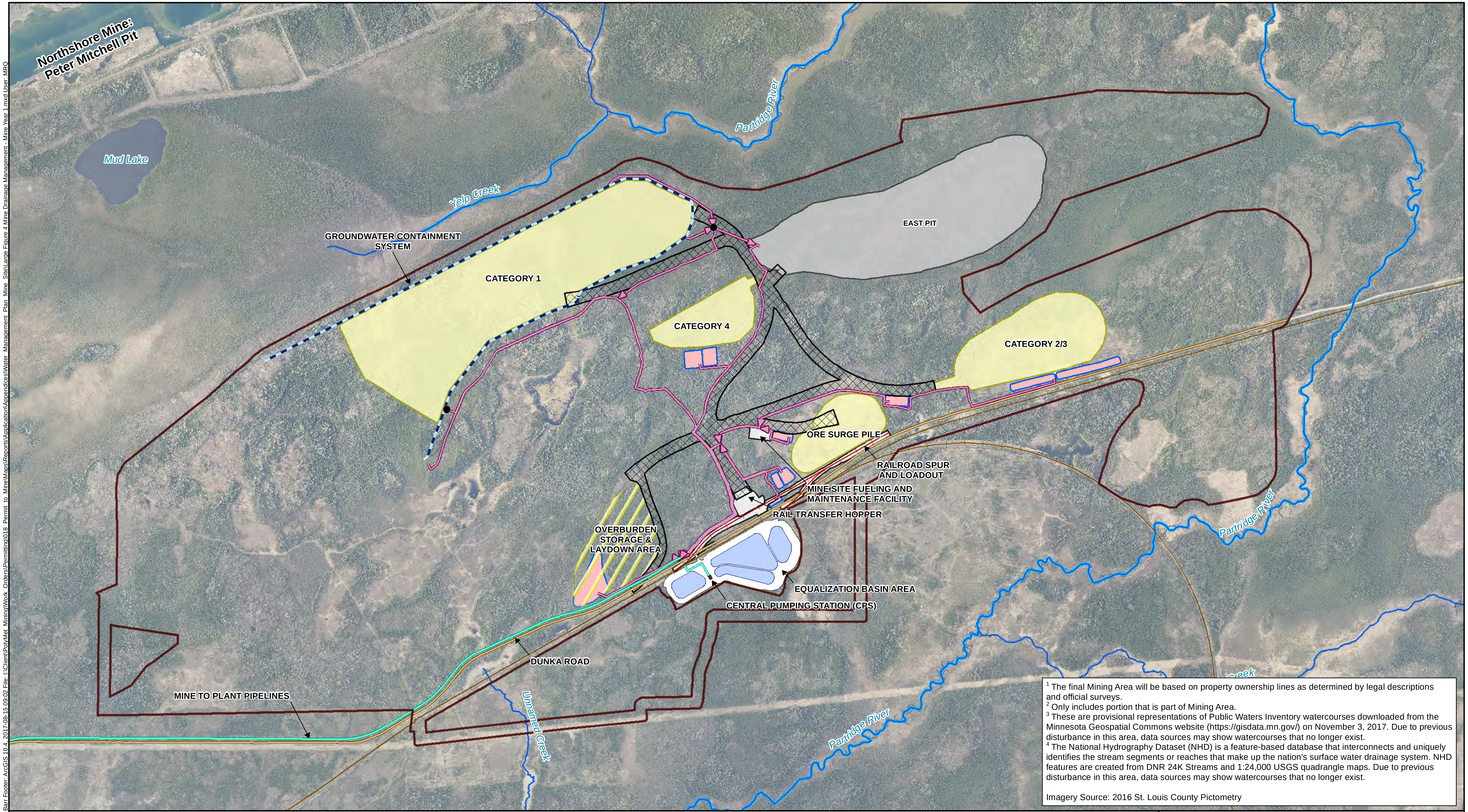
Mine Site[1]
Subwatershed Flow Direction
Partridge River Subwatersheds
100-yr Floodplain (without NorthMet Project)
WL = Water Level
Mine Footprint - Year 20
Haul Roads
Dunka Road[2]
Proposed Railroad Track
Existing Private Railroad
Public Waters Inventory (PWI) Watercourses[3]
National Hydrography Dataset (NHD) Rivers & Streams[4]

N

0 2,000 4,000
Feet

MINE SITE EXISTING SUBWATERSHED BOUNDARIES AND PARTRIDGE RIVER FLOODPLAIN
NorthMet Project
Poly Met Mining, Inc.

Large Figure 3
Water Management Plan - Mine



[1] The final Mining Area will be based on property ownership lines as determined by legal descriptions and official surveys.
[2] Only includes portion that is part of Mining Area.
[3] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[4] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

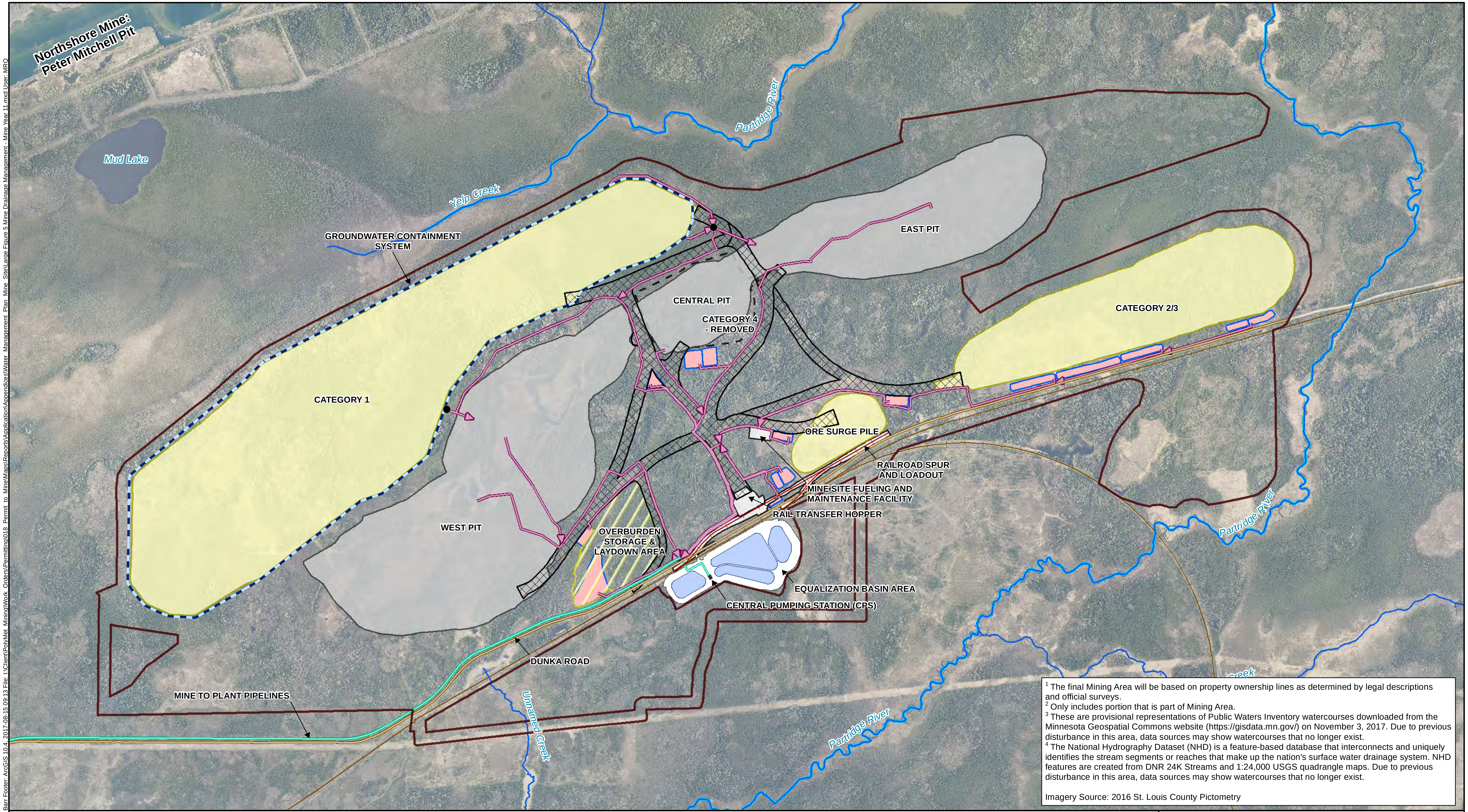
Imagery Source: 2016 St. Louis County Pictometry

