



POLYMET
MINING

NorthMet Project
Wetland Data Package

Version 10

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



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Acronyms, Abbreviations and Units

Acronym / Abbreviation	Stands For
CWA	Clean Water Act
DA	Department of the Army
FTB	Flotation Tailings Basin
IAP	Impact Assessment Planning
HRF	Hydrometallurgical Residue Facility
LTVSMC	LTV Steel Mining Company
MDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
NADP	National Atmospheric Deposition Program
NEPA	National Environmental Policy Act
NHIS	Natural Heritage Information System
NWI	National Wetland Inventory
OSLA	Overburden Storage and Laydown Area
OSP	Ore Surge Pile
RFSS	Regional Forester Sensitive Species
RTH	Rail Transfer Hopper
SGCN	Species of Greatest Conservation Need
TWP	Treated Water Pipeline
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
WCA	Wetland Conservation Act
WWTF	Waste Water Treatment Facility
WWTP	Waste Water Treatment Plant



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Unit	Description
ac-ft/yr	acre-feet per year
dBA	Decibel
gpm	gallons per minute
g/cm ³	grams per cubic centimeter
g/m ² /yr	grams per square meter per year
kg/ha	Kilograms per hectare
mg/L	milligrams per Liter
mi ²	Square miles
µg/L	microgram per Liter
µg/m ² /yr	microgram per square meter per year



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1.0 Introduction

This document presents the wetlands data used by the Wetland Management Plan for the NorthMet Project (Project). In cases where a supporting document is referenced, a general description of the supporting document is provided. Information may change during wetland permitting. Permitting decisions cannot be made until the permitting process.

Note that this document uses slightly different terminology to describe areas near the processing plant and Tailings Basin than is used in other documents. Whereas the Supplemental Draft Environmental Impact Statement (SDEIS, Reference (1)) and other Project documents use the term *Plant Site* to refer to the entire Project area where the processing plant and Tailings Basin are located, this document subdivides that area, with separate analyses of the Plant Site area (where processing facilities are located), the Hydrometallurgical Residue Facility (HRF) area, and the Flotation Tailings Basin (FTB) area. Furthermore, this document uses the term *FTB* to refer to the entire area within the boundaries of what is termed the Plant Site in the SDEIS, the minus the areas referred to in this document as the Plant Site and the HRF. This usage is an artifact of the specific way that the term FTB was used when the original wetland delineations and air modeling was done. It is maintained in this document to maintain continuity between the wetland data package and supporting analyses. Large Figure 1 shows the areas of the FTB, Plant Site, and HRF as used in this document.

1.1 Outline

The outline of this document is:

- Section 2.0 Discussion of regulatory basis for wetland management
- Section 3.0 Data on wetlands in the vicinity of the Project
- Section 4.0 Discussion of the approach to evaluating direct, potential indirect, and cumulative wetlands impacts due to the Project
- Section 5.0 Evaluation of direct, potential indirect, and cumulative wetlands impacts due to the Project

This document is intended to evolve through the environmental review, permitting, operating, reclamation, and long-term closure phases of the Project. A Revision History is included at the end of the document.



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2.0 Regulatory Basis

Wetlands are defined by the *U.S. Army Corps of Engineers Wetland Delineation Manual* (Reference (2)) for administration of Section 404 of the Clean Water Act (CWA) and the Minnesota Wetland Conservation Act (WCA) of 1991 (Minnesota Rules, chapter 8420)

2.1 Section 404 of the Clean Water Act

The U.S. Army Corps of Engineers (USACE) has the authority to issue permits for the discharge of dredged or fill material into waters of the United States under Section 404 of the CWA. Because the Project will result in more than minimal adverse impact, the Project will be reviewed under the Department of the Army (DA) individual permit process. The DA Section 404 permits must be consistent with state water quality standards. This is determined through the Section 401 certification process administered by the Minnesota Pollution Control Agency (MPCA).

The U.S. Environmental Protection Agency (USEPA) reviews and comments on Federal Environmental Impact Statements pursuant to their authorities and responsibilities under the National Environmental Policy Act, Section 309 of the Clean Air Act, and Section 404 of the Clean Water Act. The USEPA has additional authorities under Section 404 of the CWA. Under Section 404(c) of the CWA, the USEPA has the authority to prohibit, restrict, or deny the discharge of dredged or fill material at defined sites in waters of the United States (including wetlands) whenever it determines, after notice and opportunity for public hearing, that use of such sites for disposal would have an unacceptable adverse impact on one or more resources, including fisheries, wildlife, municipal water supplies, or recreational areas. The 404(q) Memorandum of Agreement between the USACE and USEPA provides a procedure considering both agencies' views on projects including procedures for elevating unresolved issues to regional and national levels. The 404(q) process is most frequently used by USEPA when they wish to initiate consultation regarding concerns they may have about the impacts of a proposed project.

2.2 Section 401 Water Quality Certification

The MPCA has been delegated the authority by the USEPA to issue Section 401 Water Quality Certifications to ensure a project will comply with state water quality standards. Individual certification will be necessary because an individual Section 404 permit is required for the Project. The MPCA also has administrative authority under Minnesota Rules, part 7050.0186, regarding wetland mitigation.

2.3 Minnesota Wetland Conservation Act

The filling, excavation, and draining of wetlands is also regulated by the WCA, which is administered by a local governmental unit. For mining projects, the designated approving authority is the Minnesota Department of Natural Resources (MDNR) Division of Lands and Minerals. The WCA requires wetland mitigation for Project impacts.



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2.4 Permitting Process

Project proponents that propose to discharge dredge or fill into waters of the United States, including jurisdictional wetlands, must complete a sequencing analysis that demonstrates that they have avoided and minimized impacts to waters of the United States, including flooding, draining or excavating waters, and provided adequate compensation for unavoidable impacts. The following are examples of actions to avoid and minimize impacts to waters of the United States:

- limiting the degree or magnitude of wetland activity
- rectifying temporary impacts by repairing, rehabilitating, or restoring the affected wetland
- reducing or eliminating impacts to wetlands over time by preserving the wetlands through proper maintenance, management, and operation of the Project to avoid further draining or flooding of wetlands

As a final step in the sequencing analysis, the Project proponent must mitigate unavoidable wetland impacts by replacing with wetland areas of equal or greater public value.

Poly Met Mining Inc. (PolyMet) initially submitted a wetland permit application to the USACE and a wetland permit pre-application to the MDNR in July 2004 (Reference (3)). Based on the revised Project plans, PolyMet submitted a revised combined wetland application in 2013, to fulfill the requirements of Sections 404 and 401 of the CWA and the WCA for the Project (Reference (4)). The wetland permit application describes the proposed mining activities that may impact wetlands and identify areas with potential impacts to wildlife, state or federally listed endangered and threatened species, and cultural resources. This revised combined application was sent to the USACE and the MDNR in August 2013. The USACE will send the form to the MPCA as deemed necessary. A permit or certification must be received from each agency before Project work can begin in wetlands.

2.5 Cumulative Wetland Impact Analysis

The cumulative wetland impact study is intended to help satisfy the requirements of Section 3.3.3.2 of the Scoping Decision Document (Reference (5)) to meet National Environmental Policy Act (NEPA) requirements (42 U.S.C. 4321 et seq.). The Council on Environmental Quality (CEQ), which oversees administration of the NEPA process, has defined cumulative effects in its regulations as:

[T]he impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions (40 CFR § 1508.7).



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While Section 404 of the CWA and the WCA provide programs for evaluating project-specific wetland impacts, the NEPA establishes national goals and a process to analyze cumulative effects on protected wetland resources (Section 404 permit authorization). The consideration of resources available in the past compared to those present currently, and the effects of reasonably foreseeable future actions, provides a context for assessing the cumulative impacts on wetland, lake, and deepwater resources.



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3.0 Wetland Data

This section summarizes the wetland resources within the Project. Section 3.1 describes the various assessments of wetland resources that have been conducted for the Project. The wetlands within the Project footprint (Large Figure 1) and within select non-Project areas are presented in Section 3.2.

3.1 Wetland Delineation

Delineation and functional assessment of wetlands that may be impacted by the Project have been conducted as the Project has evolved. This section contains summaries of and references to the reports that have been submitted. Large Table 1 provides details for all wetlands located within the Project areas. For each area, the table provides the total acreage of the wetland, wetland type, total wetland area within the Project area (acres), direct wetland impacts (acres), remaining wetland area (acres), quality rating, and type of direct impact disturbance factor.

3.1.1 Initial Report (RS14 Draft-02)

Reference (3) was submitted in November 2006 and describes wetland delineation activities conducted at the Project site between August 2004 and July 2006 including the methods, findings, and a summary of wetland resources within the Project site. The Project areas have changed since the July 2004 permit application and the wetland resources within the Project areas have been refined based on additional field delineations (Sections 3.1.2 through 3.1.5).

Reference (3) presents the results of an evaluation of wetlands delineated within the following Project areas: mine pits, stockpiles, Tailings Basin, railroad access routes to the Plant Site, the Plant Site, and tailings dam drain system and water pipeline. The Tailings Basin is an actively permitted waste storage facility, and is therefore, not subject to state and federal wetland regulations.

3.1.2 Wetland Impacts – Dunka Road Improvements and Treated Water Pipeline (Technical Memorandum)

Reference (6) was submitted on April 26, 2007 and provides information pertaining to wetlands impacted by the Dunka Road improvements and the Treated Water Pipeline. The pipeline will be constructed adjacent to and north of Dunka Road. A field review was conducted in March 2007 to determine the wetland boundaries and verify wetland types in an area 100 feet south and 100 feet north of the road edge starting at the proposed location of the Minnesota Power Substation and ending just north of the junction of Dunka Road and the road to Area 5.

3.1.3 Wetland Impacts – Tailings Basin Mitigation Alternative (Technical Memorandum)

Reference (7) was submitted on June 2, 2008 and describes potential wetland impacts resulting from the construction of the tailings dam in the FTB area. A wetland delineation



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and functional assessment was conducted in March 2007, November 2007, and May 2008 to identify wetlands not included in prior delineations.

3.1.4 Memo: TB-12 Pipeline Route Threatened and Endangered Species Survey and Wetland Delineation Results for Tailings Basin Alternative

Reference (8) was submitted on December 7, 2009 and describes potential wetland impacts from the construction of the TB-12 pipeline. The construction corridor was 8.4 miles long and 50 feet wide, for a total of 50.6 acres, starting at the Plant Site and ending at the Partridge River. The field delineation was conducted on September 8-9, 2009. The TB-12 Pipeline is also referred to as the Colby Lake Water Pipeline. The Colby Lake Pipeline is not identified as a Project area because no construction will occur in this area.

3.1.5 Project Baseline Wetland Type Evaluation

Reference (9) was submitted in April 2011 and provides baseline data regarding the classification and acreages of wetlands surrounding the Mine Site (Area One) and Tailings Basin (Area Two) (Large Figure 2). Wetlands were evaluated within two areas using data collected from 2004-2010: a 23,927-acre area surrounding the Mine Site (referred to as Area One) and a 19,397-acre area located north and northwest of the Tailings Basin (referred to as Area Two). There were 11,195 acres of wetland identified within Area One (Large Figure 3) and 8,606 acres of wetland identified within Area Two (Large Figure 4). Area One and Area Two include all of the wetland delineations described in Sections 3.1.1 through 3.1.3. The wetlands identified within the TB-12 pipeline (Section 3.1.4) are not found within either Area One or Area Two.

Based on Reference (9), the most common wetland types in Area One include coniferous bog (42%), shrub swamp (30%), and coniferous swamp (18%). In Area Two, the most common wetland types include shrub swamp (34%), coniferous swamp (26%), and coniferous bog (15%). Wetlands across the two areas consist of large wetland complexes that are forested wetland communities dominated by black spruce and tamarack trees.

3.1.6 Updates to Previous Wetland Delineations

Updates to previous wetland delineations were made between April 2011 when Reference (9) was submitted and fall of 2012. Following additional site visits and aerial photograph review, wetland boundaries and types were further refined. Based on these updates, there are approximately 11,201 acres of wetland identified in Area One and 8,622 acres of wetlands identified in Area Two (Table 3-1).

Table 3-1 Wetland Types within Area One and Area Two

Eggers and Reed Wetland Community	Area One (acres)	Area Two (acres)
Coniferous bog	4,581	1,018
Coniferous swamp	2,072	2,537
Deep marsh	220	514
Hardwood swamp	27	161
Open bog	283	354
Open water (includes shallow, open water and lakes)	245	285
Sedge/wet meadow	46	137
Shallow marsh	359	654
Shrub swamp (includes alder thicket and shrub-carr)	3,368	2,962
Total acres of wetland	11,201	8,622

The wetland types in Area One include coniferous bog (41%), shrub swamp (30%), coniferous swamp (18%), shallow marsh (3%), open bog (3%), open water (2%), deep marsh (2%), sedge/wet meadow (less than 1%), and hardwood swamp (less than 1%). In Area Two, the wetland types include shrub swamp (34%), coniferous swamp (29%), coniferous bog (12%), shallow marsh (8%), deep marsh (6%), open bog (4%), open water (3%), hardwood swamp (2%), and sedge/wet meadow (2%).

3.1.7 Additional Non-Project Areas

Additional non-project areas were evaluated, which included the Colby Lake Water Pipeline and Second Creek (Reference (10)). The purpose of evaluating the Second Creek area was to provide data regarding potential indirect wetland impacts associated with stream flow augmentation activities for Second Creek, which are described in Reference (11). No Project construction is planned in the Second Creek area.

The area of analysis for Second Creek began at its origin, at the south end of Tailings Basin Cell 1E, and ended at the east edge of County Highway 666 (Large Figure 1). The majority of this area of analysis is located outside of the Project Areas (Large Figure 1). The Second Creek area included some areas adjacent to Second Creek that were also assessed within the FTB survey or the Colby Lake Pipeline survey.

3.2 Wetland Summary for the Project Areas

The Project footprint that will be used for this analysis has been defined and detailed in the Project Description (Reference (12)). Wetlands are summarized within the Project footprint, and in select non-Project areas. Project areas for the wetland analysis include the Mine Site,



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Railroad Connection Corridor, Dunka Road and Utility Corridor, Plant Site, FTB, and Hydrometallurgical Residue Facility (HRF). Non-Project areas for the wetland analysis include the Colby Lake Water Pipeline and Second Creek (Large Figure 1).

The Project areas include 166 wetlands covering approximately 1,579 acres (Large Table 1). The percentage (based on acreage) of Eggers and Reed (Reference (13)) wetland types identified in the Project areas include: coniferous bog (55%); alder thicket (12%); shallow marsh (11%); coniferous swamp (9%); deep marsh (7%); sedge meadow (2%); open bog (1%); wet meadow (1%); hardwood swamp (1%); shallow, open water (less than 1%); and shrub-carr (less than 1%).

The overall quality of the wetlands was evaluated using the Minnesota Rapid Assessment Method (MnRAM 3.0). Within the Project areas, 105 of the 166 wetlands (63%) in the Project area are rated as high quality, 11 wetlands (7%) are rated as moderate quality, and 50 wetlands (30%) are rated as low quality (Large Table 1). Low quality wetlands are located at the FTB and HRF. Wetlands at the Mine Site, Dunka Road and Utility Corridor, and Railroad Connection Corridor are ranked as high or moderate quality.

3.2.1 Mine Site

Wetlands were delineated on the 3,014 acre Mine Site (Large Figure 5). Construction of the following systems will occur in the Mine Site: mine pits, stockpiles, haul roads, Rail Transfer Hopper (RTH), Waste Water Treatment Facility (WWTF) and Central Pumping Station (CPS), stormwater ditches and ponds, process water pipes and ponds, culverts, perimeter dike, Category 1 Waste Rock Stockpile Groundwater Containment System, Treated Water Pipeline (TWP), and Dunka Road upgrades (Reference (12)).

A summary of the wetlands, classified by Reference (13) wetland community type, is provided in Table 3-2.



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Table 3-2 Wetland Types within the Mine Site

Eggers and Reed Wetland Community	Mine Site (acres)
Coniferous bog	873.43
Coniferous swamp	128.61
Deep marsh	5.03
Hardwood swamp	12.79
Open bog	18.34
Open water (includes shallow, open water and lakes)	0
Sedge/wet meadow	39.53
Shallow marsh	44.02
Shrub swamp (includes alder thicket and shrub-carr)	176.03
Total acres of wetland	1,297.78

A total of 87 wetlands covering approximately 1,298 acres have been identified within the Mine Site (Large Table 1). A total of 7 wetlands, each over 50 acres in size within the Project area, comprise approximately 774 acres of wetlands within the Mine Site. There are an additional 5 wetlands, each over 20 acres in size within the Mine Site. Together, these 12 wetlands comprise 72% of the wetland area within the Mine Site.

A total of 79% of the wetlands in the Mine Site are coniferous swamp/bog and open bog communities. Shrub swamp wetland communities comprise 13%, shallow marshes comprise about 3%, sedge/wet meadow communities make up 3%, and hardwood swamp communities comprise 1% of the wetlands in the Mine Site. Deep marshes comprise less than 1% of the wetland area in the Mine Site.

Approximately 92% of the wetlands in the Mine Site are of high quality and 8% of wetlands are of moderate quality. High quality wetlands have low disturbance levels and high vegetative diversity and integrity. Moderate quality wetlands have impounded open water because of beaver dams and downstream culverts under Dunka Road or the railroad, are adjacent to U.S. Forest Service (USFS) roads, the Dunka Road corridor, or the Railroad Connection Corridor.

3.2.2 Railroad Connection Corridor

An approximately 1.1 mile length of railroad is proposed to connect two existing rail lines between the Mine Site and the Plant Site (Large Figure 6). A summary of the wetlands, classified by Reference (13) wetland community type, is provided in Table 3-3.



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Table 3-3 Wetland Types within the Railroad Connection Corridor

Eggers and Reed Wetland Community	Railroad Connection Corridor (acres)
Coniferous bog	0
Coniferous swamp	0.07
Deep marsh	0
Hardwood swamp	0
Open bog	0
Open water (includes shallow, open water and lakes)	0
Sedge/wet meadow	0
Shallow marsh	0.07
Shrub swamp (includes alder thicket and shrub-carr)	0.30
Total acres of wetland	0.44

A total of 4 wetlands covering 0.44 acres have been identified within the Railroad Connection Corridor (Large Table 1). A total of 68% of the wetlands are shrub swamp, 16% are coniferous swamp, and 16% are shallow marsh.

All of the wetlands in the Railroad Connection Corridor are high quality. While these wetlands are moderately impacted by either a haul road or an existing railroad, they have high vegetative diversity/integrity.

3.2.3 Dunka Road and Utility Corridor

This Project area will include improvements to Dunka Road and construction of the Treated Water Pipeline (TWP) that will be located adjacent to and north of Dunka Road (Large Figure 7, Reference (6)). Dunka Road is an unpaved gravel road that was used as an active mine road in the former LTV Steel Mining Company (LTVSMC) operations. Dunka Road will be utilized to transport mine equipment between the Mine Site and the Area 1 Shop, as well as mine personnel between the Mine Site and the Area 2 Shop (Large Figure 1). The TWP will carry water from the CPS to the FTB. A summary of the wetlands, classified by Reference (13) wetland community type, is provided in Table 3-4.

Table 3-4 Wetland Types within the Dunka Road and Utility Corridor

Eggers and Reed Wetland Community	Dunka Road Corridor (acres)
Coniferous bog	0.89
Coniferous swamp	1.54
Deep marsh	0
Hardwood swamp	0
Open bog	0
Open water (includes shallow, open water and lakes)	0
Sedge/wet meadow	0
Shallow marsh	0.52
Shrub swamp (includes alder thicket and shrub-carr)	3.81
Total acres of wetland	6.76

A total of 21 wetlands, encompassing 6.76 acres, have been identified within the Dunka Road and Utility Corridor (Large Table 1). The wetlands in the corridor include shrub swamp (56%), coniferous swamp (23%), coniferous bog (13%), and shallow marsh (8%).

These wetlands are currently located adjacent to Dunka Road and some of the wetlands have been previously logged. Wetlands in the western half of the corridor are located within areas previously disturbed by mining activities in the former LTVSMC operations. All of the wetlands are of high quality.

3.2.4 Plant Site

The Plant Site is the location of the former LTVSMC facilities (Large Figure 8). The existing facilities will be upgraded and construction of the following systems will occur: Flotation Building, Concentrate Dewatering/Storage Building, Hydrometallurgical Plant, Oxygen Plant, and supporting infrastructure (e.g., road, etc.; Reference (12)).

Nearly the entire Plant Site is disturbed by past mining activities. No wetlands are present within the Plant Site, although there is a Plant Reservoir located east of the concentrator that is not regulated as a wetland (Reference (9)).

3.2.5 Flotation Tailings Basin (FTB)

The FTB includes the Tailings Basin cells identified as Cell 1E, Cell 2E, and Cell 2W (Large Figure 9). Construction of the following systems will occur in the FTB area: The FTB, an FTB Containment System to manage FTB seepage along the western, northern, and portions of the eastern sides of the Tailings Basin; a buttress for stability along the northern



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and eastern sides of Cell 2E; a drainage swale located northeast of Cell 2E; and an overflow channel located northeast of Cell 2E.

A summary of the wetlands located within the Project area, classified by Reference (13) wetland community type, is provided in Table 3-5.

Table 3-5 Wetland Types within the FTB

Eggers and Reed Wetland Community	FTB (acres)
Coniferous bog	0
Coniferous swamp	14.44
Deep marsh	106.27
Hardwood swamp	1.03
Open bog	0
Open water (includes deep water, shallow, open water and lakes)	0.85
Sedge/wet meadow	1.48 ⁽¹⁾
Shallow marsh	99.79
Shrub swamp (includes alder thicket and shrub-carr)	14.39
Total acres of wetland	238.25 ⁽¹⁾

(1) A 0.03 acre area of sedge/wetland meadow is classified as exempt.

A total of 52 wetlands covering approximately 238 acres were identified within the FTB (Large Table 1). There is a 0.03 acre portion of the sedge/wet meadow wetland identified as exempt because the wetlands are located within the Cliffs Erie LLC (formerly LTVSMC) Permit To Mine Ultimate Tailings Basin Limit boundary and are not regulated by state and federal wetland regulations (Section 5.1). The wetlands in the FTB include deep marsh (45%), shallow marsh (42%), coniferous swamp (6%), shrub swamp (6%), sedge/wet meadow (less than 1%), open water (less than 1%), and hardwood swamp (less than 1%).

The wetlands in the FTB have been previously impacted by LTVSMC tailings deposition, roads, and impoundment. The majority (92%) of wetlands within the FTB are currently rated as low quality with low vegetative diversity/integrity. Eight percent of the wetlands are rated as moderate quality.

3.2.6 Hydrometallurgical Residue Facility (HRF)

The HRF will be located near the southwest corner of the Cell 2W, at the site of the Emergency Basin used in the former LTVSMC operations (Large Figure 10, Reference (12)).

A summary of the wetlands located within the Project area, classified by Reference (13) wetland community type, is provided in Table 3-6.



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Table 3-6 Wetland Types within the HRF

Eggers and Reed Wetland Community	HRF (acres)
Coniferous bog	0
Coniferous swamp	0
Deep marsh	0
Hardwood swamp	0
Open bog	0
Open water (includes deepwater, shallow, open water and lakes)	0
Sedge/wet meadow	0
Shallow marsh	36.07 ⁽¹⁾
Shrub swamp (includes alder thicket and shrub-carr)	0
Total acres of wetland	36.07 ⁽¹⁾

(1) A 28.56 acre area of shallow marsh is classified as exempt.

A total of 2 shallow marsh wetlands, covering 36.07 acres, were identified within the HRF (Large Table 1). There is a 28.56 acre portion of the shallow marsh wetland identified as exempt because wetlands located within the Cliffs Erie LLC (formerly LTVSMC) Permit to Mine Ultimate Tailings Basin Limit boundary are not regulated by state and federal wetland regulations (Section 5.1).

An unpaved, gravel road is located along the north side of these wetlands along with small buildings and associated facilities used in the former LTVSMC operations.

3.2.7 Colby Lake Water Pipeline

The Colby Lake Water Pipeline area of analysis contains an existing pipeline that was used to provide makeup water in the former LTVSMC operations (Large Figure 11). There will be no construction within this area as the existing pipeline will be used to provide water for the Project. A summary of the delineated wetlands, classified by Reference (13) wetland community type, is provided in Table 3-7.



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Table 3-7 Wetland Types within the Colby Lake Water Pipeline

Eggers and Reed Wetland Community	Colby Lake Water Pipeline Corridor (acres)
Coniferous bog	0
Coniferous swamp	0
Deep marsh	1.00
Hardwood swamp	0
Open bog	0
Open water (includes deep water, shallow, open water and lakes)	0
Sedge/wet meadow	1.35
Shallow marsh	2.58
Shrub swamp (includes alder thicket and shrub-carr)	2.06
Total acres of wetland	6.99

A total of 14 wetlands covering 6.99 acres were identified within the Colby Lake Water Pipeline area of analysis. The wetlands include shallow marsh (37%), shrub swamp (30%), wet meadow (19%), and deep marsh (14%).

The wetlands are located adjacent to an unpaved, gravel road and within a previously disturbed corridor. The majority of wetlands in this corridor are rated as low quality (93%), with the remaining wetland rated as moderate quality (7%).

3.2.8 Second Creek

The Second Creek area of analysis is located south of the FTB (Large Figure 8). There will be no Project construction in this area.

A summary of delineated wetlands within the Second Creek area of analysis, classified by Reference (13) wetland community type, is provided in Table 3-8.



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Table 3-8 Wetlands within the Second Creek Area

Eggers and Reed Wetland Community	Second Creek Area (acres)
Coniferous swamp	16.82
Deep marsh	19.57
Hardwood swamp	21.05
Open water (includes deep water, shallow, open water and lakes)	1.29
Wet meadow	1.28
Shallow marsh	106.02
Shrub swamp (includes alder thicket and shrub-carr)	132.88
Total acres of wetland	298.91

A total of 30 wetlands covering 298.91 acres were identified within the Second Creek area of analysis (Reference (10)). The wetlands include alder thicket or shrub-carr (44%), shallow marsh (35%), hardwood swamp (7%), deep marsh (7%), coniferous swamp (6%), wet meadow (less than 1%), and shallow, open water (less than 1%). Of these 30 wetlands, only 22 are unique to the Second Creek analysis area. One of these wetlands is located in the FTB area, and 7 are located in the Colby Lake Pipeline area of analysis. To avoid double counting those areas, the analysis of direct and potential indirect impacts in the Second Creek area (Sections 5.1.8 and 5.2.4) excludes areas that fall within the FTB or Colby Pipeline areas.



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4.0 Methods for Impact Evaluation

The Wetland Work Plan (Attachment A) was approved by the Co-lead Agencies on September 16, 2011 and describes the methods that will be used to identify direct wetland impacts and potential indirect wetland impacts for the Project. The Wetland Work Plan was developed as specified in the Wetland Resources Impact Assessment Planning (IAP) Final Summary Memo and Co-lead Agency Final Work Plan Preparation Guidance of July 1, 2011 (Guidance Document) and the Wetland IAP Work Plan Compiled Comments dated August 30, 2011. Wetland impacts for the Project were previously evaluated for the Draft Environmental Impact Statement (DEIS) (Reference (14)) and included direct, potential indirect, and cumulative impacts. The results of the wetland analysis are presented in Section 5.0.



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5.0 Impact Analysis

5.1 Direct Impacts

For this impact analysis, direct impacts are defined as mining-related activities that result in filling or excavation within the boundaries of a wetland. The analysis performed for the DEIS is described in Section 4.2 of Reference (14). The analysis performed for the Supplemental DEIS duplicates that effort using the revised Project Footprint and using accepted tools and protocols as defined in Attachment A. Wetlands within the Project Footprint were classified using Reference (13) wetland community types. The wetland types and acreages were identified in Reference (9), which was discussed with the Wetland IAP Workgroup and approved by the Co-lead Agencies on March 30, 2011.

The FTB and the HRF are located within the LTVSMC Permit to Mine Ultimate Tailings Basin Limit boundary. When LTVSMC ceased production in January 2001, the mining related assets were transferred to Cleveland Cliffs, Inc. which formed Cliffs Erie LLC. Wetlands located within the Cliffs Erie LLC (formerly LTVSMC) Permit to Mine Ultimate Tailings Basin Limit boundary, are not regulated by state and federal wetland regulations so are not included in this analysis.

The direct impacts associated with each wetland within the Project areas are shown in Large Table 1. The direct wetland impacts are summarized by wetland type using Reference (13) wetland community types as shown in Large Table 2. Of the 166 wetlands in the Project area, 128 wetlands will be directly impacted, totaling 913.84 acres of direct wetland impact. The Mine Site will contain the majority of direct wetland impacts (83%), followed by the FTB (15%), HRF (less than 1%), Dunka Road and Utility Corridor (less than 1%), and the Railroad Connection Corridor (less than 0.1%). No direct impacts are associated with the Plant Site, the Colby Lake Water Pipeline area, or Second Creek area.

The direct wetland impacts within the Project areas will occur in the following wetland types: coniferous bog (56%), shrub swamp (12%), coniferous swamp (9%), shallow marsh (9%), deep marsh (8%), sedge/wet meadow (4%), hardwood swamp (1%), and open bog (1%).

5.1.1 Mine Site

The Project features within the Mine Site were buffered up to 100 feet, then the feature and buffer areas were merged, resulting in the proposed area of disturbance as shown in Large Figure 5. Creating a maximum area of potential disturbance for the Project features will avoid underestimating the direct wetland impacts in the Project area.

There are 59 directly impacted wetlands located in the Mine Site covering approximately 758 acres (Large Figure 5 and Large Table 2). The total wetlands impacted by direct wetland impact include fill (39%), excavation (24%), or both fill and excavation (37%). Three wetland types comprise 89% of the proposed wetland impacts in the Mine Site and include



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508 acres of coniferous bog (67%), 98 acres of shrub swamp (13%), and 70 acres of coniferous swamp (9%). In addition, 38 acres of sedge/wet meadow (5%), 24 acres of shallow marsh (3%), 12 acres of hardwood swamp (2%), 8 acres of open bog (1%), and deep marsh (less than 1%) will also be impacted.

Approximately 99% of the directly impacted wetlands are rated high quality (Large Table 1). One percent of the directly impacted wetlands are rated as moderate quality with the disturbances in these wetlands related to impoundment and proximity to roads.

5.1.2 Railroad Connection Corridor

The proposed area of disturbance for the Railroad Connection Corridor includes the entire area shown in Large Figure 6. The Project features within the Railroad Connection Corridor were buffered up to 10 feet, then the feature and buffer areas were merged, resulting in the proposed area of disturbance as shown Large Figure 6. Creating a maximum area of potential disturbance for the Project features will avoid underestimating the direct wetland impacts in the Project area.

There are 4 directly impacted wetlands located in the Railroad Connection Corridor covering 0.44 acres (Large Figure 6 and Large Table 2). The type of direct wetland impact is fill (100%). The wetland types that will be directly impacted include shrub swamp (68%), coniferous swamp (16%), and shallow marsh (16%).

All of the wetlands in this area are high quality and have high vegetative diversity/integrity (Large Table 1). These wetlands have been moderately impacted by either a haul road or an existing railroad.

5.1.3 Dunka Road and Utility Corridor

The Project features within the Dunka Road and Utility Corridor were buffered up to 10 feet, then the feature and buffer areas were merged, resulting in the proposed area of disturbance as shown in Large Figure 7. Creating a maximum area of potential disturbance for the Project features will avoid underestimating the direct wetland impacts in the Project area.

There are 21 directly impacted wetlands located in the Dunka Road and Utility Corridor covering 6.76 acres (Large Figure 7 and Large Table 2). The type of direct wetland impact is fill (100%). The wetland types that will be directly impacted include shrub swamp (56%), coniferous swamp (23%), coniferous bog (13%), and shallow marsh (8%).

Some of the wetlands have been previously logged and wetlands in the western half of the corridor are located within areas previously disturbed by mining activities in the former LTVSMC operations. All of the wetlands are of high quality (Large Table 1).



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5.1.4 Plant Site

There are no direct wetland impacts in the Plant Site because no wetlands are present. The constructed Plant Reservoir located east of the Concentrator Building is not regulated as a wetland (Large Figure 8).

5.1.5 Flotation Tailings Basin (FTB)

Wetlands located outside of the Cliffs Erie LLC Permit to Mine Ultimate Tailings Basin boundary but within the FTB are included in the direct wetland impact analysis (Large Figure 9). The wetland in the FTB that is not subject to state and federal regulations includes 0.03 acres of Wetland ID T8.

The Project features within the FTB were buffered up to 25 feet, then the feature and buffer areas were merged, resulting in the proposed area of disturbance as shown in Large Figure 9. Creating a maximum area of potential disturbance for the Project features will avoid underestimating the direct wetland impacts in the Project area.

There will be 43 directly impacted wetlands located in the FTB covering 140.93 acres (Large Figure 9, Large Table 2). The total wetlands impacted by direct wetland impact include fill (29%), excavation (2 %), excavation and fill (2 %), and the FTB Containment System (46%). The wetland types that will be directly impacted include deep marshes (53%), shallow marshes (32%), coniferous swamps (8%), shrub swamps (6%), and fresh/wet meadows (1%).

Wetlands in this area have been disturbed by previous mining activities in the former LTVSMC operations or by impoundments caused by beaver activity throughout the area. All of the directly impacted wetlands are disturbed by impoundment, fill, or ditches, and are low or moderate quality wetlands (Large Table 1).

5.1.6 Hydrometallurgical Residue Facility (HRF)

Wetlands located outside of the Cliffs Erie LLC Permit to Mine Ultimate Tailings Basin boundary but within the HRF are included in the direct wetland impact analysis (Large Figure 10). The wetland in this Project area that is not subject to state and federal regulations includes 28.56 acres of Wetland ID 1155.

The Project features within the HRF were buffered up to 50 feet, then the feature and buffer areas were merged, resulting in the proposed area of disturbance as shown Large Figure 10. Creating a maximum area of potential disturbance for the Project features will avoid underestimating the direct wetland impacts in the Project area.

There are two directly impacted wetlands located in the HRF covering 7.51 acres (Large Figure 10, Large Table 2). The type of direct wetland impact includes fill (100%). The wetland type that will be directly impacted includes shallow marsh (100%) which is currently a low quality wetland (Large Table 1).



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5.1.7 Colby Lake Water Pipeline

There are no direct impacts to wetlands along the Colby Lake Water Pipeline because there will be no construction within this area (Large Figure 11).

5.1.8 Second Creek Area

There are no direct impacts to wetlands within the Second Creek area because there will be no construction within this area (Large Figure 8).

5.2 Potential Indirect Impacts

The analysis of potential indirect wetland impacts was completed based on information in Attachment A. The purpose of this analysis is to provide an estimate of potential indirect wetland impacts. The results of these respective analyses and assessments identify areas to be monitored for potential wetland impacts as part of the monitoring plan that is expected to be implemented as part of the Section 404 permit conditions for the Project.

Potential indirect wetland impacts were assessed based on:

- Changes in wetland watershed areas (during operation and long-term closure);
- Groundwater drawdown resulting from open pit mine dewatering;
- Groundwater drawdown resulting from operation of the FTB including groundwater seepage containment;
- Changes in stream flow near the Mine Site and FTB and associated impacts to wetlands abutting the streams (during operation and long-term closure);
- Wetland fragmentation from Project elements such as open pits, stockpiles, haul roads, etc.; and
- Potential change in wetland water quality related to atmospheric deposition of dust and rail car spillage associated with Mine Site and FTB operations.

Each analysis in the above list was completed using the same set of wetlands that were not directly impacted (Section 5.1), therefore there are wetlands that may be potentially indirectly impacted by more than one type of assessed source (e.g., Wetland ID X may be impacted by fragmentation, change in watershed, and groundwater drawdown). Therefore, the potential indirect impacts for each wetland cannot be summed across the analysis as this may result in double-counting acres for a wetland.

The potential indirect wetland impact analysis was completed for the Mine Site Area, the FTB Area, the transportation corridors (railroad and Dunka Road), the Colby Lake Water Pipeline area, and the Second Creek area. Wetlands that were identified as directly impacted



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in Section 5.1 were excluded from this evaluation. No potential indirect impacts are identified within the Plant Site due to the lack of wetlands in this area, or in the HRF, because all wetlands in the HRF are directly impacted.

5.2.1 Mine Site Area

Wetlands were identified within 500-foot increments beginning at the edge of the mine pits and continuing out to a total of 10,000 feet (Large Figure 12). The area of evaluation only included wetlands within Area One (Large Figure 12) where wetland type information has been developed and it did not include wetlands identified as directly impacted (Section 5.1). In addition, wetlands in the Peter Mitchell open pit taconite mine and areas north of this mine were excluded from evaluation as described in Attachment A). Large Table 3 identifies each wetland within each of the 500-foot zones and Large Table 4 provides a summary of wetland types within each 500-foot increment.

5.2.1.1 Potential Indirect Impacts – Wetland Fragmentation

For remaining wetlands not directly impacted (Section 5.1), an estimate of potential indirect wetland impacts from wetland fragmentation by Project features (open pits, stockpiles, haul roads, etc.) was determined based on an analysis of the various factors that may contribute to potential fragmentation. Considerations for determining a wetland fragment impact included: wetland type, source of hydrology, size of remaining wetland, location in the current watershed, location in the future watershed, connectivity to other wetlands, and direction of flow in the area. Wetland fragments in the Mine Site are identified in Table 5-1.

Wetlands were determined to be fragmented and their associated remaining acreage included as a potential indirect wetland impact if they were small remnants of a directly impacted wetland located between Project features (e.g., in the area between the Category 1 Waste Rock Stockpile and the West Pit).

Approximately 26.4 acres of wetland fragments were identified in the Mine Site (Table 5-1). The majority of the wetland fragments in the Mine Site consist of coniferous bog (79%), followed by alder thicket (14%), coniferous swamp (7%), and sedge meadow (less than 1%).

Table 5-1 Fragmented Wetlands in the Mine Site

Wetland ID	Eggers and Reed Wetland Community	Total Wetland Size (acres)	Direct Impact (acres)	Potential Indirect Impact (acres)
20	Sedge meadow	17.06	16.96	0.10
32	Coniferous bog	73.36	70.99	2.37
45	Alder thicket	37.55	28.83	3.58
48	Coniferous bog	89.16	27.8	1.86
51	Alder thicket	7.47	7.45	0.02
52	Alder thicket	3.88	3.88	<0.01
55	Alder thicket	3.91	3.85	0.06
57	Coniferous swamp	78.06	50.49	1.41
68	Coniferous swamp	23.81	10.89	0.09
77	Coniferous bog	13.01	0.92	<0.01
80	Coniferous bog	0.29	0.22	0.08
81	Coniferous swamp	1.68	1.44	0.24
82	Coniferous bog	62.4	60.77	1.63
86	Coniferous bog	2.47	2.46	0.01
97	Coniferous bog	4.46	2.57	1.89
98	Coniferous bog	15.5	15.07	0.42
100	Coniferous bog	176.19	102.96	3.44
101	Coniferous bog	14.21	11.73	0.08
103	Coniferous bog	118.84	109.97	8.86
104	Coniferous bog	3.57	3.47	0.10
107	Coniferous bog	40.92	31.63	0.10
107A	Coniferous swamp	1.74	1.69	0.05
Total acres of wetland		789.54	566.04	26.39



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5.2.1.2 Potential Indirect Impacts – Change in Hydrology

5.2.1.2.1 Potential Indirect Impacts – Change in Hydrology due to Change in Watershed Area

Potential for indirect impacts to wetland acreage not directly impacted (Section 5.1) due to change in watershed area were assessed by evaluating the change in watershed area per acre of wetland. Watersheds were defined for each wetland within the Mine Site boundary as well as wetlands outside the Mine Site with watershed area that may be impacted by Project features. Wetland and watershed areas were determined for the following conditions: existing conditions, during operations when the maximum amount of watershed has been removed (i.e., maximum Project extent), and at long-term closure. The analysis was completed using the following steps:

- The watershed area is defined as the sum of the upland area and the wetland area within each watershed. For each wetland in the Mine Site Area, GIS was used to determine the upland area (acres) and wetland area (acres) within each watershed area (acres). Using these acreages, the percentage of a wetland within its watershed was calculated.
- The tributary acres per wetland acre were determined as a proportion of the watershed area (acres) to the wetland area (acres).
- The equivalent watershed yield (acre-feet/year (ac-ft/yr)) was determined for the existing, maximum operational extent, and long-term closure conditions. The average net precipitation rate is 11.77 inches/year, as calculated using the Partridge River streamflow data (Reference (15)). This rate was applied to each watershed to convert the tributary ratio in Step 2 to an equivalent flow (expressed as ac-ft/yr per acre of wetland) and an equivalent yield (expressed as inches/year).
- The change in the equivalent yield (inches/year) estimated over the life of the Project was evaluated relative to existing conditions equivalent yield to calculate a maximum percent change in yield. The change was compared to the range in observed yield estimated from USGS flow data of the Partridge River watershed for the historical period 1978-1988 (USGS gage 04015475).

The existing conditions include the wetlands which represent the existing, relatively undisturbed conditions in the Mine Site Area. Large Table 5 identifies the acreage for each wetland and its associated watershed for the existing conditions. This analysis includes wetlands and associated watersheds that are partially or completely within the Mine Site boundary. There is a total of 3,325 acres of wetlands within 6,287 acres of watershed; this results in about 53% of the analysis area covered by wetlands.

During operations, some watershed areas may be directly impacted by the Project and will no longer be considered as a tributary area to the wetland. Additionally, wetland areas may be



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directly impacted by the Project. As a result, the amount of water potentially contributed by the watershed to support the hydrology of the remaining wetlands may also change. Large Table 5 identifies the acreage for each wetland and its associated watershed for the operational conditions.

There were 20 wetlands that show an increase or decrease of greater than 20% equivalent yield which were identified as potentially indirectly impacted¹. Ombrotrophic coniferous bogs and open bogs, identified in Large Table 5 were not included in the total wetland acreage because their hydrology is supported by precipitation and not dependent on the size of the watershed. There are 11 wetlands (totaling approximately 35 acres) that have the potential to experience an increase in yield per wetland acre of greater than 20% and 9 wetlands (totaling approximately 15 acres) that may experience a decrease in yield per wetland acre in excess of 20% (Large Table 5; Large Figure 13).

The 49.39 acres of potentially indirectly impacted wetland types include alder thicket (52%), coniferous swamp (34%), minerotrophic coniferous bog (8%), shallow marsh (6%), and sedge meadow (less than 1%).

During reclamation, a portion of the wetlands and wetland watersheds within the Mine Site will be restored to the existing condition. Large Table 5 identifies the acreage for each wetland and its associated watershed for the long-term closure conditions.

5.2.1.2.2 Potential Indirect Impacts – Changes in Hydrology – due to Drawdown

Suggested guidelines for potential wetland indirect impact zones resulting from changes in hydrology associated with the proposed mine development were provided by John Adams, ERM on February 26, 2011 (Reference (16)). Those suggested guidelines were supported by a 2009 position paper by the MDNR (Reference (17)), which provided a scientific analysis and analog data from other sites along the Mesabi Iron Range. The suggested potential impact zones were modified slightly by the Wetland IAP Group and the modified potential impact zones are referenced in Attachment A. The use of the potential impact zones referenced in Attachment A, as supported by the analog information referenced above, is a reasonable approach to estimating potential indirect wetland impacts resulting from hydrologic effects but is likely to overestimate the potential wetland impacts.

¹ The +/-20% threshold was used to assess impacts to wetland hydrology based on the direction of the Co-Lead Agencies to use this threshold to assess hydrologic changes to surface water resources downstream of the project, including streamflow. The +/-20% threshold, as used for streams, is referenced in the USEPA's proposed determination on the Pebble Mine in Alaska; that document states: "A compilation of research from around the world indicates that, regardless of geographic location, daily streamflow alterations of greater than 20% can cause major changes in the structure and function of streams (Reference (46))."



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Analog Data

This section discusses the justification for the use of the analog data (Reference (16)) “based upon comparisons of the existing regional and site-specific geologic data (such as bedrock faults, bedrock joint systems, bedrock topography, glacial till hydraulic conductivities, etc.), site-specific engineering controls such as the Category 1 Waste Rock Stockpile Groundwater Seepage Containment System, and the geologic settings of the analog information sites and the Mine Site” per Attachment A.

The analog data was used in place of a numerical model such as MODFLOW, which cannot practically be used to estimate potential indirect wetland impacts at the Mine Site, due to the complex mix of fractured bedrock, glacial deposits, and wetland soils at the Mine Site (Reference (17)) and therefore cannot be used to accurately assess the potential indirect impacts of pit dewatering on wetlands. As stated in Reference (17), previous versions of the MODFLOW model assumed that homogenous vertical and horizontal hydraulic conductivities were present within each model unit (i.e., bedrock, glacial deposits, and wetland soils), which is not the case at the Mine Site. Since the Adams and Liljegren position paper (Reference (17)) was issued, the MODFLOW model calibration was updated and the surficial deposits are represented as heterogeneous in the horizontal direction (Attachment B of Reference (15)). Despite the addition of heterogeneity to the MODFLOW model, the purpose of the model is to provide estimates of groundwater inflow rates to the pits. The model is not intended to represent the complex, localized heterogeneity that will likely exert a significant influence on whether potential indirect wetland impacts will occur.

The hydraulic properties of the bedrock and surficial deposits have been estimated at the Mine Site by a variety of methods, including conducting aquifer tests and using grain-size distribution data from soil borings. The range of hydraulic conductivities are as follows:

- Based on aquifer tests, the hydraulic conductivity of the unconsolidated deposits range from 0.012 to 31 feet/day (Reference (15)). Analysis of grain-size distribution data yielded a range of hydraulic conductivity estimates from 2 to 167 feet/day (Attachment B of Reference (15)).
- The hydraulic conductivity of bedrock of the Duluth Complex ranges from 0.00026 to 0.041 feet/day as measured by single well tests conducted in boreholes (Reference (15)).
- The hydraulic conductivity of bedrock of the Virginia Formation ranges from 0.0024 to 1.0 feet/day as measured by conducting four pumping tests (Reference (15)).
- Undecomposed, surface peat soils have hydraulic conductivities of up to several feet per day (Reference (17)).
- Deep, more decomposed peat layers have hydraulic conductivities on the order of 0.0028 feet/day (Reference (17)).



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Because there is such a wide range in hydraulic conductivity within the natural geologic formations at the Mine Site, each model layer would contain widely variable hydraulic conductivities. Therefore, it is not realistic to model the expected effects of mine dewatering on wetlands in a meaningful fashion.

The Canisteo Pit analog site provides a clear example of how MODFLOW modeling cannot be expected to accurately estimate conditions in areas with highly variable, complex geology. In the Canisteo Pit modeling effort, the difference between simulated and measured water levels ranged from +28 feet to -4 feet and clearly could not accurately estimate water level changes of a few feet or less as would be necessary for estimating wetland impacts resulting from hydrologic changes (Reference (17)).

The low hydraulic conductivities result in most water movement in peat wetlands occurring horizontally in the upper layers of peat. The deeper, more decomposed peat soils limit vertical seepage because of the low hydraulic conductivities (~0.0028 feet/day) (Reference (17)). Increased vertical seepage will not be induced by the lowering of groundwater below such a peat layer, the wetland hydrology is simply perched on the impermeable peat layer as in many perched wetlands with no underlying groundwater. Therefore, hydrologic impacts to peat wetlands have only been observed to occur within 1,000 feet from the edge of the mine pits.

Vertical seepage losses from wetlands without peat soils will only have the potential to occur in isolated areas of contiguous, high hydraulic conductivity bedrock faults and fracture zones located under isolated areas of high hydraulic conductivity glacial till and aligned with wetlands containing high hydraulic conductivity soils. The probability of these three features aligning on a broad scale is extremely low (Reference (17)).

The geologic and hydrogeologic settings of the Mine Site and the analog sites are relatively similar with a thin veneer of heterogeneous unconsolidated deposits underlain by fractured bedrock. The hydraulic conductivity of the unconsolidated deposits and bedrock are lower at the Mine Site than at the analog sites, so it is expected that the stated impact zones will likely overestimate the extent of potential wetland impacts (Attachment A). In addition, due to the thin, discontinuous nature of the surficial deposits at the Mine Site, drawdown effects are expected to be more localized at the Mine Site than at the analog sites. The numerous bedrock outcrops present at the Mine Site are also expected to act as barriers to flow in the unconsolidated aquifer, thereby limiting the area of influence of the pit. The analog sites have fewer or no bedrock outcrops compared to the Mine Site. Finally, the presence of the Partridge River approximately 4,000-6,000 feet south (downstream) of the mine pits, is likely to act as a natural barrier to the expansion of the cone of depression within the surficial aquifer in the zone from 3,500-10,000 feet from the pit.