Mine Site[1]
Mine Year 1 Footprints
Mine Pit
Active Stockpile
Storage & Laydown Area
Haul Roads
Dunka Road[2]
Groundwater Containment System Sump
Groundwater Containment System
Mine to Plant Pipelines
Mine Water Pipes
Mine Water Ponds and Sumps
Public Waters Inventory (PWI) Watercourses[3]
National Hydrography Dataset (NHD) Rivers & Streams[4]

0 1,500 3,000
Feet

MINE WATER MANAGEMENT - MINE YEAR 1
NorthMet Project
Poly Met Mining, Inc.

Large Figure 4
Water Management Plan - Mine



[1] The final Mining Area will be based on property ownership lines as determined by legal descriptions and official surveys.
[2] Only includes portion that is part of Mining Area.
[3] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[4] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

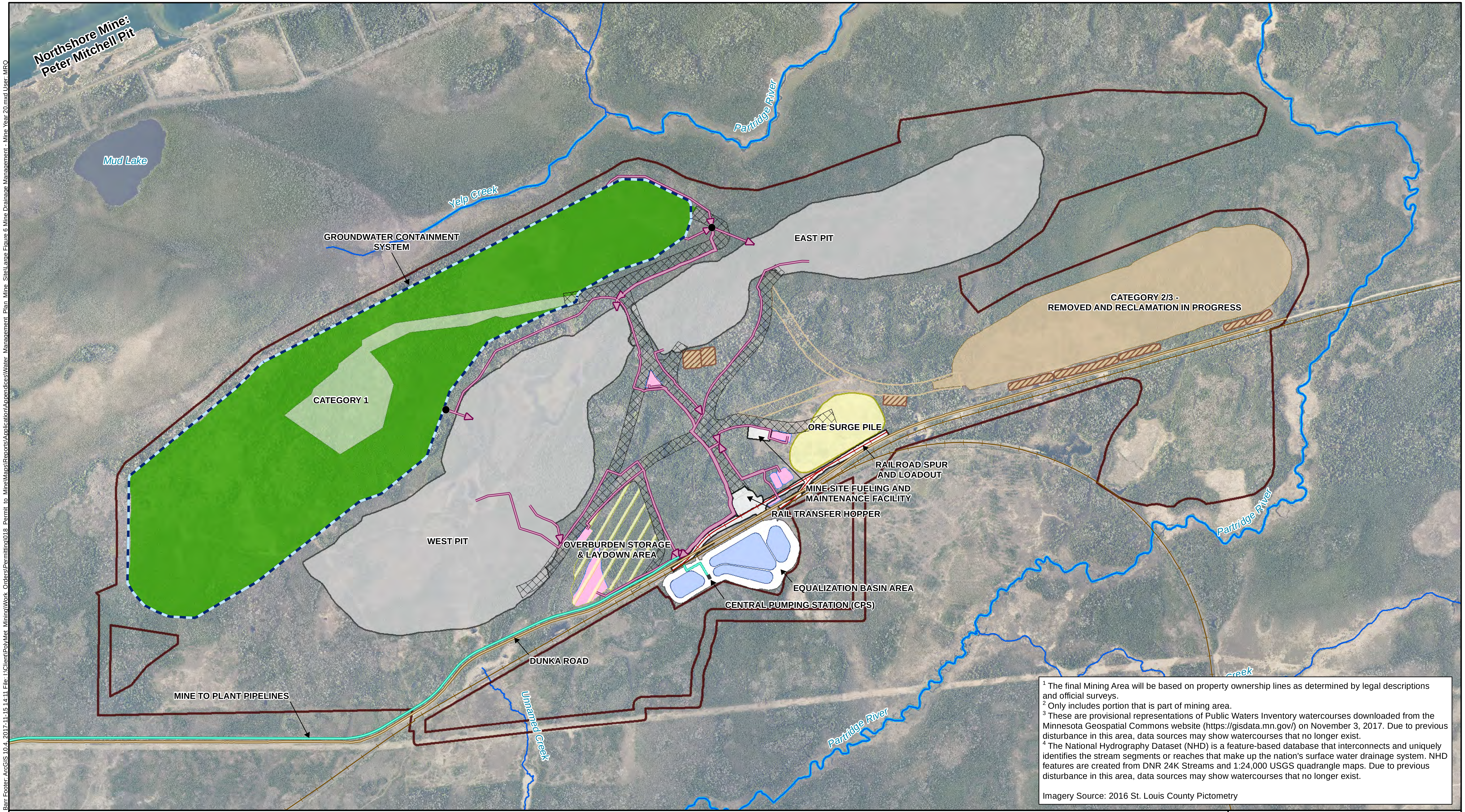
Imagery Source: 2016 St. Louis County Pictometry

Mine Site[1]
Mine Year 11 Footprints
Mine Pit
Active Stockpile
Storage & Laydown Area
Removed Stockpile
Haul Roads
Dunka Road[2]
Proposed Railroad Track
Existing Private Railroad
Groundwater Containment System Sump
Groundwater Containment System
Mine to Plant Pipelines
Mine Water Pipes
Mine Water Ponds and Sumps
Public Waters Inventory (PWI) Watercourses[3]
National Hydrography Dataset (NHD) Rivers & Streams[4]

0 1,500 3,000
Feet

MINE WATER MANAGEMENT -
MINE YEAR 11
NorthMet Project
Poly Met Mining, Inc.

Large Figure 5
Water Management Plan - Mine



[1] The final Mining Area will be based on property ownership lines as determined by legal descriptions and official surveys.
[2] Only includes portion that is part of mining area.
[3] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[4] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

Imagery Source: 2016 St. Louis County Pictometry

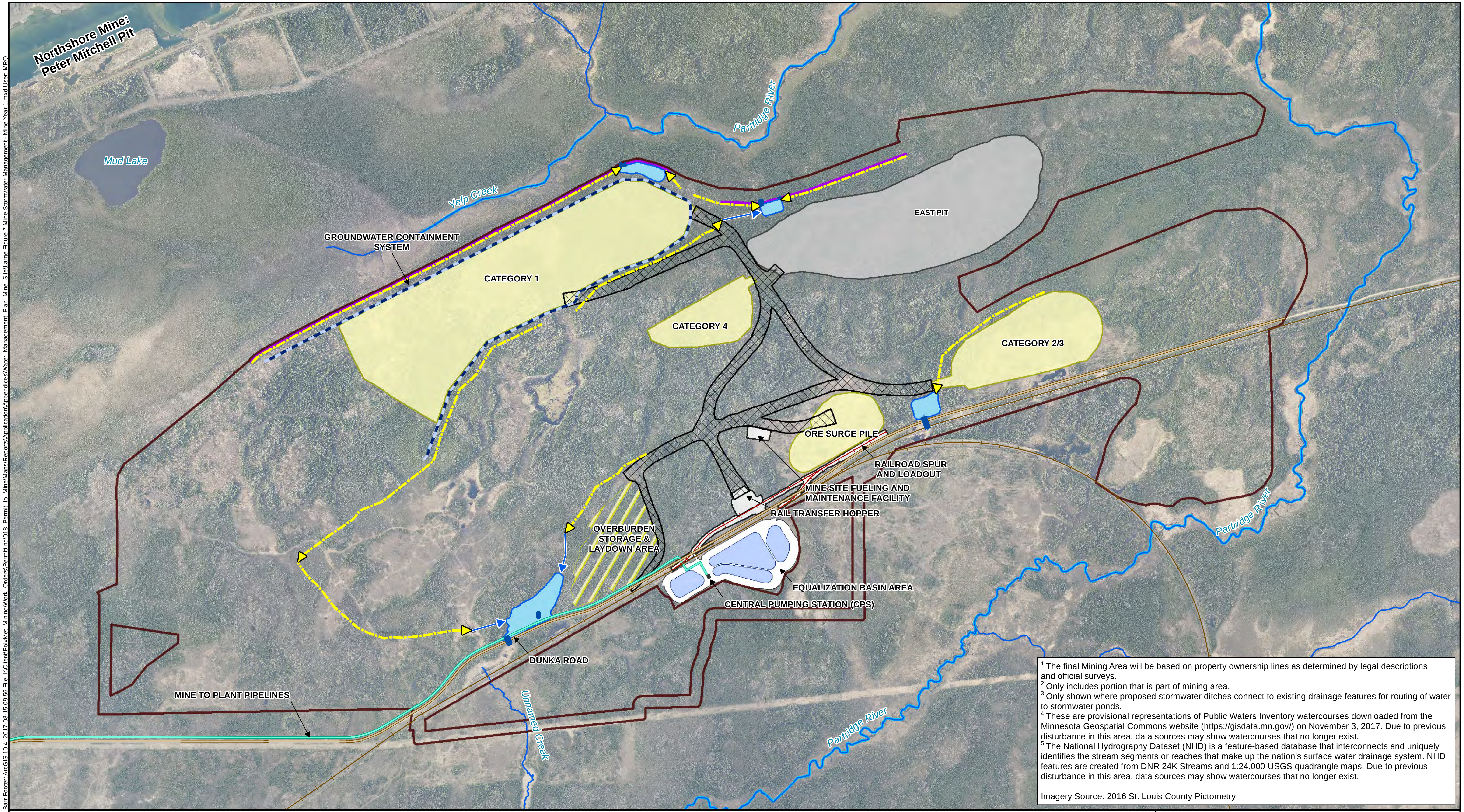
Mine Site[1]
Mine Year 20 Footprints
Mine Pits
Open Stockpile
Covered Stockpile
Active Stockpile
Storage & Laydown Area
Removed and Reclaimed Stockpiles
Haul Roads
Reclaimed Haul Roads
Dunka Road[2]
Proposed Railroad Track
Existing Private Railroad
Groundwater Containment System Sumps
Groundwater Containment System
Mine to Plant Pipelines
Mine Water Pipelines
Mine Water Ponds and Sumps
Reclaimed Mine Water Ponds and Sumps
Public Waters Inventory (PWI) Watercourses[3]
National Hydrography Dataset (NHD) Rivers & Streams[4]

N

0 1,500 3,000
Feet

MINE WATER MANAGEMENT-
MINE YEAR 20
NorthMet Project
Poly Met Mining, Inc.

Large Figure 6
Water Management Plan - Mine



[1] The final Mining Area will be based on property ownership lines as determined by legal descriptions and official surveys.
[2] Only includes portion that is part of mining area.
[3] Only shown where proposed stormwater ditches connect to existing drainage features for routing of water to stormwater ponds.
[4] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[5] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

Imagery Source: 2016 St. Louis County Pictometry

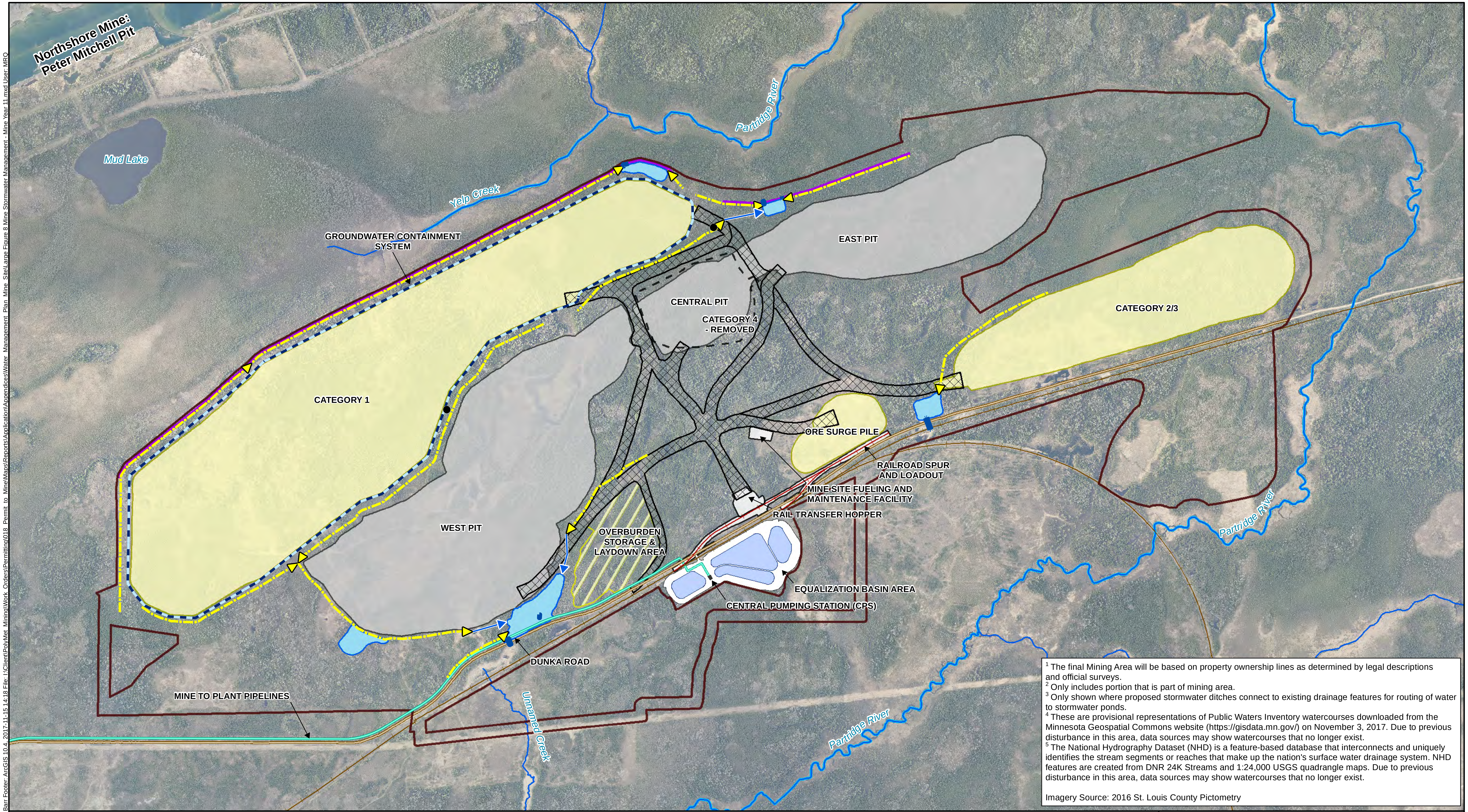
Mine Site[1]
Mine Year 1 Footprints
Mine Pit
Active Stockpile
Storage & Laydown Area
Haul Roads
Dunka Road[2]
Existing Private Railroad
Proposed Railroad Track
Groundwater Containment System
Mine to Plant Pipelines
Perimeter Dike
Existing Drainage[3]
Stormwater Culverts
Stormwater Ditches
Stormwater Ponds
Public Waters Inventory (PWI) Watercourses[4]
National Hydrography Dataset (NHD) Rivers & Streams[5]