Prior to conducting the analysis to identify potential indirect wetland impacts resulting from changes in hydrology, bog wetlands within and surrounding the Mine Site were reclassified as either ombrotrophic or minerotrophic consistent with the November 2011, USACE Memorandum (Reference (18)). For purposes of addressing potential indirect impacts for the



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Project, the Wetlands Workgroup recommended that wetlands identified as open bog or coniferous bog, using the Eggers and Reed (Reference (13)) classification system, should be subcategorized as either ombrotrophic or somewhat minerotrophic. This is important because ombrotrophic bogs would likely not be impacted by groundwater drawdown associated with dewatering during the Project, whereas more minerotrophic bogs would have a higher likelihood of being impacted (Reference (18)). Using a conservative approach for the analysis (i.e., one that errs on the side of estimating greater wetland impacts), all bog communities within 0-1,000 feet from the edge of the mine pits were categorized as Low Likelihood of wetland hydrology impact.

Wetlands are identified within four analog impact zones located within 0-1,000 feet, >1,000-2,000 feet, >2,000-3,500 feet, and >3,500-10,000 feet from the edge of the mine pits within Area One (Large Figure 14). Based on Attachment A, wetlands that are located within multiple analog impact zones are included in the analog impact zone that is closest to the edge of the mine pits. The likelihood of wetland hydrology impact is categorized as High, Medium, Low, and No Impact within the analog impact zones. The acreage of each wetland type within these potential impact zones is summarized in Large Table 6 and locations are shown in Attachment B, Large Figures B-1 to B5. Using this analysis, there are 1,328 acres of wetlands in the 0-1,000 foot zone (Large Figure B-2), 619 acres in the >1,000-2,000 foot zone (Large Figure B-3), 1,162 acres of wetlands in the >2,000-3,500 foot zone (Large Figure B-4), and 2,718 acres of wetlands in the >3,500-10,000 foot zone (Large Figure B-5) beyond the edge of the pits.

Large Figure B-5 shows the 5,827 acres of wetlands within these zones, with the likelihood of wetland hydrology impact categorized as: No Impact - 3,679 acres of wetlands (63%); Low Likelihood - 750 acres of wetlands (13%); Moderate Likelihood - 531 acres of wetlands (9%); and High Likelihood - 867 acres of wetlands (15%) (Large Table 6). Within 0-10,000 feet from the edge of the mine pits, wetland types with a High Likelihood of wetland hydrology impact include alder thicket (848 acres), coniferous swamp (19 acres), and sedge/wet meadow (less than 1 acre); with a Moderate Likelihood include alder thicket or shrub-carr (327 acres), coniferous swamp (195 acres), deep marsh (5 acres), shallow marsh (3 acres), and hardwood swamp (less than 1 acre); and with a Low Likelihood include coniferous swamp (223 acres), coniferous bog (453 acres), alder thicket or shrub-carr (68 acres), shallow marsh (4 acres), sedge/wet meadow (2 acres), and hardwood swamp (less than 1 acre).

The wetlands categorized as High Likelihood are dominated by one alder thicket (824 acres; wetland ID 53D) that has approximately 4 acres (less than 1%) within the 0-1,000 foot analog impact zone. The remainder of this wetland (more than 99%) is located more than 1,000 feet away from the edge of the mine pits and extends out to the edge of Area One (Large Figure B-1). Based on the analog data, hydrologic impacts to peat wetlands are only observed to occur within 1,000 feet from the edge of the mine pits. Therefore, wetlands were categorized within the analog impact zones using an alternate method to determine the likelihood of wetland hydrology impact. For this method, wetlands that are located within



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multiple analog impact zones are split along zone edges and acreage is calculated by zone. As a result, the acreage for wetlands crossing zone edges is split among multiple zones, rather than included in the analog impact zone that is closest to the edge of the mine pits (Attachment B, Large Figures B-1 through B5). The acreage of each wetland type within these potential impact zones is summarized in Large Table 7 and locations are shown in Attachment B, Large Figures B-6 through B10. Using this analysis, there are 234 acres of wetlands in the 0-1,000 feet zone (Large Figure B-7), 311 acres in the >1,000-2,000 feet zone (Large Figure B-8), 718 acres of wetlands in the >2,000-3,500 feet zone (Large Figure B-9), and 4,564 acres of wetlands in the >3,500-10,000 feet zone (Large Figure B-10).

Large Figure B-10 shows the 5,827 acres of wetlands within these zones, with the likelihood of wetland hydrology impact categorized as: No Impact - 5,094 acres of wetlands (87%); Low Likelihood - 568 acres of wetlands (10%); Moderate Likelihood - 119 acres of wetlands (2%); and High Likelihood - 46 acres of wetlands (1%) (Large Table 7). Within 0-10,000 feet from the edge of the Mine Pits, wetland types with a High Likelihood of wetland hydrology impact include alder thicket (27 acres), coniferous swamp (19 acres), and sedge/wet meadows (less than 1 acre); with a Moderate Likelihood include alder thicket and shrub-carr (96 acres), coniferous swamp (14 acres), deep marsh (5 acres), shallow marsh (3 acres), and hardwood swamp (less than 1 acre); and Low Likelihood include alder thicket and shrub-carr (247 acres), coniferous swamp (135 acres), coniferous bog (179 acres), shallow marsh (4 acres), sedge/wet meadow (2 acres), and hardwood swamp (1 acre).

Qualitative Discussion

This section includes the general discussion regarding potential indirect wetland impacts that might occur based on hypothetical hydrologic drawdown levels using the hydrologic wetland sensitivity method as described in Attachment A. The potential indirect wetland impacts may include: conversion to other wetland community types, a change in vegetation without a change in community type, conversion to uplands, or other impacts.

Three categories of hydrologic wetland sensitivity, each with associated groundwater drawdown levels for each wetland community type, were defined as follows:

- **None-to-Slight:** Water level changes in which impact on the community will be slight to none with the potential for slight changes in abundance of various species but no change in species present. Monitoring or mitigation not anticipated.
- **Moderate:** Water level changes that may have a moderate impact on the wetland community with the potential for the loss and addition of some species. Monitoring recommended with mitigation based on monitoring results.
- **Severe:** Water level changes expected to result in severe impacts on the community with the potential for considerable loss of characteristic plant species and invasion by other species, conversion of wetland type or conversion to upland. Monitoring should



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be conducted and mitigation may be required. According to the hydrologic wetland sensitivity method, wetlands in which groundwater is not the principal source of water and in which mitigation of surface water is planned (e.g., streamflow augmentation) should be excluded from this category.

The wetland community sensitivity and estimating of changes to wetland communities as a result of groundwater drawdown for the hydrologic wetland sensitivity method were determined based on evaluating the vegetation characteristics of numerous Minnesota wetlands contained in the MDNR Natural Heritage Information System (NHIS) database (Attachment A). That data was used to develop an ordination, which groups wetlands within the various native plant community system groups (Reference (19)) reflecting differences in the degree of wetness of each community. However, the degree of wetness and the source of wetness information were not well-documented so it is unclear if the wetness parameter is related to persistence of wetness throughout the growing season, the typical maximum depth of water within the wetland, or some other wetness characteristic.

That ordination was then used to estimate how wetland communities will respond to decreasing water levels, with the main assumption that wetlands will move to the drier part of the ordination. The three categories of potential impact to the wetland communities were defined as None-to-Slight, Moderate, or Severe. The method states that the changes in the wetland communities associated with the Severe category are less valid for estimating vegetation changes than wetland communities included in the Moderate or None-to-Slight categories (Attachment A). Therefore, the hydrologic wetland sensitivity method simply estimated how wetland communities will respond to groundwater drawdown by assuming that they will change to drier native plant communities or variants of the original community. No data or research was utilized from actual wetlands responding to groundwater drawdown so this analysis and related data should only be used as an initial estimate of what changes might be expected should groundwater levels actually fall as a result of the proposed mining activities. Monitoring of hydrology and vegetation within potentially impacted wetlands represents the best method for documenting actual community changes resulting from hydrology changes, understanding complex hydrologic conditions, and identifying potential future indirect impacts related from mine features.

The preliminary information developed for the hydrologic wetland sensitivity method was utilized to estimate what type of wetland impacts might occur at the Mine Site assuming various, theoretical groundwater drawdown levels. Large Table 8 provides a summary of the estimated wetland community changes using the groundwater drawdown thresholds for each wetland type as indicated in the hydrologic wetland sensitivity method (Attachment A). The hydrologic wetland sensitivity method did not evaluate shallow marsh, deep marsh, or shallow open water communities, so the groundwater breaks and estimated community changes were developed based on past experience and professional judgment.

5.2.1.2.3 Quantification of Potential Indirect Impacts due to Change in Hydrology

Large Table 8 shows that for minor groundwater drawdown, ranging from 0.5 feet to 2 feet for the various wetland communities, no substantial wetland community changes are identified. In the moderate impact sensitivity category with water level changes ranging from 0.5 feet to 4 feet, some changes to vegetation are possible in all wetland communities with marshes, open water, and meadow communities potentially resulting in conversion of wetland type and increased shrub and tree growth in shrub and forested wetlands. In the severe impact sensitivity category, nearly all wetland community types are estimated to convert to other wetland types with a few wetlands estimated to convert to upland, including meadow wetlands and possibly hardwood swamps. Monitoring to document impacts to wetlands is recommended for all potential impacts in the moderate and severe impact categories.

Because groundwater modeling cannot reasonably estimate potential indirect wetland impacts, Attachment A concluded that analog impact zones can provide a reasonable estimate of the areal extent of potential indirect wetland impacts resulting from hydrologic effects. In addition, the evaluation of theoretical groundwater drawdown levels can help estimate what types of potential indirect wetland impacts might occur. However, wetland hydrology is a complex mix of precipitation, surface runoff, and in some cases, groundwater. The response of complex natural systems to human disturbances can only be estimated. Therefore, monitoring of wetland hydrology and vegetation communities is the best way to document the extent and magnitude of wetland responses (potential indirect impacts) to human disturbances.

5.2.1.3 Potential Indirect Impacts – Wetlands Abutting the Partridge River

Wetlands abutting the Partridge River within Area One (Large Figure 3) are identified by wetland ID, wetland type using the Eggers and Reed (Reference (13)) wetland community types, and acreage in Table 5-2. There are approximately 1,478 acres of wetlands which include alder thicket or shrub-carr (86% of total acres), coniferous bog (13% of total acres), and shallow marsh (1% of total acres).

Table 5-2 Wetlands Abutting the Partridge River

Wetland ID	Eggers and Reed Wetland Community	Wetland Size (acres)
53D	Alder thicket	885.97
315	Alder thicket or Shrub-carr	322.84
678	Alder thicket	58.42
691	Alder thicket	6.23
708	Shallow marsh	3.92



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Wetland ID	Eggers and Reed Wetland Community	Wetland Size (acres)
709	Shallow marsh	8.14
888	Coniferous bog	192.96
Total acres of wetland		1,478.48

The XP-SWMM model identified that the changes in average annual flow (and therefore stage) of the Partridge River will be within the naturally occurring annual variation for the Partridge River (Reference (15)). Therefore, no potential indirect wetland impacts are identified for the wetlands abutting the Partridge River.

5.2.1.4 Potential Indirect Impacts – Water Quality Changes

5.2.1.4.1 Fugitive Dust / Metals and Sulfide Dust Emissions

As described in Attachment A, a screening analysis was conducted that estimated potential annual deposition of dust, metals, and sulfur to wetlands within and adjacent to the proposed Mine Site and the FTB, respectively, from fugitive dust emissions. Note that this section discusses only the Mine Site and the FTB, unlike other subsections of 5.2.1. Emission rates and particle size distributions were based on total particulate matter. The estimated deposition from fugitive dust emissions is then used to identify those wetlands that have the potential for water quality changes (e.g., potential for water chemistry changes related to sulfide dust deposition).

The potential additions of dust, metals, and sulfur to wetlands from fugitive dust emissions at the Mine Site and the FTB were estimated using air dispersion/deposition modeling. The estimated inputs of the dust, metals, and sulfur to wetlands were evaluated for significance to potential changes in water quality. Specific components of the analysis identified in Attachment A are summarized below.

Sources of Fugitive Dust and Estimated Air Emissions

Sources of dust to be modeled at the Mine Site and at the FTB are identified in Table 5-3 and include the sources specified in Attachment A. One model run was conducted for each area – the Mine Site and the FTB. Each respective model run provided an estimate of potential dust deposition from a number of general fugitive dust sources. The source grouping function within the AERMOD model was used to identify the different sources of metals and sulfur.

Table 5-3 Emission Sources Modeled in the Assessment of Potential Indirect Wetland Impacts Related to Deposition of Dust, Metals, and Sulfur

Fugitive Dust Source⁽¹⁾	Mine Site Modeling for Dust	Mine Site Modeling for Metals and Sulfur	FTB Modeling for Dust	FTB Modeling for Metals and Sulfur
Overburden and other construction rock screening and/or crushing	Included	Excluded	n/a	n/a
Loading/unloading of tailings from the former LTVSMC operations and construction of dams	n/a	n/a	Included	Included
Dust generation from traffic on unpaved roads at the ground surface (not in mine pits)				
<ul style="list-style-type: none"> Roads made of general construction material Roads made of LTVSMC Tailings 	Included n/a	Excluded n/a	Included Included	Excluded n/a ⁽⁴⁾
Handling activities associated with ore and waste rock outside of the pits, includes truck loading and unloading outside of the pits. Activities related to:	Included	Included	n/a	n/a
<ul style="list-style-type: none"> Category 1 waste rock stockpile Category 2/3 waste rock stockpile Category 4 waste rock stockpile 	Included Included Included	Excluded Included Included	n/a n/a n/a	n/a n/a n/a
Rail car loading (RTH (ore))	Included	Included	n/a	n/a
Rock handling and roads within the pits ⁽²⁾	Excluded	Excluded	n/a	n/a
Wind erosion				
<ul style="list-style-type: none"> From stockpiles⁽³⁾ From beaches consisting of Flotation Tailings From dams constructed of LTVSMC tailings 	Excluded n/a n/a	Excluded n/a n/a	n/a Included Included	n/a Included Included

n/a = not applicable

(1) sources as identified in Attachment A

(2) Fugitive dust sources excluded from the analysis per Attachment A include rock handling and roads within the pits as these emissions are expected to be trapped within the respective pits and have minimal contribution to estimated air concentrations.

(3) The potential for wind erosion from the stockpiles was evaluated as part of the air emissions inventory and it was determined that wind erosion will not occur through the use of USEPA approved wind erosion calculations procedures in Section 13.2.5 of Reference (20).

(4) General road construction material assumed to be laid over the top of the LTVSMC tailings.



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Potential fugitive dust emissions from the specified sources were calculated based on the following information:

- Particulate matter as Total Particulate Matter (TPM); particles smaller than about 20 to 50 μm (microns) in aerodynamic diameter.
- Current Mine Site layout; Mine Year 8 and Mine Year 13.
- Expected operations at the FTB (e.g., dam construction, wind erosion)

At the Mine Site, the material handling emissions occurring on the stockpiles and at the RTH were modeled as surface-based volume sources. The stockpile volume source dimensions were based on a typical haul truck height of 30 feet and a dumping zone side length of 197 feet, similar to the particulate emissions modeling conducted for Class II areas (Reference (21)).

The RTH volume source parameters were also identical to the parameters used in the particulate modeling conducted for Class II areas (Reference (21)).

For the Class II modeling for the Mine Site (Reference (21)), the maximum emissions were identified to occur in Mine Year 8 and Mine Year 13. Emissions from both years were modeled for this assessment.

For the FTB, the emissions and modeling were based in part on the assumption that non-reactive road construction material will be used to construct a roadbed on top of the LTVSMC tailings and that haul trucks will not be travelling on roads made from LTVSMC tailings.

Modeling with AERMOD in Deposition Mode

Modeling was conducted with the AERMOD model (version 12060) in deposition mode with plume wet and dry depletion to estimate annual particle deposition. Surface meteorological data used in the modeling are for Hibbing, Minnesota (2006-2010) and upper air meteorology from International Falls, Minnesota. Meteorological data were processed using AERMET (version 11059). See Class II Modeling Protocol (Reference (21)). Each year of meteorological data was modeled individually and the highest estimated dust deposition rate for each receptor node was brought forward into the mapping of deposition isopleths.

Deposition modeling with AERMOD requires inputs for particle size, particle density, and mass fraction within each particle size category. The modeling for this assessment used one particle size (30 microns) and a particle density of 2.7 grams per cubic centimeter (g/cm^3), which is consistent with inputs used for Class II air modeling.



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Receptors

The receptors of interest for this analysis are the wetlands that are not identified as directly impacted (Section 5.1). The respective initial receptor grids for the Mine Site and FTB were set up with near-field and far-field spacing. For the Mine Site, the near-field receptor spacing was 250 meters (within the ambient air boundary and out to 1,000 meters beyond the ambient air boundary). The far-field receptor spacing was 1,000 meters (from 1 kilometer out to 5 kilometers from the ambient air boundary). For the FTB, the near-field receptor spacing was 250 meters within the ambient air boundary. The far-field receptor spacing was 1,000 meters from the ambient air boundary out to 5 kilometers.

At both the Mine Site and the FTB, the fine grid (i.e., near-field grid) receptor spacing of 250 meters generally had at least one receptor being located over the wetlands within the property boundary and out to 1 kilometer beyond the property boundary (Large Figure 15 and Large Figure 16). However, for the area encompassed by the fine grid, a visual check was made using GIS mapping tools to ensure that wetland areas encompassed by the fine grid had at least one receptor within their boundaries. Additional receptors were then included in the grid such that at least one receptor node was specifically located within the area of each wetland. For the coarse grid (i.e., far-field grid), the specific assignment of a receptor to a wetland area was not done for either the Mine Site or the FTB Area. A visual review (again using GIS mapping) identified that most wetland areas for the coarse grid had a receptor within their respective boundaries or relatively close to them. In other words, the coarse grid receptor spacing of 1,000 meters provided good coverage of the wetland areas. In addition, initial modeling of dust deposition identified that deposition rates changed very little beyond about 1 kilometer from the ambient air boundary. Based on these two pieces of information, it was determined that for those wetland areas covered by the coarse grid that did not have a receptor within their respective area, the modeled deposition at the nearest receptor would be used.

Dust Deposition and Speciation to Individual Metals and Sulfur

For the general dust emission sources identified in Table 5-3, total particulate emissions on an annual basis were modeled for the Mine Site and the FTB, respectively. Each year of meteorological data (5 years in total) were modeled individually. The estimated annual dust deposition rate (grams per square meter; g/m²/yr) for each receptor node for each modeled year was then post-processed in a calculation spreadsheet to identify the highest estimated dust deposition rate for each receptor node.

For the dust emission sources identified for assessing potential metals and sulfur deposition at the Mine Site and the FTB, respectively, the highest estimated dust deposition rate for each receptor node was then speciated to the respective metal and sulfur deposition rates based on the contribution of the sources to a receptor node and the metal and sulfur composition identified for each contributing source (ore and waste rock at the Mine Site and tailings at the FTB). The estimated metal or sulfur deposition for each contributing dust



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source at a receptor node was then summed to provide a “total” deposition rate for each respective metal and for sulfur at that receptor location.

Dust deposition rates were speciated for the following metals: arsenic, cadmium, chromium, lead, manganese, nickel, and selenium (Attachment A). Copper and vanadium were added to the evaluation because background deposition estimates were provided in Reference (22). Attachment C provides the chemical composition of ore, waste rock and tailings used in the dust speciation. The maximum concentration for each metal and sulfur was used in the speciation calculations.

For both the Mine Site and the FTB, for each receptor node, the post-processing of the dust deposition rate by source contribution was then summed to provide a “total” metal deposition rate and a “total” sulfur deposition rate.

The speciation of the model-estimated dust deposition rate to the respective metal and sulfur deposition rates is slightly different from the approach identified in Attachment A; page 6 for the Mine Site; page 10 for the FTB) which identified that “... *the total particulate emission rates (grams per second) will be speciated and converted to metals and sulfur emission rates based on data on the chemical composition of each material generating dust. ...*”. However, with regard to estimating a potential deposition rate for the individual metals and sulfur, there is no difference in the two approaches.

Estimates of Rural Background Deposition

Estimates of rural background deposition rates for dust, metals and sulfur are provided in Table 5-4. The background dust deposition rate is based on an effects-level for vegetation (Reference (23), Reference (24)). Background metal deposition rates are estimated from monitoring data collected at a site near the shore of Lake Superior near Eagle Harbor, Michigan (Reference (22)). The background sulfur deposition rate is from data collected at the Fernberg Road Monitoring Site (National Atmospheric Deposition Program, NADP) near Ely, Minnesota (Reference (25)).

For dust, an annual effects-level deposition rate of 365 grams per square meter (g/m²/yr) is compared to modeled annual dust deposition rates. This deposition rate is a potential effects threshold for photosynthesis (i.e., potential for reduced photosynthesis due to “dusting” of the plant surface) (References (23), Reference (24)). However, for this analysis, the vegetative surface area of the wetlands is not calculated or included in the analysis. The modeled dust deposition rate is assumed to be applied to the land surface area which is a smaller area than the vegetative surface area. Vegetative surface area can be up to 13 times greater than the land surface area (Reference (26)). For example, the ratio of leaf area in a forest compared to the ground surface area ranges from 1.4 to 8.4 and for grasslands it can range from 2.5 to 6.3. By only assessing dust deposition to the land surface area instead of the vegetative surface area, it is likely the ratio of modeled deposition rate to the effects level is being overestimated. In other words, the modeled deposition rate is not being spread over the larger surface area of the vegetation which would reduce the effective deposition rate.

For example, for a minimally vegetated ground surface with a surface area of 1.4 m², the deposition of 365 g to the 1.4 m² of vegetation surface results in deposition rate of 261g/m². Because this application does not include the deposition of dust to the vegetative surface area, it is likely that the areas identified to exceed the effects threshold of 365 g/m²/yr has been overestimated.

For metals, background deposition is based on the data from Reference (22). Sweet et al. (Reference (22)) indicated that precipitation was under-collected by 45% to 70% when sample volumes were compared to corresponding rain gage amounts. Because wet deposition was considered to be underestimated, the wet deposition component was adjusted upward by a factor of 1.6 (see Attachment D for calculations). Table 5-4 presents the adjusted total deposition estimates.

Table 5-4 Estimated Background Deposition of Metals and Sulfur

Parameter	Background Deposition Rate (wet + dry)	Units ⁽¹⁾	Comments
Arsenic ⁽⁴⁾	216	µg/m ² /yr	Wet deposition adjusted by a factor of 1.6. Attachment D.
Cadmium ⁽⁴⁾	505	µg/m ² /yr	Wet deposition adjusted by a factor of 1.6. Attachment D.
Chromium ⁽⁴⁾	255	µg/m ² /yr	Wet deposition adjusted by a factor of 1.6. Attachment D.
Copper ⁽⁴⁾	3,520	µg/m ² /yr	Wet deposition adjusted by a factor of 1.6. Attachment D.
Dust ^{(2),(3)}	365	g/m ² /yr	Dust from total particulate matter (TPM). A “no effects” deposition rate related to photosynthesis.
Lead ⁽⁴⁾	1,800	µg/m ² /yr	Wet deposition adjusted by a factor of 1.6. Attachment D.
Manganese ⁽⁴⁾	5,580	µg/m ² /yr	Wet deposition adjusted by a factor of 1.6. Attachment D.
Nickel ⁽⁴⁾	938	µg/m ² /yr	Wet deposition adjusted by a factor of 1.6. Attachment D.
Selenium ⁽⁴⁾	572	µg/m ² /yr	Selenium deposition as reported in Reference (24).



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Parameter	Background Deposition Rate (wet + dry)	Units ⁽¹⁾	Comments
Sulfur ^{(5),(6)}	0.16	g/m ² /yr	Wet deposition estimated from 2007-2011 NADP data (Reference (25)); dry deposition estimated to be 22% of total deposition based on recent estimates from Voyageurs National Park and from Reference (26)).
Vanadium ⁽⁴⁾	385	µg/m ² /yr	Wet deposition adjusted by a factor of 1.6. Attachment D.
Zinc ⁽⁴⁾	10,900	µg/m ² /yr	Wet deposition adjusted by a factor of 1.6. Attachment D.

(1) Units are µg/m²/yr = microgram per square meter per year or g/m²/yr = grams per square meter per year

(2) Reference (23)

(3) Reference (24)

(4) Reference (22)

(5) Reference (25)

(6) Reference (26)

Total background sulfur deposition includes both wet and dry deposition. Background wet deposition rates of sulfate are available from the NADP. The NADP maintains a network of monitors throughout the United States to measure wet deposition and includes several monitors in northeastern Minnesota. The closest monitoring site to Hoyt Lakes is the “Fernberg” site (ID: MN18) near Ely, Minnesota. The average annual wet deposition rate of sulfate over the past five years (2007-2011) at the Fernberg site was estimated (3.75 kg/ha), then converted to sulfur (sulfur is 33% of the sulfate; 1.25 kg/ha), and used as the background estimate for the wet deposition rate.

The Clean Air Status and Trends Network (CASTNET) operates a similar monitoring network for dry deposition and coordinates some sites with the NADP, however, this network does not have a site near Ely. The closest CASTNET site to Hoyt Lakes is in Voyageurs National Park near Sullivan Bay. Dry deposition monitored at this site in Voyageurs National Park indicates that dry sulfur deposition is approximately 19% of total (wet+dry) deposition. A 1991-1993 study (Reference (26)) estimated the percentage of dry deposition to total (wet + dry) deposition for various monitoring sites in Minnesota, including the Fernberg site near Ely (22.2%). This percentage of dry sulfur deposition to total (wet + dry) sulfur deposition (22%; average of three years) was used to estimate a total (wet + dry) background deposition of sulfur in the Hoyt Lakes area.

The calculation for background deposition in g/m²/year, the deposition units in AERMOD, is as follows:



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- average wet deposition of sulfate at NADP monitoring station MN18 = 3.75 kg/ha/yr
- sulfur as a percent of sulfate (SO₄) = molecular weight of 32 / molecular weight of 96 = 33%
- sulfur content of wet sulfate deposition = 3.75 kg/ha x 0.33 = 1.25 kg/ha/yr
- percentage of dry deposition to total (wet + dry) sulfur deposition at Ely = 22.2%
- total (wet + dry) deposition of sulfur = wet deposition/(100 - % dry)/100 = 1.6 kg/ha/yr
- total background deposition of sulfur = 0.16 g/m²/yr

The estimated background deposition for metals and sulfur is from data collected at sites characterized as open areas in rural settings that are reasonably distant from industrial sources and population centers. Reference (27) identifies that for forested areas, dry deposition may be underestimated. Vegetation can effectively scavenge fine particles and aerosols from the atmosphere and this interception can result in dry deposition being 50% or more of the total deposition. As noted for the Fernberg Road monitoring site, dry deposition is assumed to be 22% of total deposition. It is possible that the background sulfur deposition estimated for this analysis may be low due to an underestimation of dry deposition. However, no adjustments were made to the background sulfur deposition estimated for this analysis.

Significance Levels for Estimating the Potential Effects

For dust, metals, and sulfur, the following breakpoints are used for assessing the significance of a modeled deposition rate at a receptor node:

< 100% of background: no potential for effects expected

> 100% of the background value: potential for effects, include in future wetland monitoring

These are general categories of potential for effects. As this is a screening analysis to identify wetlands for potential inclusion in a monitoring program, there is some flexibility in identifying a potential level of deposition that suggests a potential for effect. Another consideration for selecting a deposition rate that is a high percent of the background rates is the likely overestimation of modeled deposition and the underestimation of background deposition. For example, with regard to model-estimated metal deposition, this screening evaluation used a maximum concentration from a range of possible values (see Attachment C for metal and sulfur concentrations) to speciate a maximum estimated dust deposition for a receptor node. Using a maximum metal concentration to speciate a maximum modeled deposition rate for each receptor node likely overestimates individual metal deposition. The underestimation of background metal deposition (i.e., wet deposition due to under-collection



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of precipitation) was identified in (Reference (22)). In addition, wet sulfate deposition may be underestimated as well because the NADP data for the Fernberg Road monitoring site (site MN18 in Reference (25)) indicates rainfall in the last 3 years is about 22% below the annual average. If sulfate deposition from 2007 and 2008 is used (both years approximately normal for precipitation amount), a background sulfur deposition rate of 0.23 g/m²/yr is calculated, about 44% higher than the background deposition used in this screening analysis. Also, Reference (27) identifies that for forested areas, dry deposition may be systematically underestimated due to sample collection and analysis methodology. It is possible that the background sulfur deposition estimated for this analysis may be low due to an underestimate of dry deposition.

Given the potential for overestimation of modeled deposition and underestimation of background deposition, and balancing the conservatism when their respective results are combined in this analysis, it seems reasonable to select the wetlands estimated to receive greater than 100% of background deposition (a potential doubling of the background deposition) for consideration in potential future monitoring.

Results (Modeled Deposition Rates Compared to Background Values)

Model results in the form of isopleths where model-estimated deposition exceeds background deposition (i.e., modeled deposition is greater than 100% of background deposition) are overlain on the wetlands. For this screening analysis, the maximum extent of potential for effects on the wetlands for dust are presented and then for metals and sulfur at the Mine Site and the FTB, respectively. The model results for the individual metals and sulfur are not presented here, only the maximum area having the potential for effects from one or more the dust constituents.

Dust Deposition

At the Mine Site, dust deposition is concentrated relatively close to the ore loading pocket near the southern portion of the ambient air boundary (Large Figure 17). All receptors have model-estimated dust deposition of 25% or less of the effects-level background of 365 g/m²/yr.

At the FTB, dust deposition is highest in three locations: southwest corner, northwest of the Plant Site; southeast corner; and the northeast corner, towards Area 5. All receptors have model-estimated dust deposition of 50% or less of the effects-level background of 365 g/m²/yr (Large Figure 18).

Overall, model-estimated dust deposition is largely constrained to within the respective ambient air boundaries at the Mine Site and at the FTB and model-estimated deposition is 50% or less of the effects-level background dust deposition.



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Metals and Sulfur Deposition

The highest model-estimated metal and sulfur deposition at the Mine Site are in two defined areas: 1) near the ore loading pocket; and 2) at the east end of the Category 2/3 Waste Rock Stockpile near the eastern portion of the ambient air boundary (Large Figure 19). All of the receptor nodes with the highest model-estimated deposition rates (deposition rates greater than 100% of background) are located within the ambient air boundary.

At the FTB, there are two locations showing model-estimated deposition rates greater than 100% of background deposition: 1) approximately the southern and western two-thirds of the basin; and 2) a small area on the northern and eastern portion of the ambient air boundary (Large Figure 20). Approximately 90% of the receptor nodes with the highest model-estimated deposition rates (rates greater than 100% of background deposition) are located within the ambient air boundary. The remaining 10% of the receptor nodes with the highest-modeled deposition are located to the south and east of the FTB outside of the ambient air boundary.

Summary and Conclusions

There are 19,914 acres of wetlands identified within the receptor grid at the Mine Site. The deposition modeling results indicates that 1.1% of the wetlands within the receptor grid area are identified for consideration in future monitoring. There are 234 acres of wetland potentially indirectly impacted (modeled metal deposition greater than 100% of background), with 228 acres (97%) of the wetlands located within the Mine Site ambient air boundary. Based on the modeling results, approximately 234 acres of wetlands in the Mine Site Area are identified for potential inclusion in future monitoring.

At the FTB, there are 25,846 acres of wetlands identified within the receptor grid. Wetland ID 1155 in the HRF Area, which is not subject to state and federal regulations (Section 5.1.6), and a deepwater pit area located south of the FTB were not included in the total wetland acreage. The deposition modeling results indicates that 0.7% of the wetlands within the receptor grid area are identified for consideration in future monitoring. There are 194 acres of wetland potentially indirectly impacted (modeled metal deposition greater than 100% of background), with 59 acres (31%) of the wetlands located within the FTB ambient air boundary. Based on the modeling results, approximately 194 acres of wetlands in the FTB Area are identified for potential inclusion in future monitoring.

The deposition modeling results for dust, metals and sulfur do not indicate or suggest a degree of impact or that adverse effects will be expected to occur. The modeling only indicates those areas that were estimated to have deposition rates greater than 100% of background deposition. These specific wetland areas are identified for consideration in any future monitoring to be conducted for the Project.



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5.2.1.4.2 Ore Spillage

See Section 5.2.3.2.1 for a discussion of potential indirect wetland impacts as related to ore spillage along the transportation corridors.

5.2.1.4.3 Leakage from Stockpiles/Mine Features and Seepage from Mine Pits

The stockpiles, mine pits, and other mine features (e.g., WWTF) are located within the Partridge River watershed. Water containing constituents generated in the waste rock stockpiles and mine pits has the potential to enter the shallow groundwater system via potential leakage from the liners (stockpiles and WWTF equalization basins) or seepage from the pits (Reference (15)). The leakage or seepage that enters groundwater will then be transported toward the Partridge River along groundwater flow paths. The Groundwater IAP process identified five such groundwater flow paths connecting the mine features to the Partridge River. These flow paths are being considered in the assessment of potential groundwater quality impacts (Reference (15)). The five flow paths are described in (Reference (15)) and include: East Pit – Category 2/3 flow path, Ore Surge Pile (OSP) flow path, WWTF flow path, Overburden Storage and Laydown Area (OSLA) flow path, and West Pit flow path. Because the water quality within these flow paths has the potential to change as a result of the Project, these same flow paths are considered in the assessment of potential indirect wetland impacts associated with leakage or seepage from mine features.

Wetlands within the groundwater flow paths were identified by wetland type using the Eggers and Reed (Reference (13)) wetland community types and acreage in Large Table 9. There are approximately 516 acres of wetlands, which include alder thicket or shrub-carr (56% of total acres), coniferous bog (33% of total acres), coniferous swamp (6% of total acres), open bog (2% of total acres), shallow marsh (2% of total acres), deep marsh (1% of total acres), and sedge/wet meadow (less than 1% of total acres).

Bog wetlands within and surrounding the Mine Site were reclassified as either ombrotrophic or minerotrophic consistent with the November 2011, USACE Memorandum (Large Table 10; Reference (18)). Other wetlands were classified as dominated by groundwater, although all wetlands receive precipitation and, as stated in Section 5.2.1.2.2, virtually all water movement in peat wetlands occurs horizontally in the upper layers of peat. Approximately 66% of the wetlands within the flow paths are classified as dominantly groundwater-fed while 34% of the wetlands are supported only by precipitation (Large Table 9).

The Partridge River currently represents the primary discharge location for shallow groundwater at the Mine Site. During operations, reclamation and long-term closure, groundwater in areas south of the mine pits will continue to discharge to the Partridge River while groundwater in areas north of the mine pits will discharge to the pits. The amount of groundwater discharge to surface water and wetlands between the mine features and the Partridge River is expected to be minimal relative to the amount of groundwater discharge to the Partridge River itself. Significant quantities of groundwater are not expected to discharge to the wetlands because of the very low hydraulic conductivities of the underlying peat



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layers, as cited in Section 5.2.1.2.2. In the water quality model, it is assumed that the leakage/seepage from mine features discharges to the Partridge River; there is assumed to be no groundwater discharge to surface water or wetlands along intermediate portions of the flow paths (Reference (15)). Therefore, the water quality model cannot be used to quantify the amount of leakage/seepage from mine features that discharges directly to individual wetlands. However, the water quality model can be used to provide a conservative estimate of the potential indirect wetlands impacts caused by water quality changes due to leakage/seepage from mine features. This approach and the resulting estimates are described in the following paragraphs.

The water quality model includes groundwater quality evaluation locations within the surficial aquifer and located along the Dunka Road for each of the groundwater flow paths. These evaluation locations are within the PolyMet property boundary, typically within close proximity of the mine features and are located up gradient of most of the groundwater-fed wetlands at the Mine Site. Thus, results of the water quality modeling within these flow paths can be used to evaluate groundwater quality that could flow to down gradient groundwater fed wetlands.

Water quality modeling results indicate groundwater quality along each flow path is likely to change from existing conditions. For this indirect wetland impact analysis, it is conservatively assumed that these changes may cause potential indirect impacts to the character, function, and quality of groundwater fed wetlands. Therefore this analysis also assumes that all down gradient groundwater-fed wetlands located within the five Mine Site surficial aquifer flow paths may have potential indirect wetland impacts related to water quality changes as a result off leakage/seepage from mine features.

The leakage/seepage rates associated the mine features are summarized in Table 5-5. Large Table 9 summarizes the wetland types within the flow paths with potential indirect wetland impacts resulting from mine feature leakage/seepage changes to water quality. Large Table 11 identifies wetlands within the flow path. Consistent with other potential indirect wetland impacts identified in this Data Package, the wetlands identified in Large Table 11 can be used to inform the development of a monitoring plan for potential future indirect impacts related water quality changes resulting from leakage/seepage from mine features.

Table 5-5 Leakage/Seepage Rates Associated with Mine Features

Mine Feature	Type of Flow	Maximum Rate ⁽¹⁾ (gpm)
East Pit – Category 2/3 Stockpile	Seepage from the Mine Pit	6.5
	Liner Leakage	0.13
OSP	Liner Leakage	0.0062
WWTF	Liner Leakage	0.030
OSLA	Infiltration	32
West Pit	Seepage from the Mine Pit	6.4

(1) Flows shown represent the maximum monthly rate at a 90% probability.

This analysis does not indicate or suggest that actual adverse effects will occur or that adverse effects are expected to occur. The analysis only indicates areas that can be conservatively assumed to have potential indirect impacts due to changes in groundwater quality. These specific wetland areas are identified for consideration in future monitoring to be conducted during facility operations.

5.2.1.5 Potential Indirect Impacts – Wildlife Utilization of Nearby Habitats from Project Noise

The following sections summarize the potential indirect impacts to wildlife utilization of nearby habitats from Project noise. As outlined in Attachment A, the following three steps were used in the potential indirect impact analysis: 1) potential sources and range of Project noise were identified; 2) potential wildlife species and habitat preferences within the area were identified; and 3) potential impacts to wildlife utilization of nearby habitats from Project noise were qualitatively assessed.

5.2.1.5.1 Potential Sources and Range of Project Noise

Existing ambient steady equivalent noise levels for most of the Mine Site are in the range of 35 to 45 decibels (dBA), which is a range comparable to secluded woods or a quiet bedroom (Reference (28)). The Peter Mitchell Mine, north of the Mine Site, and traffic along Dunka Road and the existing railway, along the south edge of the Mine Site, also contribute brief, episodic noise impacts.

The primary sources of Project noise from the Mine Site will be blasting, haul trucks, and train horns, with noise levels ranging from 89-115 dBA. Noise from equipment such as graders, bull dozers, and support trucks will be less dominant sources of noise, ranging from 75-95 dBA (Reference (29)). Blasting at the Mine Site is expected to occur once every two to three days. Typically, rock blasting generates a single event noise level ranging from 111-115 dBA at 50 feet from the blasting site (Table 5.5-7 of Reference (30)). Within most of the Mine Site, the sound from the blast will be similar to a loud clap of thunder.



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5.2.1.5.2 General Habitat Types

Vegetation within the Mine Site consists primarily of forested and shrub wetlands, older forested uplands dominated by black spruce and/or jack pine, young aspen stands, and recently logged areas dominated by aspen, ferns, and grasses. Upland areas are likely to be used more by wildlife than wetlands in the Mine Site as preferred habitat, likely because uplands offer more cover and browse during the winter than wetlands.

5.2.1.5.3 Wildlife Species Present

Common wildlife species utilizing the Mine Site include the following (Reference (31), Reference (32)):

- large mammals, including white-tailed deer (*Odocoileus virginianus*), black bear (*Ursus americanus*), moose (*Alces americanus*), gray wolf (*Canis lupus*), coyote (*Canis latrans*)
- intermediate mammals, including muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), red fox (*Vulpes vulpes*), grey fox (*Urocyon cinereoargenteus*) and woodchucks (*Marmota monax*)
- small mammals, including species of bats, squirrels, voles, and mice
- wetland birds, including ducks and other waterfowl, wading birds, and perching birds with specific wetland habitat preferences
- upland birds, including most perching birds, owls, turkey vultures (*Cathartes aura*), hawks, and other birds of prey
- reptiles and amphibians, including common turtles, frogs, snakes, and lizards
- a wide range of insect species in wetland, upland, and transitional habitats

The MDNR Comprehensive Wildlife Conservation Strategy lists 65 Species of Greatest Conservation Need (SGCN) in the combined Laurentian Uplands and Nashwauk Uplands Subsections, in which the Mine Site is located (Reference (33)). Large Table 12 lists the SGCN species, along with their specific preferred habitat types. Habitat preferences for the SGCN species were reviewed, and the species were sorted in Large Table 12 to separate those species which utilize only wetland habitat types, those species which utilize only upland habitat types, and those species which utilize both wetland and upland habitats.

Based on the preferred habitat utilization, there are ten SGCN species that utilize only wetland habitats and fourteen SGCN species that utilize only upland habitats. The remaining 42 SGCN species utilize both wetland and upland habitats. The wetland habitat types utilized by the most SGCN species are lowland coniferous forest (25 species) and lowland shrub (22 species).



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According to the MDNR NHIS database, the following three state-listed species (Reference (34)) have documented occurrences within ten miles of the Mine Site:

- gray wolf (*Canis lupus*), special concern
- bald eagle (*Haliaeetus leucocephalus*), special concern
- wood turtle (*Clemmys insculpta*), threatened

The wood turtle was found approximately 0.8 mile south of the Mine Site in 2004. The bald eagle may also be in the vicinity of the Mine Site, although the MDNR NHIS database has no records for bald eagle nests within 5 miles of the Mine Site. The bald eagle is no longer listed under the Endangered Species Act, but is protected under the Bald and Golden Eagle Protection Act. The habitat preferences for these three species are summarized in Large Table 12.

There are three federally listed species in St. Louis County; they include the Canada lynx (*Lynx canadensis*), a threatened mammal species; the gray wolf (*Canis lupus*), a threatened mammal species; and the piping plover (*Charadrius melodus*), an endangered wading bird species. Canada lynx may occasionally utilize the Mine Site (Reference (32)); however, there is no suitable habitat for piping plover at the Mine Site.

In addition to species listed under State and Federal endangered species acts, some wildlife species are also protected as Regional Forester Sensitive Species (RFSS) by the USFS (Reference (35)). The habitat preferences for these species are summarized in Large Table 12.

5.2.1.5.4 Potential Indirect Impacts to Wildlife Utilization of Nearby Habitats

The impacts of noise on wildlife are largely unknown and the assessment of impacts remains subjective (Reference (36)). Wildlife are receptive to different sound frequency spectrums, many of which may be inaudible to humans. Local wildlife are likely to be accustomed to the sound from mine activities currently found in the area. Noise from sources such as mine construction, mine and plant operations, and ore transport are sources of noise that will be relatively low-toned and constant, consistent with industrial fans, so it should present less annoyance than higher-pitched or variable tones of changing loudness (Reference (36)).

Some animals can adapt to predictable human activities, so if the activity generally occurs at predictable time periods at the same places or along the same routes, animals may become habituated to the activity (Reference (36)). Response of the animal depends on the context within which a human/animal encounter takes place, the behavioral state of the animal, the type of human activity, and the time and location of the activity.

Potential noise-related impacts to wildlife vary between species. The more common wildlife species (deer, small mammals, common birds) are habitat generalists with a relatively high tolerance of disturbance and human presence, and the noise generated by human activities.



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These species may temporarily abandon habitats immediately adjacent to the Mine Site at the onset of the Project, but would likely return to those habitats as they become habituated to the activity.

Wildlife species with more specific habitat needs, and/or those that are more sensitive to proximity to human activities may abandon habitats near the Mine Site and migrate to habitats further from the noise sources. The distances migrated from the Mine Site will vary depending on the sensitivity to noise of each species.

5.2.2 Flotation Tailings Basin (FTB) Area

Wetlands were identified within the 500-foot increments beginning at the FTB boundary and continuing out to a total of 30,000 feet (Large Figure 21). The area of evaluation included only wetlands within Area Two where wetland type information has been developed and it did not include wetlands identified as directly impacted (Section 5.1). Large Table 13 identifies each wetland within each of the 500-foot zones and Large Table 14 provides a summary of wetland types within each 500-foot increment.

5.2.2.1 Potential Indirect Impacts – Wetland Fragmentation

For remaining wetlands not directly impacted as discussed in Section 5.1, an estimate of potential indirect wetland impacts from wetland fragmentation by Project features (i.e., containment system) was determined based on an analysis of the various factors that may contribute to potential fragmentation. Wetland fragments in the FTB Area are identified in Table 5-6.

Approximately 0.5 acres of wetland fragments were identified in the FTB Area. The majority of wetland fragments consist of shallow marsh (61%), followed by deep marsh (35%), coniferous swamp (4%), and alder thicket (less than 0.01%).

Table 5-6 Fragmented Wetlands in the FTB Area

Wetland ID	Eggers and Reed Wetland Community	Total Wetland Size (acres)	Direct Impact (acres)	Potential Indirect Impact (acres)
272	Deep marsh	1.11	1.10	0.01
279	Alder thicket	4.84	3.33	<0.01
290	Coniferous swamp	0.48	0.22	0.02
307	Shallow marsh	0.78	0.77	<0.01
593	Deep marsh	9.80	8.47	0.15
595	Deep marsh	2.14	1.09	0.01
1134	Shallow marsh	14.45	8.71	0.04
1155	Shallow marsh	0.55	7.30 ⁽¹⁾	0.15
1156	Shallow marsh	14.49	11.08	0.06
1159	Shallow marsh	0.05	0.62 ⁽²⁾	0.05
Total acres of wetland		48.69	35.18	0.49

(1) Wetland 1155 is directly impacted by the HRF and FTB.

(2) Wetland 1159 is directly impacted by the HRF.

5.2.2.2 Potential Indirect Impacts – Changes in Hydrology

5.2.2.2.1 Wetlands within the FTB Surficial Groundwater Flow Paths

The three surficial aquifer groundwater flow paths are shown in Large Figure 22 and include Unnamed Creek (west flow path), Trimble Creek (northwest flow path), and Mud Lake Creek (north flow path) (Reference (37)). Large Figure 22 also includes several surface water model evaluation locations within these flow paths (e.g., PM-11) and the approximate locations of Project surface water discharges (e.g., SD006). Large Table 15 summarizes the wetland types within the flow paths with potential indirect wetland impacts resulting from changes in hydrology. Large Table 16 identifies wetlands within the flow paths and hydrology source. Consistent with other potential indirect wetland impacts identified in this Data Package, the wetlands identified in Large Table 16 can be used to inform the development of a monitoring plan for potential future indirect impacts related water quality changes resulting from leakage/seepage from mine features.

5.2.2.2.2 Seepage from the FTB

Seepage modeling from the FTB is described in detail in Reference (37). The following discussion is a summary of information regarding seepage that leaves the FTB via the west, northwest, and north flow paths. Seepage from the southern toe of the Tailings Basin, which forms the headwaters of Second Creek, is discussed in Section 5.2.4.



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The FTB Containment System, located along the northern and western sides of the Tailings Basin (Reference (37)) will collect approximately 90% of the seepage from the FTB to groundwater and 100% of the seepage from the FTB to surface water. The FTB Containment System located along a portion of the eastern side of the Tailings Basin will collect 100% of the seepage from the FTB (both groundwater and surface water). The seepage water to the west that bypasses the FTB Containment System is described in Reference (37). The seepage to the west is assumed to travel all the way to the Embarrass River via the west flow path. The seepage water to the northwest that bypasses the FTB Containment System is estimated to be about 6 gpm. The seepage to the northwest discharges to Trimble Creek at PM-19 via the northwest flow path. The seepage water to the north that bypasses the FTB Containment System is estimated to be about 4 gpm. The seepage to the north discharges to Mud Lake Creek at MLC-2 via the north flow path. The total amount of groundwater that is estimated to discharge to surface water from the west, northwest, and north flow paths is on average approximately 170 gpm, 85 gpm, and 70 gpm respectively. The total flow discharging to surface water is higher than the seepage flow entering groundwater because of the addition of recharge to the flow paths along the length of each flow path.