0 1,500 3,000
Feet

STORMWATER MANAGEMENT - MINE YEAR 1
NorthMet Project
Poly Met Mining, Inc.

Large Figure 7
Water Management Plan - Mine

Barr Footer: ArcGIS 10.4, 2017-08-15 09:56 File: I:\Client\PolyMet_Mining\Work_Orders\Permitting\018_Permit_to_Mine\Maps\Reports\Application\Appendices\Water_Management_Plan_Mine_Site\Large Figure 7 Mine Stormwater Management - Mine Year 1.mxd User: MRO



[1] The final Mining Area will be based on property ownership lines as determined by legal descriptions and official surveys.
[2] Only includes portion that is part of mining area.
[3] Only shown where proposed stormwater ditches connect to existing drainage features for routing of water to stormwater ponds.
[4] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[5] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

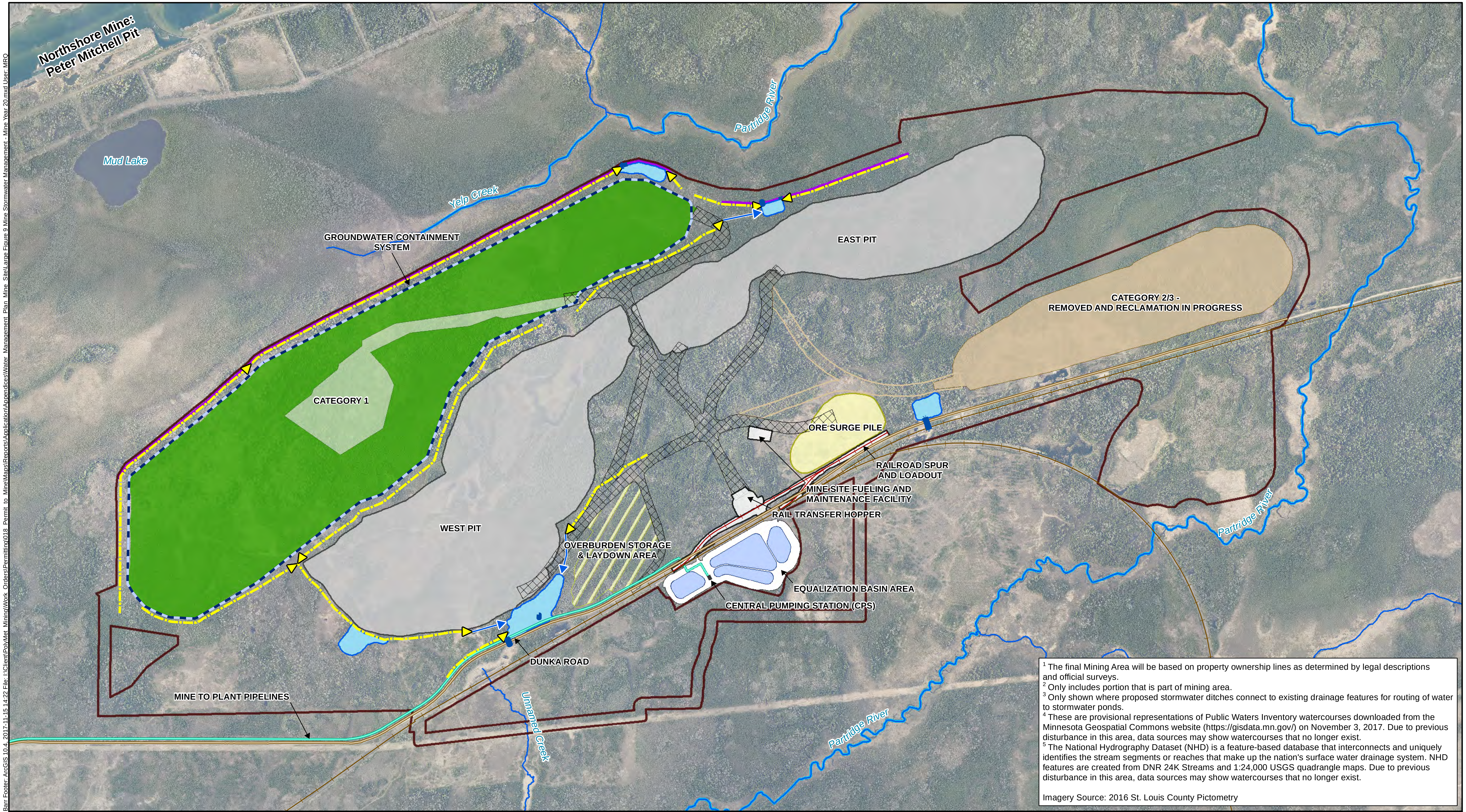
Imagery Source: 2016 St. Louis County Pictometry

Mine Site[1]
Mine Year 11 Footprints
Mine Pit
Active Stockpile
Storage & Laydown Area
Removed Stockpile
Haul Roads
Dunka Road[2]
Existing Private Railroad
Proposed Railroad Track
Groundwater Containment System Sump
Groundwater Containment System
Mine to Plant Pipelines
Perimeter Dike
Existing Drainage[3]
Stormwater Culverts
Stormwater Ditches
Stormwater Ponds
Public Waters Inventory (PWI) Watercourses[4]
National Hydrography Dataset (NHD) Rivers & Streams[5]

0 1,500 3,000
Feet

STORMWATER MANAGEMENT - MINE YEAR 11
NorthMet Project
Poly Met Mining, Inc.

Large Figure 8
Water Management Plan - Mine



[1] The final Mining Area will be based on property ownership lines as determined by legal descriptions and official surveys.
[2] Only includes portion that is part of mining area.
[3] Only shown where proposed stormwater ditches connect to existing drainage features for routing of water to stormwater ponds.
[4] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[5] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

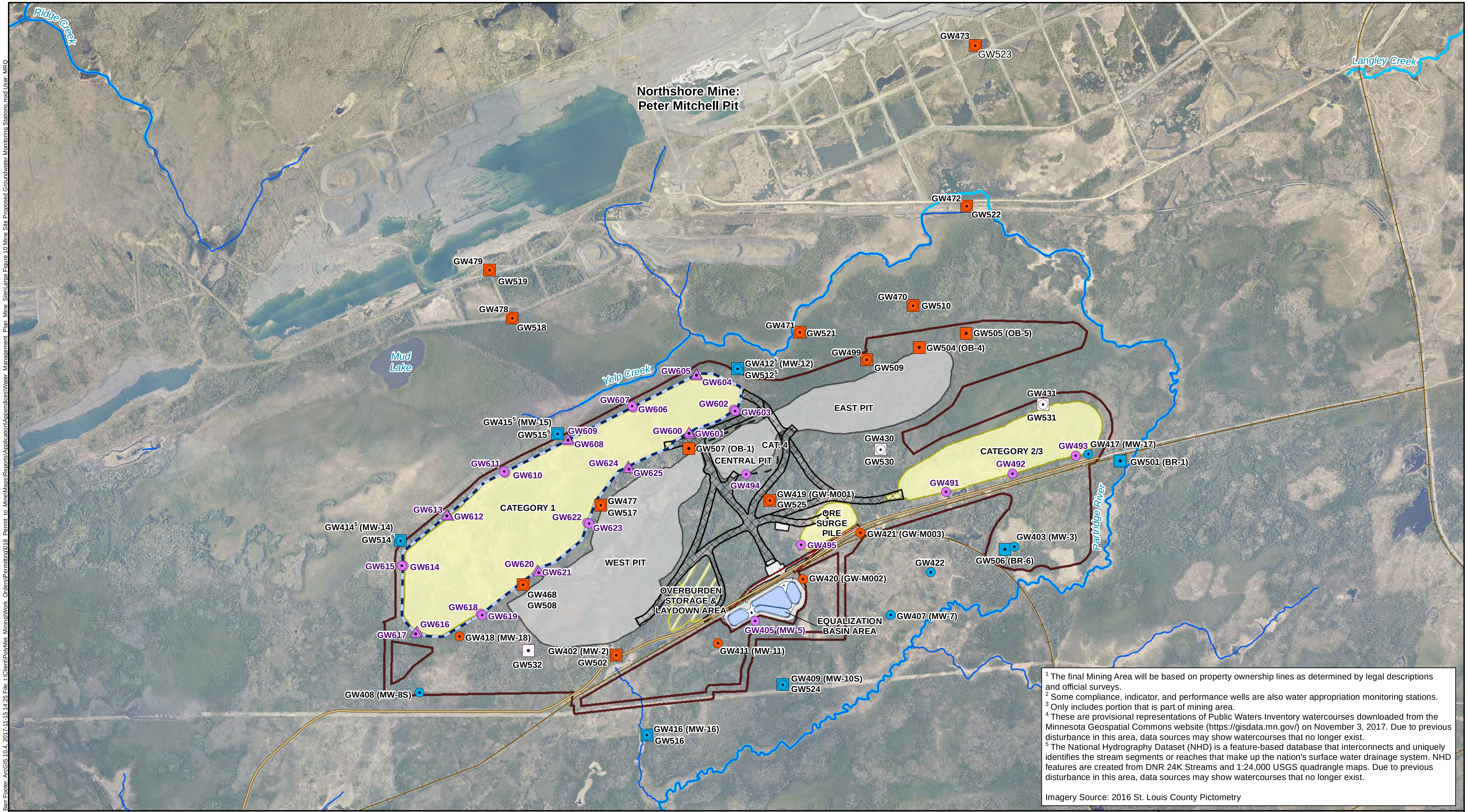
Imagery Source: 2016 St. Louis County Pictometry

Mine Site[1]
Mine Year 20 Footprints
Mine Pits
Haul Roads
Reclaimed Haul Roads
Open Stockpile
Covered Stockpile
Active Stockpile
Storage & Laydown Area
Removed and Reclaimed Stockpiles
Dunka Road[2]
Existing Private Railroad
Proposed Railroad Track
Groundwater Containment System
Mine to Plant Pipelines
Perimeter Dike
Existing Drainage[3]
Stormwater Culverts
Stormwater Ditches
Stormwater Ponds
Public Waters Inventory (PWI) Watercourses[4]
National Hydrography Dataset (NHD) Rivers & Streams[5]

0 1,500 3,000
Feet

STORMWATER MANAGEMENT -
MINE YEAR 20
NorthMet Project
Poly Met Mining, Inc.

Large Figure 9
Water Management Plan - Mine



[1] The final Mining Area will be based on property ownership lines as determined by legal descriptions and official surveys.
[2] Some compliance, indicator, and performance wells are also water appropriation monitoring stations.
[3] Only includes portion that is part of mining area.
[4] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[5] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

Imagery Source: 2016 St. Louis County Pictometry

Mine Site[1]

Proposed Surficial Aquifer Monitoring Stations[2]
- Compliance Well
- Indicator Well
- Performance Well
- Performance Piezometer
- Water Appropriation Only

Proposed Bedrock Monitoring Stations[2]
- Compliance
- Indicator
- Water Appropriation Only

GW405 (MW-5) Proposed NPDES/SDS Monitoring Station ID (Current Monitoring Station ID)