The aquifer capacity at the north, northwest, and west toes (which feed the north, northwest, and west flow paths respectively) is estimated to be 44 gpm, 55 gpm, and 110 gpm respectively. Under existing conditions, seepage from the Tailings Basin is in excess of the aquifer capacity at the toes of the Tailings Basin. Therefore, excess seepage that cannot be contained within the aquifer upwells to surface flow near the toes of the Tailings Basin and contributes flow to the nearby tributaries via surface runoff.

Under Project conditions, the FTB Containment System will capture all of the surface flow that is currently upwelling near the northern, northwestern, western, and portions of the eastern toes of the Tailings Basin dams. To prevent significant hydrologic impacts to Trimble Creek and Unnamed Creek due to reduction in flow, the water collected by the FTB Containment System will be treated by the WWTP and discharged to the tributaries. To the west, the discharge(s) will be directed to a location near the existing surface discharge SD006. To the northwest and north, the discharge(s) will be spigotted at multiple locations along the downstream side of the FTB Containment System to add flow to the adjacent wetlands, similar to what is occurring under existing conditions. Flow to Mud Lake Creek will be augmented entirely with off-site runoff diverted toward Mud Lake Creek by a drainage swale constructed northeast of Cell 2E. Augmentation will not be necessary at the eastern segment of the FTB Containment System. This area is currently flowing into the Tailings Basin, thus the collection of seepage will not have hydrologic impacts to the watershed. Reference (37) shows the expected amount of water needed for stream augmentation on an average annual basis.

5.2.2.2.3 Potential Indirect Impacts – Changes in Hydrology due to Drawdown or Surge

The augmentation described in Section 5.2.2.2.2 is designed such that the average annual water yield at the toe of the Tailings Basin is within +/- 20% of the No Action condition.



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Plus or minus 20% is within the range of annual variability in precipitation, as well as streamflow, in the Embarrass watershed (Reference (15) and Reference (37))². Therefore, anticipated changes to downstream hydrology, including wetlands, is expected to be within the range of that typically observed due to natural variability.

The potential for indirect impacts due to reduced or increased seepage at the toe of the Tailings Basin is greatest immediately downstream of the toe, where seepage and augmentation account for nearly all the water yield (i.e., there is no upstream watershed). Downstream of the toe, the potential for impact will be reduced as the watershed area tributary to that location increases, and the portion of total water yield derived from runoff increases. That is, the potential for hydrologic impact diminishes radially as distance from the FTB increases. Large Table 13 categorizes wetland areas downstream of the Tailings Basin according to distance from the Tailings Basin. Wetlands located further from the Tailings Basin are anticipated to have less potential for indirect impacts due to hydrologic changes.

Wetland hydrology is a complex mix of precipitation, surface runoff, and in some cases, groundwater. Despite the use of augmentation to mitigate impacts, the response of complex natural systems to human disturbances can only be estimated. Therefore, monitoring of wetland hydrology and vegetation communities is the most appropriate way to document the extent and magnitude of wetland responses (potential indirect impacts) to the Project.

5.2.2.2.4 Quantification of Potential Indirect Impacts due to Change in Hydrology

See Section 5.2.1.2.2 for a discussion of potential indirect wetland impacts due to change in hydrology.

5.2.2.3 Potential Indirect Impacts – Wetlands Abutting Unnamed Creek, Trimble Creek, and Mud Lake Creek

Wetlands abutting Unnamed Creek, Trimble Creek, and Mud Lake Creek within Area Two (Large Figure 4) are identified by wetland ID, wetland type using the Eggers and Reed (Reference (13)) wetland community types, and acreage in Table 5-7 through Table 5-9.

There are approximately 2,576 acres of wetlands which include alder thicket or shrub-carr (63% of total acres), coniferous swamp (24% of total acres), hardwood swamp (5% of total

² The +/-20% is used as the limit of acceptable impacts (i.e., impacts without necessary mitigation) to downstream surface water resources at the direction of the Co-Lead Agencies. The range of natural variation is noted to provide a frame of reference for comparing impacts relative to observed conditions, but is not considered as a criterion for acceptability of impacts.



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acres), shallow marsh (5% of total acres), deep marsh (2% of total acres), and wet meadow (1% of total acres).

Wetlands abutting Unnamed Creek within Area Two include approximately 527 acres of wetlands which include alder thicket and shrub-carr (52% of total acres), hardwood swamp (19% of total acres), shallow marsh (16% of total acres), deep marsh (10% of total acres), and coniferous swamp (3% of total acres) (Table 5-7).

Table 5-7 Wetlands Abutting Unnamed Creek

Wetland ID	Eggers and Reed Wetland Community	Wetland Size (acres)
270	Shallow marsh	85.84
593A	Deep marsh	25.73
625	Coniferous swamp	3.70
627	Alder thicket or Shrub-carr	187.09
788	Hardwood swamp	98.13
820	Deep marsh	26.92
845	Coniferous swamp	12.64
876	Alder thicket	39.13
1071	Alder thicket or Shrub-carr	29.18
1147	Alder thicket or Shrub-carr	13.46
996	Alder thicket or Shrub-carr	4.10
593	Deep marsh	1.18
	Total acres of wetland	527.10

Wetlands abutting Trimble Creek within Area Two include approximately 886 acres of wetlands which include alder thicket and shrub-carr (78% of total acres), coniferous swamp (15% of total acres), shallow marsh (4% of total acres), wet meadow (2% of total acres), and deep marsh (1% of total acres) (Table 5-8).

Table 5-8 Wetlands Abutting Trimble Creek

Wetland ID	Eggers and Reed Wetland Community	Wetland Size (acres)
253	Deep marsh	5.89
254	Shallow marsh	36.72
953	Alder thicket or Shrub-carr	614.34
955	Alder thicket or Shrub-carr	39.24



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Wetland ID	Eggers and Reed Wetland Community	Wetland Size (acres)
956	Wet meadow	17.40
989	Coniferous swamp	130.31
990	Alder thicket or Shrub-carr	42.22
529	Wet meadow	0.30
	Total acres of wetland	886.42

Wetlands abutting Mud Lake Creek within Area Two include approximately 1,162 acres of wetlands which include alder thicket and shrub-carr (56% of total acres), coniferous swamp (41% of total acres), and hardwood swamp (3 of total acres) (Table 5-9).

Table 5-9 Wetlands Abutting Mud Lake Creek

Wetland ID	Eggers and Reed Wetland Community	Wetland Size (acres)
285	Coniferous swamp	364.87
953	Alder thicket or Shrub-carr	614.34
866	Hardwood swamp	31.04
652	Coniferous swamp	109.44
986	Alder thicket or Shrub-carr	22.21
988	Alder thicket or Shrub-carr	20.51
	Total acres of wetland	1,162.41

A detailed hydrologic model has not been developed for the streams downstream of the Tailings Basin. Water management at the Plant Site consists of flow augmentation immediately downstream of the FTB Containment System (Section 5.2.2.2.2 and Reference (37)) to minimize hydrologic impacts to downstream watercourses. The hydrologic analysis presented in Reference (37) estimates that the changes in average annual flow (and therefore stage) of Unnamed Creek, Trimble Creek, and Mud Lake Creek will be within the annual variability that naturally occurs in the Embarrass River watershed. Therefore, no potential indirect wetland impacts are identified for the wetlands abutting Unnamed Creek, Trimble Creek, and Mud Lake Creek.

5.2.2.4 Potential Indirect Impacts – Water Quality Changes

5.2.2.4.1 Fugitive Dust / Metals and Sulfide Dust Emissions

The discussion, tables, and figures for this section are found in Section 5.2.1.4.1 which discusses the Mine Site and FTB.

5.2.2.4.2 Potential Indirect Impacts – Water Quality Changes

The Project will impact water quality downstream of the Tailings Basin by altering the chemistry and volume of seepage and surface water discharges leaving the Tailings Basin. Impacts to surface water and groundwater quality are quantified in (Reference (37)). The collection of existing seepage by the containment system and augmentation with WWTP effluent water will generally improve downstream water quality relative to current conditions. Water quality impacts to receiving waters are described in (Reference (37)). Even if water quality is improved, there is potential for indirect impacts to wetlands due to changes in water quality.

Potential indirect wetland impacts due to water quality changes may occur due to:

- Changes in groundwater quality,
- Changes in surface water quality, or
- Changes in both groundwater and surface water quality.

Wetland areas potentially impacted by water quality changes are shown in Large Figure 22 and listed in Table 5-10. Note that within this section, the term groundwater and surface water refer to the path by which Project water leaves the Tailings Basin (e.g., potential impacts from Tailings Basin groundwater seepage that discharges to surface water at a downstream location are classified as a potential impact due to changes in *groundwater* quality).

Table 5-10 Wetland Area Potentially Indirectly Impacted by Changes in Water Quality

Wetland Area (acres) Potentially Impacted by Changes in Water Quality	Mud Lake Creek (North)	Trimble Creek (Northwest)	Unnamed Creek (West)	Downstream of Groundwater Flow Paths ⁽³⁾	Total
Groundwater Quality ¹	296.50	514.03	1,162.15	--	1972.68
Surface Water and Groundwater Quality ²	835.77	568.92	690.87	570.16	2665.72
Total	1,132.27	1,082.95	1,853.02	570.16	4638.40

(1) Groundwater refers to water leaving the FTB within the surficial aquifer. Impacts resulting from the discharge of that seepage to surface water are considered an impact due to groundwater in this analysis.

(2) All areas potentially impacted by changes in surface water quality are also potentially impacted by changes in groundwater quality

(3) Potentially impacted wetlands are located along Trimble Creek and Mud Lake Creek, but outside of groundwater flow paths (see also Footnote (1)).

Potential for indirect impacts from changes in groundwater quality may occur anywhere along the modeled groundwater flow paths (Section 5.2.2.2.1). Wetlands that may be



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impacted in this manner are identified in Large Figure 22 and include a total of 4,068 acres. Potential for impacts to groundwater quality are diminished as distance from the Tailings Basin increases, as the relative portion of total groundwater that originates from the Tailings Basin decreases (Reference (37)). It should be noted that the amount of Tailings Basin seepage remaining in the surficial aquifer is very small (Section 5.2.2.2.1). Thus, the potential for indirect impacts due to changes in groundwater quality is anticipated to be small.

Potential impacts from changes in groundwater quality may also occur in any wetlands abutting tributary streams into which impacted groundwater may discharge. This includes all reaches of Unnamed Creek, Trimble Creek, and Mud Lake Creek (Large Figure 22). Wetlands abutting these streams and outside of the modeled groundwater flow paths add an additional 570 acres of potential indirect impacts due to changes in groundwater quality.

Changes in surface water quality may also potentially indirectly impact wetlands. Potential indirect impacts from changes in surface water quality may occur in wetlands within the surface watersheds immediately downstream of the Tailings Basin (Large Figure 22). This includes watersheds upstream of modeling locations UC-1a, TC-1, and MLC-3. These areas include 1,158 acres of wetlands (all of which may also be potentially indirectly impacted by changes in groundwater quality). Downstream of these locations, potential indirect impacts due to changes in surface water quality are limited to wetlands abutting the tributary streams. These areas include an additional 1,505 acres of wetlands (all of which may also be potentially indirectly impacted by changes in groundwater quality).

As with impacts from changes in groundwater quality, potential impacts due to changes in surface water quality are expected to diminish as distance from the Tailings Basin increases and flows originating from the Project are diluted by natural runoff.

The wetland hydrology downstream of the Tailings Basin is too complex to be accurately incorporated into the Plant Site probabilistic model detailed in Reference (37). The response of such complex natural systems to water quality changes originating at the Tailings Basin can only be estimated. Therefore, monitoring of wetland hydrology and vegetation communities is the best way to document the extent and magnitude of wetland responses (potential indirect wetland impacts) to the Project.

5.2.2.5 Potential Indirect Impacts – Wildlife Utilization of Nearby Habitats from Project Noise

The following sections summarize the potential indirect impacts to wildlife utilization of nearby habitats from Project noise. As outlined in Attachment A, the following three steps were used in the potential indirect impact analysis: 1) potential sources and range of Project noise were identified; 2) potential wildlife species and habitat preferences within the area were identified; and 3) potential impacts to wildlife utilization of nearby habitats from Project noise were qualitatively assessed.



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5.2.2.5.1 Potential Sources and Range of Project Noise

Noise at the FTB will be generated primarily by the placement of FTB Containment System, construction of FTB dams, and by operation of various types of pumping equipment used to transport the tailings slurry and recovered water from the FTB Containment System. Noise levels heard by individual wildlife species cannot be exactly determined, because wildlife species are mobile. As an individual moves, the noise level from a given source changes with the distance between the source and the receptor (the individual animal).

5.2.2.5.2 General Habitat Types

The FTB and surrounding area is currently dominated by grasslands, extensive wetland complexes, and open water areas. The existing Tailings Basin is dominated by upland grassland communities across its flat upper surface and down the tailings dams that descend to the wetlands to the north and west. A natural upland promontory occurs along the northeastern edge of the FTB. This promontory is dominated by young aspen along the lower two-thirds of the slope, and by mixed hardwood and coniferous forest on the upper slopes.

5.2.2.5.3 Wildlife Species Present

Wildlife species within and adjacent to the FTB are similar to those described in Section 5.2.1.5 for the Mine Site. Most of the same common SGCN and RFSS species present at the Mine Site are also present at the FTB.

5.2.2.5.4 Potential Impacts to Wildlife Utilization of Nearby Habitats

Noise-related potential indirect impacts to wildlife utilization of nearby habitats will be similar to those for the Mine Site, described in Section 5.2.1.5, with one notable exception - the FTB is at least 5.5 miles from the nearest potential blasting site. At this distance, the sound of the blast will be under 61 dBA, based on a sound pressure level of 115 dBA at 50 feet from the blast (Reference (28)). As a result, the physiological and behavioral changes potentially induced by blast noise will be greatly diminished at the FTB as compared to the Mine Site. In addition, the level of activity, including use of heavy equipment and number of support vehicles in operation, is expected to be lower at the FTB than at the Mine Site. As a result, overall noise generation should be lower at the FTB, resulting in fewer impacts to wildlife.

5.2.3 Transportation Corridors

Wetlands abutting the railroad corridor from the Mine Site to the Plant Site, within Area One and Area Two, are identified by wetland ID, wetland type using the Eggers and Reed (Reference (13)) wetland community types, and acreage in Large Table 17. There are approximately 543 acres of wetlands which include alder thicket or shrub-carr (75% of total acres), coniferous swamp (15% of total acres), shallow marsh (7% of total acres), deep marsh (1% of total acres), shallow, open water (1% of total acres), and sedge/wet meadow (less than 1% of total acres). Wetlands abutting the Dunka Road and Utility Corridor are identified in Section 3.2.3 and shown in Large Figure 7.



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5.2.3.1 Potential Indirect Impacts – Wetland Fragmentation

For remaining wetlands not directly impacted as discussed in Section 5.1, an estimate of potential indirect wetland impacts from wetland fragmentation by Project features (Dunka Road and Utility Corridor and Railroad Connection Corridor) was determined based on an analysis of the various factors that may contribute to potential fragmentation.

An approximately 0.01 acre alder thicket (Wetland ID 1034A), which is located just outside of the Dunka Road and Utility Corridor, was identified as a wetland fragment. Wetland ID 1034A is connected to Wetland ID 1034, which is directly impacted by the Dunka Road and Utility Corridor.

5.2.3.2 Potential Indirect Impacts – Water Quality Changes

5.2.3.2.1 Mine to Plant Railroad

The potential release of dust from railcars transporting ore from the Mine Site to the Plant Site was addressed in the May 6, 2011 Air Impact Assessment Planning Summary Memo: “The Air IAP group concluded that there will be minimal air impacts from any dust generated from ore hauled in the railcars due to the coarse nature of the ore.” Based on this conclusion, air modeling of potential release of dust from railcars was not performed because the potential wetland impacts will not be significant.

The Air IAP group concluded that any dust generated from ore hauled in railcars will be coarse in nature (i.e., relatively large particles). These larger particles will tend to deposit on the soil surface near the railcar and not be dispersed to any great extent. An estimate of the spillage of ore fines along the rail corridor is shown in Section 8.4.3 of Reference (38). It was assumed that all spillage of the coarse material will occur in a 2-meter wide strip on both sides of the centerline of the railway (total width = 4 meters) over the entire haul distance after loading (~ 8 miles; ~13,000 meters), resulting in approximately 0.11 Kg/square meter of ore fines deposited annually or 2.14 Kg/square meter deposited for the 20-year Project. This equates to 0.002 inch of depth of ore fines deposited annually or 0.05 inches deposited for the 20-year Project.

Using the geochemical modeling methods described in Section 8.4.3 of Reference (38) for the spilled ore, the quality of water contacting this material was estimated on a per-unit area basis which is also a per unit length of the rail corridor (see Attachment E for details). The contact water was assumed to mix with the background surface runoff, using the runoff water quality and quantity determined in Sections 5.3.2 and 6.1.3.3.2 of Reference (15) for the Mine Site water quality model. For each meter of railway (2 meter spillage strip on one side), the area required to have a less than 10% likelihood of the mixed contact and natural runoff exceeding water quality standards (as defined in Section 2.2 of Reference (15)) was estimated by successive runs of a probabilistic water quality model.

For most chemical constituents, the contact water leaving the spillage strip is estimated to have a greater than 90% likelihood of complying with surface water standards at all times. Constituents that have the potential to exceed surface water standards at the edge of the 2-meter spillage strip include aluminum, cobalt, copper, and nickel. Aluminum concentrations are often above the surface water standard in the background runoff, and it is not possible to achieve a less than 10% likelihood of exceeding the standard in the mixed water (Section 4.4.4.1.1 of Reference (15)). For cobalt, copper, and nickel the estimated area (square meters per meter of railroad track on each side) necessary to provide sufficient dilution for 90% probability of compliance is shown in Table 5-11.³

Table 5-11 Estimated Runoff Area Required for Dilution of Spillage Contact Water

Constituent	Surface Water Standard (µg/L)	Natural runoff area (m ² per m of track)
Cobalt	5.0	2.5
Copper	9.3 ⁽¹⁾	675
Nickel	52 ⁽¹⁾	30

(1) Standard is hardness-based, value shown for 100 mg/L hardness

The limiting area required to provide sufficient dilution water for all constituents is estimated at 675 square meters per meter of track (one-sided). Approximately 543 acres of wetlands along the railroad corridor that may have potential indirect impacts are identified in Large Table 17. Watersheds were delineated for each wetland that abutted the railroad corridor as well as wetlands with contributing watersheds abutting the railroad corridor.

Wetlands that have contributing watersheds that include no segments of the railway (e.g., many of the wetlands uphill to the north of the rail corridor) were identified as having no potential indirect impacts from rail spillage. Wetlands immediately abutting the railway and whose watersheds include the rail centerline were identified as potentially being impacted, although the impacts may not extend to the full area of the wetland. Wetlands that have contributing watersheds which include natural areas that are larger than 675 square meters per meter of track (one-sided) in the contributing watershed were identified as having no potential indirect impacts.

5.2.3.2.2 Dunka Road

Loaded mine haul trucks will not travel on the Dunka Road. Empty mine haul trucks will only travel on the Dunka Road when they are in need of maintenance at the Area 1 Shop. It is

³ Based on the PolyMet rail car modification evaluation (Reference (40)), ore spillage may be reduced by up to 97%, which would proportionally reduce the dilution needed to meet surface water standards.

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estimated that each truck will travel to Area 1 Shop twice per year. The total one-way trips per year are estimated at 44. Given the low traffic volumes (< 1 trip per week on average) and the consideration that the ore trucks will be empty, it was determined in Attachment A that a quantitative assessment of impacts from ore particle discharge from haul truck travelling down the Dunka Road is not warranted. Therefore, no potential indirect wetland impacts were identified for wetlands abutting the Dunka Road.

5.2.3.2.3 Product Shipping

Products produced in the hydrometallurgical plant (Gold and Platinum Group Metals concentrate, mixed hydroxide precipitate) will be loaded into super sacks (i.e., large industrial sacks used to transport solid material) and then loaded onto trucks or railcars. There is little or no potential for spillage with this method of shipping and Attachment A concluded that with respect to flotation concentrate, as stated in the Project Description (Reference (12)), "Each filtered concentrate will be conveyed to separate stockpiles within an enclosed 10,000 ton storage facility for loading into covered rail cars. The storage facility will store about 7 to 10 days of production capacity when flotation concentrate will be directed to Concentrate Dewatering/Storage. The storage facility will have a concrete floor and provisions to wash wheeled equipment leaving the facility to prevent concentrates from being tracked out of the facility." Best Management Practices adopted at other mining facilities, such as enclosed storage and loading, covered cars, top-loaded gondola-type cars, and vehicle wash facilities, are proposed for use at the Project. PolyMet will be paid on tons received by customers so it has a vested interest in not losing any concentrate. The covered rail cars will be inspected for holes and any holes repaired before concentrate loading. Attachment A determined that because the common carrier route (i.e., the rail line used to transport products) is not known (ultimate customer not known and could change), there is no way to assess impacts along the common carrier route. Therefore, no potential indirect wetland impacts were identified for wetlands along a common carrier route.

5.2.3.3 Potential Indirect Impacts – Wildlife Utilization of Nearby Habitats from Project Noise

The following sections summarize the potential indirect impacts to wildlife utilization of nearby habitats from Project noise. As outlined in Attachment A, the following three steps were used in the potential indirect impact analysis: 1) potential sources and range of Project noise were identified; 2) potential wildlife species and habitat preferences within the area were identified; and 3) potential impacts to wildlife utilization of nearby habitats from Project noise were qualitatively assessed.

5.2.3.3.1 Potential Sources and Range of Noise

Noise along the transportation corridors will be generated by trucks along Dunka Road and trains. Noise from trucks passing along Dunka Road is estimated to range from 67 dBA for light trucks to 90 dBA for larger dump trucks (Table 3.7-1 of Reference (39)). The decibel level of a passing freight train at approximately 50 feet is 80 dBA. A locomotive's horn decibel level is 96 dBA at 100 feet ahead of the locomotive (Table 3.7-1 of Reference (39)).



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5.2.3.3.2 General Habitat Types

Wildlife habitat along the transportation corridors is varied, and includes wetlands, forested uplands, and maintained grasslands adjacent to existing roads and railroads.

5.2.3.3.3 Wildlife Species Present

Wildlife species present in the transportation corridors are similar to those described in Section 5.2.1.5 for the Mine Site. Most of the same common SGCN and RFSS species present at the Mine Site are also present along the transportation corridors.

5.2.3.3.4 Potential Impacts to Wildlife Utilization of Habitats

Noise-related impacts to wildlife utilization of habitats nearby the transportation corridors will be similar to those for the Mine Site, described in Section 5.2.1.5.

Blasting noise along the transportation corridors will be somewhat reduced relative to the Mine Site. For portions of transportation corridors within one mile of the Mine Site, the noise generated from a blast will range from 71-75 dBA. Tree cover and atmospheric absorption will decrease these levels further.

Species currently utilizing the grassland rights-of-way along Dunka Road and the railroad will likely continue to use these areas. Currently there is low to moderate traffic along Dunka Road. During the Project, increased traffic along the transportation routes may cause some wildlife species to abandon the adjacent habitats. However, these are already moderately disturbed habitats, and are therefore most likely used by habitat generalists rather than SGCN and other more sensitive species. As a result, increases in traffic along Dunka Road and the railroad are not likely to result in significant abandonment of adjacent habitats.

5.2.4 Second Creek

A total of 30 wetlands covering 298.91 acres were identified within the Second Creek area of analysis (Table 3-8). The wetlands include alder thicket or shrub-carr (44%), shallow marsh (35%), hardwood swamp (7%), deep marsh (7%), coniferous swamp (6%), wet meadow (less than 1%), and shallow, open water (less than 1%). Wetlands within the Second Creek area are identified in Section 3.2.8 and shown in Large Figure 8.

The potential indirect wetland impacts were assessed based on changes to hydrology due to groundwater flow or seepage, drawdown or surface water quantity, or changes in surface water quality or metals deposition. There are no potential indirect wetland impacts due to wetland fragmentation, changes in watershed area, or dust deposition.

5.2.4.1 Potential Indirect Impacts – Change in Hydrology

5.2.4.1.1 Potential Indirect Impacts – Change in Hydrology due to Groundwater Flow or Seepage

Seepage from the south side of the FTB is generally restricted by bedrock outcrops and does



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not contribute to the groundwater flow south of the FTB. All seepage from the south side of the FTB is surface water, forming the headwaters of Second Creek (Sections 4.3.2.2.1 and 5.1.1.2 of Reference (37)). There are no potential indirect impacts to wetlands as a result of changes in groundwater flow in the area of analysis.

The current seepage capture system located at the southern toe of Tailing Basin Cell 1E, which was installed as part of the Cliffs Erie Consent Decree, has reduced seepage leaving the existing Tailings Basin. No further reductions in flow to Second Creek are anticipated as part of the Project, rather, the Project will augmented stream flow in Second Creek with treated water from the WWTP in order to return flows to conditions that existed before the current seepage capture system was constructed as part of the Cliffs Erie Consent Decree. There will be no construction in this area as a result of stream augmentation.

5.2.4.1.2 Potential Indirect Impacts – Change in Hydrology due to Drawdown or Surge

Wetlands abutting Second Creek are identified by wetland ID, wetland type using Reference (13) wetland community types, and acreage in Table 5-12 and Large Figure 8. There are 8 wetlands covering approximately 179 acres which include alder thicket or shrub-carr (66%), shallow marsh (26%), and deep marsh (8%).

Table 5-12 Wetlands Abutting Second Creek

Wetland ID	Dominant Eggers and Reed Wetland Community	Total Wetland Area (acres)
595 ⁽¹⁾	Deep marsh	1.05
595A	Deep marsh	3.06
1161	Deep marsh	9.41
1162	Shallow marsh	40.84
1174	Alder thicket or Shrub-carr	118.75
1176	Shallow marsh	4.92
P5-1	Deep marsh	0.77
P5-1A	Deep marsh	0.03
Total acres of wetland		178.83

(1) Wetland 595 includes 3 separate areas.

Flow augmentation at the south toe of the Tailings Basin is designed such that the average annual discharge to that location is within +/- 20% of the pre-Consent Decree condition (Section 5.2.2.8.1 of Reference (37)). Plus or minus 20% is within the range of annual variability in precipitation, as well as streamflow, in the Partridge and Embarrass watersheds (Section 5.2.2.8.1 of Reference (37)). Therefore, anticipated changes to downstream hydrology, including adjacent wetlands, is expected to be within the range of that typically



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observed due to natural variability. Therefore, no potential indirect wetland impacts are identified for the wetlands abutting Second Creek.

5.2.4.2 Potential Indirect Impacts – Water Quality Changes

5.2.4.2.1 Potential Indirect Impacts – Change in Surface Water Quality

The Project will impact water quality in Second Creek by altering the chemistry of surface water discharges to the headwaters of Second Creek (Sections 5.2.2.8.1 and Section 6.6 of Reference (37)). The collection of seepage by the South Seepage Management System and augmentation with WWTP effluent water will generally improve downstream water quality relative to current conditions. Even if water quality is improved, there is potential for indirect impacts to wetlands due to changes in water quality.

Potential indirect wetland impacts due to changes in water quality will be limited to wetlands abutting Second Creek. Potential indirect impacts due to changes in surface water quality are expected to diminish as the distance from the Tailings Basin increases. Upstream of County Road 666, there are approximately 179 acres of wetlands abutting Second Creek (Table 5-13) that have the potential to be indirectly impacted by the change in water quality due to stream flow augmentation of Second Creek.

Table 5-13 Wetlands Abutting Second Creek

Wetland ID	Dominant Eggers and Reed Wetland Community	Total Wetland Area (acres)
595 ⁽¹⁾	Deep marsh	1.05
595A	Deep marsh	3.06
1161	Deep marsh	9.41
1162	Shallow marsh	40.84
1174	Alder thicket or Shrub-carr	118.75
1176	Shallow marsh	4.92
P5-1	Deep marsh	0.77
P5-1A	Deep marsh	0.03
Total acres of wetland		178.83

(1) Wetland 595 includes 3 separate areas.

5.2.4.2.2 Potential Indirect Impacts – Metals Deposition

The deposition modeling results (Section 5.2.1.4.1) indicate there are 7 wetlands in the Second Creek area covering approximately 44 acres that are potentially indirectly impacted (modeled metal deposition greater than 100% of background); of these, 1.05 acres are located within the FTB ambient air boundary (Large Figure 16). The wetlands are identified by



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wetland ID, wetland type using Eggers and Reed (Reference (13)), and acreage in Table 5-14.

Table 5-14 Wetlands Potentially Indirectly Impacted by Metal Deposition

Wetland ID	Dominant Eggers and Reed Wetland Community	Revised Total Wetland Area (acres) ⁽¹⁾	Reference (40) Total Wetland Area (acres)
595 ⁽²⁾	Deep marsh	1.05	1.05
595A	Deep marsh	3.06	3.06
1161 ⁽³⁾	Deep marsh	9.41	6.34
1166 ⁽³⁾	Shallow marsh	28.04	15.03
1167 ⁽³⁾	Shallow marsh	2.88	2.40
Total acres of wetland		44.44	

(1) Acreage for wetland IDs 595 and 595A did not change.

(2) Wetland 595 includes 3 separate areas.

(3) Previously identified in Reference (40) using the NWI.

5.2.5 Summary of Potential Indirect Wetland Impacts

The analysis in Section 5.2 identified six factors that may result in potential indirect wetland impacts: wetland fragmentation, change in wetland hydrology from changes in watershed area, changes in wetland hydrology from groundwater drawdown, water quality changes related to deposition of dust, water quality changes related to ore spillage along the transportation corridor, and changes in water quality related to leakage from stockpiles/mine features and seepage from mine pits. A wetland may be potentially indirectly impacted by none of these factors or up to a maximum of six, with different combinations of factors possible. A rating was developed for the wetlands based on the number of factors that may potentially affect it – from No Impact (0 factors) to 6 (all six factors potentially indirectly impacting the wetland). Using this approach, no wetlands were rated as a 6 in this analysis.

Using the method identified in Attachment A to identify potential indirect wetland impacts from drawdown (Section 5.2.1.2.2), approximately 54% of wetlands received a rating of 1, with one factor potentially indirectly impacting the wetland; 42% of wetlands received a rating of 2, with two factors potentially indirectly impacting the wetland; 3% of wetlands received a rating of 3, with three factors potentially indirectly impacting the wetland; less than 0.2% of wetlands received a rating of 4, with four factors potentially indirectly impacting the wetland; and less than 0.1% of wetlands received a rating of 5, with five factors potentially indirectly impacting the wetland. Table 5-15 shows the wetland acreage for each rating for Attachment A method Ratings 1, 2, 3, 4, and 5. Large Figure 23 through Large Figure 25 show the ratings for wetlands in the Project analysis areas.

Table 5-15 Rating for Wetlands Potentially Indirectly Impacted in the Project Area

Rating	Attachment A Method		Alternate Method	
	Wetlands (acres)	Wetlands (% of total acres)	Wetlands (acres)	Wetlands (% of total acres)
1	4,043.19	54.4%	3,466.12	52.8%
2	3,126.77	42.1%	2,888.37	44.0%
3	245.31	3.3%	205.97	3.1%
4	15.89	0.2%	8.11	0.1%
5	0.25	<0.1%	0.25	<0.1%
Total acres of wetland	7,431.41		6,568.82	

Using the alternative method to identify potential indirect wetland impacts from drawdown (Section 5.2.1.2.2), approximately 53% of wetlands received a rating of 1, with one factor potentially indirectly impacting the wetland; 44% of wetlands received a rating of 2, with two factors potentially indirectly impacting the wetland; 3% of wetlands received a rating of 3, with three factors potentially indirectly impacting the wetland; less than 1% of wetlands received a rating of 4, with four factors potentially indirectly impacting the wetland; and less than 0.1% of wetlands received a rating of 5, with five factors potentially indirectly impacting the wetland. Table 5-15 shows the wetland acreage for alternate method Ratings 1, 2, 3, 4, and 5. Large Figure 26 through Large Figure 28 show the ratings for wetlands in the Project Area.

5.3 Cumulative Wetland Impacts

An analysis was conducted to determine the cumulative effects of direct impacts from all past, present, and reasonably foreseeable future projects to the wetlands, lakes, and deepwater resources located in the Partridge River and Embarrass River watersheds. The number and extent of wetland, lake, and deepwater resources were estimated for three time periods, including pre-settlement, existing, and the foreseeable future. Attachment A summarizes the methodology used for the cumulative wetland impact analysis.

5.3.1 Pre-settlement Wetland and Water Resources

The pre-settlement condition time period represents wetland, lake, and deepwater resources as they existed prior to mining and urban development in the late 1800s to early 1900s. An estimate of pre-settlement wetland, lake, and deepwater acreages within the Partridge River and Embarrass River watersheds was developed using the U.S. Fish and Wildlife Service



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(USFWS) National Wetland Inventory (NWI) maps and the original survey maps developed using data from the original Government Land Surveys.

In order to develop a relationship between NWI mapping and pre-settlement mapping of wetland, lake, and deepwater resources, townships in each watershed with minimal disturbance were used to calculate ratios of NWI to original survey wetland, lake, and deepwater resources. These ratios were used as adjustment factors to conform the original survey data to the standards and scales of the NWI data for estimating the pre-settlement wetland, lake, and deepwater resources within the disturbed areas of each watershed. The methodology used to identify disturbed areas in each watershed is summarized in Attachment A.

5.3.1.1 Partridge River Watershed

Township 58, Range 12 is one of the least disturbed townships in the Partridge River Watershed (0.2% disturbance in the entire township and 0.4% disturbance for the portion contained within the watershed: Large Figure 29). Using the disturbance at the township level (0.2%), the ratio of NWI to original survey wetlands, lakes, and deepwater resources was calculated to be 1.21 for the least disturbed township in the Partridge River Watershed. This ratio indicates there were approximately 21% more wetlands, lakes, and deepwater resources identified on the NWI maps than the original survey maps in the Partridge River Watershed.

Disturbance within the townships located in the Partridge River Watershed range between 0.4% and 52.4%, with approximately 15% of the entire Partridge River Watershed containing significant human disturbance since settlement of the area (Large Figure 29). The disturbance types (and percent of the disturbance area) include: mining features including stockpiles, pits, roads, and other infrastructure (82% of the disturbance area); primarily municipal/residential development (e.g., Cities of Aurora and Hoyt Lakes) with some barren land and cultivated crops (13% of the disturbance area); and roads and railroads (5% of the disturbance area). Approximately 85% of the Partridge River Watershed was judged to be relatively undisturbed, so NWI mapping was used in these areas to represent pre-settlement conditions for wetland, lake, and deepwater resources.

Based on the original survey maps, approximately 2,991 acres of wetland were mapped within the disturbed areas in the Partridge River Watershed. This wetland acreage was adjusted to 3,620 acres using the 1.21 adjustment factor. After accounting for the disturbed areas, a total of 33,601 acres of wetlands were identified in the 101,812 acre Partridge River Watershed, comprising 33% of the watershed (Large Table 18, Large Figure 29).

Based on the original survey maps, 24 acres of lake were mapped within the disturbed areas in the Partridge River Watershed. This lake acreage was adjusted to 29 acres using the 1.21 adjustment factor. After accounting for the disturbed areas, a total of 2,688 acres of lake were identified in the 101,812 acre watershed comprising 2.6% of the watershed (Large Table 19, Large Figure 29).



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No deepwater habitat (i.e., mine pits;

Large Table 20, Large Figure 29) was identified in the watershed for the pre-settlement conditions.

5.3.1.2 Embarrass River Watershed

Township 61, Range 14 is one of the least disturbed townships in the Embarrass River Watershed (0.6% disturbance in the entire township and 0.7% disturbance for the portion contained within the watershed: Large Figure 29). Using the disturbance at the township level (0.6%), the ratio of NWI to original survey wetlands, lakes, and deepwater resources was calculated to be 0.85 for the least disturbed township in the Embarrass River Watershed. Based on this analysis, the ratio of NWI to original survey wetlands, lakes, and deepwater resources was calculated to be approximately 15% fewer wetlands, lakes, and deepwater resources identified on the NWI maps than the original survey maps in the Embarrass River Watershed.

Disturbance within the portions of townships located in the Embarrass River Watershed range between 0.7% and 63.3%, with approximately 12% of the entire Embarrass River Watershed containing significant human disturbance since settlement of the area (Large Figure 29). The disturbance types (and percent of the disturbance area) include: mining features including stockpiles, pits, roads, and other infrastructure (61% of the disturbance area); primarily municipal/residential development (e.g., Cities of Babbitt, Biwabik, Gilbert, and McKinley) with some barren land and cultivated crops (27% of the disturbance area); and roads and railroads (12% of the disturbance area). Approximately 88% of the Embarrass River watershed was judged to be relatively undisturbed, so NWI mapping was used in these areas to represent pre-settlement conditions for wetland, lake, and deepwater resources.

Based on the original survey maps, approximately 2,388 acres of wetland were mapped within the disturbed areas of the Embarrass River Watershed. This wetland acreage was adjusted to 2,030 acres using the 0.85 adjustment factor. After accounting for the disturbed areas, a total of 34,650 acres of wetlands were identified in the 116,797 acre Embarrass River Watershed, comprising approximately 30% of the watershed (Large Table 18, Large Figure 29).

Based on the original survey maps, 224 acres of lake were mapped within the disturbed areas in the Embarrass River Watershed. This lake acreage was adjusted to 190 acres using the 0.85 adjustment factor. After accounting for the disturbed areas, a total of 3,121 acres of lakes were identified in the 116,797 acre watershed comprising less than 3% of the watershed (Large Table 19, Large Figure 29).

No deepwater habitat (i.e., mine pits;

Large Table 20, Large Figure 29) was identified in the watershed for the pre-settlement conditions.



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5.3.2 Existing Wetland and Water Resources

The existing conditions time period represents wetlands, lakes, and deepwater resources as they exist today, prior to the development of the Project (Large Figure 30). Existing wetlands, lakes, and deepwater resources were estimated using the following sources of data: wetland delineations completed in the area (described in Section 3.0), NWI maps, USGS National Hydrograph Dataset to estimate lake or lacustrine water bodies, and MDNR Mesabi Mining Features (2009) in combination with 2010 LiDAR data and aerial photographs from 2003, 2008, 2009, and 2010 to estimate deepwater or mine pit water bodies.

5.3.2.1 Partridge River Watershed

A total of 31,318 acres of existing wetlands were identified in the 101,812 acre watershed, comprising 31% of the land area (Large Table 18, Large Figure 30). There has been a decrease of approximately 2,283 acres of wetland; this represents a 7% decrease in wetland area compared to pre-settlement conditions (Large Table 21).

A total of 3,194 acres of lakes were identified in the 101,812 acre watershed, comprising 3% of the land area (Large Table 19, Large Figure 30). There has been an increase of approximately 506 acres of lakes; this represents a 19% increase in lake area compared to pre-settlement conditions (Large Table 22).

A total of 3,146 acres of deepwater resources (i.e., mine pits) were identified in the 101,812 acre watershed, comprising 3% of the land area (

Large Table 20, Large Figure 30). There has been an increase of 3,146 acres of deepwater resources in the watershed compared to no deepwater resources present under pre-settlement conditions (Large Table 23).

The change in wetland, lake, and deepwater acreage has resulted primarily from mining projects, development of municipalities, and construction of transportation infrastructure such as roads and railroads.

5.3.2.2 Embarrass River Watershed

A total of 34,249 acres of existing wetlands were identified in the 116,797 acre watershed, comprising 29% of the land area (Large Table 18, Large Figure 30). There has been a decrease of approximately 402 acres of wetland; this represents a 1% decrease in wetland area compared to pre-settlement conditions (Large Table 21).

A total of 2,904 acres of lakes were identified in the 116,797 acre watershed, comprising 3% of the land area (Large Table 19, Large Figure 30). There was a decrease of approximately 217 acres of lakes in the watershed; this represents a 7% decrease in lake area compared to pre-settlement conditions (Large Table 22).



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A total of 977 acres of deepwater resources (i.e., mine pits) were identified in the 116,797 acre watershed, comprising 1% of the land area (

Large Table 20, Large Figure 30). There has been an increase of 977 acres of deepwater resources in the watershed compared to no deepwater resources present under pre-settlement conditions (Large Table 23).

The change in wetland, lake, and deepwater acreage has resulted primarily from mining projects, development of municipalities, and construction of transportation infrastructure such as roads and railroads.

5.3.3 Projected Future Wetland and Water Resources

The future conditions time period represents wetlands, lakes, and deepwater resources expected to be present following the conclusion and long-term closure of the Project. It is assumed that the future conditions represents the time period after the conclusion of the future projects when the mine pits will have flooded with water.

Relevant agencies were contacted to identify foreseeable future actions within the Partridge River and Embarrass River watersheds. Agency officials were asked to identify actual or potential development projects that may occur during the life of the Project. The Project Description (Reference (12) describes a 20-year mine life followed by reclamation and long-term closure. Public officials from city, county, state, and federal agencies were contacted as shown in Attachment F. Based on Reference (41), foreseeable future actions did not include projects that have only been proposed because it is too speculative to include in this analysis.

Future projects were identified in the Partridge and Embarrass River watersheds that may impact wetland, lake, and deepwater resources. The locations of these projects are shown on Large Figure 31 and their potential effects on future conditions for wetland and deepwater habitat resources are summarized on Large Table 24. The following projects are included in assessment of cumulative wetland impacts:

- The Project, located in the Embarrass and Partridge River watersheds, has identified the potential for 914 acres of direct wetland impact over the next 20 years. Approximately 321 acres of deepwater habitat is planned at the Mine Site at the conclusion of the Project.
- The proposed Mesabi Nugget Phase II project, located in the Partridge River watershed, has identified the potential for approximately 267 acres of direct wetland impact (Reference (42)) over the life of the project (Large Table 24, Large Figure 31). Approximately 1,601 acres of deepwater habitat is planned at the conclusion of the project (Reference (43)), resulting in an increase of 49 acres from existing 1,552 acres of deepwater habitat (Large Table 24).
- The ArcelorMittal East Reserve project, located in the Embarrass River watershed, has identified the potential for approximately 116 acres of direct wetland impact



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(Reference (44)) over the life of the project. Through 2014, there have been 67.14 acres of direct wetland impact (Reference (45)). Approximately 275 acres of deepwater habitat is planned at the conclusion of the project (Reference (46)), resulting in an increase of 275 acres from the existing 0 acres of deepwater habitat.

- The ArcelorMittal Pushback project, located in the Embarrass River watershed, has identified the potential for approximately 23 acres of direct wetland impact (Reference (47)) over the life of the project. Approximately 107 acres of deepwater habitat may develop at the conclusion of the project (Reference (47)), resulting in an increase of 107 acres from the existing 0 acres of deepwater habitat.
- The Mining Resources Austin Powder (Biwabik) project, located in the Embarrass River watershed, has identified the potential for approximately 4 acres of direct wetland impact (Reference (48)) over the life of the project. No deepwater habitat is planned at the conclusion of the project.
- The Mining Resources McKinley project, located in the Embarrass River watershed, has identified the potential for approximately 50 acres of direct wetland impact (Reference (48), Reference (49)) over the life of the project. No deepwater habitat is planned at the conclusion of the project.
- The Laskin Energy Park is located in the Partridge River watershed and south of the Minnesota Power Laskin Energy Center. It is located adjacent to Colby and Whitewater Lakes, near the City of Hoyt Lakes. If every lot in the 220-acre industrial park was fully developed, the potential direct wetland impacts could range from zero to seven acres. The amount of wetland mitigation that may be conducted in the Partridge River watershed is unknown at this time.
- St. Louis County Public Works will be conducting 8 bridge replacements in the Partridge and Embarrass River watersheds over the next 10 years. Bridge replacements generally directly impact 10,000 square feet of wetlands or less, so the maximum direct wetland impact from the bridge projects will be 1.8 acres. Information was not provided regarding potential indirect wetland impacts for this project.

To estimate the future projected wetland, lake, and deepwater resources impacts from the Project, the Mesabi Nugget Phase II project, the Laskin Energy Park project, and the St. Louis County bridge replacement, the maximum impact acreages were used to calculate total acreages in Large Table 24. For the projected future conditions, the acreage of wetland, lake, and deepwater resources was estimated by subtracting the future projected wetland impacts and adding the future projected development of wetland, lake, and deepwater resources to the existing resource totals (Large Table 24).



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5.3.3.1 Partridge River Watershed

In addition to the Project, development of other projects (and associated impacts to and mitigation of wetland, lake and deepwater resources in the Partridge River Watershed) will occur under the foreseeable future conditions. Large Table 21 through Large Table 23 summarize future conditions for wetland, lake, and deepwater resources.

Approximately 30,276 acres of wetlands are projected to be present in the watershed in the foreseeable future comprising 30% of the land area (Large Table 18, Large Figure 31). The change in wetlands, as a proportion of all wetlands within the study area, will be a 10% reduction from pre-settlement conditions and a 3% reduction compared to existing conditions (Large Table 21).

Approximately 3,194 acres of lakes are projected to be present in the watershed in the foreseeable future, comprising 3% of the land area (Large Table 19, Large Figure 31). The change in lakes, as a proportion of the total study area, will be a 19% increase from pre-settlement conditions and there will be no changes compared to existing conditions (Large Table 22).

Approximately 3,516 acres of deepwater resources are projected to be present in the watershed in the foreseeable future, comprising 4% of the land area (Large Table 20, Large Figure 31). The change in deepwater, as a proportion of the total study area, will be a 100% increase from pre-settlement conditions and a 12% increase compared to existing conditions (Large Table 23).

5.3.3.2 Embarrass River Watershed

In addition to the Project, development of other projects (and associated impacts to and mitigation of wetland, lake, and deepwater resources in the Embarrass River Watershed) will occur under the foreseeable future conditions. Large Table 21 through Large Table 23 summarize future conditions for wetland, lake, and deepwater resources.

Approximately 33,947 acres of wetlands are projected to be present in the watershed in the foreseeable future comprising 29% of the land area (Large Table 18, Large Figure 31). The change in wetlands, as a proportion of all wetlands within the study area, will be a 2% reduction from pre-settlement conditions and a 1% reduction compared to existing conditions (Large Table 21).

Approximately 2,904 acres of lakes are projected to be present in the watershed in the foreseeable future, comprising 3% of the land area (Large Table 19, Large Figure 31). The change in lakes, as a proportion of the total study area, will be a 7% increase from pre-settlement conditions and there will be no changes compared to existing conditions (Large Table 22).



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Approximately 1,359 acres of deepwater resources are projected to be present in the watershed in the foreseeable future, comprising 1% of the land area (Large Table 20, Large Figure 31). The change in deepwater, as a proportion of the total study area, will be a 100% increase from pre-settlement conditions and a 39% increase compared to the existing conditions (Large Table 23).

5.3.4 Qualitative Analysis of Cumulative Wetland Impacts for the St. Louis River below the Ordinary High Water Mark from Its Confluence with the Embarrass River to Lake Superior

The XP-SWMM model developed for the Partridge River identified that the changes in average annual flow (and therefore stage) of the Partridge River will be within the naturally occurring annual variation for the Partridge River (Section 5.2.1.3). Therefore, no potential indirect wetland impacts are identified for the wetlands abutting the Partridge River.

The St. Louis River is located downstream of the Partridge River. Thus, impacts to flows (and by extension water surface elevations) generated by the Project are anticipated to be less than those estimated for the Partridge River and within the natural variation of flow within the St. Louis River. Therefore, no potential indirect wetland impacts are identified for the wetlands within the St. Louis River below the ordinary high water mark from its confluence with the Embarrass River to Lake Superior.

5.3.5 Quantitative Analysis of Cumulative Wetland Impacts

The quantitative analysis of cumulative wetland impacts for the Partridge and Embarrass River watersheds is discussed in Section 5.3.3.

5.3.6 Climate Change

The qualitative assessment of the potential impacts of climate change on wetlands was included in the Climate Change Evaluation Report developed by the Air IAP. No additional assessment was conducted for this data package.



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Revision History

Date	Version	Description
10/14/2011	1	Initial release
12/16/2011	2	Revisions based on comments received for Version 1 and additional information regarding Mine Site features.
1/20/2012	3	Revisions based on reviewing the status of wetlands within the currently permitted (Cliffs Erie LLC) waste facility boundary.
2/16/2012	4	Revisions based on comments received for Version 3
12/12/2012	5	Revisions based on additional information regarding Project features and wetland information.
12/28/2012	6	Revisions based on analysis of potential indirect wetland impacts.
3/1/2013	7	Revisions based on analysis of potential indirect wetland impacts.
11/17/2014	8	Revisions based on Project changes.
1/6/2015	9	Revisions based on agency comments provided for v8.
2/10/2015	10	Revisions based on agency comments provided for v9.



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- Attachment B Wetlands within Analog Zones – Mine Site Area
- Attachment C Chemistry of NorthMet Ore, NorthMet Tailings, and LTVSMC Tailings
- Attachment D Adjustment of Background Metal Deposition
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- Attachment F Foreseeable Future Actions within the Partridge River and Embarrass River Watersheds

Large Tables

Large Table 1 Summary of Wetlands in Project Areas

Project Area	Wetland ID	Dominant Circular 39 Community	Total Wetland Area within the Project Area (acres)	Direct Wetland Impacts (acres)	Remaining Wetland Area (acres)	Dominant Eggers and Reed ⁽¹⁾ Wetland Community	Wetland Quality	Type of Direct Impact ⁽²⁾
Mine Site	1	3	0.42	0.00	0.42	Shallow marsh	Moderate	
Mine Site	3	3	0.35	0.00	0.35	Shallow marsh	Moderate	
Mine Site	5	2	0.61	0.61	0.00	Wet meadow	High	F
Mine Site	6	3	0.62	0.00	0.62	Shallow marsh	Moderate	
Mine Site	7	2	0.07	0.00	0.07	Wet meadow	Moderate	
Mine Site	8	2	6.80	6.80	0.00	Sedge meadow	Moderate	F,E
Mine Site	9	3	1.80	0.07	1.73	Shallow marsh	High	F
Mine Site	10	2	1.17	0.00	1.17	Sedge meadow	High	
Mine Site	11	8	8.88	0.00	8.88	Coniferous bog	High	
Mine Site	12	6	0.13	0.00	0.13	Alder thicket	High	
Mine Site	13	4	5.03	0.09	4.94	Deep marsh	High	F
Mine Site	14	2	0.33	0.33	0.00	Wet meadow	High	F
Mine Site	16	3	0.31	0.00	0.31	Shallow marsh	High	
Mine Site	18	3	18.90	18.90	0.00	Shallow marsh	High	E
Mine Site	19	3	1.68	0.05	1.63	Shallow marsh	High	E
Mine Site	20	2	17.06	16.96	0.10	Sedge meadow	High	E
Mine Site	22	3	1.43	0.00	1.43	Shallow marsh	High	
Mine Site	22A	7	0.89	0.00	0.89	Coniferous swamp	High	
Mine Site	24	6	0.80	0.39	0.41	Alder thicket	High	E
Mine Site	25	8	1.95	0.00	1.95	Coniferous bog	High	
Mine Site	27	8	1.07	1.07	0.00	Coniferous swamp	Moderate	E
Mine Site	29	3	12.02	0.00	12.02	Shallow marsh	High	
Mine Site	32	8	73.36	70.99	2.37	Coniferous bog	High	F,E
Mine Site	33A	6	18.46	5.77	12.69	Alder thicket	High	E
Mine Site	33B	7	4.56	0.00	4.56	Coniferous swamp	High	
Mine Site	37	6	2.39	2.39	0.00	Shrub-carr	High	F
Mine Site	43	6	8.29	7.26	1.03	Alder thicket	High	F
Mine Site	44	6	3.27	1.99	1.28	Alder thicket	High	E
Mine Site	45	6	37.55	28.83	8.72	Alder thicket	High	F,E
Mine Site	47	8	0.54	0.54	0.00	Open bog	High	F
Mine Site	48	8	89.16	27.80	61.36	Coniferous bog	High	F,E
Mine Site	48A	7	2.65	2.21	0.44	Coniferous swamp	High	F

Project Area	Wetland ID	Dominant Circular 39 Community	Total Wetland Area within the Project Area (acres)	Direct Wetland Impacts (acres)	Remaining Wetland Area (acres)	Dominant Eggers and Reed ⁽¹⁾ Wetland Community	Wetland Quality	Type of Direct Impact ⁽²⁾
Mine Site	51	6	7.47	7.45	0.02	Alder thicket	High	F
Mine Site	52	6	3.88	3.88	0.00	Alder thicket	High	F,E
Mine Site	53	6	18.59	0.00	18.59	Alder thicket	High	
Mine Site	53A	7	2.35	0.00	2.35	Coniferous swamp	High	
Mine Site	53B	7	0.43	0.00	0.43	Coniferous swamp	High	
Mine Site	53C	7	2.88	0.00	2.88	Coniferous swamp	High	
Mine Site	54	7	4.11	0.00	4.11	Coniferous swamp	High	
Mine Site	54C	6	0.74	0.00	0.74	Alder thicket	High	
Mine Site	55	6	3.91	3.85	0.06	Alder thicket	High	F,E
Mine Site	56	8	2.79	2.79	0.00	Open bog	High	E
Mine Site	57	7	78.06	50.49	27.57	Coniferous swamp	High	F,E
Mine Site	58	6	34.58	0.00	34.58	Alder thicket	High	
Mine Site	60	6	6.71	6.71	0.00	Alder thicket	High	F
Mine Site	61	7	0.45	0.00	0.45	Coniferous swamp	High	
Mine Site	62	8	12.13	0.00	12.13	Coniferous bog	High	
Mine Site	64	7	0.31	0.00	0.31	Hardwood swamp	High	
Mine Site	68	7	23.81	10.89	12.92	Coniferous swamp	High	F,E
Mine Site	72	7	1.39	0.00	1.39	Coniferous swamp	High	
Mine Site	74	7	6.12	6.12	0.00	Hardwood swamp	High	E
Mine Site	76	8	3.92	2.21	1.71	Coniferous bog	High	E
Mine Site	77	8	13.01	0.92	12.09	Coniferous bog	High	F,E
Mine Site	78	8	1.75	1.75	0.00	Coniferous bog	High	F
Mine Site	79	8	2.39	0.00	2.39	Coniferous bog	High	
Mine Site	80	8	0.29	0.22	0.07	Coniferous bog	High	F
Mine Site	81	7	1.68	1.44	0.24	Coniferous swamp	High	F,E
Mine Site	82	8	62.40	60.77	1.63	Coniferous bog	High	F,E
Mine Site	83	8	3.99	0.00	3.99	Open bog	High	
Mine Site	84	8	1.33	0.00	1.33	Coniferous bog	High	
Mine Site	85	8	1.41	1.41	0.00	Coniferous bog	High	E
Mine Site	86	8	2.47	2.46	0.01	Coniferous bog	High	F
Mine Site	88	8	5.58	5.02	0.56	Coniferous bog	High	F
Mine Site	90	8	176.08	34.22	141.86	Coniferous bog	High	F,E
Mine Site	90A	8	7.91	1.20	6.71	Open bog	High	F

Project Area	Wetland ID	Dominant Circular 39 Community	Total Wetland Area within the Project Area (acres)	Direct Wetland Impacts (acres)	Remaining Wetland Area (acres)	Dominant Eggers and Reed ⁽¹⁾ Wetland Community	Wetland Quality	Type of Direct Impact ⁽²⁾
Mine Site	95	8	2.54	2.54	0.00	Coniferous swamp	High	E
Mine Site	96	8	17.30	13.14	4.16	Coniferous bog	High	F,E
Mine Site	97	8	4.46	2.57	1.89	Coniferous bog	High	F,E
Mine Site	98	8	15.50	15.07	0.43	Coniferous bog	High	F,E
Mine Site	99	8	1.40	0.49	0.91	Coniferous bog	High	F,E
Mine Site	100	8	176.19	102.96	73.23	Coniferous bog	High	F,E
Mine Site	100A	6	1.66	1.66	0.00	Alder thicket	High	F
Mine Site	101	8	14.21	11.73	2.48	Coniferous bog	High	F,E
Mine Site	103	8	118.84	109.97	8.87	Coniferous bog	High	F,E
Mine Site	104	8	3.57	3.47	0.10	Coniferous bog	High	F
Mine Site	105	8	15.48	0.00	15.48	Coniferous bog	High	
Mine Site	107	8	40.92	31.63	9.29	Coniferous bog	High	F,E
Mine Site	107A	7	1.74	1.69	0.05	Coniferous swamp	High	F,E
Mine Site	107B	3	4.51	2.89	1.62	Shallow marsh	High	F,E
Mine Site	107C	6	27.60	27.60	0.00	Alder thicket	High	E
Mine Site	114	8	0.73	0.73	0.00	Coniferous bog	High	F
Mine Site	120	3	0.58	0.12	0.46	Shallow marsh	Moderate	E
Mine Site	200	7	6.36	6.36	0.00	Hardwood swamp	High	F
Mine Site	201	2	13.49	13.49	0.00	Wet meadow	High	F
Mine Site	202	8	3.11	3.11	0.00	Open bog	High	F
Mine Site	552	8	8.72	8.72	0.00	Coniferous bog	High	F
Mine Site	567	3	1.40	1.40	0.00	Shallow marsh	High	F
MINE SITE SUBTOTAL	87		1297.78	758.19	539.59		80/87 High 7/87 Moderate	
Railroad Connection Corridor	1038	7	0.07	0.07	0.00	Coniferous swamp	High	F
Railroad Connection Corridor	R-3	6	0.10	0.10	0.00	Shrub-carr	High	F
Railroad Connection Corridor	R-4	6	0.20	0.20	0.00	Alder thicket	High	F
Railroad Connection Corridor	R-5	3	0.07	0.07	0.00	Shallow marsh	High	F
RAILROAD CONNECTION CORRIDOR SUBTOTAL	4		0.44	0.44	0.00		4/4 High	
Dunka Road and Utility Corridor	22B	3	0.34	0.34	0.00	Shallow marsh	High	F
Dunka Road and Utility Corridor	22C	6	0.38	0.38	0.00	Alder thicket	High	F
Dunka Road and Utility Corridor	54A	7	0.60	0.60	0.00	Coniferous swamp	High	F
Dunka Road and Utility Corridor	54B	6	0.13	0.13	0.00	Alder thicket	High	F

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Dunka Road and Utility Corridor	54D	7	0.09	0.09	0.00	Coniferous swamp	High	F
Dunka Road and Utility Corridor	390	6	0.41	0.41	0.00	Alder thicket	High	F
Dunka Road and Utility Corridor	392	6	0.14	0.14	0.00	Alder thicket	High	F
Dunka Road and Utility Corridor	394	7	0.64	0.64	0.00	Coniferous swamp	High	F
Dunka Road and Utility Corridor	395	7	0.01	0.01	0.00	Coniferous swamp	High	F
Dunka Road and Utility Corridor	396	6	0.65	0.65	0.00	Alder thicket	High	F
Dunka Road and Utility Corridor	400	8	0.14	0.14	0.00	Coniferous bog	High	F
Dunka Road and Utility Corridor	553	7	0.09	0.09	0.00	Coniferous swamp	High	F
Dunka Road and Utility Corridor	554	7	0.11	0.11	0.00	Coniferous swamp	High	F
Dunka Road and Utility Corridor	569	6	0.68	0.68	0.00	Alder thicket	High	F
Dunka Road and Utility Corridor	716	6	0.02	0.02	0.00	Alder thicket	High	F
Dunka Road and Utility Corridor	814	8	0.75	0.75	0.00	Coniferous bog	High	F
Dunka Road and Utility Corridor	862	6	0.78	0.78	0.00	Alder thicket	High	F
Dunka Road and Utility Corridor	1034	6	0.02	0.02	0.00	Alder thicket	High	F
Dunka Road and Utility Corridor	1035	6	0.16	0.16	0.00	Alder thicket	High	F
Dunka Road and Utility Corridor	1124	6	0.44	0.44	0.00	Alder thicket	High	F
Dunka Road and Utility Corridor	R-7	3	0.18	0.18	0.00	Shallow marsh	High	F
DUNKA ROAD AND UTILITY CORRIDOR SUBTOTAL	21		6.76	6.76	0.00		21/21 High	
FTB	251	6	1.43	1.43	0.00	Alder thicket	Moderate	C
FTB	272	4	1.11	1.10	0.01	Deep marsh	Low	C
FTB	278	6	1.04	0.23	0.81	Alder thicket	Low	C
FTB	279	6	4.84	3.33	1.51	Alder thicket	Low	C
FTB	282	3	14.25	7.42	6.83	Shallow marsh	Moderate	C
FTB	284	6	2.92	2.51	0.41	Alder thicket	Low	C
FTB	290	7	0.48	0.22	0.26	Coniferous swamp	Moderate	F,E
FTB	292	4	1.71	1.29	0.42	Deep marsh	Low	C
FTB	307	3	0.78	0.77	0.01	Shallow marsh	Low	C
FTB	308	4	7.17	1.95	5.22	Deep marsh	Low	C
FTB	309	2	0.02	0.02	0.00	Wet meadow	Low	C
FTB	312	6	1.98	1.33	0.65	Shrub-carr	Low	C
FTB	314	3	24.87	5.70	19.17	Shallow marsh	Low	C
FTB	573	3	0.12	0.00	0.12	Shallow marsh	Low	
FTB	582	4	27.49	8.11	19.38	Deep marsh	Low	C

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FTB	585	6	1.58	0.00	1.58	Alder thicket	Low	
FTB	586	4	1.89	1.53	0.36	Deep marsh	Low	C
FTB	587	3	0.97	0.17	0.80	Shallow marsh	Low	C
FTB	590	3	5.43	5.38	0.05	Shallow marsh	Low	C
FTB	591	4	2.71	0.70	2.01	Deep marsh	Low	C
FTB	593	4	9.80	8.47	1.33	Deep marsh	Low	C
FTB	594	4	0.06	0.00	0.06	Deep marsh	Low	
FTB	595	4	2.14	1.09	1.05	Deep marsh	Low	F
FTB	811	7	0.20	0.20	0.00	Coniferous swamp	Low	C
FTB	968	7	13.76	10.27	3.49	Coniferous swamp	Low	C
FTB	1027	6	0.20	0.00	0.20	Alder thicket	Moderate	
FTB	1125	2	0.07	0.07	0.00	Sedge meadow	Low	F
FTB	1126	7	0.69	0.69	0.00	Hardwood swamp	Low	F
FTB	1134	3	14.45	8.71	5.74	Shallow marsh	Low	C
FTB	1135	4	0.51	0.00	0.51	Deep marsh	Low	
FTB	1139	3	20.25	2.54	17.71	Shallow marsh	Low	C
FTB	1155	3	0.55	0.41	0.14	Shallow marsh	Low	C
FTB	1156	3	15.07	11.08	3.99	Shallow marsh	Low	C
FTB	1159	3	0.05	0.00	0.05	Shallow marsh	Low	
FTB	1160	5	0.85	0.00	0.85	Deep water	Low	
FTB	1176	7	0.34	0.00	0.34	Hardwood swamp	Moderate	
FTB	P10	6	0.34	0.00	0.34	Alder thicket	Low	
FTB	T1	4	1.93	0.11	1.82	Deep marsh	Low	F
FTB	T2	4	0.90	0.90	0.00	Deep marsh	Low	F
FTB	T3	2	0.09	0.09	0.00	Wet meadow	Low	F
FTB	T4	2	1.02	1.02	0.00	Wet meadow	Low	F
FTB	T5	2	0.24	0.24	0.00	Wet meadow	Low	F
FTB	T6	6	0.07	0.07	0.00	Shrub-carr	Low	F
FTB	T7	3	0.92	0.92	0.00	Shallow marsh	Low	F
FTB	T8	2	0.03	0.01	0.02	Wet meadow	Low	F
FTB	T10	4	1.48	1.48	0.00	Deep marsh	Low	F
FTB	T11	4	0.95	0.95	0.00	Deep marsh	Low	F
FTB	T12	3	0.39	0.39	0.00	Shallow marsh	Low	F

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FTB	T13	4	1.05	0.97	0.08	Deep marsh	Low	F
FTB	T13A	4	0.45	0.45	0.00	Deep marsh	Low	F
FTB	T14	4	45.20	45.20	0.00	Deep marsh	Low	E
FTB	T15	3	1.70	1.70	0.00	Shallow marsh	Low	F
FTB SUBTOTAL	52		238.25	140.93	97.32		5/52 Moderate 47/52 Low	
HRF	1155	3	35.45	6.89	28.56	Shallow marsh	Low	F
HRF	1159	3	0.62	0.62	0.00	Shallow marsh	Low	F
HRF SUBTOTAL	2		36.07	7.51	28.56		2/2 Low	
PROJECT TOTAL	166		1,579.24	913.83	665.41		105/166 High 12/166 Moderate 49/166 Low	

(1) Reference (13)

(2) The types of direct wetland impact disturbance factors include excavation €, fill (F), and containment system (C).

Large Table 2 Summary of Direct Wetland Impacts

Project Area	Circular 39 Wetland Classification	1	2	2	3	4	5	6	6	7	7	8	8	Wetland Total	
	Eggers and Reed Wetland Community ⁽¹⁾	Seasonally Flooded	Fresh (Wet) Meadow	Sedge Meadow	Shallow Marsh	Deep Marsh	Shallow, Open Water	Shrub-Carr	Alder Thicket	Hardwood Swamp	Coniferous Swamp	Open Bog	Coniferous Bog		Deepwater
Mine Site	Direct Impact (acres)	0.00	14.43	23.76	23.43	0.09	0.00	2.39	95.39	12.48	70.33	7.64	508.26	0.00	758.20
	# of directly impacted wetlands	0	3	2	6	1	0	1	11	2	7	4	22	0	59
Railroad Connection Corridor	Direct Impact (acres)	0.00	0.00	0.00	0.07	0.00	0.00	0.10	0.20	0.00	0.07	0.00	0.00	0.00	0.44
	# of directly impacted wetlands	0	0	0	1	0	0	1	1	0	1	0	0	0	4
Dunka Road and Utility Corridor	Direct Impact (acres)	0.00	0.00	0.00	0.52	0.00	0.00	0.00	3.81	0.00	1.54	0.00	0.89	0.00	6.76
	# of directly impacted wetlands	0	0	0	2	0	0	0	11	0	6	0	2	0	21
FTB	Direct Impact (acres)	0.00	1.38	0.07	45.19	74.01	0.00	1.40	7.50	0.69	10.69	0.00	0.00	0.00	140.93
	# of directly impacted wetlands	0	5	1	12	15	0	2	4	1	3	0	0	0	43
HRF	Direct Impact (acres)	0.00	0.00	0.00	7.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.51
	# of directly impacted wetlands	0	0	0	2	0	0	0	0	0	0	0	0	0	2
Total	(acres)	0.00	15.81	23.83	76.72	74.10	0.00	3.89	106.90	13.17	82.63	7.64	509.15	0.00	913.84

(1) Reference (13)

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Mine Pits																			
		0 - 500 Feet	500 - 1,000 Feet	1,000 – 1,500 Feet	1,500 – 2,000 Feet	2,000 – 2,500 Feet	2,500 – 3,000 Feet	3,000 – 3,500 Feet	3,500 – 4,000 Feet	4,000 – 4,500 Feet	4,500 – 5,000 Feet	5,000 – 5,500 Feet	5,500 – 6,000 Feet	6,000 – 6,500 Feet	6,500 – 7,000 Feet	7,000 – 7,500 Feet	7,500 – 8,000 Feet	8,000 – 8,500 Feet	8,500 – 9,000 Feet	9,000 – 9,500 Feet	9,500 – 10,000 Feet
101	Coniferous bog	2.26	0.21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
103	Coniferous bog	8.86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
104	Coniferous bog	0	0	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105	Coniferous bog	0	0	0	0	0	0	0	0	0	5.78	8.38	1.31	0	0	0	0	0	0	0	0
105A	Coniferous bog	0	0	0	0	0	0	0	0	0	0.04	0.09	0	0	0	0	0	0	0	0	0
106	Coniferous swamp	0	0	0	0	0	1.60	10.47	4.55	8.97	28.37	26.58	3.00	0	0	0	0	0	0	0	0
106B	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0.16	16.44	4.72	0	0	0	0	0
106C	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	5.70	10.75	3.48	0	0	0	0	0
106D	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.79	16.01	1.00	0	0	0
107	Coniferous bog	7.94	1.35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
107A	Coniferous swamp	0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
107B	Shallow marsh	1.61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
120	Shallow marsh	0	0	0	0	0	0.46	0	0	0	0	0	0	0	0	0	0	0	0	0	0
315	Alder thicket or Shrub-carr	0	0	6.31	10.90	34.96	60.64	57.68	46.65	44.89	25.08	16.34	6.77	12.04	0.42	0	0	0	0	0	0
394A	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.48	6.95	21.58	37.21
396A	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.80	1.88	0	0	0
397	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0.54	11.99	23.56	29.74	39.05	37.66	34.16	34.53
404	Coniferous swamp	0	0	0	0	0	0	0	1.09	8.72	2.97	0	0	0	0	0	0	0	0	0	0
406	Coniferous bog	0	0	0	0	2.26	0.17	0	0	0	0	0	0	0	0	0	0	0	0	0	0
407	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	2.27	6.93	5.38	0	0	0	0

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Mine Pits																			
		0 - 500 Feet	500 - 1,000 Feet	1,000 – 1,500 Feet	1,500 – 2,000 Feet	2,000 – 2,500 Feet	2,500 – 3,000 Feet	3,000 – 3,500 Feet	3,500 – 4,000 Feet	4,000 – 4,500 Feet	4,500 – 5,000 Feet	5,000 – 5,500 Feet	5,500 – 6,000 Feet	6,000 – 6,500 Feet	6,500 – 7,000 Feet	7,000 – 7,500 Feet	7,500 – 8,000 Feet	8,000 – 8,500 Feet	8,500 – 9,000 Feet	9,000 – 9,500 Feet	9,500 – 10,000 Feet
409	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.16	11.30	11.10	15.53	19.45
410	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.07	1.96	0	0	0	0
457	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.90	16.40	31.66
458	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33
459	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.29	7.47	5.00	5.87	8.89	4.50
460	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	1.82	4.82	0.09	0	0	0	0	0
461	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.85	2.80
465	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.53	5.58	11.36	3.29	0
466	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	6.35	6.25	6.88	4.28	1.10	0	0
467	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	2.20	10.27	7.10	8.72	1.29	0	0
468	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.46	6.45	8.81	3.95	0	0
470	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.20
473	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.64	3.52	0.50
474	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.15	10.08	8.18	0.02	0	0
477	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.69
478	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.21	1.79	0
479	Coniferous bog	0	0	0	0	0	0	0	0	0.94	13.70	9.82	9.28	2.74	0.40	0	0	0	0	0	0
480	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	4.44	2.84	1.59	0	0	0	0	0	0	0	0
487	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.13	4.14	7.32

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Mine Pits																			
		0 - 500 Feet	500 - 1,000 Feet	1,000 - 1,500 Feet	1,500 - 2,000 Feet	2,000 - 2,500 Feet	2,500 - 3,000 Feet	3,000 - 3,500 Feet	3,500 - 4,000 Feet	4,000 - 4,500 Feet	4,500 - 5,000 Feet	5,000 - 5,500 Feet	5,500 - 6,000 Feet	6,000 - 6,500 Feet	6,500 - 7,000 Feet	7,000 - 7,500 Feet	7,500 - 8,000 Feet	8,000 - 8,500 Feet	8,500 - 9,000 Feet	9,000 - 9,500 Feet	9,500 - 10,000 Feet
539	Deep marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.01	8.34
540	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.45
546	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	5.93	20.25	24.83	39.97	47.95	30.85	19.89	33.37
547	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.58	9.57	1.18	0	0	0
548	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.25	10.11	1.21
553A	Coniferous swamp	0	0	0	0	0	0	0.73	1.73	0	0	0	0	0	0	0	0	0	0	0	0
554A	Coniferous swamp	0	0	0	0	0	0	0	0.83	1.22	0	0	0	0	0	0	0	0	0	0	0
555	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	2.45	3.28	9.06	20.65	25.15	25.81	16.25	11.96	11.14	4.04	1.44	0.40
556	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	1.84	0	0	0	0	0	0	0	0	0
557	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	2.72	0.20	0	0	0	0	0	0	0	0	0	0
558	Coniferous bog	0	0	0	0	0	0	0	0		4.65	7.57	3.85	0	0	0	0	0	0	0	0
559	Coniferous bog	0	0	0	0	0	0	0.09	2.61	7.89	10.74	8.29	4.49	0.01	0	0	0	0	0	0	0
561	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.87	11.82	3.84
562	Coniferous bog	0	0	0	0	0	3.60	1.67	0	0	0	0	0	0	0	0	0	0	0	0	0
564	Coniferous bog	0	0	0	0	0	0	0.44	3.14	0	0	0	0	0	0	0	0	0	0	0	0
565	Alder thicket or Shrub-carr	0	0	0	0	0.06	1.85	0	0	0	0	0	0	0	0	0	0	0	0	0	0
566	Alder thicket or Shrub-carr	0	0	0	0	0	0	2.54	3.00	0.32	0	0	0	0	0	0	0	0	0	0	0
568	Deep marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.32	0.10	0	0	0	0
569A	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	1.17	3.89	3.25	0	0	0	0	0
570	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.69	10.02	5.27	8.71	12.38	4.88

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Mine Pits																			
		0 - 500 Feet	500 - 1,000 Feet	1,000 - 1,500 Feet	1,500 - 2,000 Feet	2,000 - 2,500 Feet	2,500 - 3,000 Feet	3,000 - 3,500 Feet	3,500 - 4,000 Feet	4,000 - 4,500 Feet	4,500 - 5,000 Feet	5,000 - 5,500 Feet	5,500 - 6,000 Feet	6,000 - 6,500 Feet	6,500 - 7,000 Feet	7,000 - 7,500 Feet	7,500 - 8,000 Feet	8,000 - 8,500 Feet	8,500 - 9,000 Feet	9,000 - 9,500 Feet	9,500 - 10,000 Feet
571	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.29	2.85
678	Alder thicket	0	0	0	0	0	0	0	0	0	0.15	14.50	15.18	18.90	9.66	0	0	0	0	0	0
679	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0.50	0	0	0	0	0	0	0	0	0
68	Coniferous swamp	7.97	4.94	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
681	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0.88	1.21	0	0	0	0	0	0	0
682	Open bog	0	0	0	0	0	0	0	0	0	0	0	2.14	0.02	0	0	0	0	0	0	0
688	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	1.28	0.74	0	0	0	0	0	0
689	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	4.20	0.42	0	0	0	0	0	0
691	Alder thicket	0	0	0	0	0	0	0	0	0	0	0.35	3.62	2.27	0	0	0	0	0	0	0
693	Coniferous bog	0	0	0	0	0	0	0	0	0	0	3.46	8.87	0	0	0	0	0	0	0	0
695	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	3.30	0	0	0	0	0	0	0	0
697	Coniferous bog	0	0	0	0	0	0	0	0	2.52	2.02	0	0	0	0	0	0	0	0	0	0
699	Coniferous bog	0	0	0	0	0	0	0	0.76	1.44	0	0	0	0	0	0	0	0	0	0	0
700	Open bog	0	0	0	0	0	0	0	0	0	0	0.63	0	0	0	0	0	0	0	0	0
701	Coniferous swamp	0	0	0	0.37	12.42	28.46	32.50	56.82	22.12	0.24	0	0	0	0	0	0	0	0	0	0
708	Shallow marsh	0	0	0	0	0	0	0	0	1.31	2.61	0	0	0	0	0	0	0	0	0	0
709	Shallow marsh	0	0	0	0	0	0	0	0	0	1.70	6.43	0	0	0	0	0	0	0	0	0
713	Coniferous bog	0	0	0	0	0	0	0	0	1.13	6.33	0.44	0	0	0	0	0	0	0	0	0
714	Coniferous bog	0	0	0	0	0	19.80	44.26	45.74	28.37	18.99	19.10	13.19	5.08	0.12	0	0	0	0	0	0
716A	Alder thicket	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.08
725	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.62	5.21	2.17
726	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0.92	5.18	0.72	0	0	0	0	0

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Mine Pits																			
		0 - 500 Feet	500 - 1,000 Feet	1,000 - 1,500 Feet	1,500 - 2,000 Feet	2,000 - 2,500 Feet	2,500 - 3,000 Feet	3,000 - 3,500 Feet	3,500 - 4,000 Feet	4,000 - 4,500 Feet	4,500 - 5,000 Feet	5,000 - 5,500 Feet	5,500 - 6,000 Feet	6,000 - 6,500 Feet	6,500 - 7,000 Feet	7,000 - 7,500 Feet	7,500 - 8,000 Feet	8,000 - 8,500 Feet	8,500 - 9,000 Feet	9,000 - 9,500 Feet	9,500 - 10,000 Feet
727	Open bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0.26	0	0	0	0	0	0
728	Open bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0
729	Sedge meadow	0	0	0	0	0	0	0	0	0	0	0	0	0.57	0.20	0	0	0	0	0	0
730	Open bog	0	0	0	0	0	0	0	0	0	0	0.27	0	0	0	0	0	0	0	0	0
731	Shallow open water	0	0	0	0	0	0	0	0	0	0	0	0	0.15	0	0	0	0	0	0	0
732	Open bog	0	0	0	0	0	0	0	0	0	0	0	0	0.10	0	0	0	0	0	0	0
733	Open bog	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0
734	Open bog	0	0	0	0	0	0	0	0	0	0	0	0.26	0	0	0	0	0	0	0	0
735	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0.91	0	0	0	0	0	0
736	Alder thicket	0	0	0	0	0	0	0	0	0	0	0	0.16	0.42	0	0	0	0	0	0	0
737	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0.17	0.25	0	0	0	0	0	0	0
738	Open bog	0	0	0	0	0	0	0	0	0	0	0	0	0.59	0	0	0	0	0	0	0
739	Open bog	0	0	0	0	0	0	0	0	0	0	0	0	0.26	0	0	0	0	0	0	0
740	Open bog	0	0	0	0	0	0	0	0	0	0	0	0	0.15	0	0	0	0	0	0	0
741	Alder thicket	0	0	0	0	0	0	0	0	0	0	0	0.20	0.38	0	0	0	0	0	0	0
742	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0.01	2.56	0.91	0	0	0	0	0	0	0
743	Alder thicket	0	0	0	0	0	0	0	0	0	0.44	0.20	0	0	0	0	0	0	0	0	0
744	Alder thicket	0	0	0	0	0	0	0	0	0	0.96	0	0	0	0	0	0	0	0	0	0
745	Coniferous swamp	0	0	0	0	0	0	5.66	6.23	1.43	0	0	0	0	0	0	0	0	0	0	0
746	Alder thicket	0	0	0	0	0	0	0	0	0.33	0	0	0	0	0	0	0	0	0	0	0
747	Alder thicket	0	0	0	0	0	0	0	0.23	0.70	0	0	0	0	0	0	0	0	0	0	0
748	Alder thicket	0	0	0	0	0	0	0	0	0.47	0	0	0	0	0	0	0	0	0	0	0
749	Alder thicket	0	0	0	0	0	0	0	0	0.69	8.52	0.23	0	0	0	0	0	0	0	0	0
752	Alder thicket	0	0	0	0	0	0	0.16	3.43	0	0	0	0	0	0	0	0	0	0	0	0
753	Alder thicket	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.27	0.25	0	0
754	Hardwood swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.18	0.80	0	0	0	0
755	Alder thicket	0	0	0	0	0	0	0	0	0	0	0	0	0	0.29	0.36	0	0	0	0	0

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Mine Pits																			
		0 - 500 Feet	500 - 1,000 Feet	1,000 - 1,500 Feet	1,500 - 2,000 Feet	2,000 - 2,500 Feet	2,500 - 3,000 Feet	3,000 - 3,500 Feet	3,500 - 4,000 Feet	4,000 - 4,500 Feet	4,500 - 5,000 Feet	5,000 - 5,500 Feet	5,500 - 6,000 Feet	6,000 - 6,500 Feet	6,500 - 7,000 Feet	7,000 - 7,500 Feet	7,500 - 8,000 Feet	8,000 - 8,500 Feet	8,500 - 9,000 Feet	9,000 - 9,500 Feet	9,500 - 10,000 Feet
756	Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.54	0	0	0	0	0
757	Open bog	0	0	0	0	0	0	0	0	0	0	0	0	0.30	0	0	0	0	0	0	0
759	Open bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	5.79	4.29	0	0	0
760	Hardwood swamp	0	0	0	0	0	0	0	0	0	0	0	0	0.57	0	0	0	0	0	0	0
764	Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.65	3.28	4.12	3.41	13.77	24.20
765	Alder thicket	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.15	0
766	Alder thicket	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.88	0	0
768	Hardwood swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.29
773	Coniferous bog	0	0	0	4.96	3.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
774	Coniferous bog	0	0	0	0	0	5.29	2.93	0	0	0	0	0	0	0	0	0	0	0	0	0
775	Hardwood swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.78	2.28	0
776	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.61	2.89	0.39	0	0
777	Open bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0	0	0	0	0
778	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0.02	0.46	0	0	0	0	0	0	0	0
779	Alder thicket	0	0	0	0	0	0	0	0	0	0	0.96	0.07	0	0	0.55	0	0	0	0	0
780	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0.45	1.00	0	0	0	0	0	0	0	0
781	Coniferous bog	0	0	0	0	0	0	0	0	0.62	0.00	0	0	0	0	0	0	0	0	0	0
782	Coniferous bog	0	0	0	0	0	0	0	0		0.99	1.11	0	0	0	0	0	0	0	0	0
783	Coniferous bog	0	0	0	0	0	0	0	0	0.83	1.09	0	0	0	0	0	0	0	0	0	0
784	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	1.41	0.24	0	0	0	0	0	0	0
785	Alder thicket	0	0	0	0	0	0	0	0	0	0	0	0	1.33	0	0	0	0	0	0	0
790	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.59	2.81	2.09
791	Lake	0	0	0	0	0	0	0	0	0	0	0	0	1.01	16.84	11.83	0.91	0	0	0	0

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Mine Pits																			
		0 - 500 Feet	500 - 1,000 Feet	1,000 – 1,500 Feet	1,500 – 2,000 Feet	2,000 – 2,500 Feet	2,500 – 3,000 Feet	3,000 – 3,500 Feet	3,500 – 4,000 Feet	4,000 – 4,500 Feet	4,500 – 5,000 Feet	5,000 – 5,500 Feet	5,500 – 6,000 Feet	6,000 – 6,500 Feet	6,500 – 7,000 Feet	7,000 – 7,500 Feet	7,500 – 8,000 Feet	8,000 – 8,500 Feet	8,500 – 9,000 Feet	9,000 – 9,500 Feet	9,500 – 10,000 Feet
792	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	1.36	5.59	0.15	0	0	0	0
802	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	3.55	6.23	8.90	9.00	5.19	2.69	4.51
805	Deep marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
807	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.07	3.61
808	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	1.69	8.31	6.90	3.41	0	0	0	0	0
856	Coniferous swamp	0	0	0.00	6.90	2.74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
864	Coniferous swamp	0	0	0	0	0	0.02	9.54	25.19	30.52	28.01	13.68	5.38	0.14	0	0	0	0	0	0	0
885	Open bog	0	0	0	0	0	0	0	12.96	37.36	37.85	23.34	9.32	10.84	5.11	2.46	0	0	0	0	0
887	Coniferous bog	0	0	0	0	0	0.65	20.75	43.72	33.07	27.97	44.84	54.45	47.30	44.90	50.38	51.06	43.00	29.33	20.15	14.11
888	Coniferous bog	0	1.18	36.50	50.85	55.24	25.94	14.79	8.37	0	0	0	0	0	0	0	0	0	0	0	0
889	Shallow marsh	0	0	0	0	12.22	17.96	6.48	0.31	0	0	0	0	0	0	0	0	0	0	0	0
890	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	3.34	11.24	19.69	3.00	0	0	0	0	0	0	0	0
891	Coniferous swamp	0	0	0	0	0	0	0	0	0.58	6.36	7.82	0.02	0	0	0	0	0	0	0	0
899	Open bog	0	0	0	0	0.68	10.96	16.35	2.15	0	0	0	0	0	0	0	0	0	0	0	0
900	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.23	7.97	1.37	0	0	0
901	Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0.02	0.46	0	0	0	0	0	0	0
903	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.89	3.64	4.17	0
904	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	2.33	0	0	0	0	0	0
906	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.87	3.38	0	0
924	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.58	0.03	0
925	Open bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.93	2.46	0
930	Open bog	0	0	0	0	0	0	0	0	0	0	0	0	0.05	2.18	0	0	0	0	0	0

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Mine Pits																			
		0 - 500 Feet	500 - 1,000 Feet	1,000 - 1,500 Feet	1,500 - 2,000 Feet	2,000 - 2,500 Feet	2,500 - 3,000 Feet	3,000 - 3,500 Feet	3,500 - 4,000 Feet	4,000 - 4,500 Feet	4,500 - 5,000 Feet	5,000 - 5,500 Feet	5,500 - 6,000 Feet	6,000 - 6,500 Feet	6,500 - 7,000 Feet	7,000 - 7,500 Feet	7,500 - 8,000 Feet	8,000 - 8,500 Feet	8,500 - 9,000 Feet	9,000 - 9,500 Feet	9,500 - 10,000 Feet
931	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	1.54	2.78	0	0	0	0	0	0
949	Coniferous bog	0	0	0	0	0	0	0	0	0.30	1.50	0	0	0	0	0	0	0	0	0	0
972	Hardwood swamp	0	0	0	0	0	0	0.90	0	0	0	0	0	0	0	0	0	0	0	0	0
973	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.47	4.59	3.93	0	0	0
984	Coniferous bog	0	0	0	0	14.64	0.41	0	0	0	0	0	0	0	0	0	0	0	0	0	0
997	Shallow marsh	0	0	0	0	0	0	0	0	0	0	1.15	0.36	0	0	0	0	0	0	0	0
999	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0.01	0.70	0	0	0	0	0	0	0	0
1004	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0	0.94	0	0	0	0	0	0	0
1005	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.91	0.50	0
1131	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0.36	4.19	0	0	0	0	0	0	0
1132	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.16	0	0	0	0	0
1136	Deep marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.12	11.88	24.49	3.01	0
1137	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.76	4.35	6.73	0.25	0	0
1138	Deep marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.59	0.64		0	0	0
1144	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.08	9.41	14.78	19.60	7.49	0.44
1145	Coniferous swamp	0	0	0	0	0	0	0	0	0	2.80	16.78	23.58	28.22	8.51	0.66	0	0	0	0	0
1146	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.39	2.77	0	0	0	0
1149	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.80	0	0	0	0	0
1153	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.39	9.39	4.14	0	0	0
1154	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	4.06	11.06	1.99	0	0	0	0	0
Total acres of wetland		118.36	114.99	147.94	162.94	195.14	231.13	291.33	351.58	306.52	326.40	357.56	345.18	355.05	381.79	343.77	405.60	422.32	348.93	318.66	298.94

(1) Reference (13)

Large Table 4 Summary of Wetlands within 500-foot Increments – Mine Site Area

Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Mine Pits																			
	0 - 500 Feet	500 - 1,000 Feet	1,000 - 1,500 Feet	1,500 - 2,000 Feet	2,000 - 2,500 Feet	2,500 - 3,000 Feet	3,000 - 3,500 Feet	3,500 - 4,000 Feet	4,000 - 4,500 Feet	4,500 - 5,000 Feet	5,000 - 5,500 Feet	5,500 - 6,000 Feet	6,000 - 6,500 Feet	6,500 - 7,000 Feet	7,000 - 7,500 Feet	7,500 - 8,000 Feet	8,000 - 8,500 Feet	8,500 - 9,000 Feet	9,000 - 9,500 Feet	9,500 - 10,000 Feet
Alder thicket	21.62	5.85	30.82	45.52	32.05	18.16	35.08	59.88	50.11	59.13	90.36	149.08	130.72	62.67	40.76	33.10	41.12	38.04	33.12	16.10
Alder thicket or Shrub-carr	0	0	6.31	13.35	35.02	62.49	60.22	49.65	53.72	44.24	49.77	32.01	38.36	33.82	44.36	50.24	50.64	34.92	46.90	54.54
Coniferous bog	84.21	94.51	103.53	85.82	93.07	70.80	102.23	123.03	88.08	97.57	118.94	116.91	122.29	203.43	187.58	221.64	216.50	144.79	120.87	101.11
Coniferous swamp	10.81	7.96	0.96	13.45	21.46	44.20	69.51	102.76	74.59	68.75	64.88	34.13	47.67	57.03	49.68	75.88	78.83	80.02	75.97	86.37
Deep marsh	0.01	4.93	0	0	0	0	0	0	0	0	0	0	0	0	1.91	1.86	12.64	29.93	5.62	8.34
Hardwood swamp	0	0	0	0.31	0	0	0.90	0	0	0	0	0	0.57	0	0.18	0.80	0	0.78	2.28	4.29
Lake	0	0	0	0	0	0	0	0	0	0	0	0	1.01	16.84	11.83	0.91	0	0	0	0
Open bog	0	0	3.97	2.74	0.68	10.96	16.35	15.11	37.36	40.30	25.78	11.97	12.31	7.80	6.12	17.89	16.58	12.81	13.15	0
Sedge meadow	0.10	0	0	0	0.12	1.05	0	0	0	0	0	0	0.57	0.20	0	0	0	0	0	0
Sedge meadow or Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.70
Shallow marsh	1.61	1.74	2.35	1.75	12.22	20.04	6.48	1.15	2.66	16.41	7.83	1.06	0.94	0	0.16	0	1.89	4.23	6.98	3.29
Shallow, open water	0	0	0	0	0	0	0	0	0	0	0	0	0.15	0	0	0	0	0	0	0
Shrub-carr	0	0	0	0	0.52	3.43	0	0	0	0	0	0.02	0.46	0	1.19	3.28	4.12	3.41	13.77	24.20
Wet meadow	0	0	0	0	0	0	0.56	0.00	0	0	0	0	0	0	0	0	0	0	0	0
Total acres of wetland	118.36	114.99	147.94	162.94	195.14	231.13	291.33	351.58	306.52	326.40	357.56	345.18	355.05	381.79	343.77	405.60	422.32	348.93	318.66	298.94

(1) Reference (13)

Large Table 5
Wetland and Watershed Acreages During Existing Operations Conditions, and Reclamation Conditions – Mine Site

Wetland ID ⁽²⁾	Eggers and Reed Wetland Type	Change in Equivalent Yield ⁽³⁾ (%)	Pre-Mining (Existing) Conditions					Operations Conditions ⁽¹⁾					Reclamation Conditions							
			Watershed Total Area (acres)	Upland Area (acres)	Wetland Area (acres)	Wetland Area (%)	Tributary Acres per Wetland Acre	Contributing Net Precipitation (ac-ft/yr)	Watershed Total Area (acres)	Upland Area (acres)	Wetland Area (acres)	Wetland Area (%)	Tributary Acres per Wetland Acre	Contributing Net Precipitation (ac-ft/yr)	Watershed Total Area (acres)	Upland Area (acres)	Wetland Area (acres)	Wetland Area (%)	Tributary Acres per Wetland Acre	Contributing Net Precipitation (ac-ft/yr)
1	shallow marsh	0%	2.63	2.21	0.42	16.0%	6.26	6.14	2.63	2.21	0.42	16.0%	6.26	6.14	2.64	2.21	0.42	16.1%	6.22	5.86
3	shallow marsh	0%	1.95	1.60	0.35	17.9%	5.57	5.46	1.95	1.60	0.35	17.9%	5.57	5.46	1.95	1.60	0.35	18.1%	5.51	5.19
5	wet meadow	R	5.99	5.38	0.61	10.2%	9.82	9.63												
6	shallow marsh	50%	3.22	2.60	0.62	19.3%	5.19	5.09	1.61	0.99	0.62	38.5%	2.60	2.55	3.22	2.60	0.62	19.2%	5.21	4.91
7	wet meadow	0%	0.72	0.65	0.07	9.7%	10.29	10.09	0.72	0.65	0.07	9.7%	10.29	10.09	0.72	0.65	0.07	9.2%	10.88	10.25
8	sedge meadow	R	33.23	26.43	6.80	20.5%	4.89	4.79	2.94	2.94	0.00			33.24	26.43	6.80	20.5%	4.89	4.60	
9	shallow marsh	18%	8.04	6.24	1.80	22.4%	4.47	4.38	6.36	4.63	1.73	27.2%	3.68	3.61	8.04	6.31	1.73	21.5%	4.65	4.38
10	sedge meadow	0%	9.64	8.47	1.17	12.1%	8.24	8.08	9.64	8.47	1.17	12.1%	8.24	8.08	9.63	8.47	1.17	12.1%	8.25	7.77
11	coniferous bog	NA	23.99	15.11	8.88	37.0%	2.70	2.65	23.99	15.11	8.88	37.0%	2.70	2.65	23.99	15.11	8.88	37.0%	2.70	2.54
12	alder thicket	0%	0.13	0.00	0.13	100.0%	1.00	0.98	0.13	0.00	0.13	100.0%	1.00	0.98	0.13	0.00	0.13	100.0%	1.00	0.94
13	deep marsh	11%	11.60	6.57	5.03	43.4%	2.31	2.26	10.13	5.19	4.94	48.8%	2.05	2.01	11.60	6.66	4.94	42.6%	2.35	2.21
14	wet meadow	R	4.44	4.11	0.33	7.4%	13.45	13.20							4.25	3.92	0.33	7.8%	12.86	12.11
16	shallow marsh	86%	15.07	14.76	0.31	2.1%	48.61	47.68	2.08	1.77	0.31	14.9%	6.71	6.58	15.06	14.76	0.31	2.0%	48.88	46.03
18	shallow marsh	R	38.67	19.77	18.90	48.9%	2.05	2.01												
19	shallow marsh	-2%	8.46	6.78	1.68	19.9%	5.04	4.94	8.38	6.75	1.63	19.5%	5.14	5.04	8.46	6.83	1.63	19.2%	5.20	4.90
20	sedge meadow	30%	24.44	7.38	17.06	69.8%	1.43	1.41	0.10	0.10	0.10	100.0%	1.00	0.98	0.10	0.10	0.10	100.0%	1.00	0.94
22	shallow marsh	0%	3.47	2.04	1.43	41.2%	2.43	2.38	3.47	2.04	1.43	41.2%	2.43	2.38	3.47	2.04	1.43	41.1%	2.43	2.29
22A	coniferous swamp	0%	12.49	11.60	0.89	7.1%	14.03	13.76	12.49	11.60	0.89	7.1%	14.03	13.76	12.49	11.60	0.89	7.1%	14.06	13.24
22E	coniferous swamp	0%	8.06	5.61	2.45	30.4%	3.29	3.23	8.06	5.61	2.45	30.4%	3.29	3.23	8.06	5.61	2.45	30.4%	3.29	3.10
24	alder thicket	57%	12.68	11.88	0.80	6.3%	15.85	15.55	2.78	2.37	0.41	14.7%	6.78	6.65	2.79	2.37	0.41	14.8%	6.73	6.34
25	coniferous bog	NA	5.59	3.64	1.95	34.9%	2.87	2.81	5.59	3.64	1.95	34.9%	2.87	2.81	5.59	3.64	1.95	34.8%	2.87	2.70
27	coniferous swamp	R	13.33	12.26	1.07	8.0%	12.46	12.22												
29	shallow marsh	7%	22.17	10.15	12.02	54.2%	1.84	1.81	20.64	8.62	12.02	58.2%	1.72	1.68	22.16	10.15	12.02	54.2%	1.84	1.74
32	coniferous bog	-159%	131.46	58.10	73.36	55.8%	1.79	1.76	10.98	8.61	2.37	21.6%	4.63	4.54	45.79	0.90	44.89	98.0%	1.02	0.96
33A	alder thicket	30%	43.79	25.33	18.46	42.2%	2.37	2.33	21.11	8.42	12.69	60.1%	1.66	1.63	21.12	8.42	12.69	60.1%	1.66	1.57
33B	coniferous swamp	0%	9.16	4.60	4.56	49.8%	2.01	1.97	9.16	4.60	4.56	49.8%	2.01	1.97	9.16	4.60	4.56	49.8%	2.01	1.89
37	shrub-carr	R	11.22	8.83	2.39	21.3%	4.69	4.60												
43	alder thicket	56%	25.17	16.88	8.29	32.9%	3.04	2.98	1.39	0.36	1.03	74.1%	1.35	1.32	25.17	16.88	8.29	32.9%	3.04	2.86
44	alder thicket	-65%	20.79	17.52	3.27	15.7%	6.36	6.24	13.42	12.14	1.28	9.5%	10.48	10.28	13.42	12.14	1.28	9.5%	10.52	9.91
45	alder thicket	-63%	70.31	32.76	37.55	53.4%	1.87	1.84	26.67	17.95	8.72	32.7%	3.06	3.00	29.15	20.43	8.72	29.9%	3.34	3.15
47	open bog	R	28.60	28.06	0.54	1.9%	52.96	51.95												
48	coniferous bog	20%	199.33	110.17	89.16	44.7%	2.24	2.19	109.87	48.51	61.36	55.8%	1.79	1.76	188.28	120.80	67.47	35.8%	2.79	2.63
48A	coniferous swamp	60%	6.68	4.03	2.65	39.7%	2.52	2.47	0.44	0.00	0.44	100.0%	1.00	0.98	4.87	4.43	0.44	9.0%	11.06	10.42
51	alder thicket	-3635%	18.60	11.13	7.47	40.2%	2.49	2.44	1.86	1.84	0.02	1.1%	93.00	91.22	18.29	14.93	3.36	18.4%	5.44	5.12
52	alder thicket	R	23.44	19.56	3.88	16.6%	6.04	5.93	1.88	1.88	0.00			23.44	20.80	2.64	11.3%	8.89	8.37	
53	alder thicket	0%	53.71	35.12	18.59	34.6%	2.89	2.83	53.71	35.12	18.59	34.6%	2.89	2.83	53.70	35.12	18.59	34.6%	2.89	2.72
53A	coniferous swamp	0%	3.77	1.42	2.35	62.3%	1.60	1.57	3.77	1.42	2.35	62.3%	1.60	1.57	3.77	1.42	2.35	62.3%	1.60	1.51
53B	coniferous swamp	20%	6.14	5.71	0.43	7.0%	14.28	14.01	4.92	4.49	0.43	8.7%	11.44	11.22	6.14	5.71	0.43	7.0%	14.29	13.45
53C	coniferous swamp	36%	24.02	21.14	2.88	12.0%	8.34	8.18	15.41	12.53	2.88	18.7%	5.35	5.25	24.15	21.27	2.88	11.9%	8.38	7.89
53D	coniferous swamp	0%	1320.57	651.40	669.17	50.7%	1.97	1.94	1319.65	650.48	669.17	50.7%	1.97	1.93	1321.47	652.30	669.17	50.6%	1.97	1.86
54	coniferous swamp	0%	36.06	31.95	4.11	11.4%	8.77	8.61	36.06	31.95	4.11	11.4%	8.77	8.61	36.06	31.95	4.11	11.4%	8.78	8.27
54C	alder thicket	0%	0.74	0.00	0.74	100.0%	1.00	0.98	0.74	0.00	0.74	100.0%	1.00	0.98	0.74	0.00	0.74	100.0%	1.00	0.94
54E	alder thicket	-7%	5.82	3.22	2.60	44.7%	2.24	2.20	6.21	3.61	2.60	41.9%	2.39	2.34	6.21	3.61	2.60	41.9%	2.39	2.25
54F	alder thicket	0%	0.43	0.00	0.43	100.0%	1.00	0.98	0.43	0.00	0.43	100.0%	1.00	0.98	0.43	0.00	0.43	100.0%	1.00	0.94
54G	alder thicket	33%	6.48	4.94	1.54	23.8%	4.21	4.13	4.36	2.82	1.54	35.3%	2.83	2.78	6.47	4.94	1.54	23.8%	4.21	3.96
55	alder thicket	-364%	17.70	13.79	3.91	22.1%	4.53	4.44	1.26	1.20	0.06	4.8%	21.00	20.60	17.70	13.79	3.91	22.1%	4.52	4.26
56	open bog	R	13.21	10.42	2.79	21.1%	4.73	4.64	2.48	2.48										
57	coniferous swamp	-12%	137.06	59.00	78.06	57.0%	1.76	1.72	54.12	26.55	27.57	50.9%	1.96	1.93	54.12	26.55	27.56	50.9%	1.96	1.85
58	alder thicket	0%	107.19	72.61	34.58	32.3%	3.10	3.04	107.19	72.61	34.58	32.3%	3.10	3.04	107.20	72.61	34.58	32.3%	3.10	2.92
60	alder thicket	R	28.48	21.77	6.71	23.6%	4.24	4.16							0.00					
61	coniferous swamp	0%	2.70	2.25	0.45	16.7%	6.00	5.89	2.70	2.25	0.45	16.7%	6.00	5.89	2.70	2.25	0.45	16.7%	5.98	5.63
62	coniferous bog	NA	24.35	12.22	12.13	49.8%	2.01	1.97	24.35	12.22	12.13	49.8%	2.01	1.97	24.35	12.22	12.13	49.8%	2.01	1.89
64	hardwood swamp	0%	4.80	4.49	0.31	6.5%	15.48	15.19	4.80	4.49	0.31	6.5%	15.48	15.19	4.79	4.49	0.31	6.4%	15.68	14.77
68	coniferous swamp	23%	59.24	35.43	23.81	40.2%	2.49	2.44	24.73	11.81	12.92	52.2%	1.91	1.88	39.78	26.51	13.27	33.4%	3.00	2.82
72	coniferous swamp	0%	5.67	4.28	1.39	24.5%	4.08	4.00	5.67	4.28	1.39	24.5%	4.08	4.00	5.66	4.28	1.39	24.5%	4.09	3.85
74	hardwood swamp	R	10.64	4.52	6.12	57.5%	1.74	1.71												
76	coniferous bog	NA	13.10	9.18	3.92	29.9%	3.34	3.28	6.49	4.78	1.71	26.3%	3.80	3.72	6.49	4.78	1.71	26.3%	3.80	3.58
77	coniferous bog	NA	25.28	12.27	13.01	51.5%	1.94	1.91	15.20	3.11	12.09	79.5%	1.26	1.23	17.18	4.18	13.01	75.7%	1.32	1.24
78	coniferous bog	R	5.73	3.98	1.75	30.5%	3.27	3.21												
79	coniferous bog	NA	10.62	8.23	2.39	22.5%	4.44	4.36	10.62	8.23	2.39	22.5%	4.44	4.36	10.62	8.23	2.39	22.5%	4.45	4.19
80	coniferous bog	-17%	5.68	5.39	0.29	5.1%	19.59	19.21	1.61	1.54	0.07	4.3%	23.00	22.56	1.61	1.54	0.07	4.4%	22.93	21.59
81	coniferous swamp	-41%	51.06	49.38	1.68	3.3%	30.39	29.81	10.32	10.08	0.24	2.3%	43.00	42.18	51.57	50.59	0.98	1.9%	52.65	49.58
82	coniferous bog	32%	113.19	50.79	62.40	55.1%	1.81	1.78	2.00	0.37	1.63	81.5%	1.23	1.20	1.99	0.36	1.63	81.8%	1.22	1.15
83	open bog	NA	18.64	14.65	3.99	21.4%	4.67	4.58	18.64	14.65	3.99	21.4%	4.67	4.58	18.64	14.65	3.99	21.4%	4.67	4.40
84	coniferous bog	NA	5.67	4.34	1.33	23.5%	4.26	4.18	5.67	4.34	1.33	23.5%	4.26	4.18	5.67	4.				