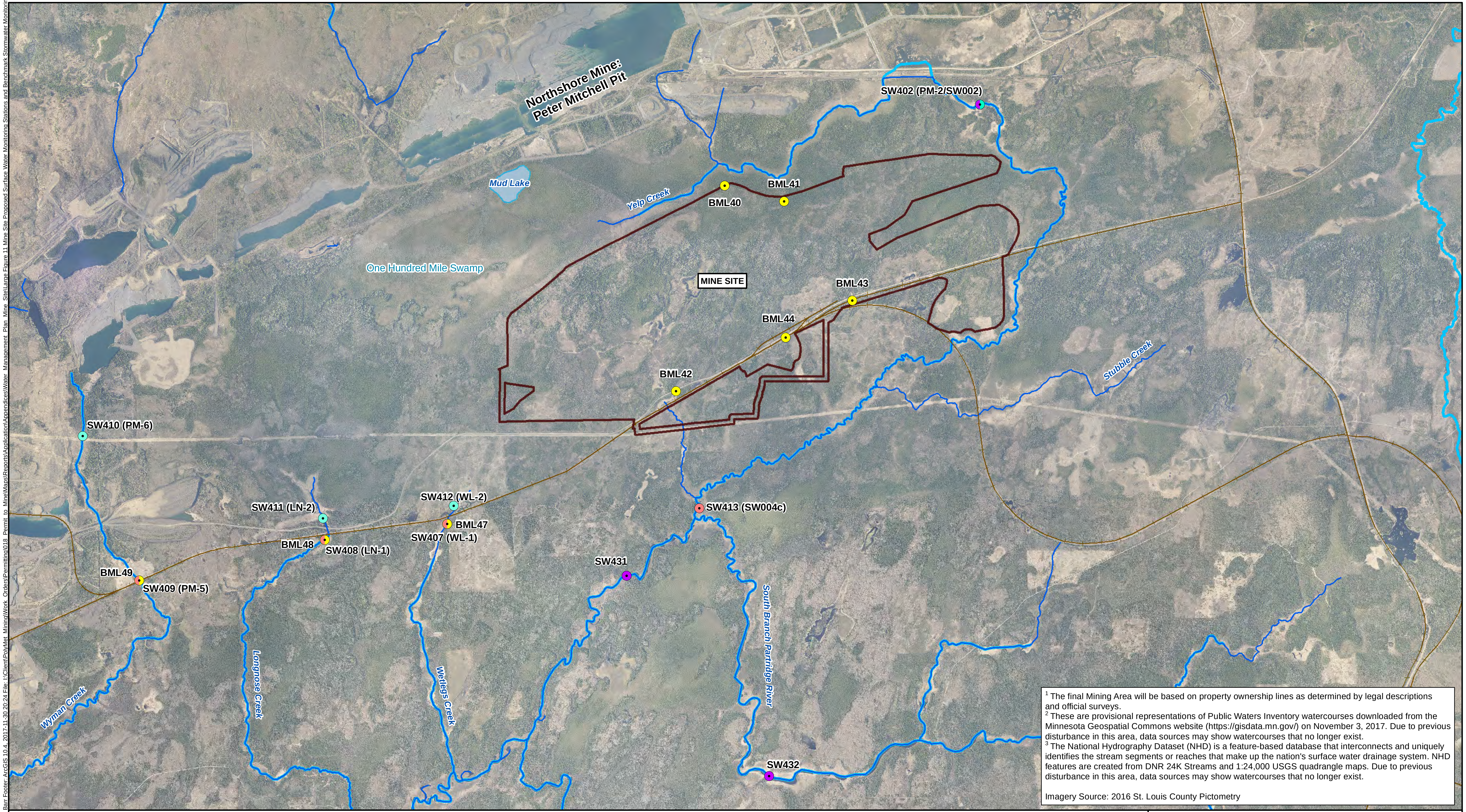
Mine Year 11 Footprints
- Mine Pit
- Active Stockpile
- Storage & Laydown Area
- Removed Stockpile
- Haul Roads
- Groundwater Containment System

- Dunka Road[3]
- Proposed Railroad Track
- Existing Private Railroad
- Public Waters Inventory (PWI) Watercourses[4]
- National Hydrography Dataset (NHD) Rivers & Streams[5]

0 1,250 2,500
Feet

MINE SITE PROPOSED GROUNDWATER MONITORING STATIONS
NorthMet Project
Poly Met Mining, Inc.

Large Figure 10
Water Management Plan - Mine



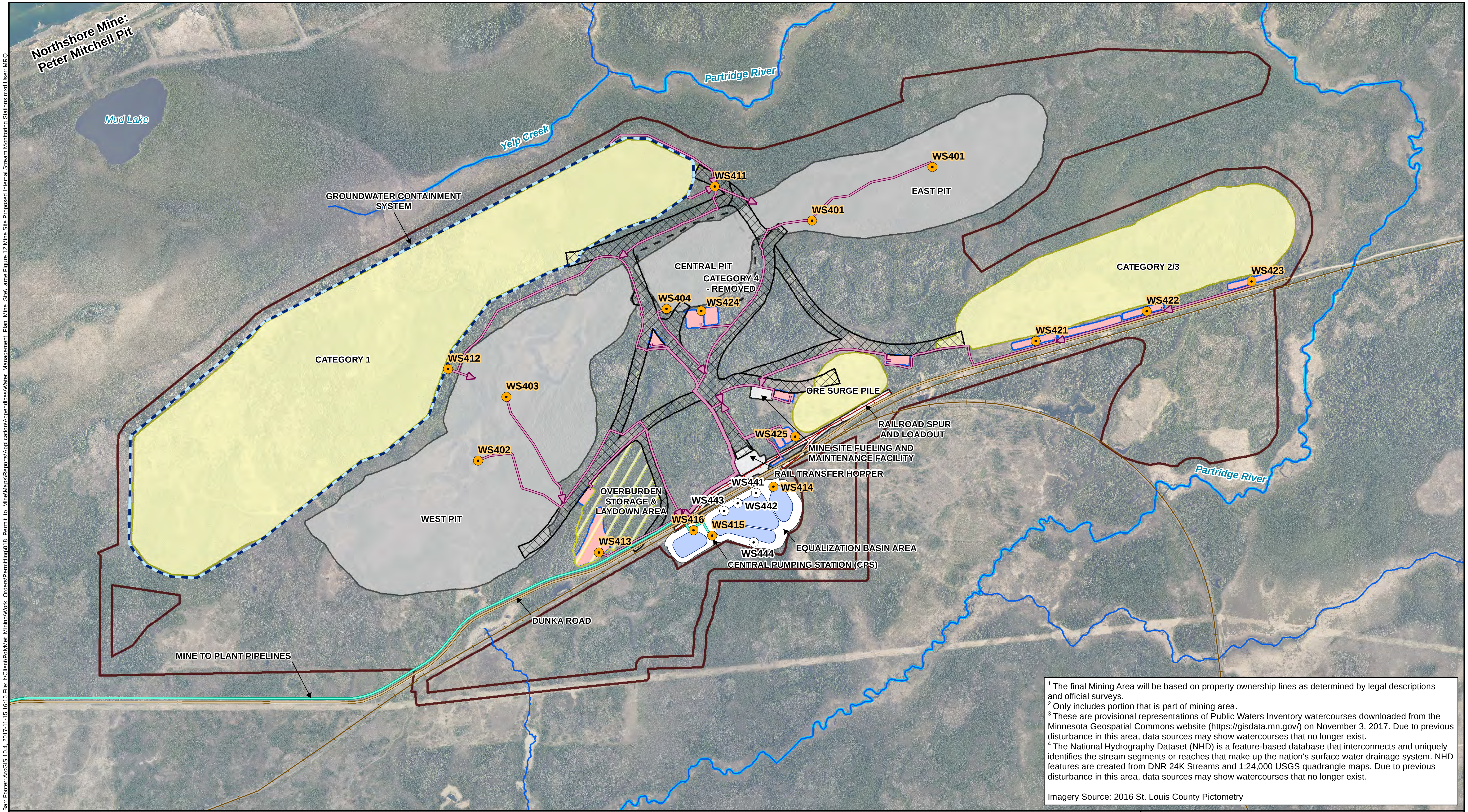
Mine Site[1]
Benchmark Stormwater Monitoring Locations
Proposed Surface Water Monitoring Stations
Monitor Only
Background
Monitor Only/Benchmark Stormwater
Streamflow
Background/Streamflow
Public Waters Inventory Basins
Public Waters Inventory (PWI) Watercourses[2]
National Hydrography Dataset (NHD) Rivers & Streams[3]
SW402 (SW002) Proposed NPDES/SDS Monitoring Station ID (Current Monitoring Station ID)

N

0 3,500 7,000
Feet

MINE SITE PROPOSED SURFACE WATER MONITORING STATIONS AND BENCHMARK STORMWATER MONITORING LOCATIONS
NorthMet Project
Poly Met Mining, Inc.