**Large Table 5
Wetland and Watershed Acreages During Existing Operations Conditions, and Reclamation Conditions – Mine Site**

Wetland ID ⁽²⁾	Eggers and Reed Wetland Type	Change in Equivalent Yield ⁽³⁾ (%)	Pre-Mining (Existing) Conditions						Operations Conditions ⁽¹⁾						Reclamation Conditions					
			Watershed Total Area (acres)	Upland Area (acres)	Wetland Area (acres)	Wetland Area (%)	Tributary Acres per Wetland Acre	Contributing Net Precipitation (ac-ft/yr)	Watershed Total Area (acres)	Upland Area (acres)	Wetland Area (acres)	Wetland Area (%)	Tributary Acres per Wetland Acre	Contributing Net Precipitation (ac-ft/yr)	Watershed Total Area (acres)	Upland Area (acres)	Wetland Area (acres)	Wetland Area (%)	Tributary Acres per Wetland Acre	Contributing Net Precipitation (ac-ft/yr)
97	coniferous bog	NA	11.03	6.57	4.46	40.4%	2.47	2.43	3.61	1.72	1.89	52.4%	1.91	1.87	3.60	1.71	1.89	52.4%	1.91	1.80
98	coniferous bog	NA	49.43	33.93	15.50	31.4%	3.19	3.13	2.36	1.93	0.43	18.2%	5.49	5.38	49.42	33.93	15.50	31.4%	3.19	3.00
99	coniferous bog	NA	5.38	3.98	1.40	26.0%	3.84	3.77	1.47	0.56	0.91	61.9%	1.62	1.58	3.83	2.56	1.27	33.2%	3.01	2.83
100	coniferous bog	NA	295.25	119.06	176.19	59.7%	1.68	1.64	93.20	19.97	73.23	78.6%	1.27	1.25	101.43	25.32	76.11	75.0%	1.33	1.25
100A	alder thicket	R	1.66		1.66	100.0%	1.00	0.98												
101	coniferous bog	NA	34.92	20.71	14.21	40.7%	2.46	2.41	4.01	1.53	2.48	61.8%	1.62	1.59	10.14	3.58	6.56	64.7%	1.54	1.45
103	coniferous bog	11%	157.93	39.09	118.84	75.2%	1.33	1.30	10.52	1.65	8.87	84.3%	1.19	1.16	10.52	1.65	8.87	84.3%	1.19	1.12
104	coniferous bog	NA	8.30	4.73	3.57	43.0%	2.32	2.28	0.87	0.77	0.10	11.5%	8.70	8.53	0.87	0.77	0.10	11.3%	8.88	8.36
105	coniferous bog	NA	59.43	43.95	15.48	26.0%	3.84	3.77	59.43	43.95	15.48	26.0%	3.84	3.77	59.44	43.95	15.48	26.0%	3.84	3.62
105A	coniferous bog	NA	0.62	0.50	0.12	19.4%	5.17	5.07	0.62	0.50	0.12	19.4%	5.17	5.07	0.63	0.50	0.12	19.7%	5.08	4.78
106	coniferous bog	0%	168.57	84.99	83.58	49.6%	2.02	1.98	168.57	84.99	83.58	49.6%	2.02	1.98	168.58	84.99	83.58	49.6%	2.02	1.90
107	coniferous bog	NA	90.50	49.58	40.92	45.2%	2.21	2.17	42.80	33.51	9.29	21.7%	4.61	4.52	40.97	29.93	11.04	26.9%	3.71	3.49
107A	coniferous swamp	-1118%	4.40	2.66	1.74	39.5%	2.53	2.48	1.54	1.49	0.05	3.2%	30.80	30.21	1.92	1.68	0.24	12.6%	7.96	7.49
107B	shallow marsh	-67%	7.41	2.90	4.51	60.9%	1.64	1.61	4.44	2.82	1.62	36.5%	2.74	2.69	3.03	1.41	1.62	53.3%	1.88	1.77
107C	alder thicket	R	28.29	0.69	27.60	97.6%	1.03	1.01												
114	coniferous bog	R	8.00	7.27	0.73	9.1%	10.96	10.75												
120	shallow marsh	-23%	8.93	8.35	0.58	6.5%	15.40	15.10	8.73	8.27	0.46	5.3%	18.98	18.61	8.93	8.47	0.46	5.1%	19.57	18.43
200	hardwood swamp	R	13.51	7.15	6.36	47.1%	2.12	2.08												
201	wet meadow	R	24.54	11.05	13.49	55.0%	1.82	1.78												
202	open bog	R	6.52	3.41	3.11	47.7%	2.10	2.06												
315	alder thicket/shrub-car	0%	533.68	210.84	322.84	60.5%	1.65	1.62	533.68	210.84	322.84	60.5%	1.65	1.62	533.68	210.84	322.84	60.5%	1.65	1.56
552	coniferous bog	R	24.35	15.63	8.72	35.8%	2.79	2.74												
566	alder thicket/shrub-car	11%	32.49	26.62	5.87	18.1%	5.53	5.43	29.05	23.18	5.87	20.2%	4.95	4.85	32.49	26.62	5.87	18.1%	5.53	5.21
567	shallow marsh	R	3.72	2.32	1.40	37.6%	2.66	2.61												
678	alder thicket	0%	148.21	89.79	58.42	39.4%	2.54	2.49	148.21	89.79	58.42	39.4%	2.54	2.49	148.22	89.79	58.42	39.4%	2.54	2.39
679	coniferous bog	NA	0.50	0.50	0.50	100.0%	1.00	0.98	0.50	0.00	0.50	100.0%	1.00	0.98	0.50	0.00	0.50	100.0%	1.00	0.94
682	open bog	NA	4.85	2.69	2.16	44.5%	2.25	2.20	4.85	2.69	2.16	44.5%	2.25	2.20	4.85	2.69	2.16	44.6%	2.24	2.11
691	alder thicket	0%	32.11	25.88	6.23	19.4%	5.15	5.06	32.11	25.88	6.23	19.4%	5.15	5.06	32.12	25.88	6.23	19.4%	5.15	4.85
693	coniferous bog	NA	26.40	14.07	12.33	46.7%	2.14	2.10	26.40	14.07	12.33	46.7%	2.14	2.10	26.40	14.07	12.33	46.7%	2.14	2.02
699	coniferous bog	NA	2.21		2.21	100.0%	1.00	0.98	2.21	0.00	2.21	100.0%	1.00	0.98	2.21	0.00	2.21	100.0%	1.00	0.94
745	coniferous bog	NA	24.65	11.32	13.33	54.1%	1.85	1.81	24.65	11.32	13.33	54.1%	1.85	1.81	24.65	11.32	13.33	54.1%	1.85	1.74
782	coniferous bog	NA	6.54	4.44	2.10	32.1%	3.11	3.05	6.54	4.44	2.10	32.1%	3.11	3.05	6.54	4.44	2.10	32.1%	3.11	2.93
783	coniferous bog	NA	4.85	2.94	1.91	39.4%	2.54	2.49	4.85	2.94	1.91	39.4%	2.54	2.49	4.86	2.94	1.91	39.4%	2.54	2.39
887	coniferous bog	4%	701.48	146.12	555.36	79.2%	1.26	1.24	670.31	114.95	555.36	82.9%	1.21	1.18	670.31	114.95	555.36	82.9%	1.21	1.14
888	coniferous bog	NA	260.25	67.29	192.96	74.1%	1.35	1.32	260.25	67.29	192.96	74.1%	1.35	1.32	260.25	67.29	192.96	74.1%	1.35	1.27
889	shallow marsh	11%	75.69	8.55	67.14	88.7%	1.13	1.11	67.35	0.21	67.14	99.7%	1.00	0.98	67.35	0.21	67.14	99.7%	1.00	0.94
972	hardwood swamp	0%	0.90		0.90	100.0%	1.00	0.98	0.90	0.00	0.90	100.0%	1.00	0.98	0.90	0.00	0.90	100.0%	1.00	0.94
984	coniferous bog	NA	16.04	0.98	15.06	93.9%	1.07	1.04	15.32	0.26	15.06	98.3%	1.02	1.00	15.32	0.26	15.06	98.3%	1.02	0.96

⁽¹⁾ Wetland areas include fragments identified in Section 5.2.1.1

⁽²⁾ Wetlands in bold are identified as ombrotrophic.

⁽³⁾ Change in the equivalent yield from existing conditions to operational conditions is identified as increasing (+), decreasing (-), no change (0), watershed is removed (R), or not applicable (NA) for ombrotrophic coniferous and open bogs.

Large Table 6 Summary of Wetlands within Analog Impact Zones Resulting from Changes in Hydrology – Mine Site

Likelihood of wetland hydrology impact based on wetland type for each analogue distance	Wetland Area (acres) within each Analogue Increment (feet)				Eggers and Reed Wetland Community ⁽¹⁾
	0-1,000 feet	1,000-2,000 feet	2,000-3,500 feet	3,500-10,000 feet	
0 – 1,000 feet					
High Likelihood	866.85	---	---	---	coniferous swamp, hardwood swamp, sedge/wet meadow, shrub-carr, and alder thicket
Moderate Likelihood	8.30	---	---	---	deep marsh, shallow marsh, and shallow, open water
Low Likelihood	452.81	---	---	---	Minerotrophic and ombrotrophic coniferous bog
No Impact	0	---	---	---	open bog
1,000 – 2,000 feet					
Moderate Likelihood	---	522.40	---	---	coniferous swamp, hardwood swamp, sedge/wet meadow, shrub-carr, and alder thicket
Low Likelihood	---	4.11	---	---	deep marsh, shallow marsh, and shallow, open water
No Impact	---	92.05	---	---	minerotrophic and ombrotrophic coniferous bog and open bog
2,000 – 3,500 feet					
Low Likelihood	---	---	293.12	---	coniferous swamp, hardwood swamp, sedge/wet meadow, shrub-carr, and alder thicket
No Impact	---	---	868.89	---	deep marsh, shallow marsh, and shallow, open water, minerotrophic and ombrotrophic coniferous bog and open bog
3,500 – 10,000 feet					
No Impact	---	---	---	2,718.30	all wetland types
Total acres of wetland	1,327.96	618.56	1,162.01	2,718.30	

(1) Reference (13)

Large Table 7 Summary of Wetlands Crossing Analog Impact Zones Resulting from Changes in Hydrology – Mine Site

Likelihood of wetland hydrology impact based on wetland type for each analogue distance	Wetland Area (acres) within each Analogue Increment (feet)				Eggers and Reed Wetland Community ⁽¹⁾
	0-1,000 feet	1,000-2,000 feet	2,000-3,500 feet	3,500-10,000 feet	
0 – 1,000 feet					
High Likelihood	46.37	---	---	---	coniferous swamp, hardwood swamp, sedge/wet meadow, shrub-carr, and alder thicket
Moderate Likelihood	8.3	---	---	---	deep marsh, shallow marsh, and shallow, open water
Low Likelihood	178.80	---	---	---	minerotrophic and ombrotrophic coniferous bog
No Impact	0	---	---	---	open bog
1,000 – 2,000 feet					
Moderate Likelihood	---	110.77	---	---	coniferous swamp, hardwood swamp, sedge/wet meadow, shrub-carr, and alder thicket
Low Likelihood	---	4.11	---	---	deep marsh, shallow marsh, and shallow, open water
No Impact	---	196.14	---	---	minerotrophic and ombrotrophic coniferous bog and open bog
2,000 – 3,500 feet					
Low Likelihood	---	---	384.99	---	coniferous swamp, hardwood swamp, sedge/wet meadow, shrub-carr, and alder thicket
No Impact	---	---	332.99	---	deep marsh, shallow marsh, and shallow, open water, minerotrophic and ombrotrophic coniferous bog and open bog
3,500 – 10,000 feet					
No Impact	---	---	---	4,564.38	all wetland types
Total acres of wetland	233.47	311.02	717.98	4,564.38	

(1) Reference (13)

Large Table 8 Summary of Potential Wetland Community Changes Due to Drawdown

Impact Sensitivity Category ⁽¹⁾	None		Moderate		Severe	
	Water Level Drawdown (feet)	Potential Impact	Water Level Drawdown (feet)	Potential Impact	Water Level Drawdown (feet)	Potential Impact
Ombrotrophic Coniferous and Open bog	<0.75	None	0.75-2	Minor vegetation changes; Increased tree growth	>2	Possible conversion of wetland type
Minerotrophic Coniferous and Open bog	<0.5	None	0.5-2	Change in vegetation; Increased tree growth	>2	Possible conversion of wetland type
Shallow marsh ⁽²⁾	<1	None	1-3	Conversion of type	>3	Conversion of wetland type
Deep marsh ⁽²⁾	<2	None	2-4	Conversion of type	>4	Conversion of wetland type
Shallow, open water ⁽²⁾	<2	None	2-4	Conversion of type	>4	Conversion of wetland type
Conifer swamp	<1	None	1-2	Minor changes in vegetation; Increased tree growth	>2	Change in vegetation
Hardwood swamp	<2	None	2-4	Change in vegetation; Increased tree growth	>4	Conversion of wetland type; possible conversion to upland
Alder thicket	<1	None	1-4	Change in vegetation; Increased shrub growth	>4	Conversion of wetland type; increased shrub growth
Shrub-carr	<0.5	None	0.5-3	Change in vegetation; Increased shrub growth	>3	Conversion of wetland type
Wet/Sedge meadow	<0.5	None	0.5-3	Change in vegetation; Conversion of type	>3	Conversion to upland

(1) Interpreted from information provided in the hydrologic wetland sensitivity method as described in the Wetland Work Plan (Attachment A).

(2) Shallow marsh, deep marsh, and shallow open water communities were not evaluated in the hydrologic wetland sensitivity method as described in the Wetland Work Plan (Attachment A), but are estimated in this table based on best professional judgment.

Large Table 9 Summary of Wetlands within the Mine Site Groundwater Flow Paths

Eggers and Reed Wetland Community ⁽¹⁾	Hydrology	Wetlands within the Mine Site Groundwater Flow Paths (acres)				
		West Pit	Overburden Storage and Laydown Area (OSLA)	Wastewater Treatment Facility (WWTF)	Ore Surge Pile (OSP)	Category 2/3 Stockpile
Alder thicket	Groundwater	90.53	40.87	18.79	27.59	103.06
Alder thicket or Shrub-carr	Groundwater	0	2.87	0	0	0
Minerotrophic coniferous bog	Precipitation/ Groundwater	0.04	0	0	0	6.27
Ombrotrophic coniferous bog	Precipitation	16.48	0	0	0	148.18
Coniferous swamp	Groundwater	0	2.88	20.06	10.16	0.04
Deep marsh	Groundwater	4.94	0	0	0	0
Open bog	Precipitation	0	0	0	0	8.87
Sedge meadow	Groundwater	0	0	0	0	1.17
Shallow marsh	Groundwater	3.35	0.11	0	0	5.48
Shrub-carr	Groundwater	0	3.95	0	0	0
Wet meadow	Groundwater	0	0	0	0	0.07
Total acres of wetland		115.34	50.68	38.85	37.75	273.14

(1) Reference (13)

Large Table 10 Summary of Coniferous and Open Bogs in Area One

Wetland ID	Eggers and Reed Community⁽¹⁾	Status
11	Coniferous bog	Ombrotrophic
25	Coniferous bog	Ombrotrophic
32	Coniferous bog	Minerotrophic
48	Coniferous bog	Minerotrophic
62	Coniferous bog	Ombrotrophic
76	Coniferous bog	Ombrotrophic
77	Coniferous bog	Ombrotrophic
79	Coniferous bog	Ombrotrophic
80	Coniferous bog	Ombrotrophic
82	Coniferous bog	Minerotrophic
83	Open bog	Ombrotrophic
84	Coniferous bog	Ombrotrophic
84A	Coniferous bog	Ombrotrophic
86	Coniferous bog	Ombrotrophic
88	Coniferous bog	Ombrotrophic
90	Coniferous bog	Ombrotrophic
90A	Open bog	Ombrotrophic
96	Coniferous bog	Ombrotrophic
97	Coniferous bog	Ombrotrophic
98	Coniferous bog	Ombrotrophic
99	Coniferous bog	Ombrotrophic
100	Coniferous bog	Ombrotrophic
101	Coniferous bog	Ombrotrophic
103	Coniferous bog	Ombrotrophic
104	Coniferous bog	Ombrotrophic
105	Coniferous bog	Ombrotrophic
105A	Coniferous bog	Ombrotrophic
106B	Coniferous bog	Ombrotrophic
106C	Coniferous bog	Ombrotrophic
106D	Coniferous bog	Ombrotrophic
107	Coniferous bog	Ombrotrophic
400A	Coniferous bog	Ombrotrophic
406	Coniferous bog	Ombrotrophic

Wetland ID	Eggers and Reed Community⁽¹⁾	Status
409	Coniferous bog	Ombrotrophic
415	Coniferous bog	Ombrotrophic
418	Coniferous bog	Ombrotrophic
419	Coniferous bog	Ombrotrophic
422	Coniferous bog	Ombrotrophic
423	Coniferous bog	Ombrotrophic
425	Coniferous bog	Ombrotrophic
435	Coniferous bog	Ombrotrophic
437	Coniferous bog	Ombrotrophic
438	Coniferous bog	Ombrotrophic
439	Coniferous bog	Ombrotrophic
441	Coniferous bog	Ombrotrophic
442	Coniferous bog	Ombrotrophic
451	Coniferous bog	Ombrotrophic
456	Coniferous bog	Ombrotrophic
459	Coniferous bog	Ombrotrophic
460	Coniferous bog	Ombrotrophic
465	Coniferous bog	Ombrotrophic
467	Coniferous bog	Ombrotrophic
469	Coniferous bog	Ombrotrophic
473	Coniferous bog	Ombrotrophic
474	Coniferous bog	Ombrotrophic
477	Coniferous bog	Ombrotrophic
478	Coniferous bog	Ombrotrophic
479	Coniferous bog	Ombrotrophic
489	Coniferous bog	Ombrotrophic
490	Coniferous bog	Ombrotrophic
492	Coniferous bog	Ombrotrophic
493	Open bog	Ombrotrophic
494	Coniferous bog	Ombrotrophic
496	Coniferous bog	Ombrotrophic
498	Coniferous bog	Ombrotrophic
499	Coniferous bog	Ombrotrophic
502	Coniferous bog	Ombrotrophic

Wetland ID	Eggers and Reed Community⁽¹⁾	Status
503	Coniferous bog	Ombrotrophic
507	Coniferous bog	Ombrotrophic
508	Coniferous bog	Ombrotrophic
510	Coniferous bog	Ombrotrophic
513	Coniferous bog	Ombrotrophic
514	Coniferous bog	Ombrotrophic
519	Coniferous bog	Ombrotrophic
520	Coniferous bog	Ombrotrophic
526	Coniferous bog	Ombrotrophic
528	Coniferous bog	Ombrotrophic
530	Coniferous bog	Ombrotrophic
531	Coniferous bog	Ombrotrophic
535	Coniferous bog	Ombrotrophic
538	Coniferous bog	Ombrotrophic
540	Coniferous bog	Ombrotrophic
541	Coniferous bog	Ombrotrophic
546	Coniferous bog	Ombrotrophic
547	Coniferous bog	Ombrotrophic
548	Coniferous bog	Ombrotrophic
550	Open bog	Ombrotrophic
558	Coniferous bog	Ombrotrophic
559	Coniferous bog	Ombrotrophic
560	Coniferous bog	Ombrotrophic
561	Coniferous bog	Ombrotrophic
562	Coniferous bog	Ombrotrophic
564	Coniferous bog	Ombrotrophic
679	Coniferous bog	Ombrotrophic
681	Coniferous bog	Ombrotrophic
682	Open bog	Ombrotrophic
693	Coniferous bog	Ombrotrophic
695	Coniferous bog	Ombrotrophic
697	Coniferous bog	Ombrotrophic
699	Coniferous bog	Ombrotrophic
700	Open bog	Ombrotrophic

Wetland ID	Eggers and Reed Community⁽¹⁾	Status
713	Coniferous bog	Ombrotrophic
714	Coniferous bog	Ombrotrophic
727	Open bog	Ombrotrophic
728	Open bog	Ombrotrophic
730	Open bog	Ombrotrophic
732	Open bog	Ombrotrophic
733	Open bog	Ombrotrophic
734	Open bog	Ombrotrophic
735	Coniferous bog	Ombrotrophic
737	Coniferous bog	Ombrotrophic
738	Open bog	Ombrotrophic
739	Open bog	Ombrotrophic
740	Open bog	Ombrotrophic
742	Coniferous bog	Ombrotrophic
757	Open bog	Ombrotrophic
759	Open bog	Ombrotrophic
773	Coniferous bog	Ombrotrophic
774	Coniferous bog	Ombrotrophic
776	Coniferous bog	Ombrotrophic
777	Open bog	Ombrotrophic
780	Coniferous bog	Ombrotrophic
781	Coniferous bog	Ombrotrophic
782	Coniferous bog	Ombrotrophic
783	Coniferous bog	Ombrotrophic
784	Coniferous bog	Ombrotrophic
795	Coniferous bog	Ombrotrophic
799	Coniferous bog	Ombrotrophic
814A	Coniferous bog	Ombrotrophic
885	Open bog	Ombrotrophic
887	Coniferous bog	Minerotrophic
888	Coniferous bog	Ombrotrophic
899	Open bog	Ombrotrophic
900	Coniferous bog	Minerotrophic
925	Open bog	Ombrotrophic

Wetland ID	Eggers and Reed Community⁽¹⁾	Status
930	Open bog	Ombrotrophic
931	Coniferous bog	Ombrotrophic
949	Coniferous bog	Ombrotrophic
984	Coniferous bog	Ombrotrophic
1044	Coniferous bog	Ombrotrophic
1131	Coniferous bog	Ombrotrophic
1149	Coniferous bog	Ombrotrophic

(1) Reference (13)

Large Table 11 Wetlands within the Mine Site Groundwater Flow Paths

Wetland ID	Eggers and Reed Wetland Community⁽¹⁾	Dominant Source of Hydrology	Wetland Size (acres)
East Pit – Category 2/3 Stockpile			
1	Shallow marsh	Groundwater	0.42
3	Shallow marsh	Groundwater	0.35
6	Shallow marsh	Groundwater	0.62
7	Wet meadow	Groundwater	0.07
10	Sedge meadow	Groundwater	1.17
11	Coniferous bog	Precipitation	8.88
12	Alder thicket	Groundwater	0.13
24	Alder thicket	Groundwater	0.41
29	Shallow marsh	Groundwater	4.09
33A	Alder thicket	Groundwater	6.31
43	Alder thicket	Groundwater	1.03
48	Coniferous bog	Groundwater	6.27
53D	Alder thicket	Groundwater	29.79
55	Alder thicket	Groundwater	0.06
58	Alder thicket	Groundwater	34.57
77	Coniferous bog	Precipitation	12.08
90	Coniferous bog	Precipitation	108.62
90A	Open bog	Precipitation	6.71
98	Coniferous bog	Precipitation	0.42
105	Coniferous bog	Precipitation	15.47
105A	Coniferous bog	Precipitation	0.12
106	Coniferous swamp	Groundwater	0.04
678	Alder thicket	Groundwater	30.76
679	Coniferous bog	Precipitation	0.50
681	Coniferous bog	Precipitation	2.09
682	Open bog	Precipitation	2.16
Waste Water Treatment Facility (WWTF)			
53	Alder thicket	Groundwater	0.38
53D	Alder thicket	Groundwater	18.41
106	Coniferous swamp	Groundwater	20.06

Wetland ID	Eggers and Reed Wetland Community⁽¹⁾	Dominant Source of Hydrology	Wetland Size (acres)
Ore Surge Pile (OSP)			
53	Alder thicket	Groundwater	0.52
53D	Alder thicket	Groundwater	27.07
106	Coniferous swamp	Groundwater	10.16
Overburden Storage and Laydown Area (OSLA)			
4	Wet meadow	Groundwater	0.00
9	Shallow marsh	Groundwater	0.11
46	Shrub-carr	Groundwater	3.95
52	Alder thicket	Groundwater	0.00
53	Alder thicket	Groundwater	1.92
53C	Coniferous swamp	Groundwater	2.88
53D	Alder thicket	Groundwater	38.95
557	Alder thicket or Shrub-carr	Groundwater	2.87
West Pit			
9	Shallow marsh	Groundwater	1.43
13	Deep marsh	Groundwater	4.94
16	Shallow marsh	Groundwater	0.31
32	Coniferous bog	Groundwater	0.04
53D	Alder thicket	Groundwater	90.53
79	Coniferous bog	Precipitation	0.07
107	Coniferous bog	Precipitation	9.29
107B	Shallow marsh	Groundwater	1.61
558	Coniferous bog	Precipitation	3.08
559	Coniferous bog	Precipitation	1.24
562	Coniferous bog	Precipitation	2.80
Total acres of wetland			515.76

(1) Reference (13)

Taxa ⁽¹⁾	Scientific Name	Common Name	State ETSC	Federal ESA or BGEPA (eagle)	SGCN	USFS RFSS	Number of habitats	Wetland Habitats								Upland Habitats								Wetland and Upland Habitats	
								Forest- Lowland Coniferous	Forest- Lowland Deciduous	Lake- Deep	Lake- Shallow	River- Headwater to large	River- Very Large	Shrub- Lowland	Wetland- Non-forest	Cropland	Developed	Forest- Upland Coniferous	Forest- Upland Deciduous (Aspen)	Forest- Upland Deciduous	Grassland	Prairie	Shoreline-dunes-cliff/talus		Shrub/woodland- Upland
BI	<i>Contopus virens</i>	Eastern Wood-pewee	NL	NL	x		5		x									x	x	x		x			B
BI	<i>Setophaga castanea</i>	Bay-breasted Warbler	NL	NL	x	x	2	x										x							B
BI	<i>Calidris alpina</i>	Dunlin	NL	NL	x		2							x									x		B
BI	<i>Dolichonyx oryzivorus</i>	Bobolink	NL	NL	x		6							x	x	x					x	x		x	B
BI	<i>Empidonax minimus</i>	Least Flycatcher	NL	NL	x		4		x									x	x	x					B
BI	<i>Falciennis canadensis</i>	Spruce Grouse	NL	NL	x		4	x						x				x						x	B
BI	<i>Falco peregrinus</i>	Peregrine Falcon	THR	NL	x		10	x			x		x	x	x			x		x	x	x	x	x	B
BI	<i>Haliaeetus leucocephalus</i>	Bald Eagle	SPC	THR	x	x	7		x	x		x						x	x	x				x	B
BI	<i>Melanerpes erythrocephalus</i>	Red-headed Woodpecker	NL	NL	x		8		x						x	x		x	x	x	x	x		x	B
BI	<i>Oporornis agilis</i>	Connecticut Warbler	NL	NL	x	x	2	x										x							B
BI	<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak	NL	NL	x		5		x									x	x	x		x			B
BI	<i>Picoides arcticus</i>	Black-backed Woodpecker	NL	NL	x		3	x										x						x	B
BI	<i>Pluvialis dominica</i>	American Golden-plover	NL	NL	x		2							x									x		B
BI	<i>Podiceps grisegena</i>	Red-necked Grebe	NL	NL	x		2				x			x											B
BI	<i>Poecile hudsonica</i>	Boreal Chickadee	NL	NL	x		2	x										x							B
BI	<i>Scolopax minor</i>	American Woodcock	NL	NL	x		4							x					x					x	B
BI	<i>Seiurus aurocapilla</i>	Ovenbird	NL	NL	x		4		x									x	x	x					B
BI	<i>Setophaga castanea</i>	Bay-breasted Warbler	NL	NL	x	x	2	x										x							B
BI	<i>Sphyrapicus varius</i>	Yellow-bellied Sapsucker	NL	NL	x		4		x									x	x	x					B
BI	<i>Stelgidopteryx serripennis</i>	Northern Rough-winged Swallow	NL	NL	x		3					x									x		x		B
BI	<i>Strix nebulosa</i>	Great grey owl	NL	NL		x		x										x							B
BI	<i>Tringa melanoleuca</i>	Greater Yellowlegs	NL	NL	x		2								x								x		B
BI	<i>Troglodytes</i>	Winter Wren	NL	NL	x		3	x	x									x							B
BI	<i>Tympanuchus phasianellus</i>	Sharp-tailed Grouse	NL	NL	x		6							x	x	x					x	x		x	B
BI	<i>Vermivora chrysoptera</i>	Golden-winged Warbler	NL	NL	x		3	x						x					x						B
BI	<i>Wilsonia canadensis</i>	Canada Warbler	NL	NL	x		4	x										x	x	x					B

Taxa ⁽¹⁾	Scientific Name	Common Name	State ETSC	Federal ESA or BGEPA (eagle)	SGCN	USFS RFSS	Number of habitats	Wetland Habitats								Upland Habitats								Wetland and Upland Habitats
								Forest- Lowland Coniferous	Forest- Lowland Deciduous	Lake- Deep	Lake- Shallow	River- Headwater to large	River- Very Large	Shrub- Lowland	Wetland- Non-forest	Cropland	Developed	Forest- Upland Coniferous	Forest- Upland Deciduous (Aspen)	Forest- Upland Deciduous	Grassland	Prairie	Shoreline-dunes-cliff/talus	
BI	<i>Zonotrichia albicollis</i>	White-throated Sparrow	NL	NL	x		7	x	x					x			x	x	x				x	B
MA	<i>Canis lupus</i>	Gray Wolf	SPC	THR	x	x	11	x						x	x	x		x	x	x	x	x	x	B
MA	<i>Lynx canadensis</i>	Canada lynx	NL	THR	x		7	x	x					x			x	x	x				x	B
MA	<i>Microtus chrotorrhinus</i>	Rock Vole	NL	NL	x		6		x					x			x	x				x	x	B
MA	<i>Sorex fumeus</i>	Smoky Shrew	SPC	NL	x		3	x									x					x		B
MA	<i>Spermophilus franklinii</i>	Franklin's Ground Squirrel	NL	NL	x		5							x	x					x	x		x	B
AM	<i>Plethodon cinereus</i>	Eastern Red-backed Salamander	NL	NL	x		3										x	x	x					U
BI	<i>Accipiter gentilis</i>	Northern Goshawk	NL	NL	x	x	3										x	x	x					U
BI	<i>Caprimulgus vociferus</i>	Whip-poor-will	NL	NL	x		2										x		x					U
BI	<i>Chordeiles minor</i>	Common Nighthawk	NL	NL	x		2									x						x		U
BI	<i>Dendroica caerulescens</i>	Black-throated Blue Warbler	NL	NL	x		3										x	x	x					U
BI	<i>Hylocichla mustelina</i>	Wood Thrush	NL	NL	x		3										x	x	x					U
BI	<i>Picoides dorsalis</i>	Three-toed woodpecker	NL	NL		x	1										x							U
BI	<i>Sturnella magna</i>	Eastern Meadowlark	NL	NL	x		2												x	x				U
BI	<i>Toxostoma rufum</i>	Brown Thrasher	NL	NL	x		2									x						x		U
BI	<i>Tryngites subruficollis</i>	Buff-breasted Sandpiper	NL	NL	x		4							x	x					x	x			U
IN	<i>Plebejus idas nabokovi</i>	Nabokov's Blue	SPC	NL	x	x	2										x						x	U
IN	<i>Oeneis macounii</i>	Macoun's Arctic	NL	NL	x		1										x							U
IN	<i>Phyciodes batesii</i>	Tawny Crescent	NL	NL	x		2										x						x	U
IN	<i>Pyrgus centaureae freija</i>	Grizzled Skipper	SPC	NL	x	x	1															x		U
MA	<i>Taxidea taxus</i>	American Badger	NL	NL	x		7							x	x	x		x	x	x		x		U

(1) Taxa include amphibians (AM), birds (BI), fish (FI), insects (IN), mammals (MA), mollusks (MO), reptiles (RE), and spiders (SP).

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Flotation Tailings Basin																			
		0 - 500 Feet	500 - 1,000 Feet	1,000 - 1,500 Feet	1,500 - 2,000 Feet	2,000 - 2,500 Feet	2,500 - 3,000 Feet	3,000 - 3,500 Feet	3,500 - 4,000 Feet	4,000 - 4,500 Feet	4,500 - 5,000 Feet	5,000 - 5,500 Feet	5,500 - 6,000 Feet	6,000 - 6,500 Feet	6,500 - 7,000 Feet	7,000 - 7,500 Feet	7,500 - 8,000 Feet	8,000 - 8,500 Feet	8,500 - 9,000 Feet	9,000 - 9,500 Feet	9,500 - 10,000 Feet
878	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
908	Shallow marsh	0	0	0	0	0	1.59	3.75	2.64	0.73	0	0	0	0	0	0	0	0	0	0	0
915	Alder thicket	0	0	0	0	0	0	0	0	0	0	5.18	0.29	0	0	0	0	0	0	0	0
917	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0.01	5.23	6.38	5.83	2.42	0	0	0	0	0
918	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	3.19	3.62	2.36	0.28	0	0	0	0	0	0
921	Alder thicket or Shrub-carr	0	0	0	0	0	0	0.13	0.25	0	0	0	0	0	0	0	0	0	0	0	0
923	Wet meadow	0	0	0	0	0	0	0.17	0.52	0	0	0	0	0	0	0	0	0	0	0	0
942	Deep marsh	0	0	0	0	0	1.40	1.56	0	0	0	0	0	0	0	0	0	0	0	0	0
943	Deep marsh	0	0	0	0.87	5.51	7.42	0.23	0	0	0	0	0	0	0	0	0	0	0	0	0
944	Hardwood swamp	0	0	0	0	1.43	0.99	0.20	0	0	0	0	0	0	0	0	0	0	0	0	0
945	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0.32	2.00	0	0	0	0	0	0	0	0	0	0	0
946	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.44	0.51	0	0
947	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	2.09	5.57	6.15	5.75	0.81	0	0	0	0	0	0
950	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
951	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.88	18.88	33.02	32.26	26.22
952	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
953	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
954	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
955	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	2.44	7.40	6.81	2.70	12.59	6.91	0.37	0	0
956	Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0.09	2.70	3.83	7.27	3.51	0	0
957	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	1.41	1.81	3.65	0	0	0	0
958	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	1.38	2.19	0	0	0	0

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Flotation Tailings Basin																			
		0 - 500 Feet	500 - 1,000 Feet	1,000 - 1,500 Feet	1,500 - 2,000 Feet	2,000 - 2,500 Feet	2,500 - 3,000 Feet	3,000 - 3,500 Feet	3,500 - 4,000 Feet	4,000 - 4,500 Feet	4,500 - 5,000 Feet	5,000 - 5,500 Feet	5,500 - 6,000 Feet	6,000 - 6,500 Feet	6,500 - 7,000 Feet	7,000 - 7,500 Feet	7,500 - 8,000 Feet	8,000 - 8,500 Feet	8,500 - 9,000 Feet	9,000 - 9,500 Feet	9,500 - 10,000 Feet
990	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.40	8.25	6.17
991	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.30	20.05	21.40
992	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
993	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
994	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
995	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
996	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.73	2.37	0	0	0
T1	Deep marsh	1.83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T13	Deep marsh	0.54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T13A	Deep marsh	2.96	4.17	2.97	1.46	1.05	0.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T8	Wet meadow	0.03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total acres of wetland		55.05	147.62	133.17	142.59	174.34	195.34	159.99	138.45	140.81	157.22	162.95	160.46	161.41	146.60	149.87	173.90	214.77	209.31	219.15	285.35

(1) Reference (13)

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Flotation Tailings Basin																			
		10,000 – 10,500 Feet	10,500 – 11,000 Feet	11,000 – 11,500 Feet	11,500 – 12,000 Feet	12,000 – 12,500 Feet	12,500 – 13,000 Feet	13,000 – 13,500 Feet	13,500 – 14,000 Feet	14,000 – 14,500 Feet	14,500 – 15,000 Feet	15,000 – 15,500 Feet	15,500 – 16,000 Feet	16,000 – 16,500 Feet	16,500 – 17,000 Feet	17,000 – 17,500 Feet	17,500 – 18,000 Feet	18,000 – 18,500 Feet	18,500 – 19,000 Feet	19,000 – 19,500 Feet	19,500 – 20,000 Feet
1078	Shallow marsh	3.37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1079	Coniferous swamp	0	0.37	2.10	0.16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1080	Coniferous swamp	4.57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1081	Alder thicket or Shrub-carr	11.32	5.26	3.44	8.13	8.29	2.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1082	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1083	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1084	Deep marsh	8.80	3.69	0.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1085	Sedge meadow or Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1086	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1091	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1092	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1093	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1094	Sedge meadow or Wet meadow	0	1.06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1095	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1096	Shallow open water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1105	Sedge meadow or Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.09	5.33	0	0	0	0
1106	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.34	15.97	14.87	4.43	0	0
1107	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0.43	0.41	0	0	0	0	0	0	0
1108	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0.80	1.71	0	0	0	0	0	0
1109	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0.62	0.14	0	0	0	0	0	0	0

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		10,000 – 10,500 Feet	10,500 – 11,000 Feet	11,000 – 11,500 Feet	11,500 – 12,000 Feet	12,000 – 12,500 Feet	12,500 – 13,000 Feet	13,000 – 13,500 Feet	13,500 – 14,000 Feet	14,000 – 14,500 Feet	14,500 – 15,000 Feet	15,000 – 15,500 Feet	15,500 – 16,000 Feet	16,000 – 16,500 Feet	16,500 – 17,000 Feet	17,000 – 17,500 Feet	17,500 – 18,000 Feet	18,000 – 18,500 Feet	18,500 – 19,000 Feet	19,000 – 19,500 Feet	19,500 – 20,000 Feet
626	Coniferous swamp	6.13	8.81	9.97	16.88	32.70	31.67	32.28	36.12	36.53	22.97	15.52	6.69	1.31	0	0	0	0	0	0	0
627	Alder thicket or Shrub-carr	13.82	11.86	11.05	11.52	12.17	9.85	4.02	0.30	0	0	0	0	0	0	0	0	0	0	0	0
628	Deep marsh	4.45	5.54	0.54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
629	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
630	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
631	Coniferous swamp	1.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
632	Alder thicket or Shrub-carr	0.99	2.39	6.43	1.32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
633	Alder thicket or Shrub-carr	0.73	0.34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
634	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
635	Alder thicket or Shrub-carr	1.54	0.22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
636	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
637	Lake	25.17	10.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
638	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
639	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
640	Coniferous bog	9.27	5.50	4.44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
641	Coniferous swamp	0	0	0	0	2.77	6.00	3.25	2.22	1.50	0.40	0	0	0	0	0	0	0	0	0	0
642	Shallow open water	0	0	0	0	0.02	4.67	3.65	0	0	0	0	0	0	0	0	0	0	0	0	0
643	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
644	Coniferous swamp	0	0	0	0	0	0	0	6.51	7.82	0	0	0	0	0	0	0	0	0	0	0
645	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0.78	0.26	0	0	0	0	0	0	0
646	Alder thicket or Shrub-carr	0	0	0	0	0	0.45	1.30	1.43	1.48	1.49	1.43	1.39	1.40	0.67	2.28	3.29	0.14	1.31	5.02	0.34
647	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	3.37	3.17	0	0	0	0	0	0	0

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Flotation Tailings Basin																			
		10,000 – 10,500 Feet	10,500 – 11,000 Feet	11,000 – 11,500 Feet	11,500 – 12,000 Feet	12,000 – 12,500 Feet	12,500 – 13,000 Feet	13,000 – 13,500 Feet	13,500 – 14,000 Feet	14,000 – 14,500 Feet	14,500 – 15,000 Feet	15,000 – 15,500 Feet	15,500 – 16,000 Feet	16,000 – 16,500 Feet	16,500 – 17,000 Feet	17,000 – 17,500 Feet	17,500 – 18,000 Feet	18,000 – 18,500 Feet	18,500 – 19,000 Feet	19,000 – 19,500 Feet	19,500 – 20,000 Feet
673	Coniferous swamp	33.66	30.42	20.90	10.76	3.39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
674	Open bog	0	0	0	0	0	0	0	0	0	1.13	1.22	0	0	0	0	0	0	0	0	0
675	Open bog	0	0	0	0	0	0	0	3.39	6.12	0.16	0	0	0	0	0	0	0	0	0	0
676	Deep marsh	0	0	0	0	0	0	0	0	0	5.77	3.71	0	0	0	0	0	0	0	0	0
677	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	9.27	24.90	23.93	12.82	30.73	30.94	24.51	8.55	0
786	Open bog	0	0	0		0.20	5.05	11.72	14.91	12.41	22.95	28.97	35.42	38.55	35.06	29.30	16.59	10.32	5.39	0	0
787	Alder thicket or Shrub-carr	0	0	0	2.64	5.79	3.02	2.93	1.85	0	0	0	0	0	0	0	0	0	0	0	0
788	Hardwood swamp	19.91	28.49	24.01	4.99	3.69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
810	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
816	Deep marsh	0	0	0	0	0	0	0	0	0	0	0	1.29	11.32	2.85	0	0	0	0	0	0
817	Deep marsh	0	0	0	0	0	0	0	0	0	2.62	6.89	0.52	0	0	0	0	0	0	0	0
818	Deep marsh	0	0	0	0	0	0	0	0	0	0	0.00	7.10	0.02	0	0	0	0	0	0	0
819	Deep marsh	0	0	0	0	0	0	0	0	0	0	0.12	0.85	0	0	0	0	0	0	0	0
820	Deep marsh	0	0	0	0	0	0	1.35	11.73	11.71	2.12		0	0	0	0	0	0	0	0	0
821	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.57	4.80	2.81	0	0	0
822	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0.07	4.39	0	0	0	0	0
823	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0.27	5.39	0.55	0	0	0	0
824	Shallow marsh	0	0	0	0	0	4.40	1.34	0	0	0	0	0	0	0	0	0	0	0	0	0
825	Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.09	1.70	0	0
826	Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.02	4.91	0	0
827	Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	2.42	0.09	0	0
828	Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.39	3.06	0.80	0	0
829	Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.99	3.82	0	0	0
830	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.13	1.75	0	0	0	0
831	Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	5.63	8.03	0	0	0	0	0
832	Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	2.92	6.45	0	0	0	0	0	0
833	Shallow marsh	0	0	0	0	0	0	0	0	0	0	0	0	2.59	12.54	0	0	0	0	0	0

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Flotation Tailings Basin																				
		10,000 – 10,500 Feet	10,500 – 11,000 Feet	11,000 – 11,500 Feet	11,500 – 12,000 Feet	12,000 – 12,500 Feet	12,500 – 13,000 Feet	13,000 – 13,500 Feet	13,500 – 14,000 Feet	14,000 – 14,500 Feet	14,500 – 15,000 Feet	15,000 – 15,500 Feet	15,500 – 16,000 Feet	16,000 – 16,500 Feet	16,500 – 17,000 Feet	17,000 – 17,500 Feet	17,500 – 18,000 Feet	18,000 – 18,500 Feet	18,500 – 19,000 Feet	19,000 – 19,500 Feet	19,500 – 20,000 Feet	
953	Alder thicket or Shrub-carr	0	0	0	4.73	24.50	17.23	18.39	23.70	33.71	84.51	117.24	113.24	62.20	32.44	30.16	35.05	16.92	0	0	0	
954	Coniferous swamp	0	0	0	14.52	17.18	17.76	28.98	32.92	44.34	19.73	0.09	0	0	0	0	0	0	0	0	0	
955	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
956	Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
957	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
958	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
963	Alder thicket or Shrub-carr	4.63	13.45	13.39	11.31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
964	Coniferous swamp	12.02	9.76	13.44	4.94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
965	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
966	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
968	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
974	Coniferous bog	20.70	15.80	18.13	9.32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
975	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
976	Coniferous swamp	4.41	7.17	22.41	27.66	12.23	1.68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
977	Coniferous swamp	0	0	0	0	0	0	0.61	12.15	11.04	2.47	2.54	16.46	8.41	0	0	0	0	0	0	0	
978	Hardwood swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
979	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
980	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
981	Alder thicket	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
982	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0.73	10.83	16.56	39.66	21.81	9.15	4.48	0

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Flotation Tailings Basin																			
		10,000 – 10,500 Feet	10,500 – 11,000 Feet	11,000 – 11,500 Feet	11,500 – 12,000 Feet	12,000 – 12,500 Feet	12,500 – 13,000 Feet	13,000 – 13,500 Feet	13,500 – 14,000 Feet	14,000 – 14,500 Feet	14,500 – 15,000 Feet	15,000 – 15,500 Feet	15,500 – 16,000 Feet	16,000 – 16,500 Feet	16,500 – 17,000 Feet	17,000 – 17,500 Feet	17,500 – 18,000 Feet	18,000 – 18,500 Feet	18,500 – 19,000 Feet	19,000 – 19,500 Feet	19,500 – 20,000 Feet
983	Hardwood swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
985	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0.25	6.97	6.22	7.73	13.03	19.24	1.81	0	0	0	0	0	0
986	Alder thicket or Shrub-carr	0	0.69	11.37	10.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
987	Shallow open water	0	0	0	0	1.47	0.32	0	0	0	0	0	0	0	0	0	0	0	0	0	0
988	Alder thicket or Shrub-carr	0	0	0	3.27	14.24	3.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
989	Coniferous swamp	0	0	0	0.00	9.96	5.41	3.33	15.36	30.62	29.93	24.04	11.59	0	0	0	0	0	0	0	0
990	Alder thicket or Shrub-carr	3.49	5.40	8.39	7.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
991	Coniferous swamp	8.27	2.65	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
992	Alder thicket or Shrub-carr	0	0	0	7.77	7.22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
993	Alder thicket or Shrub-carr	0.14	3.04	3.83	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
994	Coniferous bog	0	0	0	5.81	12.99	7.24	0.73	0	0	0	0	0	0	0	0	0	0	0	0	0
995	Coniferous swamp	0.01	3.69	8.54	6.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
996	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T1	Deep marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T13	Deep marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T13A	Deep marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T8	Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total acres of wetland		283.28	287.31	302.15	292.22	310.86	312.02	281.38	285.38	311.82	286.76	304.43	326.61	248.66	186.85	198.60	233.91	135.33	74.95	44.78	27.53

(1) Reference (13)

Wetland ID	Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Flotation Tailings Basin																			
		20,000 – 20,500 Feet	20,500 – 21,000 Feet	21,000 – 21,500 Feet	21,500 – 22,000 Feet	22,000 – 22,500 Feet	22,500 – 23,000 Feet	23,000 – 23,500 Feet	23,500 – 24,000 Feet	24,000 – 24,500 Feet	24,500 – 25,000 Feet	25,000 – 25,500 Feet	25,500 – 26,000 Feet	26,000 – 26,500 Feet	26,500 – 27,000 Feet	27,000 – 27,500 Feet	27,500 – 28,000 Feet	28,000 – 28,500 Feet	28,500 – 29,000 Feet	29,000 – 29,500 Feet	29,500 – 30,000 Feet
983	Hardwood swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
985	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
986	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
987	Shallow open water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
988	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
989	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
990	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
991	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
992	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
993	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
994	Coniferous bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
995	Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
996	Alder thicket or Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T1	Deep marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T13	Deep marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T13A	Deep marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T8	Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total acres of wetland		26.18	14.49	19.51	9.47	13.73	24.53	24.99	34.41	41.76	41.65	39.71	32.78	35.22	20.76	15.14	12.94	10.54	5.31	3.27	0.95

(1) Reference (13)

Large Table 14 Summary of Wetlands within 500-Foot Increments – Flotation Tailings Basin Area

Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Flotation Tailings Basin																			
	0 - 500 Feet	500 - 1,000 Feet	1,000 - 1,500 Feet	1,500 - 2,000 Feet	2,000 - 2,500 Feet	2,500 - 3,000 Feet	3,000 - 3,500 Feet	3,500 - 4,000 Feet	4,000 - 4,500 Feet	4,500 - 5,000 Feet	5,000 - 5,500 Feet	5,500 - 6,000 Feet	6,000 - 6,500 Feet	6,500 - 7,000 Feet	7,000 - 7,500 Feet	7,500 - 8,000 Feet	8,000 - 8,500 Feet	8,500 - 9,000 Feet	9,000 - 9,500 Feet	9,500 - 10,000 Feet
Alder thicket	2.55	1.25	0.72	0	0	0	0	0	0	0	5.18	0.29	0.08	1.76	0	0	0	0	0	0
Alder thicket or Shrub-carr	0.03	6.60	10.73	15.23	20.59	33.58	19.63	30.81	40.23	40.24	29.77	29.44	29.08	37.38	41.50	46.33	73.99	69.93	68.68	69.03
Coniferous bog	0	0	0	0	0	0	0.21	2.77	16.05	20.86	13.05	16.17	19.27	37.47	26.30	24.51	22.10	38.34	36.55	45.57
Coniferous swamp	3.76	11.22	16.52	20.98	44.51	60.25	69.63	66.78	45.05	41.15	66.58	83.36	89.60	54.91	56.17	56.15	65.94	67.72	79.39	104.50
Deep marsh	23.96	59.69	47.71	41.64	38.68	27.29	16.63	8.98	9.18	19.42	10.87	0.53	0	0	1.97	9.17	8.05	2.90	1.73	7.20
Hardwood swamp	0	0.45	1.79	0	4.66	9.42	1.20	1.76	4.40	9.27	9.05	5.87	4.50	1.43	2.93	0.84	0	0.80	4.67	11.51
Lake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.87	14.79	18.98	17.15	18.68	25.45
Open bog	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sedge meadow	0	0.07	0	0	3.36	5.28	8.08	0.40	0	0	0	0	0	0	0	0	0	0	0	0
Sedge meadow or Wet meadow	0	0	0	0.35	0	0	0	0	0	0	0	0	0	0	0	3.09	1.23	0	0	0
Shallow marsh	24.07	68.34	55.70	64.39	62.54	55.76	38.38	15.82	13.04	14.12	15.37	12.58	6.96	5.23	14.77	12.36	15.17	7.00	7.54	17.86
Shallow, open water	0	0	0	0	0	3.76	6.06	10.61	12.86	12.16	13.08	12.22	11.92	8.33	2.66	2.83	2.04	1.66	1.91	4.23
Shrub-carr	0.65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wet meadow	0.03	0	0	0	0	0	0.17	0.52	0	0	0	0	0	0.09	2.70	3.83	7.27	3.81	0	0
Total acres of wetland	55.05	147.62	133.17	142.59	174.34	195.34	159.99	138.45	140.81	157.22	162.95	160.46	161.41	146.60	149.87	173.90	214.77	209.31	219.15	285.35

Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Flootation Tailings Basin																			
	10,000 - 10,500 Feet	10,500 - 11,000 Feet	11,000 - 11,500 Feet	11,500 - 12,000 Feet	12,000 - 12,500 Feet	12,500 - 13,000 Feet	13,000 - 13,500 Feet	13,500 - 14,000 Feet	14,000 - 14,500 Feet	14,500 - 15,000 Feet	15,000 - 15,500 Feet	15,500 - 16,000 Feet	16,000 - 16,500 Feet	16,500 - 17,000 Feet	17,000 - 17,500 Feet	17,500 - 18,000 Feet	18,000 - 18,500 Feet	18,500 - 19,000 Feet	19,000 - 19,500 Feet	19,500 - 20,000 Feet
Alder thicket	0	0	11.28	18.38	9.46	0.26	2.98	2.14	4.98	3.02	14.82	18.53	1.32	0	0	0	0	0	0	0
Alder thicket or Shrub-carr	59.07	103.58	115.75	92.44	111.84	125.28	101.99	74.51	65.32	123.38	162.14	178.28	137.86	89.56	65.76	112.91	71.92	38.31	18.05	0.40
Coniferous bog	50.41	36.12	46.10	41.07	38.89	38.17	15.67	13.64	4.91	0	0	0	0.01	2.60	6.19	13.39	15.05	19.32	26.73	22.85
Coniferous swamp	103.52	86.72	98.16	125.25	124.90	91.92	99.96	122.59	147.98	84.66	48.99	48.67	29.78	31.81	74.75	74.88	21.82	4.43	0	0
Deep marsh	18.23	15.81	1.77	0	0	0	1.35	11.73	11.71	10.51	10.72	9.76	11.34	2.85	0	0	0	0	0	0
Hardwood swamp	19.91	28.49	24.01	4.99	3.69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.59
Lake	25.17	10.92	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Open bog	0	0	0	0	0.20	5.05	11.72	18.30	18.53	24.24	30.19	35.42	38.55	35.06	29.30	16.59	10.32	5.39	0	0
Sedge meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sedge meadow or Wet meadow	0	1.06	0.46	6.90	3.77	7.39	1.95	0	0	0	0	0.28	0	0	0.09	5.33	0	0	0	0
Shallow marsh	3.37	0	0	0	0	9.15	18.11	5.47	10.33	1.55	0	0.78	2.85	12.88	14.48	7.10	2.81	0	0	1.69
Shallow, open water	3.60	4.61	4.62	3.19	7.18	14.82	7.40	1.44	0	0	0	0	0	0	0	0	0	0	0	0
Shrub-carr	0	0	0	0	10.93	19.98	20.25	35.56	47.96	34.21	31.45	31.34	18.08	0.01	0	0	0	0	0	0
Wet meadow	0	0	0	0	0	0	0	0	0.10	5.19	6.12	3.55	8.87	12.08	8.03	3.71	13.41	7.50	0	0
Total acres of wetland	283.28	287.31	302.15	292.22	310.86	312.02	281.38	285.38	311.82	286.76	304.43	326.61	248.66	186.85	198.60	233.91	135.33	74.95	44.78	27.53

Eggers and Reed Wetland Community ⁽¹⁾	Wetlands (acres) within 500-Foot Increments From the Edge of the Flootation Tailings Basin																			
	20,000 - 20,500 Feet	20,500 - 21,000 Feet	21,000 - 21,500 Feet	21,500 - 22,000 Feet	22,000 - 22,500 Feet	22,500 - 23,000 Feet	23,000 - 23,500 Feet	23,500 - 24,000 Feet	24,000 - 24,500 Feet	24,500 - 25,000 Feet	25,000 - 25,500 Feet	25,500 - 26,000 Feet	26,000 - 26,500 Feet	26,500 - 27,000 Feet	27,000 - 27,500 Feet	27,500 - 28,000 Feet	28,000 - 28,500 Feet	28,500 - 29,000 Feet	29,000 - 29,500 Feet	29,500 - 30,000 Feet
Alder thicket	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alder thicket or Shrub-carr	9.16	2.52	0.01	0.08	1.41	2.91	3.54	1.85	2.53	1.60	2.82	3.07	5.34	3.73	0	0	0	0	0	0
Coniferous bog	11.90	11.97	19.50	9.39	12.32	21.62	21.27	22.67	19.66	15.07	17.23	29.47	29.88	17.03	15.14	12.94	10.54	5.31	3.27	0.95
Coniferous swamp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deep marsh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hardwood swamp	2.90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Open bog	0	0	0	0	0	0	0.18	9.89	19.57	24.98	19.66	0.24	0	0	0	0	0	0	0	0
Sedge meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sedge meadow or Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shallow marsh	2.22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shallow, open water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shrub-carr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wet meadow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total acres of wetland	26.18	14.49	19.51	9.47	13.73	24.53	24.99	34.41	41.76	41.65	39.71	32.78	35.22	20.76	15.14	12.94	10.54	5.31	3.27	0.95

(1) Reference (13)

Large Table 15 Summary of Wetlands within the FTB Groundwater Flow Paths

Eggers and Reed Wetland Community ⁽¹⁾	Hydrology	Wetlands within the FTB Groundwater Flow Paths (acres)		
		Unnamed Creek	Trimble Creek	Mud Lake Creek
Alder thicket	Groundwater	53.36	8.90	0
Alder thicket or Shrub-carr	Groundwater	433.41	227.34	144.85
Ombrotrophic coniferous bog	Precipitation	37.56	196.63	58.14
Coniferous swamp	Groundwater	375.48	308.35	630.61
Deep marsh	Groundwater	130.89	97.59	125.83
Hardwood swamp	Groundwater	126.05	0	40.91
Open bog	Precipitation	157.48	0	0
Sedge meadow	Groundwater	17.13	0	0
Sedge or Wet meadow	Groundwater	17.88	0	0.35
Shallow marsh	Groundwater	196.48	225.79	124.14
Shallow, open water	Groundwater	8.34	0	7.44
Shrub-carr	Groundwater	234.72	0.65	0
Wet meadow	Groundwater	64.24	17.70	0
Total acres of wetland		1853.02	1082.95	1132.27

(1) Reference (13)

Large Table 16 Wetlands within the FTB Groundwater Flow Paths

Wetland ID	Eggers and Reed Wetland Community⁽¹⁾	Dominant Source of Hydrology	Area (acres)
Unnamed Creek			
264	Coniferous swamp	Groundwater	10.86
265	Alder thicket or Shrub-carr	Groundwater	0.42
268	Alder thicket or Shrub-carr	Groundwater	15.44
270	Shallow marsh	Groundwater	85.84
271	Coniferous swamp	Groundwater	18.08
275	Coniferous swamp	Groundwater	30.59
276	Coniferous swamp	Groundwater	8.68
277	Alder thicket or Shrub-carr	Groundwater	14.46
278	Alder thicket	Groundwater	0.81
278A	Alder thicket or Shrub-carr	Groundwater	1.84
279	Alder thicket	Groundwater	1.50
279A	Alder thicket or Shrub-carr	Groundwater	0.33
279B	Alder thicket or Shrub-carr	Groundwater	1.13
280	Sedge meadow	Groundwater	17.13
281	Alder thicket or Shrub-carr	Groundwater	1.46
282	Shallow marsh	Groundwater	6.83
282A	Shallow marsh	Groundwater	6.63
282B	Shallow marsh	Groundwater	12.41
283	Deep marsh	Groundwater	8.89
284	Alder thicket	Groundwater	0.41
284A	Alder thicket or Shrub-carr	Groundwater	2.99
287	Alder thicket or Shrub-carr	Groundwater	5.93
293	Deep marsh	Groundwater	5.74
591	Deep marsh	Groundwater	0.36
591A	Deep marsh	Groundwater	0.15
593	Deep marsh	Groundwater	1.18
593A	Deep marsh	Groundwater	25.73
594	Deep marsh	Groundwater	0.06
594A	Deep marsh	Groundwater	0.75
596	Alder thicket or Shrub-carr	Groundwater	0.24
597	Hardwood swamp	Groundwater	4.45
598	Alder thicket or Shrub-carr	Groundwater	6.31

Wetland ID	Eggers and Reed Wetland Community⁽¹⁾	Dominant Source of Hydrology	Area (acres)
599	Alder thicket or Shrub-carr	Groundwater	2.79
600	Shallow marsh	Groundwater	8.79
601	Alder thicket or Shrub-carr	Groundwater	1.34
602	Alder thicket or Shrub-carr	Groundwater	0.60
624	Alder thicket or Shrub-carr	Groundwater	4.84
625	Coniferous swamp	Groundwater	3.70
626	Coniferous swamp	Groundwater	200.75
627	Alder thicket or Shrub-carr	Groundwater	187.10
628	Deep marsh	Groundwater	10.53
629	Alder thicket or Shrub-carr	Groundwater	10.66
630	Coniferous bog	Precipitation	8.05
631	Coniferous swamp	Groundwater	10.05
632	Alder thicket or Shrub-carr	Groundwater	11.13
633	Alder thicket or Shrub-carr	Groundwater	1.07
634	Alder thicket or Shrub-carr	Groundwater	0.51
635	Alder thicket or Shrub-carr	Groundwater	1.76
636	Coniferous bog	Precipitation	2.26
641	Coniferous swamp	Groundwater	16.16
642	Shallow, open water	Groundwater	8.34
644	Coniferous swamp	Groundwater	11.73
645	Shallow marsh	Groundwater	1.04
646	Alder thicket or Shrub-carr	Groundwater	16.76
647	Alder thicket or Shrub-carr	Groundwater	6.55
648	Alder thicket	Groundwater	11.51
649	Sedge meadow or Wet meadow	Groundwater	10.01
650	Sedge meadow or Wet meadow	Groundwater	7.87
656	Alder thicket or Shrub-carr	Groundwater	1.94
786	Open bog	Precipitation	157.48
787	Alder thicket or Shrub-carr	Groundwater	16.23
788	Hardwood swamp	Groundwater	98.13
816	Deep marsh	Groundwater	15.46
817	Deep marsh	Groundwater	10.03
818	Deep marsh	Groundwater	7.13
819	Deep marsh	Groundwater	0.97
820	Deep marsh	Groundwater	26.92

Wetland ID	Eggers and Reed Wetland Community⁽¹⁾	Dominant Source of Hydrology	Area (acres)
821	Shallow marsh	Groundwater	9.19
822	Shallow marsh	Groundwater	4.46
823	Shallow marsh	Groundwater	6.22
824	Shallow marsh	Groundwater	5.74
825	Wet meadow	Groundwater	0.07
826	Wet meadow	Groundwater	8.93
827	Wet meadow	Groundwater	2.84
828	Wet meadow	Groundwater	4.25
829	Wet meadow	Groundwater	3.50
830	Shallow marsh	Groundwater	4.88
831	Wet meadow	Groundwater	13.66
832	Wet meadow	Groundwater	9.38
833	Shallow marsh	Groundwater	15.14
834	Wet meadow	Groundwater	8.26
835	Wet meadow	Groundwater	12.66
836	Shrub-carr	Groundwater	11.50
837	Shrub-carr	Groundwater	13.50
838	Shrub-carr	Groundwater	19.00
839	Shrub-carr	Groundwater	13.07
840	Shrub-carr	Groundwater	31.30
841	Shrub-carr	Groundwater	9.24
842	Shrub-carr	Groundwater	8.30
843	Shrub-carr	Groundwater	12.56
844	Shrub-carr	Groundwater	28.54
845	Coniferous swamp	Groundwater	12.64
846	Shrub-carr	Groundwater	7.63
847	Shallow marsh	Groundwater	17.87
848	Shrub-carr	Groundwater	16.03
849	Shrub-carr	Groundwater	10.88
850	Shrub-carr	Groundwater	29.75
851	Shrub-carr	Groundwater	19.74
852	Shrub-carr	Groundwater	3.68
876	Alder thicket	Groundwater	39.13
877	Alder thicket or Shrub-carr	Groundwater	12.65
878	Alder thicket or Shrub-carr	Groundwater	35.55

Wetland ID	Eggers and Reed Wetland Community⁽¹⁾	Dominant Source of Hydrology	Area (acres)
917	Coniferous bog	Precipitation	19.88
918	Coniferous swamp	Groundwater	9.44
921	Alder thicket or Shrub-carr	Groundwater	0.38
923	Wet meadow	Groundwater	0.69
942	Deep marsh	Groundwater	2.96
943	Deep marsh	Groundwater	14.03
944	Hardwood swamp	Groundwater	2.61
945	Alder thicket or Shrub-carr	Groundwater	2.32
950	Alder thicket or Shrub-carr	Groundwater	3.13
978	Hardwood swamp	Groundwater	2.80
980	Alder thicket or Shrub-carr	Groundwater	2.82
996	Alder thicket or Shrub-carr	Groundwater	4.10
1025	Hardwood swamp	Groundwater	1.55
1070	Alder thicket or Shrub-carr	Groundwater	3.80
1071	Alder thicket or Shrub-carr	Groundwater	29.18
1072	Alder thicket or Shrub-carr	Groundwater	8.62
1073	Alder thicket or Shrub-carr	Groundwater	3.57
1129	Coniferous swamp	Groundwater	9.79
1147	Alder thicket or Shrub-carr	Groundwater	13.46
1156	Shallow marsh	Groundwater	4.08
NA	Hardwood swamp	Groundwater	16.51
NA	Coniferous swamp	Groundwater	30.02
NA	Shallow marsh	Groundwater	7.36
NA	Coniferous swamp	Groundwater	2.99
NA	Coniferous bog	Precipitation	6.23
NA	Coniferous bog	Precipitation	1.14
Trimble Creek			
252	Coniferous swamp	Groundwater	45.74
253	Deep marsh	Groundwater	5.89
254	Shallow marsh	Groundwater	36.71
256	Alder thicket or Shrub-carr	Groundwater	21.23
259	Alder thicket or Shrub-carr	Groundwater	0.34
260	Shallow marsh	Groundwater	114.62
261	Alder thicket or Shrub-carr	Groundwater	0.84
262	Shallow marsh	Groundwater	1.86

Wetland ID	Eggers and Reed Wetland Community⁽¹⁾	Dominant Source of Hydrology	Area (acres)
267	Alder thicket or Shrub-carr	Groundwater	1.09
312	Shrub-carr	Groundwater	0.65
476	Alder thicket or Shrub-carr	Groundwater	0.82
529	Wet meadow	Groundwater	0.30
549	Alder thicket or Shrub-carr	Groundwater	1.89
578	Deep marsh	Groundwater	0.69
579	Deep marsh	Groundwater	2.14
580	Alder thicket or Shrub-carr	Groundwater	1.72
581	Coniferous swamp	Groundwater	20.62
582	Deep marsh	Groundwater	18.39
582A	Deep marsh	Groundwater	19.84
584	Alder thicket or Shrub-carr	Groundwater	53.00
585	Alder thicket	Groundwater	1.58
585A	Alder thicket or Shrub-carr	Groundwater	2.78
586	Deep marsh	Groundwater	0.36
587	Shallow marsh	Groundwater	0.81
588	Alder thicket or Shrub-carr	Groundwater	18.22
589	Deep marsh	Groundwater	40.05
590	Shallow marsh	Groundwater	0.05
591	Deep marsh	Groundwater	1.65
591A	Deep marsh	Groundwater	2.60
609	Coniferous swamp	Groundwater	0.33
610	Shallow marsh	Groundwater	0.09
611	Coniferous bog	Precipitation	0.23
612	Coniferous bog	Precipitation	2.19
613	Alder thicket or Shrub-carr	Groundwater	1.59
614	Shallow marsh	Groundwater	1.23
615	Shallow marsh	Groundwater	0.44
616	Deep marsh	Groundwater	5.98
617	Shallow marsh	Groundwater	2.08
618	Alder thicket	Groundwater	1.46
619	Alder thicket or Shrub-carr	Groundwater	0.88
620	Shallow marsh	Groundwater	0.28
621	Alder thicket or Shrub-carr	Groundwater	0.52
622	Alder thicket or Shrub-carr	Groundwater	0.37

Wetland ID	Eggers and Reed Wetland Community⁽¹⁾	Dominant Source of Hydrology	Area (acres)
623	Alder thicket or Shrub-carr	Groundwater	0.89
643	Alder thicket or Shrub-carr	Groundwater	1.59
670	Coniferous swamp	Groundwater	29.76
672	Coniferous swamp	Groundwater	9.05
673	Coniferous swamp	Groundwater	110.07
810	Alder thicket or Shrub-carr	Groundwater	11.40
869	Alder thicket or Shrub-carr	Groundwater	16.50
870	Coniferous bog	Precipitation	8.60
915	Alder thicket	Groundwater	5.48
946	Alder thicket or Shrub-carr	Groundwater	0.12
947	Alder thicket or Shrub-carr	Groundwater	0.76
951	Coniferous bog	Precipitation	116.45
954	Coniferous swamp	Groundwater	39.29
956	Wet meadow	Groundwater	17.40
957	Coniferous swamp	Groundwater	6.88
958	Alder thicket or Shrub-carr	Groundwater	3.58
974	Coniferous bog	Precipitation	69.16
975	Coniferous swamp	Groundwater	26.33
979	Alder thicket or Shrub-carr	Groundwater	5.75
981	Alder thicket	Groundwater	0.38
990	Alder thicket or Shrub-carr	Groundwater	42.22
991	Coniferous swamp	Groundwater	55.70
995	Coniferous swamp	Groundwater	3.82
1139	Shallow marsh	Groundwater	17.70
1139A	Shallow marsh	Groundwater	5.31
1139B	Shallow marsh	Groundwater	44.61
Mud Lake Creek			
260	Shallow marsh	Groundwater	34.98
285	Coniferous swamp	Groundwater	243.19
286	Shallow, open water	Groundwater	7.44
288	Deep marsh	Groundwater	4.51
290	Coniferous swamp	Groundwater	0.25
292	Deep marsh	Groundwater	0.41
292A	Deep marsh	Groundwater	0.07
308	Deep marsh	Groundwater	5.22

Wetland ID	Eggers and Reed Wetland Community⁽¹⁾	Dominant Source of Hydrology	Area (acres)
308A	Deep marsh	Groundwater	75.57
314	Shallow marsh	Groundwater	19.17
314A	Shallow marsh	Groundwater	20.92
572	Deep marsh	Groundwater	7.34
573	Shallow marsh	Groundwater	0.12
573A	Shallow marsh	Groundwater	11.33
574	Deep marsh	Groundwater	6.59
575	Alder thicket or Shrub-carr	Groundwater	0.49
576	Sedge meadow or Wet meadow	Groundwater	0.35
577	Alder thicket or Shrub-carr	Groundwater	2.26
578	Deep marsh	Groundwater	16.81
582	Deep marsh	Groundwater	0.99
582A	Deep marsh	Groundwater	0.90
652	Coniferous swamp	Groundwater	109.44
669	Shallow marsh	Groundwater	21.39
810	Alder thicket or Shrub-carr	Groundwater	0.35
866	Hardwood swamp	Groundwater	31.04
867	Alder thicket or Shrub-carr	Groundwater	64.89
868	Hardwood swamp	Groundwater	9.87
870	Coniferous bog	Precipitation	58.14
908	Shallow marsh	Groundwater	8.70
947	Alder thicket or Shrub-carr	Groundwater	19.62
963	Alder thicket or Shrub-carr	Groundwater	26.88
964	Coniferous swamp	Groundwater	42.88
965	Coniferous swamp	Groundwater	11.22
966	Alder thicket or Shrub-carr	Groundwater	8.15
968	Coniferous swamp	Groundwater	3.49
986	Alder thicket or Shrub-carr	Groundwater	22.21
1130	Coniferous swamp	Groundwater	32.29
1133	Coniferous swamp	Groundwater	70.54
1134	Shallow marsh	Groundwater	5.71
1134A	Shallow marsh	Groundwater	1.82
1135	Deep marsh	Groundwater	0.51
1135A	Deep marsh	Groundwater	6.91
1151	Coniferous swamp	Groundwater	117.31

(1) Reference (13)

Large Table 17 Summary of Wetlands Abutting the Railroad Corridor - Mine Site to Plant Site

Wetland ID	Eggers and Reed Wetland Community⁽¹⁾	Wetland Size (acres)
9	Shallow marsh	1.80
13	Deep marsh	5.03
16	Shallow marsh	0.31
53	Alder thicket	18.59
53B	Coniferous swamp	0.43
53C	Coniferous swamp	2.88
53D	Alder thicket	241.16
81	Coniferous swamp	1.68
390A	Alder thicket or Shrub-carr	13.54
391	Coniferous swamp	22.32
556	Alder thicket or Shrub-carr	1.84
565	Alder thicket or Shrub-carr	1.92
568	Deep marsh	0.42
570	Alder thicket or Shrub-carr	31.69
571	Coniferous swamp	44.05
583	Alder thicket or Shrub-carr	0.13
595	Deep marsh	1.06
716A	Alder thicket	1.04
903	Shallow marsh	9.71
1037	Shallow, open water	6.59
1038A	Coniferous swamp	1.68
1041	Alder thicket or Shrub-carr	81.52
1042	Sedge meadow or Wet meadow	0.69
1119	Coniferous swamp	7.93
1137	Alder thicket or Shrub-carr	8.92
1160	Shallow, open water	0.85
R-1	Alder thicket or Shrub-carr	1.05
R-2	Alder thicket or Shrub-carr	1.65
R-3A	Alder thicket or Shrub-carr	0.53
R-4A	Alder thicket	3.31
R-5A	Shallow marsh	16.30
R-7A	Shallow marsh	12.05
Total acres of wetland		542.67

(1) Reference (13)

Large Table 18 Total Wetland Area (Acres) for Pre-Settlement, Existing, and Future Conditions

Watershed	Total Land Area (acres)	Pre-Settlement Conditions		Existing Conditions		Foreseeable Future Conditions with the Project		Foreseeable Future Conditions with the No Action Alternative	
		Area (acres)	% of Watershed	Area (acres)	% of Watershed	Area (acres)	% of Watershed	Area (acres)	% of Watershed
Partridge River	101,812	33,601	33.0%	31,318	30.8%	30,276	29.7%	31,044	30.5%
Embarrass River	116,797	34,650	29.7%	34,249	29.3%	33,947	29.1%	34,122	29.2%

Large Table 19 Total Lake Area (Acres) for Pre-Settlement, Existing, and Future Conditions

Watershed	Total Land Area (acres)	Pre-Settlement Conditions		Existing Conditions		Foreseeable Future Conditions with the Project		Foreseeable Future Conditions with the No Action Alternative	
		Area (acres)	% of Watershed	Area (acres)	% of Watershed	Area (acres)	% of Watershed	Area (acres)	% of Watershed
Partridge River	101,812	2,688	2.6%	3,194	3.1%	3,194	3.1%	3,194	3.1%
Embarrass River	116,797	3,121	2.7%	2,904	2.5%	2,904	2.5%	2,904	2.5%

Large Table 20 Total Deepwater Habitat Area (Acres) for Pre-Settlement, Existing, and Future Conditions

Watershed	Total Land Area (acres)	Pre-Settlement Conditions		Existing Conditions		Foreseeable Future Conditions with the Project		Foreseeable Future Conditions with the No Action Alternative	
		Area (acres)	% of Watershed	Area (acres)	% of Watershed	Area (acres)	% of Watershed	Area (acres)	% of Watershed
Partridge River	101,812	0	0.0%	3,146	3.1%	3,516	3.5%	3,195	3.1%
Embarrass River	116,797	0	0.0%	977	0.8%	1,359	1.2%	1,359	1.2%

Large Table 21 Summary of Future Known Changes in Wetland Resources for the Study Area⁽¹⁾

Watershed	Total Land Area (acres)	Pre-Settlement Conditions (acres)	Existing Conditions (acres)	% Change from Pre-Settlement to Existing Conditions	Foreseeable Future Conditions with the Project (acres)	% Change from Pre-Settlement to Future Conditions with the Project	% Change from Existing to Future Conditions with the Project	Foreseeable Future Conditions with the No Action Alternative (acres)	% Change from Pre-Settlement to Future Conditions with the No Action Alternative	% Change from Existing to Future Conditions with the No Action Alternative
Partridge River	101,812	33,601	31,318	-6.8%	30,276	-9.9%	-3.3%	31,044	-7.6%	-0.9%
Embarrass River	116,797	34,650	34,249	-1.2%	33,947	-2.0%	-0.9%	34,122	-1.5%	-0.4%

(1) The (-) represents a loss of wetland acres and the (+) represents a gain of wetland acres.

Large Table 22 Summary of Future Known Changes in Lake Resources for the Study Area⁽¹⁾

Watershed	Total Land Area (acres)	Pre-Settlement Conditions (acres)	Existing Conditions (acres)	% Change from Pre-Settlement to Existing Conditions	Foreseeable Future Conditions with the Project (acres)	% Change from Pre-Settlement to Future Conditions with the Project	% Change from Existing to Future Conditions with the Project	Foreseeable Future Conditions with the No Action Alternative (acres)	% Change from Pre-Settlement to Future Conditions with the No Action Alternative	% Change from Existing to Future Conditions with the No Action Alternative
Partridge River	101,812	2,688	3,194	18.8%	3,194	18.8%	0%	3,194	18.8%	0%
Embarrass River	116,797	3,121	2,904	-7.0%	2,904	-7.0%	0%	2,904	-7.0%	0%

(1) The (-) represents a loss of lake acres and the (+) represents a gain of lake acres.

Large Table 23 Summary of Future Known Changes in Deepwater Habitat Resources for the Study Area

Watershed	Total Land Area (acres)	Pre-Settlement Conditions (acres)	Existing Conditions (acres)	% Change from Pre-Settlement to Existing Conditions	Foreseeable Future Conditions with the Project (acres)	% Change from Pre-Settlement to Future Conditions with the Project	% Change from Existing to Future Conditions with the Project	Foreseeable Future Conditions with the No Action Alternative (acres)	% Change from Pre-Settlement to Future Conditions with the No Action Alternative	% Change from Existing to Future Conditions with the No Action Alternative
Partridge River	101,812	0	3,146	100%	3,516	100%	11.8%	3,195	100%	1.6%
Embarrass River	116,797	0	977	100%	1,359	100%	39%	1,359	100%	39%

(1) The (-) represents a loss of deepwater acres and the (+) represents a gain of deepwater acres.

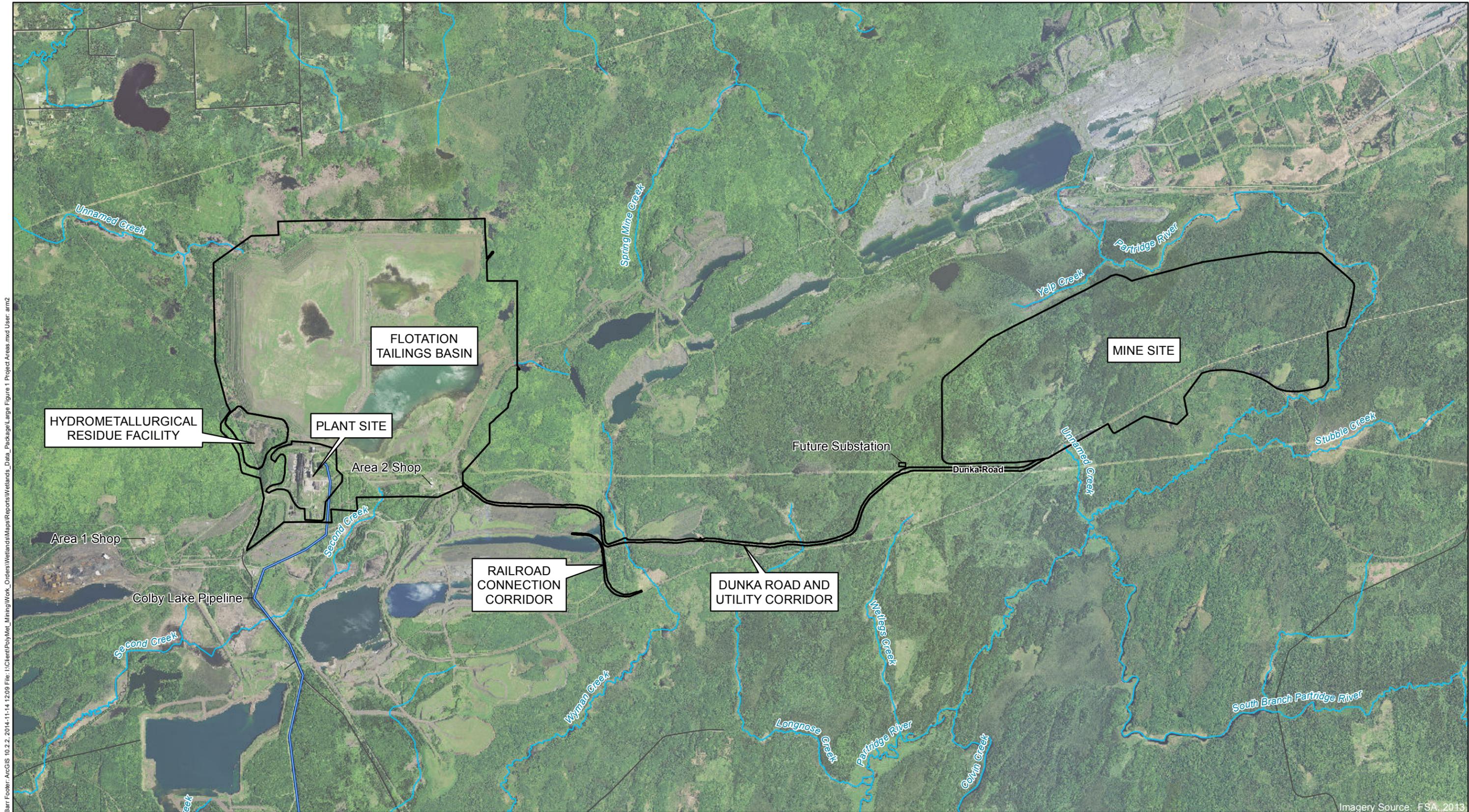
Large Table 24 Comparison of Future Conditions for Wetland and Deepwater Habitat Resources⁽¹⁾

Project Name	Watershed	Wetland Impact (acres)	Proposed Wetland Mitigation (acres)	Net Change in Wetlands (acres)	Existing Deepwater Habitat (acres)	Future Deepwater Habitat (acres)	Net Change in Deepwater (acres)
PolyMet Mining Company	Partridge River	-767.6	0	-767.6	0	321.0	321.0
Mesabi Nugget Phase II	Partridge River	-266.8	0	-266.8	1,552.0	1,601.0	49.0
Laskin Energy Park - worst case scenario	Partridge River	-6.8	0	-6.8	0	0	0
St. Louis County Public Works Bridge Replacement	Partridge River	-0.9	0	-0.9	0	0	0
Total - Partridge River Watershed with Project		-1042.1	0	-1,042.1	1,552.0	1,922.0	370.0
Total - Partridge River Watershed without Project		-275.4	0	-274.5	1,552.0	1,601.0	49.0
PolyMet Mining Company	Embarrass River	-146.2	0	-146.2	0	0	0
PolyMet Mining Company ⁽²⁾	Embarrass River	-28.6	0	-28.6	0	0	0
St. Louis County Public Works Bridge Replacement	Embarrass River	-0.9	0	-0.9	0	0	0
ArcelorMittal East Reserve	Embarrass River	-49.1	0	-71.1	0	275	275
ArcelorMittal Pushback	Embarrass River	-23.5	0	-23.5	0	107	107
Mining Resources - Powder Basin (Biwabik)	Embarrass River	-3.4	0	-3.4	0	0	0
Mining Resources - McKinley	Embarrass River	-50.1	0	-50.1	0	0	0
Total - Embarrass River Watershed with Project		-301.8	0	-301.8	0	382	382
Total - Embarrass River Watershed without Project		-127.0	0	-127.0	0	382	382

(1) The (-) represents a loss of water resources acres and the (+) represents a gain of water resources acres.

(2) These wetlands are exempt because the wetlands are located within the Cliffs Erie LLC (formerly LTVSMC) Permit To Mine Ultimate Tailings Basin Limit boundary and are not regulated by state and federal wetland regulations (Section 5.1).

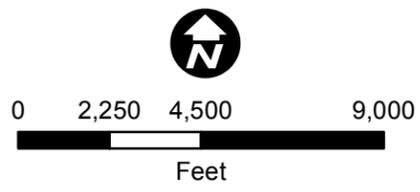
Large Figures



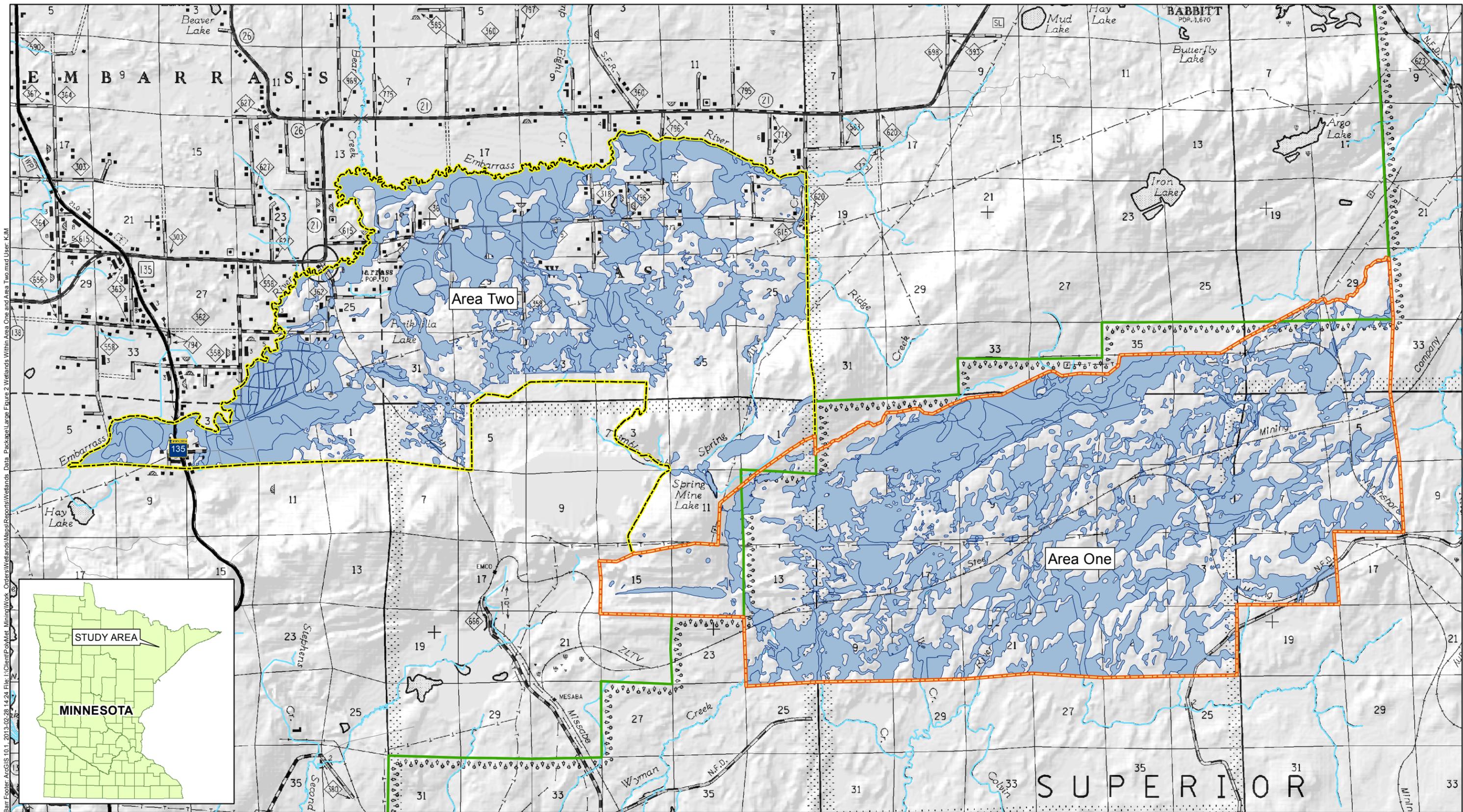
Barr Footer: ArcGIS 10.2.2, 2014-11-14 12:09 File: I:\Client\PolyMet_Mining\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 1 Project Areas.mxd User: am2

Imagery Source: FSA, 2013

- Project Areas
- ~ Rivers & Streams

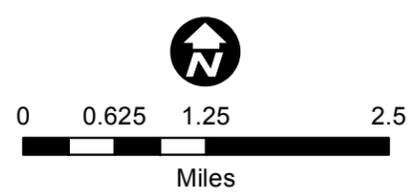


Large Figure 1
PROJECT AREAS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

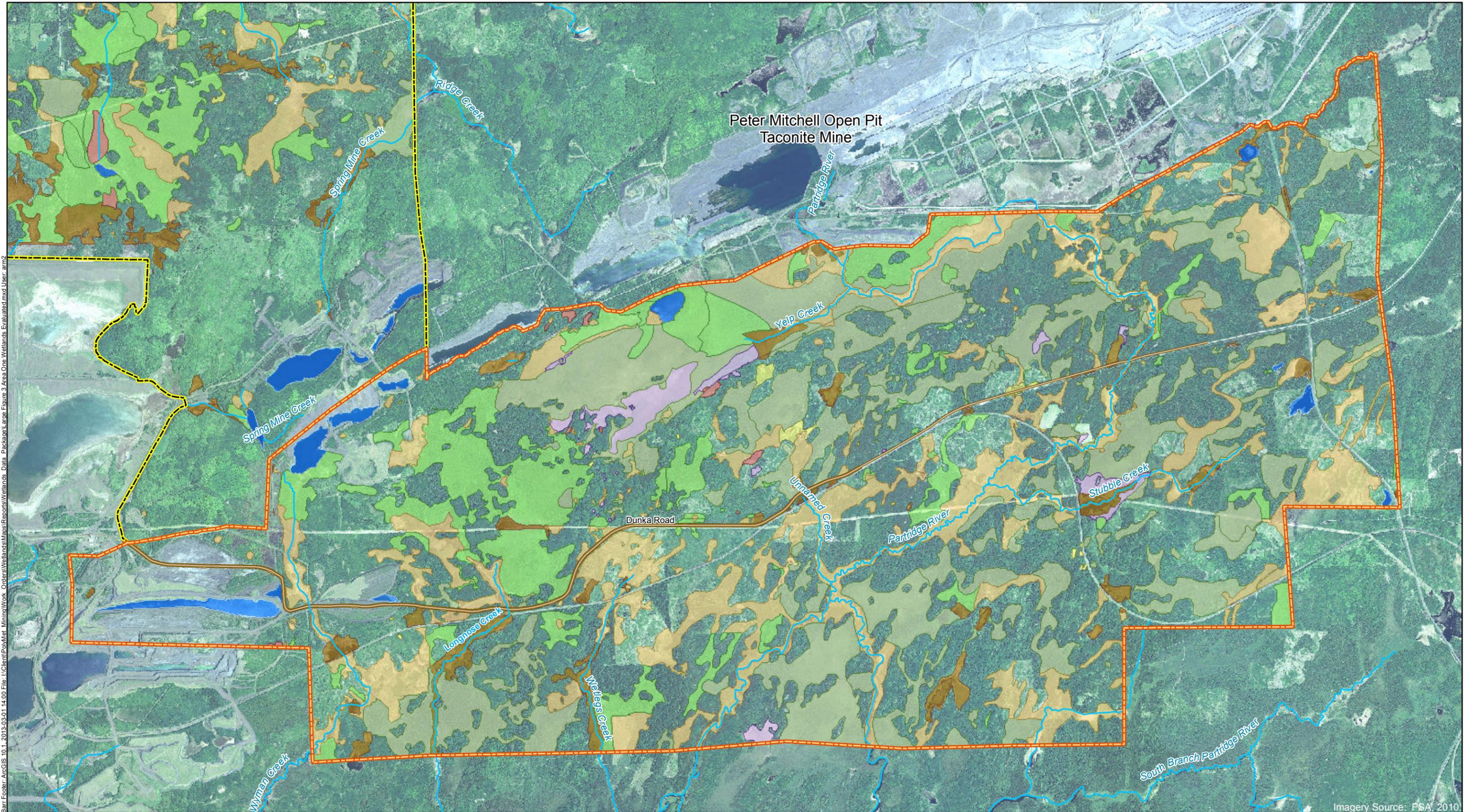


Barr Footer ArcGIS 10.1, 2013-02-28 14:24 File: I:\Client\PolyMet Mining\Work Orders\Wetlands\Map\Reports\Wetlands Data Package\Large Figure 2 Wetlands Within Area One and Area Two.mxd User: KJM