Large Figure 11
Water Management Plan - Mine



[1] The final Mining Area will be based on property ownership lines as determined by legal descriptions and official surveys.
[2] Only includes portion that is part of mining area.
[3] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[4] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

Imagery Source: 2016 St. Louis County Pictometry

Internal Waste Stream Monitoring Stations
- NPDES/SDS and Water Appropriation Monitoring Stations
- Water Appropriation Only Monitoring Stations
- Mine Site[1]

Mine Year 11 Footprints
- Mine Pit
- Active Stockpile
- Storage & Laydown Area
- Removed Stockpile
- Haul Roads
- Dunka Road[2]

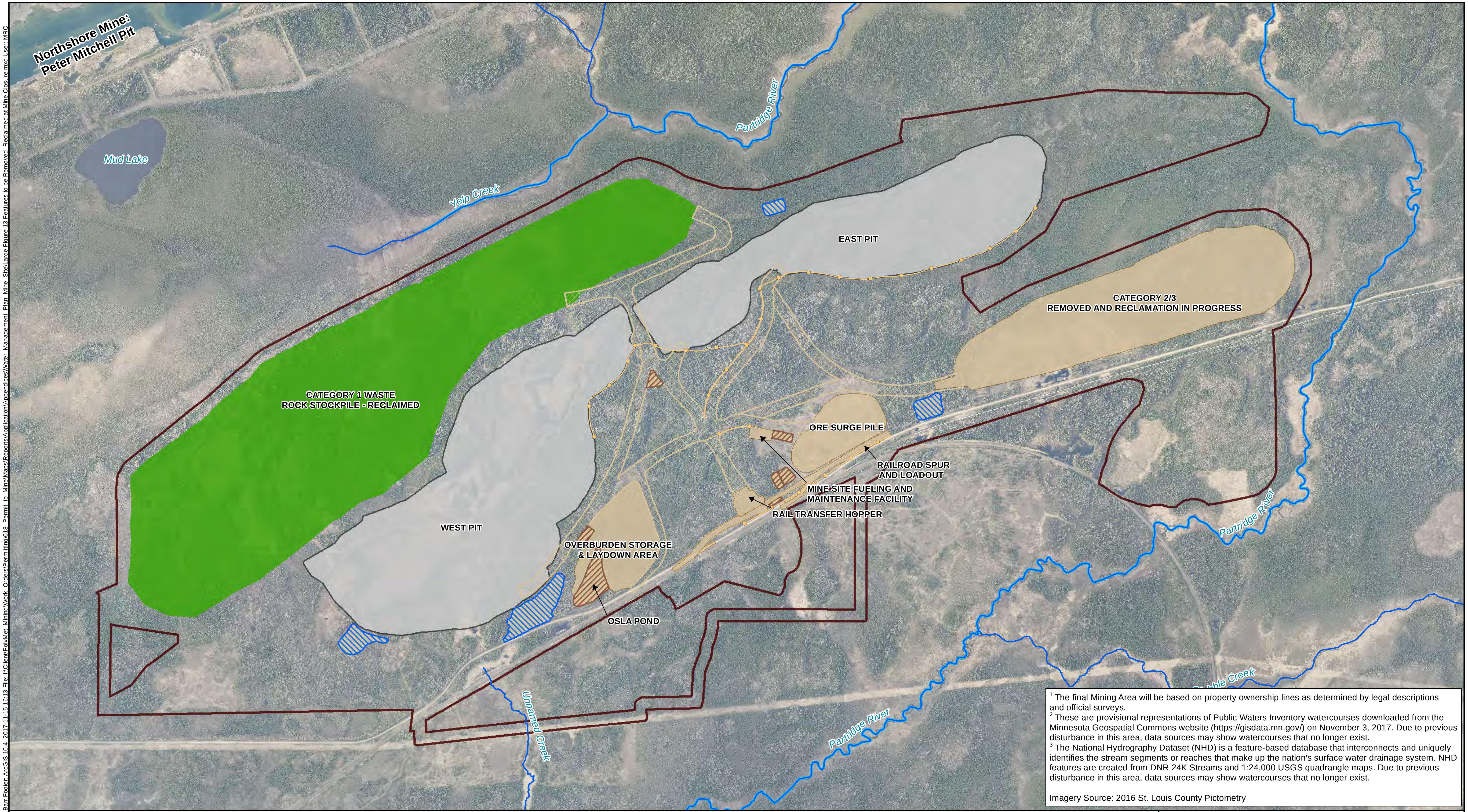
- Existing Private Railroad
- Proposed Railroad Track
- Groundwater Containment System
- Mine to Plant Pipelines
- Mine Water Pipes
- Mine Drainage Ponds and Sumps

- Public Waters Inventory (PWI) Watercourses[3]
- National Hydrography Dataset (NHD) Rivers & Streams[4]

0 1,500 3,000
Feet

MINE SITE PROPOSED INTERNAL WASTE STREAM MONITORING STATIONS
NorthMet Project
Poly Met Mining, Inc.

Large Figure 12
Water Management Plan - Mine



[1] The final Mining Area will be based on property ownership lines as determined by legal descriptions and official surveys.
[2] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[3] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