- Area One
- Area Two
- National Forest Boundary
- Wetlands
- Streams



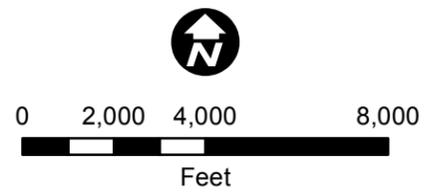
Large Figure 2
 WETLANDS WITHIN
 AREA ONE AND AREA TWO
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota



Bar Footer: ArcGIS 10.1, 2013-03-01 14:00 File: L:\Client\PolMet_Minima\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 3 Area One Wetlands Evaluated.mxd User: am2

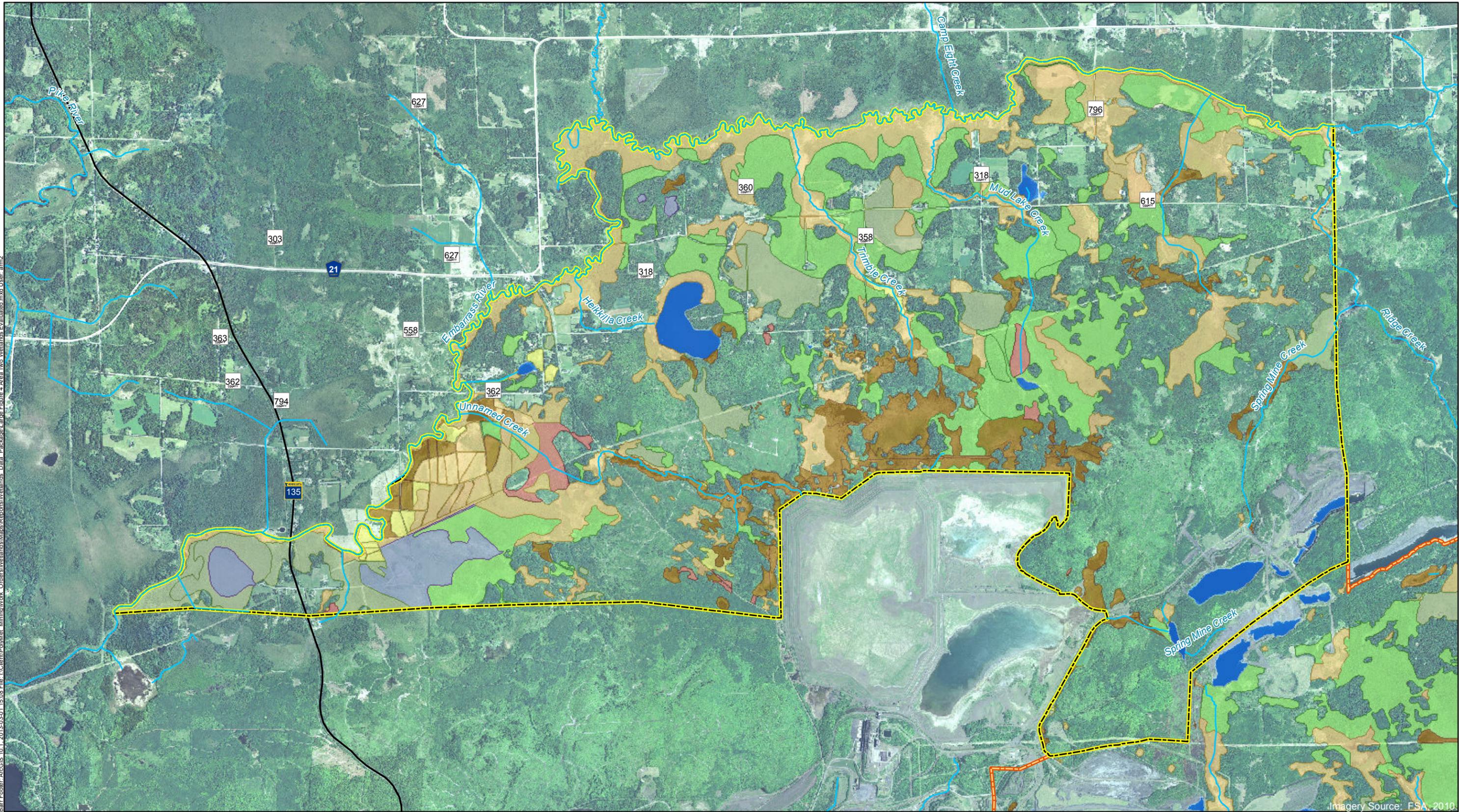
Imagery Source: FSA, 2010

- | | | |
|---|--|------------------|
| Area One | Deep marsh; Shallow marsh | Dunka Road |
| Area Two | Hardwood swamp | Rivers & Streams |
| Eggers & Reed Wetland Types | | |
| Shrub Swamps (Alder thickets & Shrub-carrs) | Open water (Shallow, open water & lakes) | |
| Coniferous bog | Open bog | |
| Coniferous swamp | Sedge meadow; Wet meadow | |



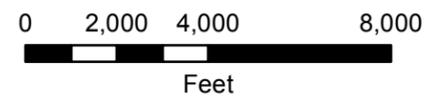
Large Figure 3
AREA ONE -
WETLANDS EVALUATED
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Bar Footer: ArcGIS 10.1, 2015-03-01 15:08 File: L:\Client\PolMet_Minima\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 4 Area Two Wetlands Evaluated.mxd User: am2



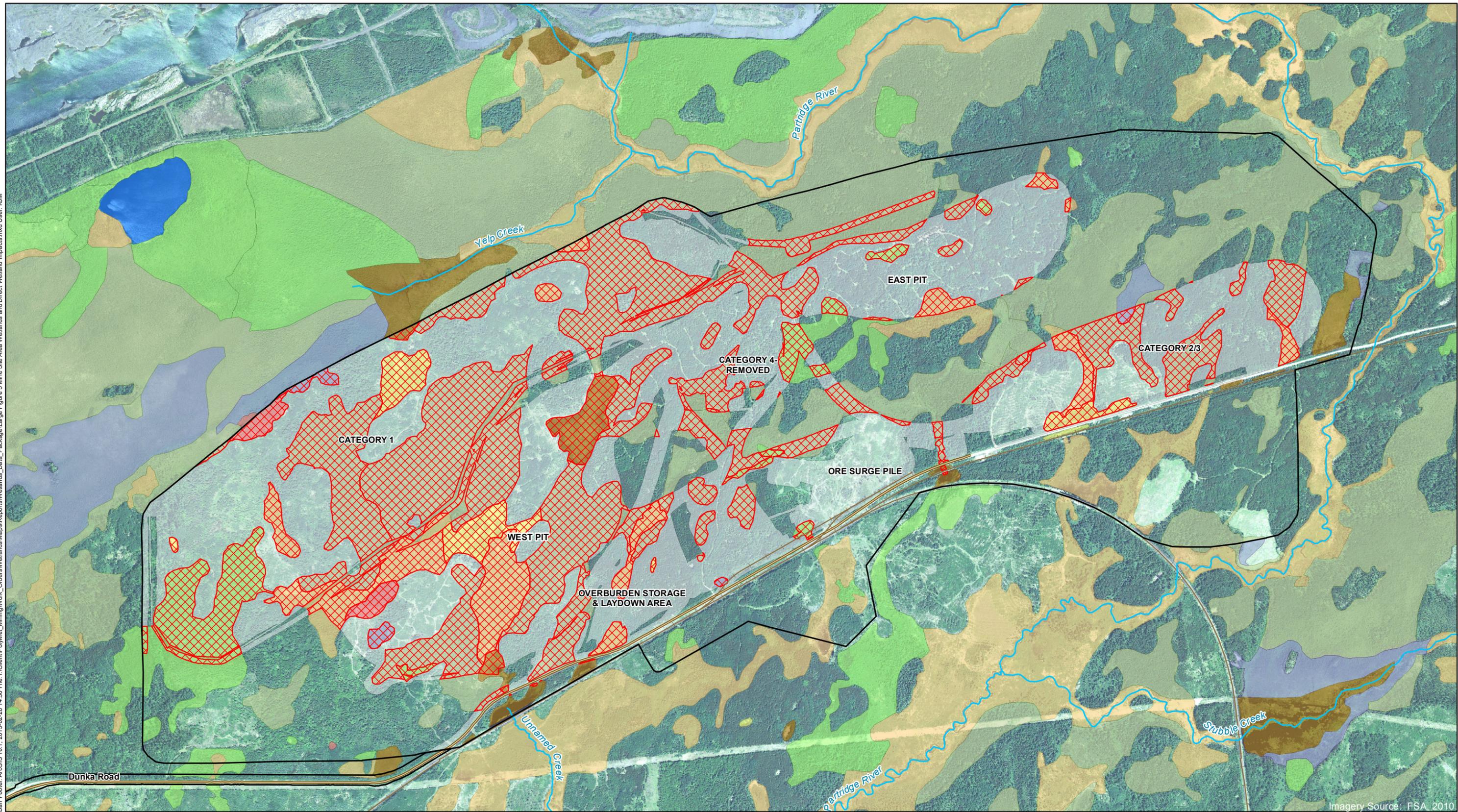
Imagery Source: FSA, 2010.

-  Area Two
-  Area One
-  Rivers & Streams
- Eggers & Reed Wetland Types**
-  Shrub Swamps (Alder thickets & Shrub-carrs)
-  Coniferous bog
-  Coniferous swamp
-  Deep marsh; Shallow marsh
-  Hardwood swamp
-  Open water (Shallow, open water & lakes)
-  Open bog
-  Sedge meadow; Wet meadow



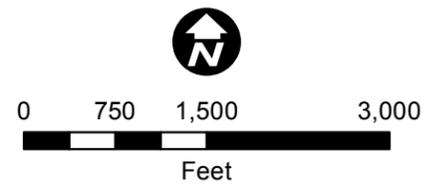
Large Figure 4
AREA TWO -
WETLANDS EVALUATED
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, Minnesota

Barr Footer: ArcGIS 10.1, 2013-02-28 14:30 File: I:\Client\PolyMet_Mining\Work_Orders\Wetlands\Map\Reports\Wetlands_Data_Package\Large Figure 5 Mine Site Area Wetlands and Direct Wetland Impacts.mxd User: KJM



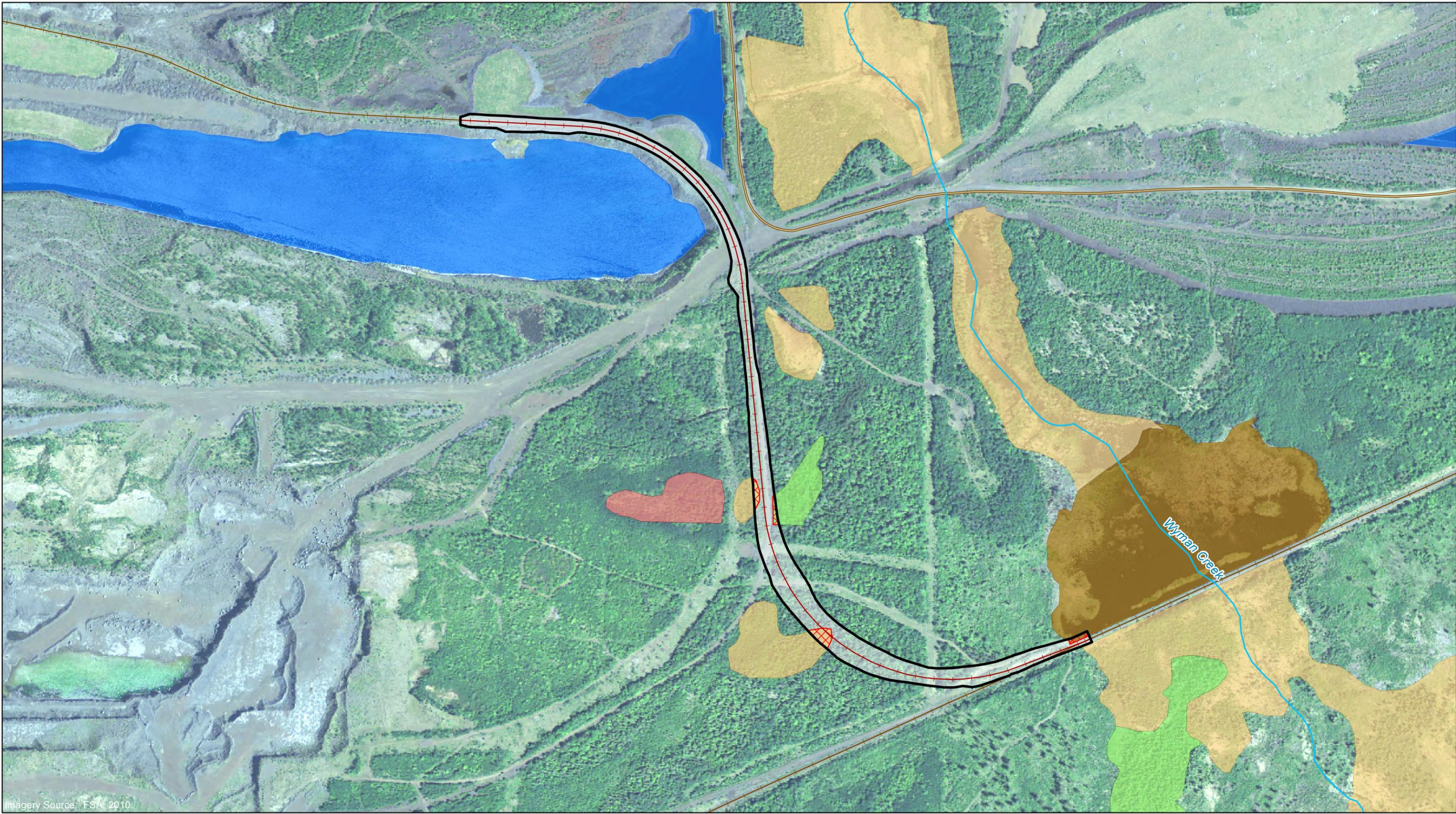
Imagery Source: FSA, 2010

- Mine Site
- Dunka Road
- Areas Disturbed by Proposed Project Features
- Direct Wetland Impacts
- Eggers & Reed Wetland Types**
- Shrub Swamps (Alder thickets & Shrub-carrs)
- Coniferous bog
- Coniferous swamp
- Deep marsh; Shallow marsh
- Hardwood swamp
- Open water (Shallow, open water & lakes)
- Open bog
- Sedge meadow; Wet meadow



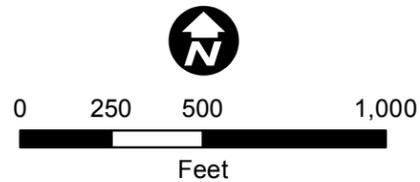
Large Figure 5
 MINE SITE AREA WETLANDS AND
 DIRECT WETLAND IMPACTS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Barr Footer: ArcGIS 10.1, 2013-02-26 14:59 File: I:\Client\PolyMet_Mining\Work_Orders\Wetlands\Map\Reports\Wetlands_Data_Package\Large Figure 6 Railroad Connection Corridor Wetlands and Direct Wetland Impacts.mxd User: KJM



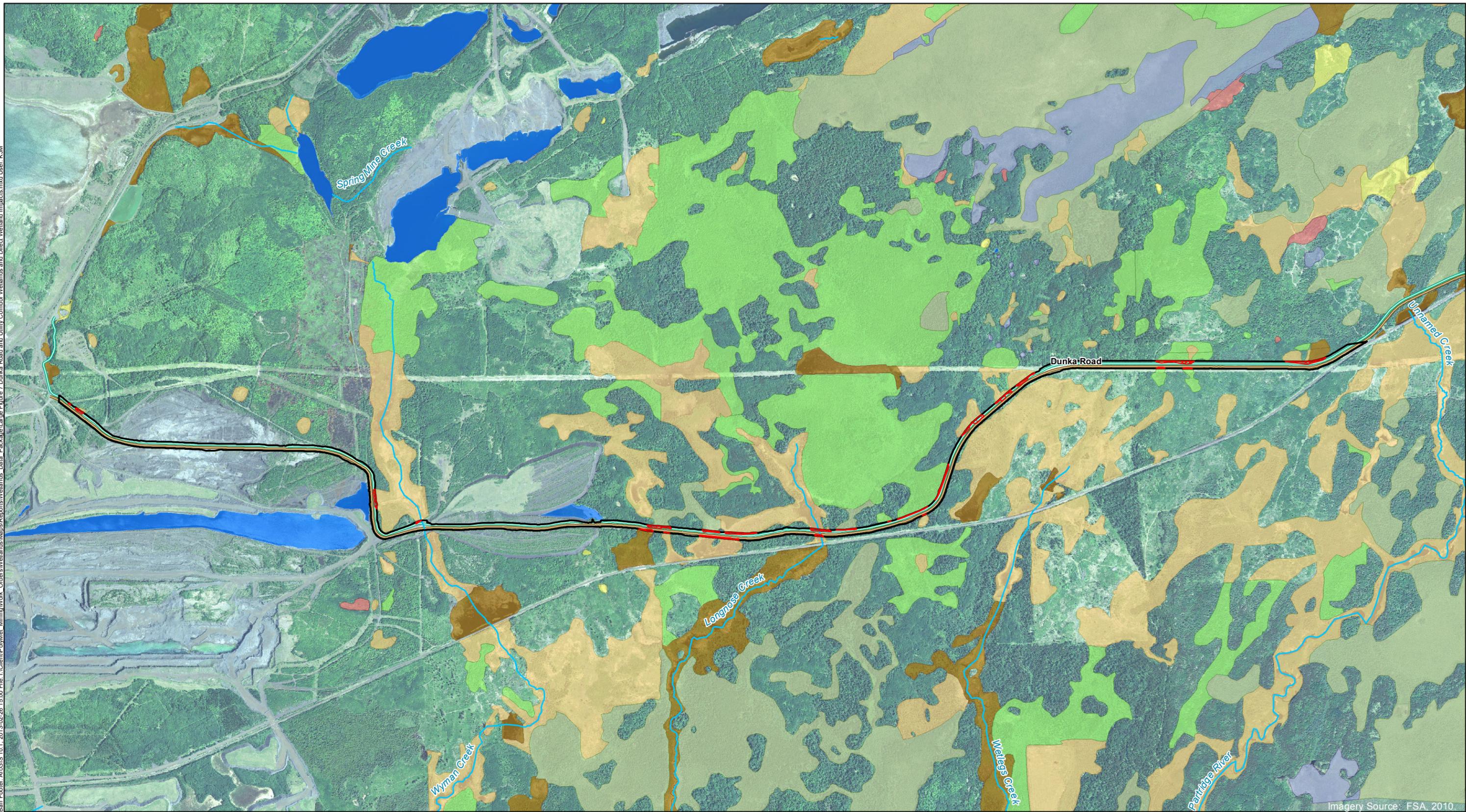
Imagery Source: FSA, 2010.

- | | | |
|--|---|--|
| Railroad Connection Corridor | Eggers & Reed Wetland Types | Hardwood swamp |
| Proposed Track | Shrub Swamps (Alder thickets & Shrub-carrs) | Open water (Shallow, open water & lakes) |
| Existing Railroad | Coniferous bog | Open bog |
| Dunka Road | Coniferous swamp | Sedge meadow; Wet meadow |
| Areas Disturbed by Proposed Project Features | Deep marsh; Shallow marsh | |
| Direct Wetland Impacts | | |



Large Figure 6
RAILROAD CONNECTION CORRIDOR WETLANDS
AND DIRECT WETLAND IMPACTS
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, Minnesota

Bar Footer: ArcGIS 10.1, 2013-02-26 15:00 File: I:\Client\PolyMet Mining\Work Orders\Wetlands\Map\Reports\Wetlands Data Package\Large Figure 7 Dunka Road and Utility Corridor Wetlands and Direct Wetland Impacts.mxd User: KJM

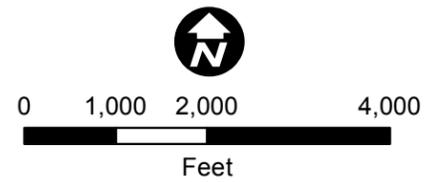


Imagery Source: FSA, 2010.

- Dunka Road and Utility Corridor
- Dunka Road
- Treated Water Pipeline
- Areas Disturbed by Proposed Project Features
- Direct Wetland Impacts

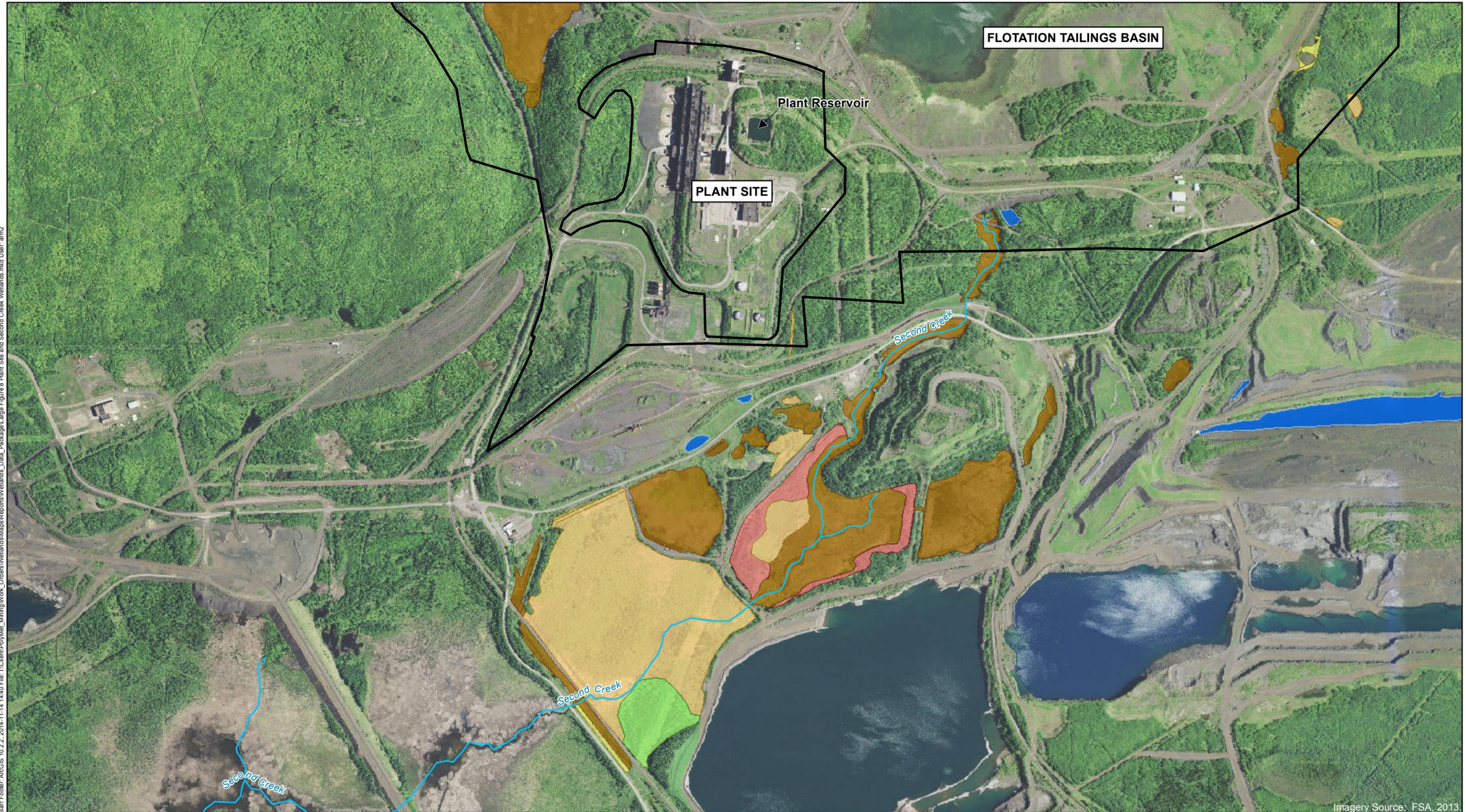
- Eggers & Reed Wetland Types**
- Shrub Swamps (Alder thickets & Shrub-carrs)
 - Coniferous bog
 - Coniferous swamp
 - Deep marsh; Shallow marsh

- Hardwood swamp
- Open water (Shallow, open water & lakes)
- Open bog
- Sedge meadow; Wet meadow



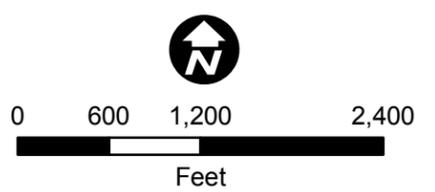
Large Figure 7
DUNKA ROAD AND UTILITY CORRIDOR WETLANDS AND DIRECT WETLAND IMPACTS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Barr Footer: ArcGIS 10.2.2, 2014-11-14 14:40 File: I:\Client\PolyMet_Mining\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 8 Plant Site and Second Creek Wetlands.mxd User: am2

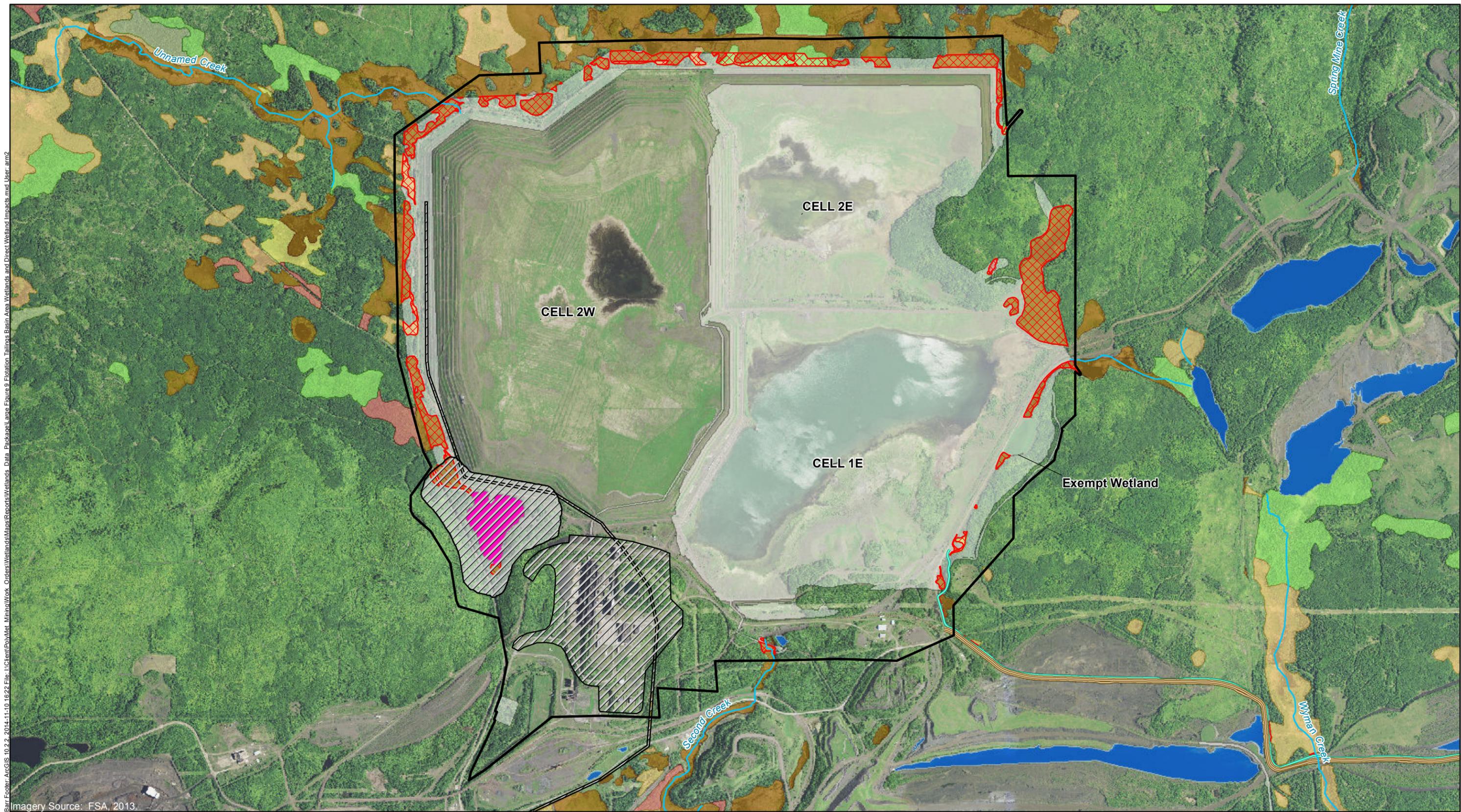


Imagery Source: FSA, 2013.

- Project Area
- Rivers & Streams
- Eggers & Reed Wetland Types**
- Shrub Swamps (Alder thickets & Shrub-carrs)
- Coniferous bog
- Coniferous swamp
- Deep marsh; Shallow marsh
- Hardwood swamp
- Open water (Shallow, open water & lakes)
- Open bog
- Sedge meadow; Wet meadow

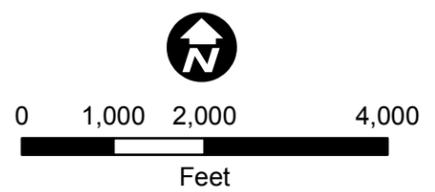


Large Figure 8
 PLANT SITE AND
 SECOND CREEK WETLANDS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota



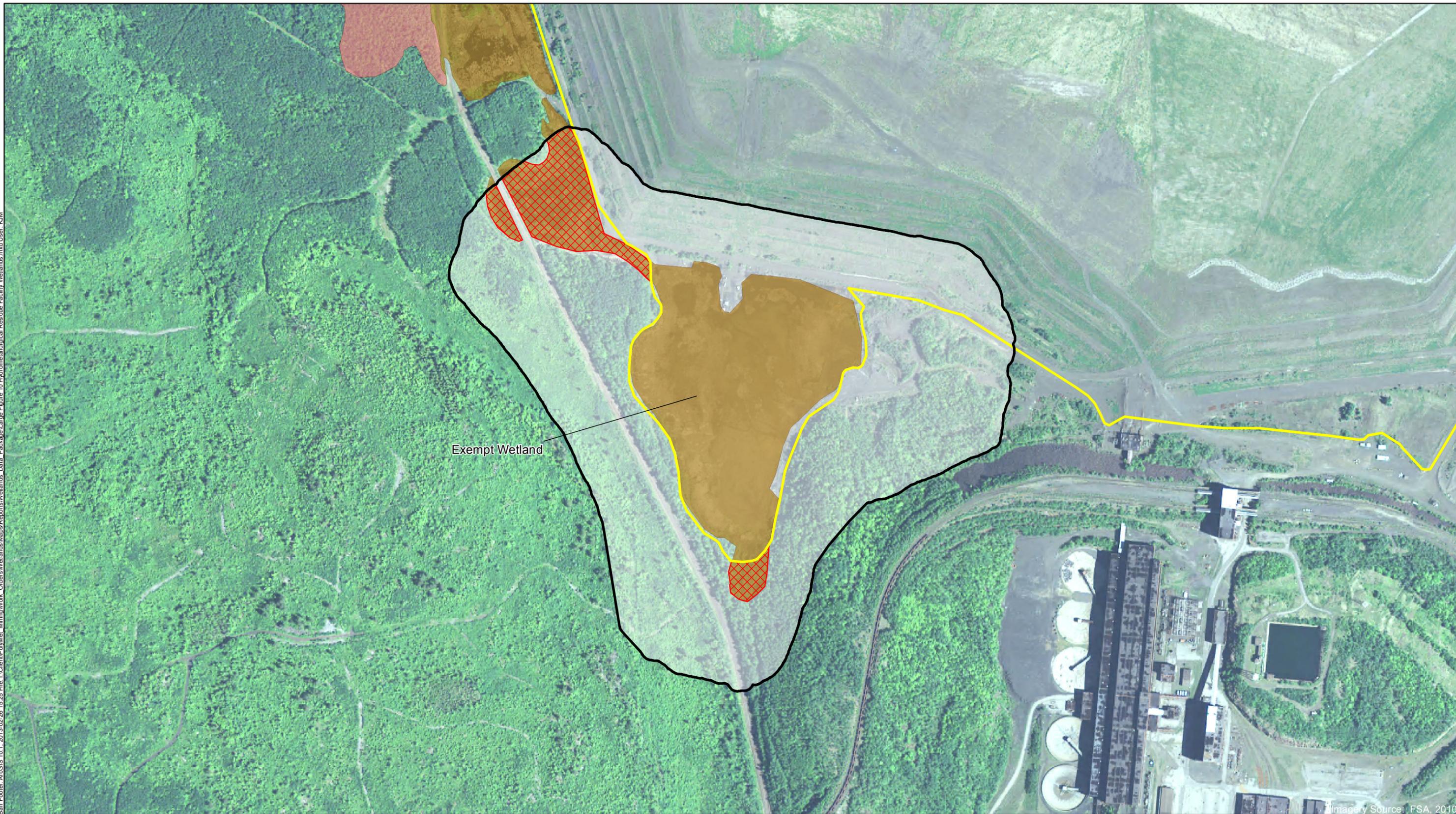
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 Imagery Source: FSA, 2013.

- | | | |
|--|---|--|
| Tailings Basin | Direct Wetland Impacts | Deep marsh; Shallow marsh |
| Areas Excluded from Tailings Basin Boundary | Exempt Wetlands | Hardwood swamp |
| Dunka Road | Eggers & Reed Wetland Types | Open water (Shallow, open water & lakes) |
| Treated Water Pipeline | Shrub Swamps (Alder thickets & Shrub-carrs) | Open bog |
| Areas Disturbed by Proposed Project Features | Coniferous bog | Sedge meadow; Wet meadow |
| | Coniferous swamp | |



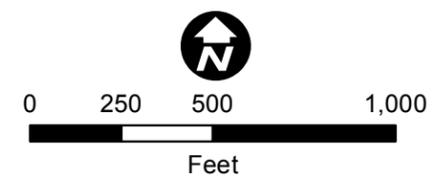
Large Figure 9
 FLOTATION TAILINGS BASIN AREA WETLANDS
 AND DIRECT WETLAND IMPACTS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Barr Footer: ArcGIS 10.1, 2013-02-26 15:25 File: I:\Client\PolyMet Mining\Work Orders\Wetlands\Mapa\Reports\Wetlands Data Package\Large Figure 10 Hydrometallurgical Residue Facility Wetlands.mxd User: KJM



Imagery Source: FSA, 2010

- | | |
|---|--|
| Hydrometallurgical Residue Facility | Direct Wetland Impacts |
| Cliffs Erie, LLC Permit to Mine Ultimate Tailings Basin Limit | Open water (Shallow, open water & lakes) |
| Areas Disturbed by Proposed Project Features | Open bog |
| Direct Wetland Impacts | Sedge meadow; Wet meadow |
| Shrub Swamps (Alder thickets & Shrub-carrs) | Hardwood swamp |
| Coniferous bog | |
| Coniferous swamp | |
| Deep marsh; Shallow marsh | |



Large Figure 10
 HYDROMETALLURGICAL RESIDUE FACILITY
 WETLANDS AND DIRECT WETLAND IMPACTS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

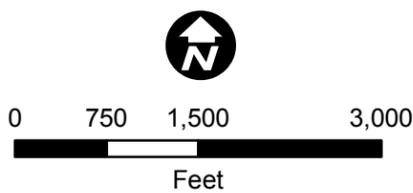


Bar Footer: ArcGIS 10.2.2, 2014-11-11 10:40 File: I:\Client\PolyMet_MinimWork_Outputs\Wetlands\Reports\Wetlands_Data_Pack\Large_Figure_11_Colby_Lake_Water_Pipeline_Corridor_Wetlands_and_Direct_Wetland_Impacts.mxd User: am2

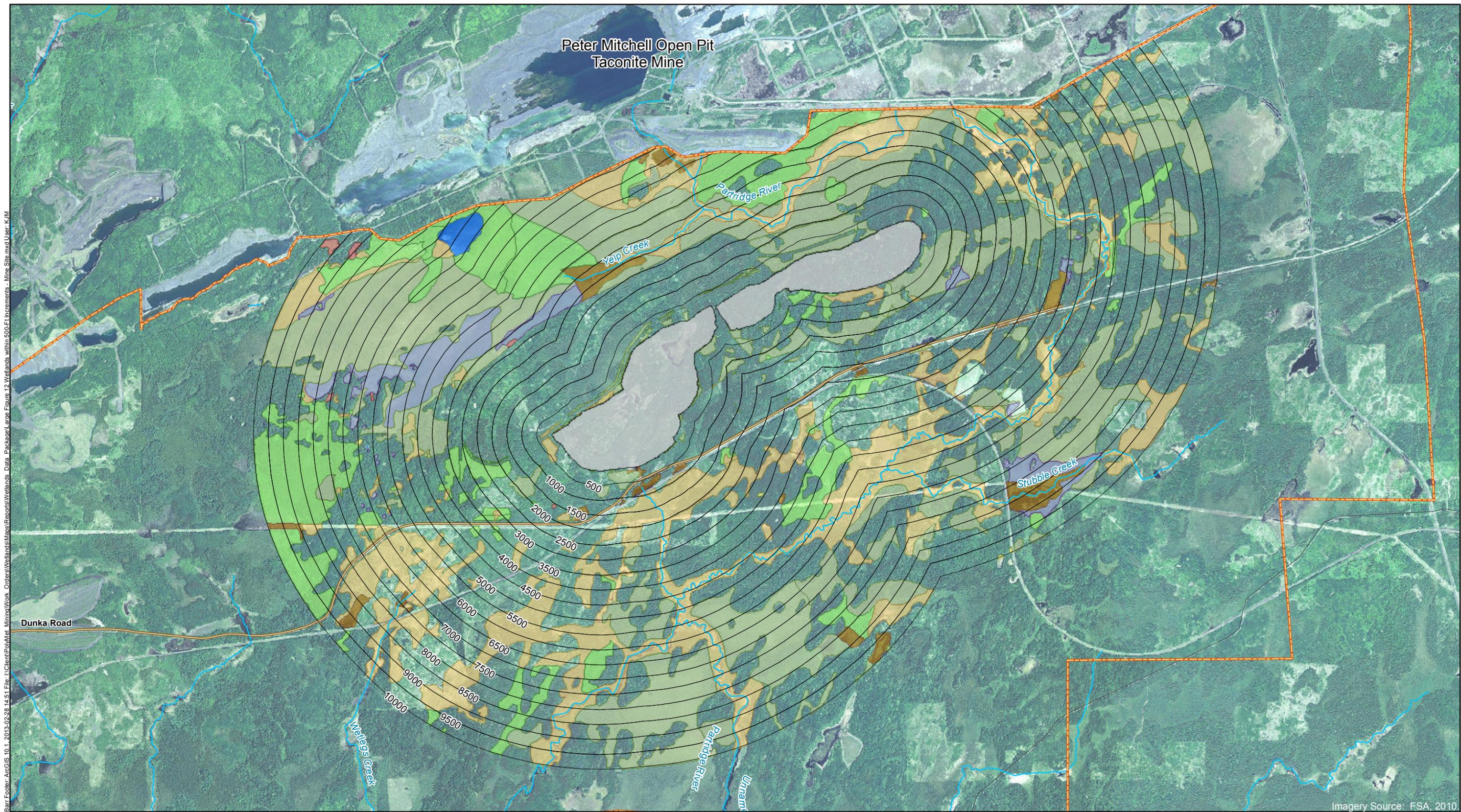
Colby Lake Water Pipeline Evaluation Area

Eggers & Reed Wetland Types

- Shrub Swamps (Alder thickets & Shrub-carrs)
- Coniferous bog
- Coniferous swamp
- Deep marsh; Shallow marsh
- Hardwood swamp
- Open water (Shallow, open water & lakes)
- Open bog
- Sedge meadow; Wet meadow



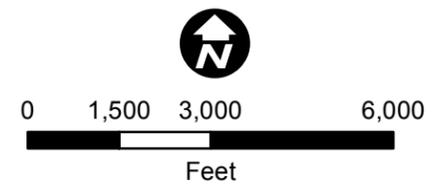
Large Figure 11
 COLBY LAKE WATER
 PIPELINE WETLANDS
 NorthMet Project
 Poly Met Mining, Inc.
 Hoyt Lakes, Minnesota



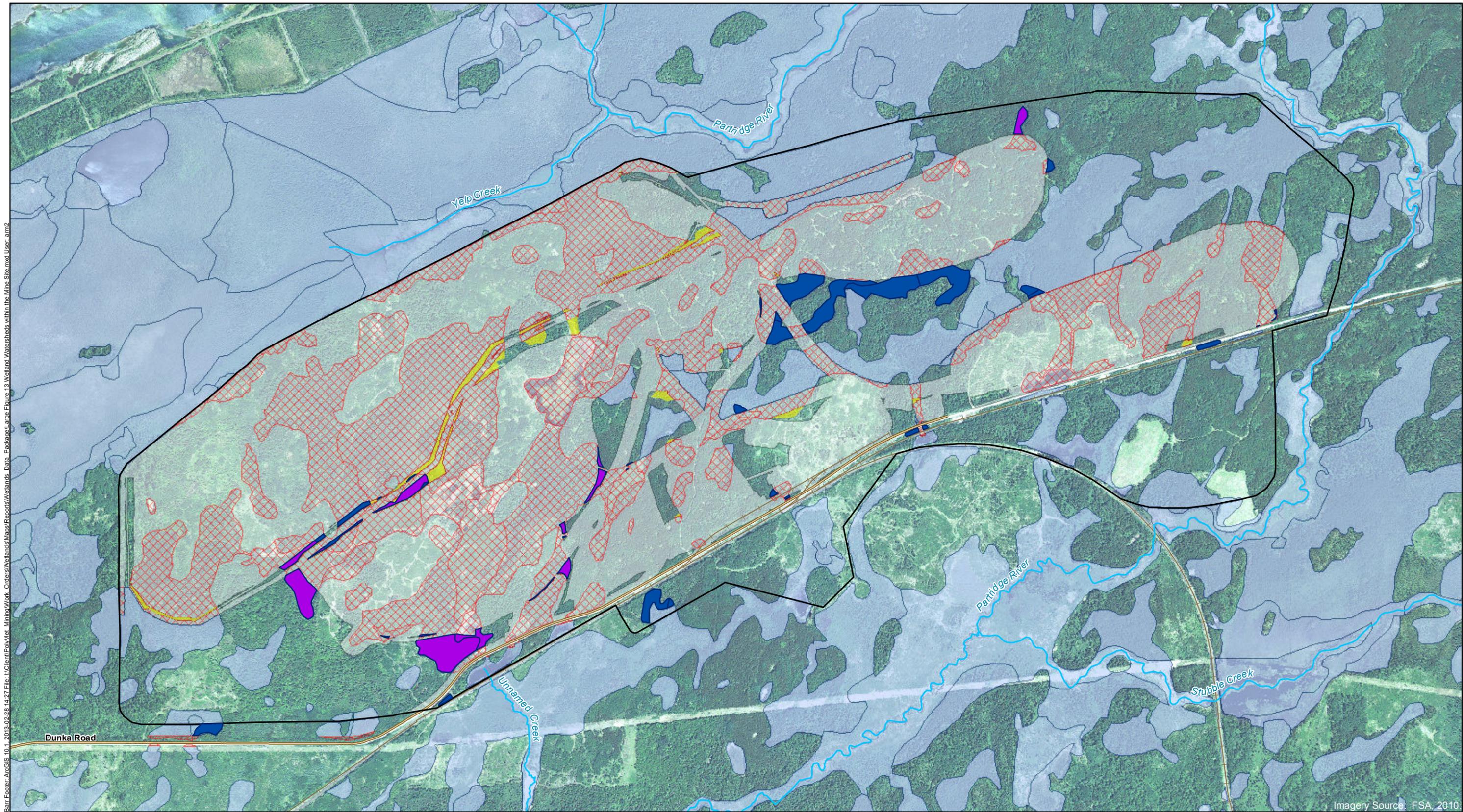
Barr Footer: ArcGIS 10.1, 2013-02-28 14:51 File: I:\Client\PolMet_Mining\Work Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 12 Wetlands within 500-Ft Increments - Mine Site.mxd User: KJM

Imagery Source: FSA, 2010

- | | | |
|---|--|------------------|
| 500-Ft Increments | Coniferous swamp | Dunka Road |
| Baseline Type Evaluation Study Areas | Deep marsh; Shallow marsh | Rivers & Streams |
| Area One | Hardwood swamp | |
| Eggers & Reed Wetland Types | Open water (Shallow, open water & lakes) | |
| Shrub Swamps (Alder thickets & Shrub-carrs) | Open bog | |
| Coniferous bog | Sedge meadow; Wet meadow | |



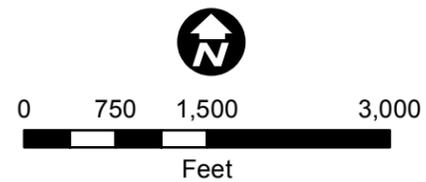
Large Figure 12
 WETLANDS WITHIN 500-FT
 INCREMENTS - MINE SITE AREA
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota



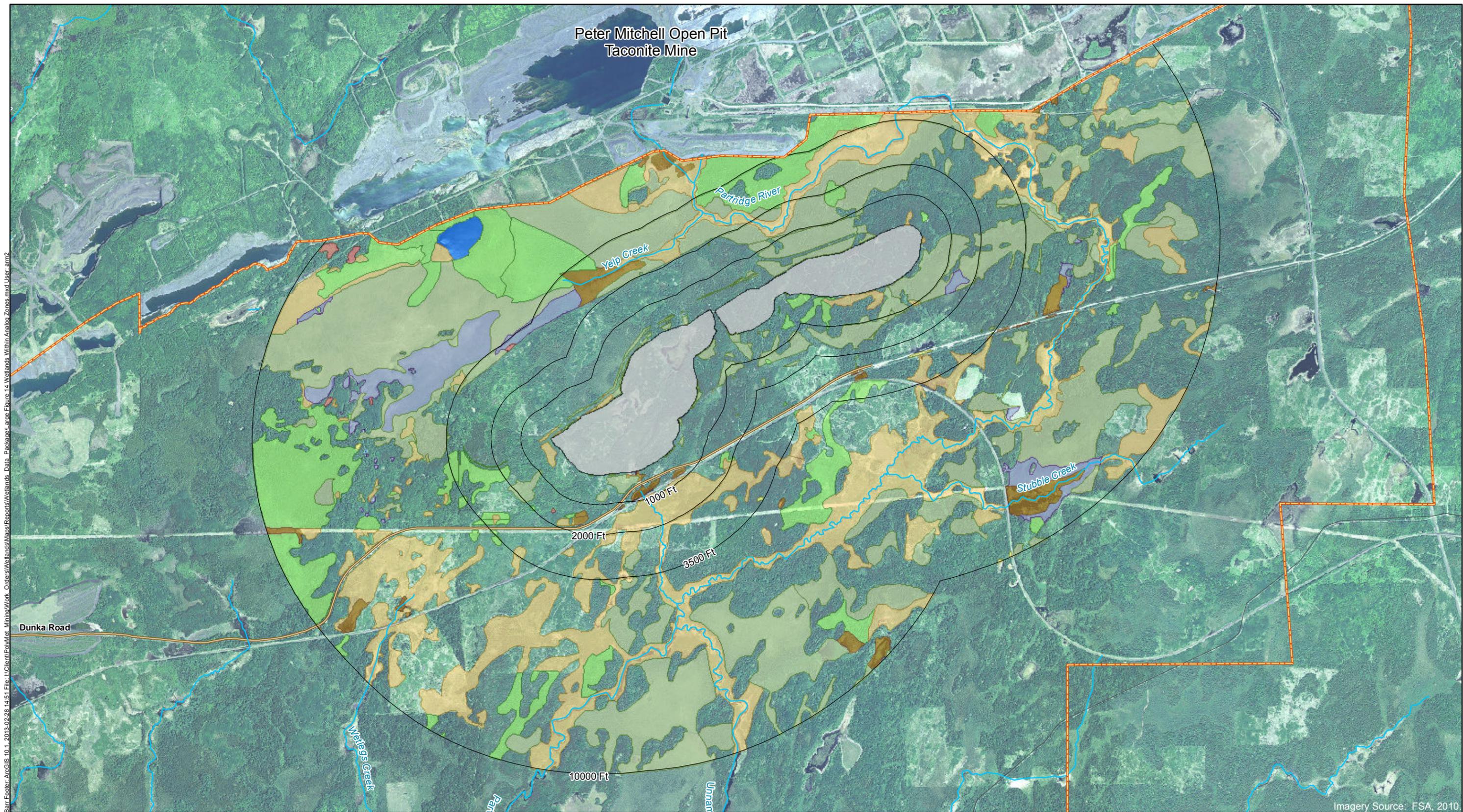
Bar Footer: ArcGIS 10.1, 2013-02-28 14:27 File: I:\Client\PolMet_Minima\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 13 Wetland Watersheds within the Mine Site.mxd User: am2