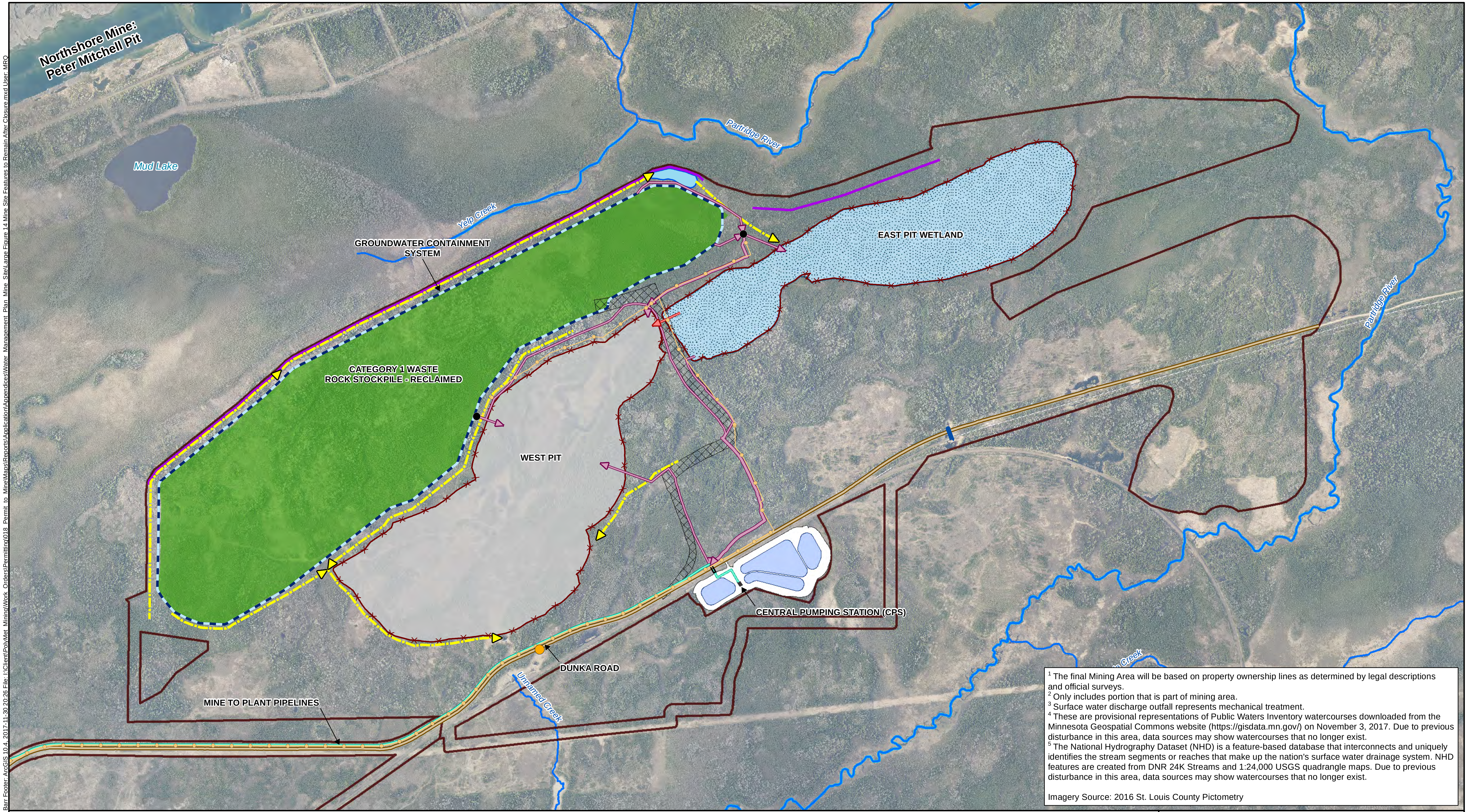
Imagery Source: 2016 St. Louis County Pictometry

- Mine Site[1]
- Mine Pits
- Covered Stockpile
- Removed and Reclaimed Features
- Reclaimed Haul Roads
- PolyMet Power Distribution Lines - Removed
- Reclaimed Mine Water Ponds and Sumps
- Reclaimed Stormwater Ponds
- Public Waters Inventory (PWI) Watercourses[2]
- National Hydrography Dataset (NHD) Rivers & Streams[3]

0 750 1,500 3,000
Feet

FEATURES TO BE REMOVED/
RECLAIMED AT CLOSURE
NorthMet Project
Poly Met Mining, Inc.

Large Figure 13
Water Management Plan - Mine



[1] The final Mining Area will be based on property ownership lines as determined by legal descriptions and official surveys.
[2] Only includes portion that is part of mining area.
[3] Surface water discharge outfall represents mechanical treatment.
[4] These are provisional representations of Public Waters Inventory watercourses downloaded from the Minnesota Geospatial Commons website (https://gisdata.mn.gov/) on November 3, 2017. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.
[5] The National Hydrography Dataset (NHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system. NHD features are created from DNR 24K Streams and 1:24,000 USGS quadrangle maps. Due to previous disturbance in this area, data sources may show watercourses that no longer exist.

Imagery Source: 2016 St. Louis County Pictometry

- Mining Area[1]
- Covered Stockpile
- West Pit
- East Pit Wetland
- Haul Roads
- Dunka Road[2]
- Pit Perimeter Barrier System
- PolyMet Power Distribution Lines
- Surface Water Discharge Outfall[3]
- Groundwater Containment System Sumps
- Groundwater Containment System
- Mine to Plant Pipelines
- Mine Water Pipelines
- East Pit Overflow
- Stormwater Ditches
- Perimeter Dike
- Stormwater Culverts
- Stormwater Pond
- Public Waters Inventory Watercourse[4]
- National Hydrography Dataset (NHD) Rivers & Streams[5]

0 1,500 3,000
Feet

MINE SITE FEATURES TO REMAIN AFTER CLOSURE
NorthMet Project
Poly Met Mining, Inc.

Large Figure 14
Water Management Plan - Mine

Attachments

Attachment A

WWTS Terminology Changes

Attachment A WWTS Terminology Changes

Some terminology associated with the WWTS has changed since the FEIS. Changes are associated with the relocation of the mine water treatment trains that were previously at the Mine Site WWTF to the Plant Site WWTS, and the relocation of the Mine Site equalization basins to south of Dunka Road. To aid review of documents prepared for the FEIS which are referenced in this plan, the following table explains WWTS terminology changes.

Former name	New name
Waste Water Treatment Plant (WWTP) and Waste Water Treatment Facility (WWTF)	Waste Water Treatment System (WWTS)[1]
Treated Water Pipeline	As a whole: • Mine to Plant Pipelines (MPP) Three individual pipes: • Construction Mine Water Pipeline • Low Concentration Mine Water Pipeline • High Concentration Mine Water Pipeline
Construction Mine Water Basin	Construction Mine Water Basin
West Equalization Basin	High Concentration Equalization Basin (HCEQ Basin)
East Equalization Basin 1	Low Concentration Equalization Basin 1 (LCEQ Basin 1)
East Equalization Basin 2	Low Concentration Equalization Basin 2 (LCEQ Basin 2)
WWTP effluent (discharged to receiving waters)	WWTS discharge
WWTF effluent (sent to the FTB via the CPS)	Treated mine water[2] (WWTS stream pumped to the FTB)
Treated mine water[3]	Treated mine water[2]
Central Pumping Station	Central Pumping Station
--	Construction Mine Water Pumping Station
--	Equalization Basin Area[4]
Splitter Structure	This structure will be integrated into the Central Pumping Station.
CPS Pond	This pond no longer exists.

(1) The two sets of treatment trains that were previously at two locations will now be housed under one roof at the Plant Site.
(2) Formerly "treated mine water", which included WWTF effluent, OSLA runoff, and construction mine water. With reconfiguration, that mixture no longer exists, and the "treated mine water" consists of effluent from the chemical precipitation and membrane filtration portion of the WWTS.
(3) "Treated mine water" formerly included WWTF effluent, OSLA runoff, and construction mine water. With reconfiguration, that mixture no longer exists, but these flows still report to the FTB.
(4) New term describing pond area south of Dunka Road

Attachment B

Mechanical Infrastructure Design Permit Application Support Drawings

Drawings are located in Appendix 8 of the Permit to Mine application and are not duplicated here.

Attachment C

Mine Site Stormwater Permit Application Support Drawings

Drawings are located in Appendix 5 of the Permit to Mine application and are not duplicated here.