Imagery Source: FSA, 2010

- | | |
|--|--|
| Mine Site | Potential Indirect Wetland Impacts |
| Areas Disturbed by Proposed Project Features | Decrease in Yield per Wetland Acre of Greater Than 20% |
| Dunka Road | Increase in Yield per Wetland Acre of Greater Than 20% |
| Direct Wetland Impact | |
| Fragmented Wetland | |
| Wetland | |

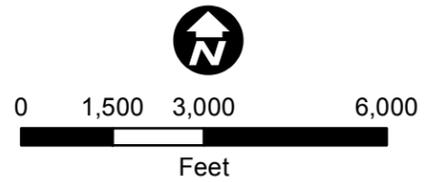


Large Figure 13
WETLANDS POTENTIALLY INDIRECTLY IMPACTED BY CHANGE IN WATERSHED AREA
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

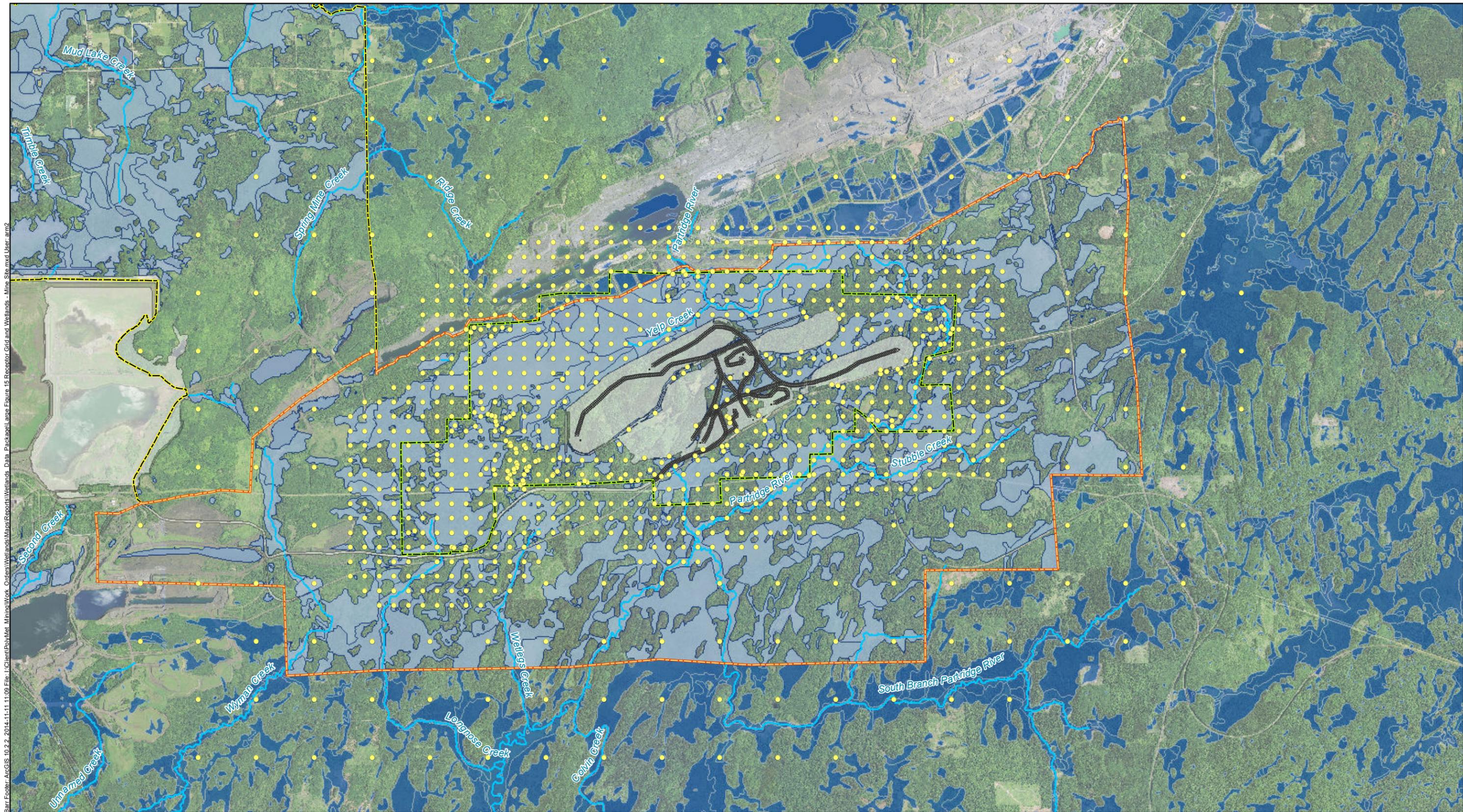


Bar Footer: ArcGIS 10.1, 2013-02-28 14:51 File: I:\Client\PolMet_Mining\Work Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 14 Wetlands Within Analog Zones.mxd User: arm2

- | | | |
|---|--|------------------|
| — Analog Impact Zones (Feet) | Coniferous swamp | Dunka Road |
| 20 Year Mine Pit | Deep marsh; Shallow marsh | Rivers & Streams |
| Baseline Type Evaluation Study Area One | Hardwood swamp | |
| Eggers & Reed Wetland Types | Open water (Shallow, open water & lakes) | |
| Shrub Swamps (Alder thickets & Shrub-carrs) | Open bog | |
| Coniferous bog | Sedge meadow; Wet meadow | |

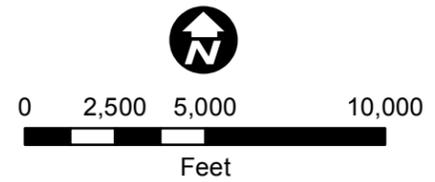


Large Figure 14
 WETLANDS WITHIN ANALOG ZONES
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

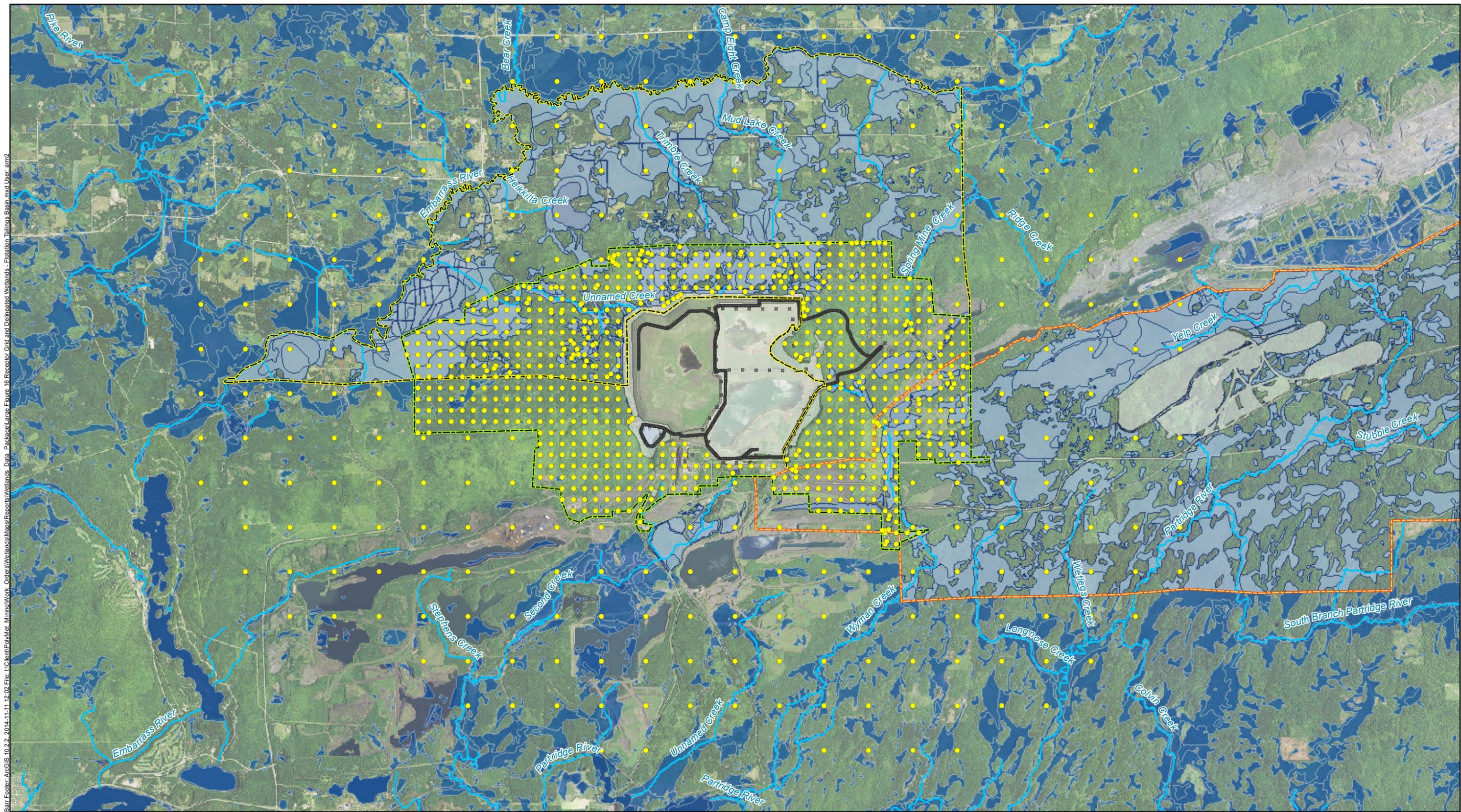


Bar Footer: ArcGIS 10.2.2: 2014-11-11 11:09 File: I:\Client\PolyMet_Mining\Work_Orders\Wetlands\Marsh\Reports\Wetlands_Data_Pack\Large Figure 15 Receptor Grid and Wetlands - Mine Site.mxd User: arm2

- Receptor Grid
- Volume Sources (Roads)
- Areas Disturbed by Proposed Project Features
- Ambient Air Boundary
- Area One
- Area Two
- Wetlands
- National Wetland Inventory (NWI)
- ~ Rivers and Streams



Large Figure 15
 RECEPTOR GRID AND
 WETLANDS - MINE SITE
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota



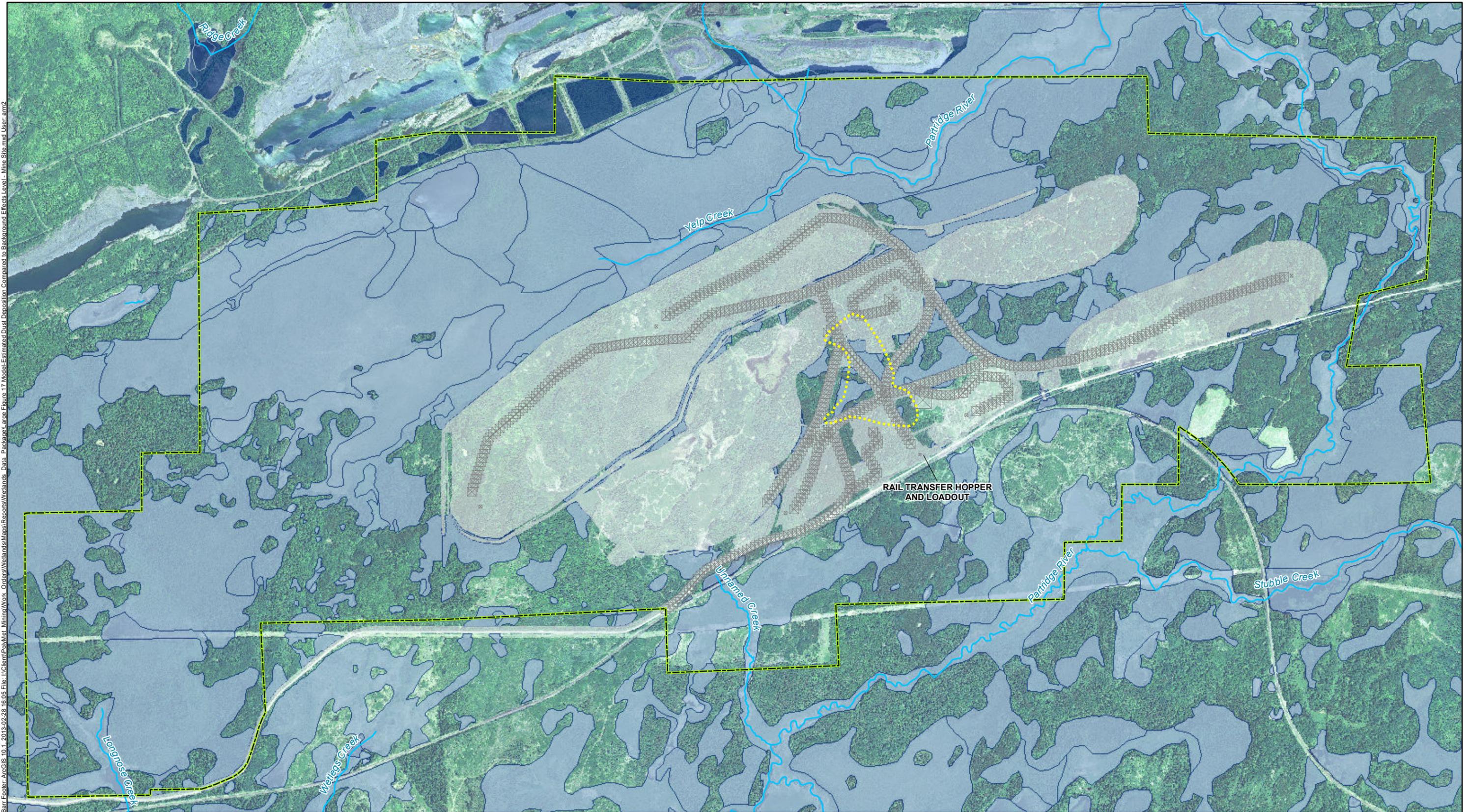
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- Receptor Grid
- Volume Sources (Roads)
- Areas Disturbed by Proposed Project Features
- Ambient Air Boundary
- Baseline Type Evaluation Study Areas
- Area One
- Area Two
- Wetlands
- National Wetland Inventory (NWI)
- ~ Rivers and Streams

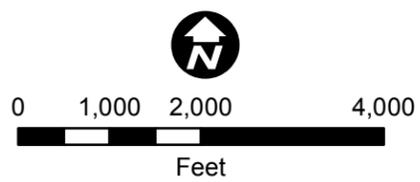


Large Figure 16
 RECEPTOR GRID AND WETLANDS -
 FLOTATION TAILINGS BASIN
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Bar Footer: ArcGIS 10.1, 2013-02-28 16:05 File: L:\Client\PolMet_Mining\Work_Orders\Wetlands\Map\Reports\Wetlands_Data_Package\Large_Figure_17_Model-Estimated_Dust_Deposition_Compared_to_Background_Effects_Level_-_Mine_Site.mxd User: am2

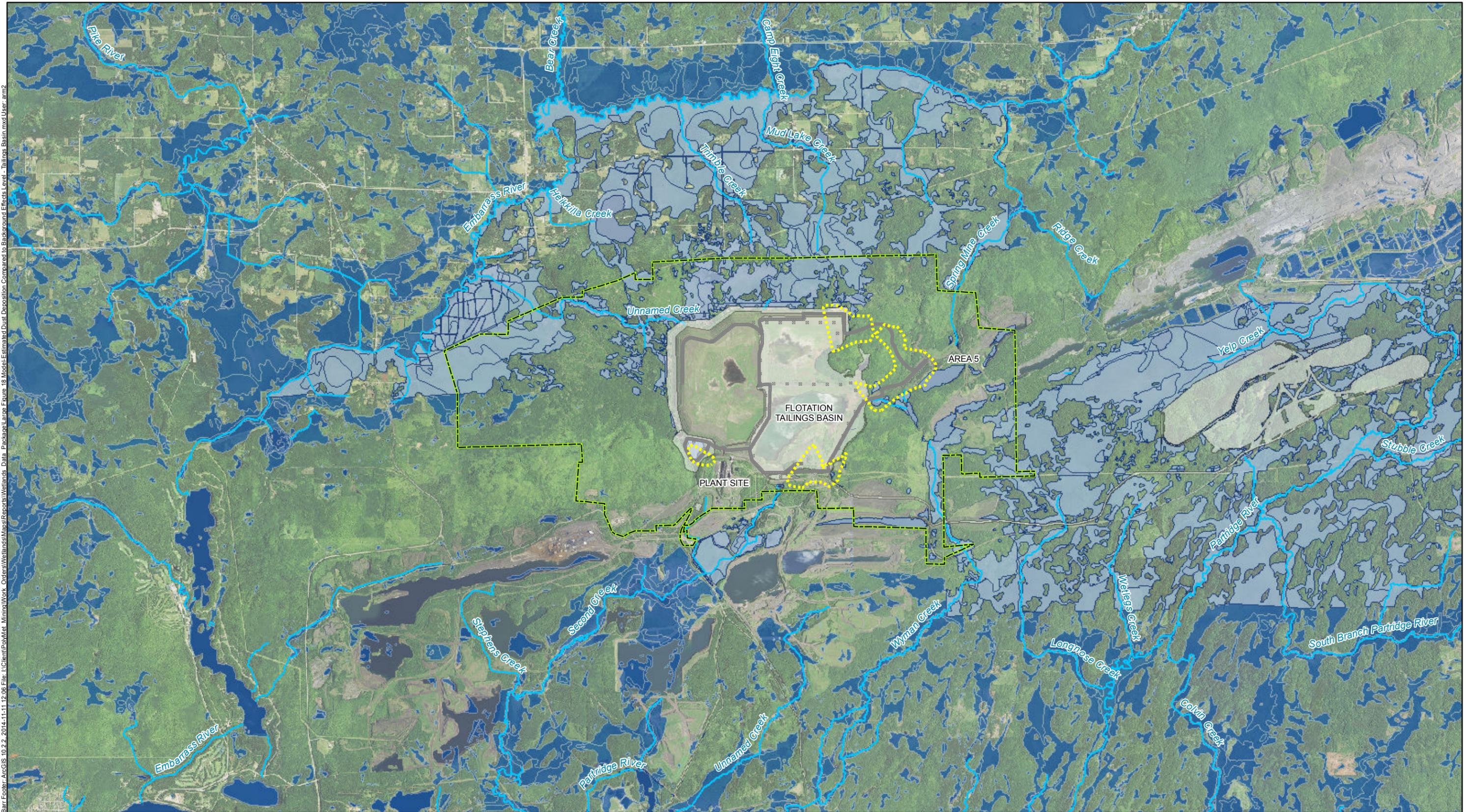


- - - - Extent of Highest Estimated Deposition
- - - - Receptors with Deposition of 25% of Background
- Volume Sources (Roads)
- Areas Disturbed by Proposed Project Features
- Ambient Air Boundary
- Wetlands
- National Wetland Inventory (NWI)
- ~ Rivers and Streams

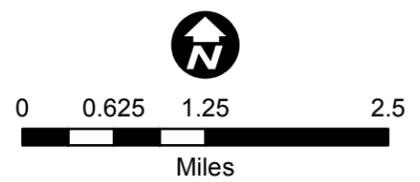


Large Figure 17
MODEL-ESTIMATED DUST DEPOSITION
COMPARED TO BACKGROUND
EFFECTS LEVEL - MINE SITE
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, Minnesota

Bar Footer: ArcGIS 10.2.2, 2014-11-11 12:06 File: I:\Client\PolMet_Mining\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large_Figure_18_Model-Estimated_Dust_Deposition_Compared_to_Background_Effects_Level_-_Tailings_Basin.mxd User: arm2

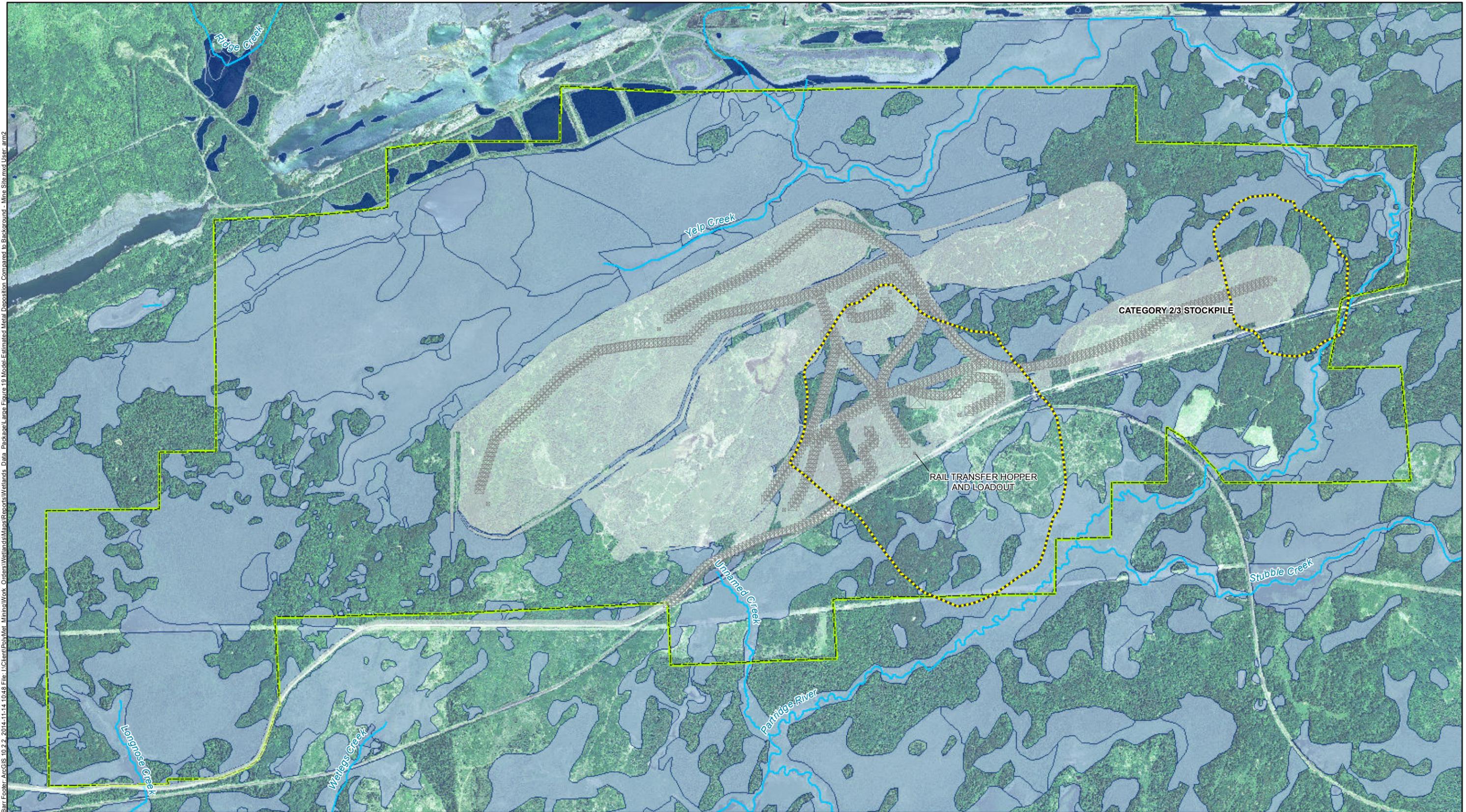


- ⋯⋯⋯ Extent of Highest Estimated Deposition
- ⋯⋯⋯ Receptors with Deposition of 50% of Background
- Volume Sources (Roads)
- Areas Disturbed by Proposed Project Features
- Ambient Air Boundary
- Wetlands
- National Wetland Inventory (NWI)
- ~ Rivers and Streams

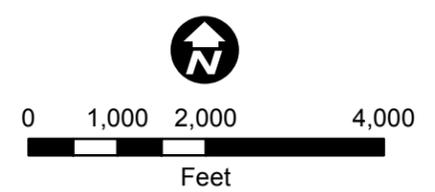


Large Figure 18
 MODEL-ESTIMATED DUST DEPOSITION
 COMPARED TO BACKGROUND
 EFFECTS LEVEL - FLOTATION TAILINGS BASIN
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

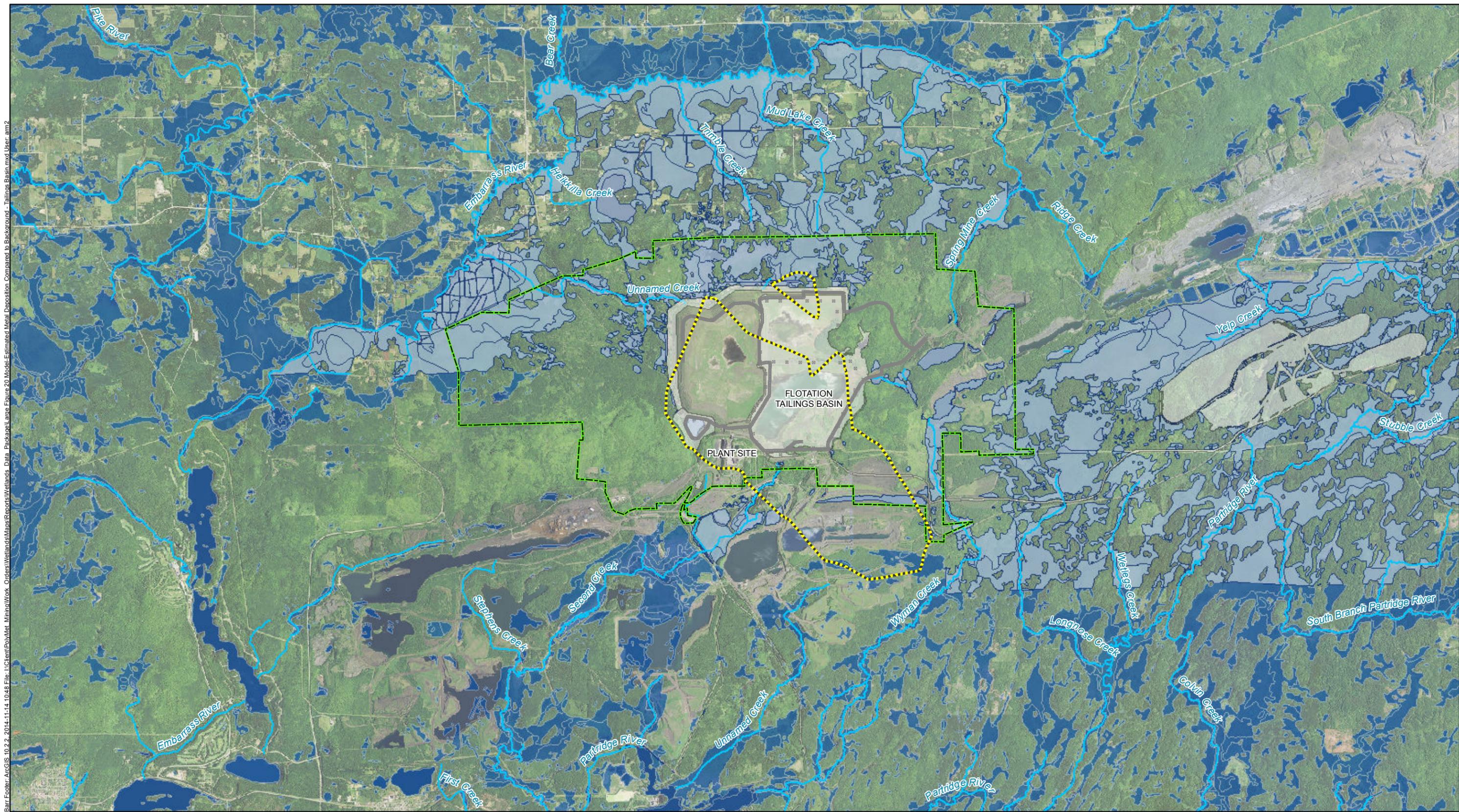
Bar Footer: ArcGIS 10.2.2, 2014-11-14 10:48 File: I:\Client\PolyMet_Mining\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 19 Model - Estimated Metal Deposition Compared to Background - Mine Site.mxd User: am2



- Extent of Highest Estimated Deposition
- Receptors with Deposition of 100% of Background
- Volume Sources (Roads)
- Ambient Air Boundary
- Areas Disturbed by Proposed Project Features
- National Wetland Inventory (NWI)
- Wetlands
- ~ Rivers and Streams



Large Figure 19
 MODEL - ESTIMATED METAL DEPOSITION
 COMPARED TO BACKGROUND
 EFFECTS LEVEL - MINE SITE
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

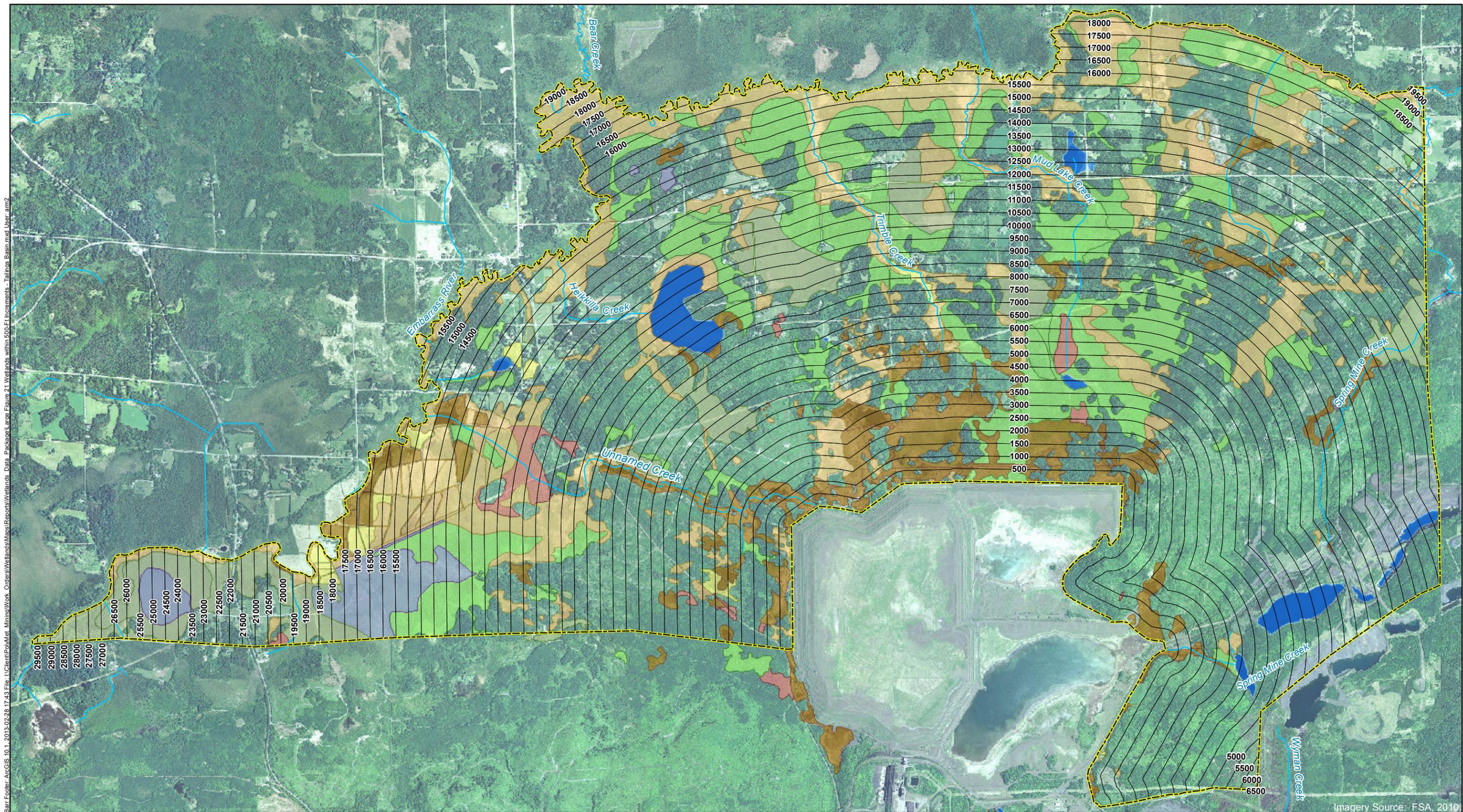


Bar Footer: ArcGIS 10.2.2, 2014-11-14 10:48 File: I:\Client\PolyMet_Mining\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Lane Figure 20 Model - Estimated Metal Deposition Compared to Background - Tailings Basin.mxd User: am2

- Extent of Highest Estimated Deposition
- Receptors with Deposition of 100% of Background
- Volume Sources (Roads)
- Ambient Air Boundary
- Areas Disturbed by Proposed Project Features
- Wetlands
- National Wetland Inventory (NWI)
- ~ Rivers and Streams



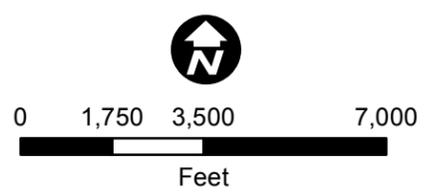
Large Figure 20
 MODEL - ESTIMATED METAL DEPOSITION
 COMPARED TO BACKGROUND EFFECTS LEVEL -
 FLOTATION TAILINGS BASIN
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota



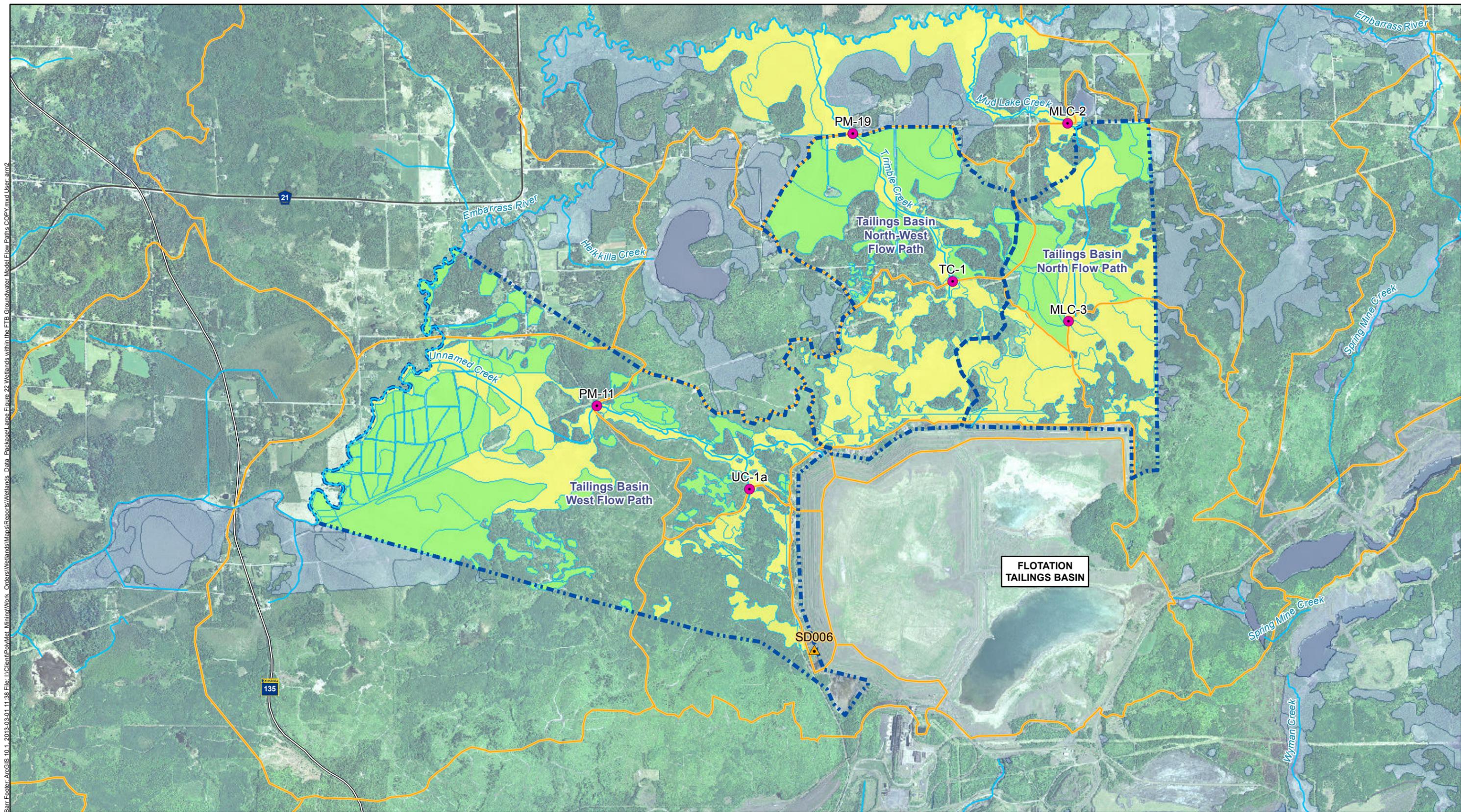
Bar Footer: ArcGIS 10.1, 2013-02-28 17:43 File: I:\Client\PolMet_Minim\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 21 Wetlands within 500-Ft Increments - Tailings Basin.mxd User: am2

Imagery Source: FSA, 2010

- 500-Ft Increments
- Baseline Type Evaluation Study Area Two
- Area Two
- Eggers & Reed Wetland Types
- Shrub Swamps (Alder thickets & Shrub-carrs)
- Coniferous bog
- Coniferous swamp
- Deep marsh; Shallow marsh
- Hardwood swamp
- Open water (Shallow, open water & lakes)
- Open bog
- Sedge meadow; Wet meadow
- Rivers & Streams

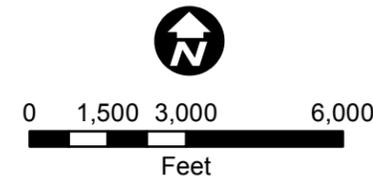


Large Figure 21
 WETLANDS WITHIN 500-FT INCREMENTS -
 FLOTATION TAILINGS BASIN AREA
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

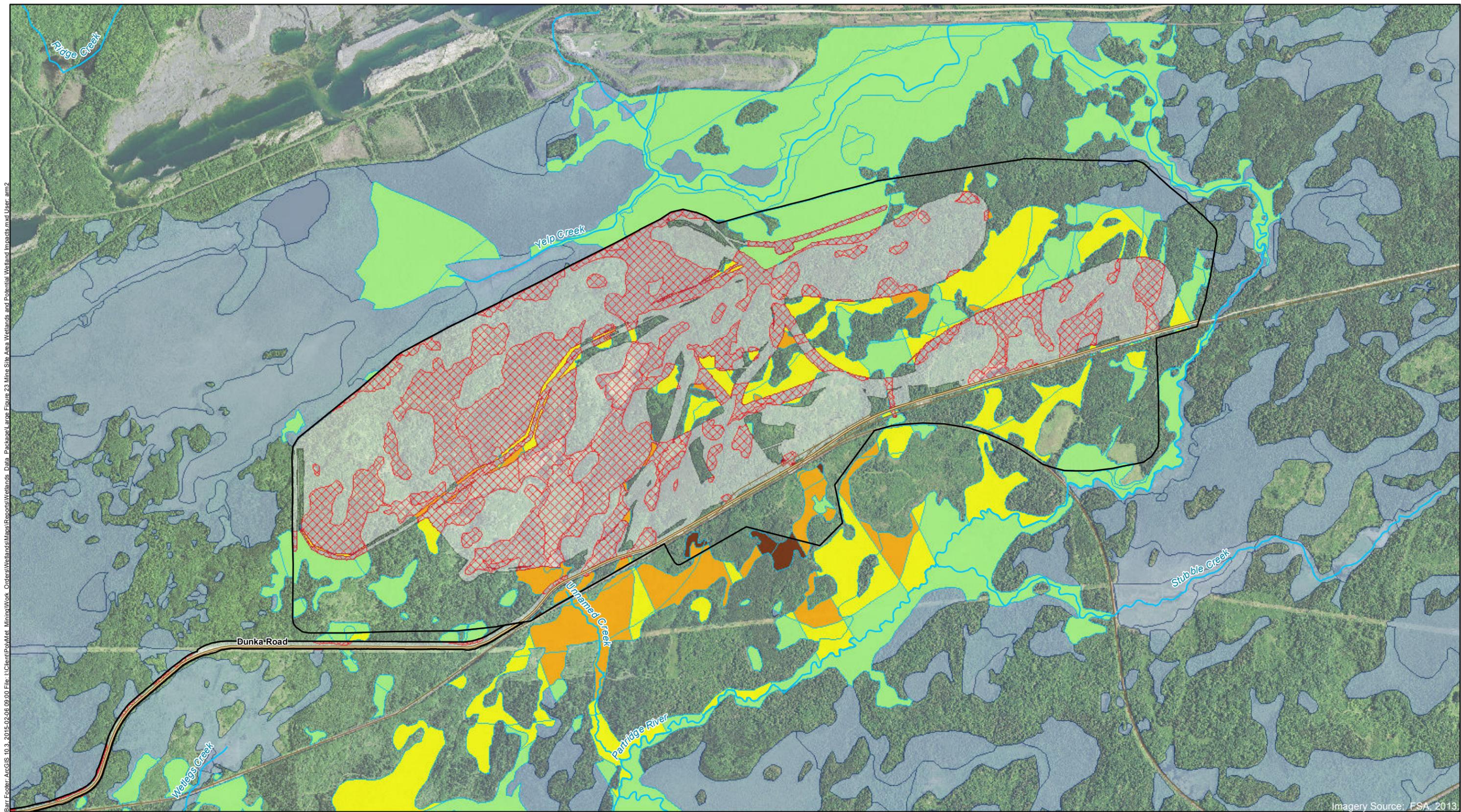


Bar Footer: ArcGIS 10.1, 2013-03-01 11:38, File: \\Client\PolMet_Minima\Work_Orders\Wetlands\Map\Reports\Wetlands_Data_Package\Large_Figure_22_Wetlands_within_the_FTB_Groundwater_Model_Flow_Paths_COPY.mxd User: arm2

- Surface Water Model Evaluation Location
- ▲ Approximate Location of Project
- ▲ Surface Water Discharge
- Rivers and Streams
- Subwatersheds with Project
- Groundwater Flow Path
- Wetlands
- Wetlands with Potential for Indirect Impacts
- Surface Water and Groundwater
- Groundwater Only

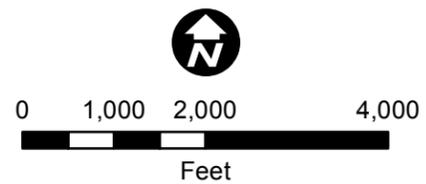
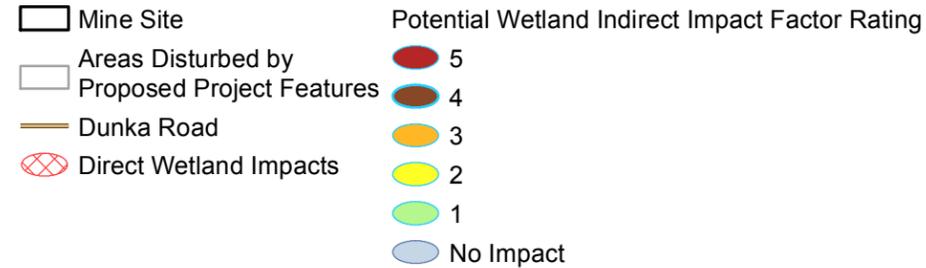


Large Figure 22
 WETLANDS WITHIN THE FTB
 GROUNDWATER MODEL FLOW PATHS
 NorthMet Project
 Poly Met Mining, Inc.
 Hoyt Lakes, MN



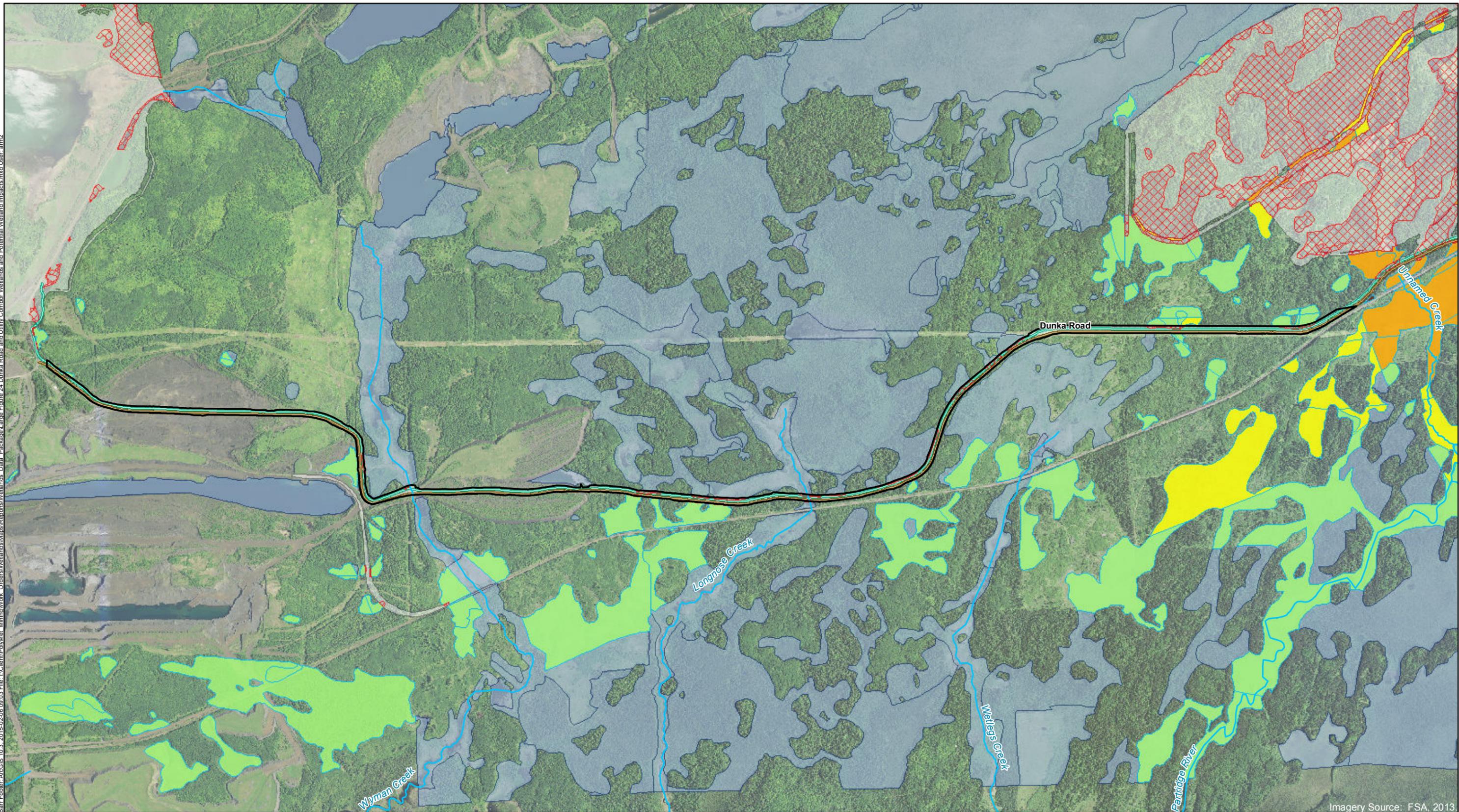
Bar Footer: ArcGIS 10.3, 2015-02-06 09:00 File: I:\Client\PolMet_Minima\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 23 Mine Site Area Wetlands and Potential Wetland Impacts.mxd User: am2

Imagery Source: FSA, 2013



Large Figure 23
 MINE SITE AREA WETLANDS AND
 POTENTIAL WETLAND IMPACTS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

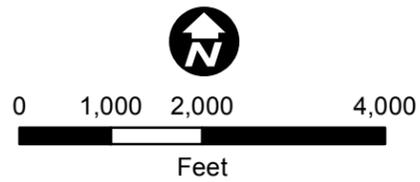
Bar Footer: ArcGIS 10.3, 2015-02-06 09:03 File: I:\Client\PolMet_Mining\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 24 Dunka Road and Utility Corridor Wetlands and Potential Wetland Impacts.mxd User: am2



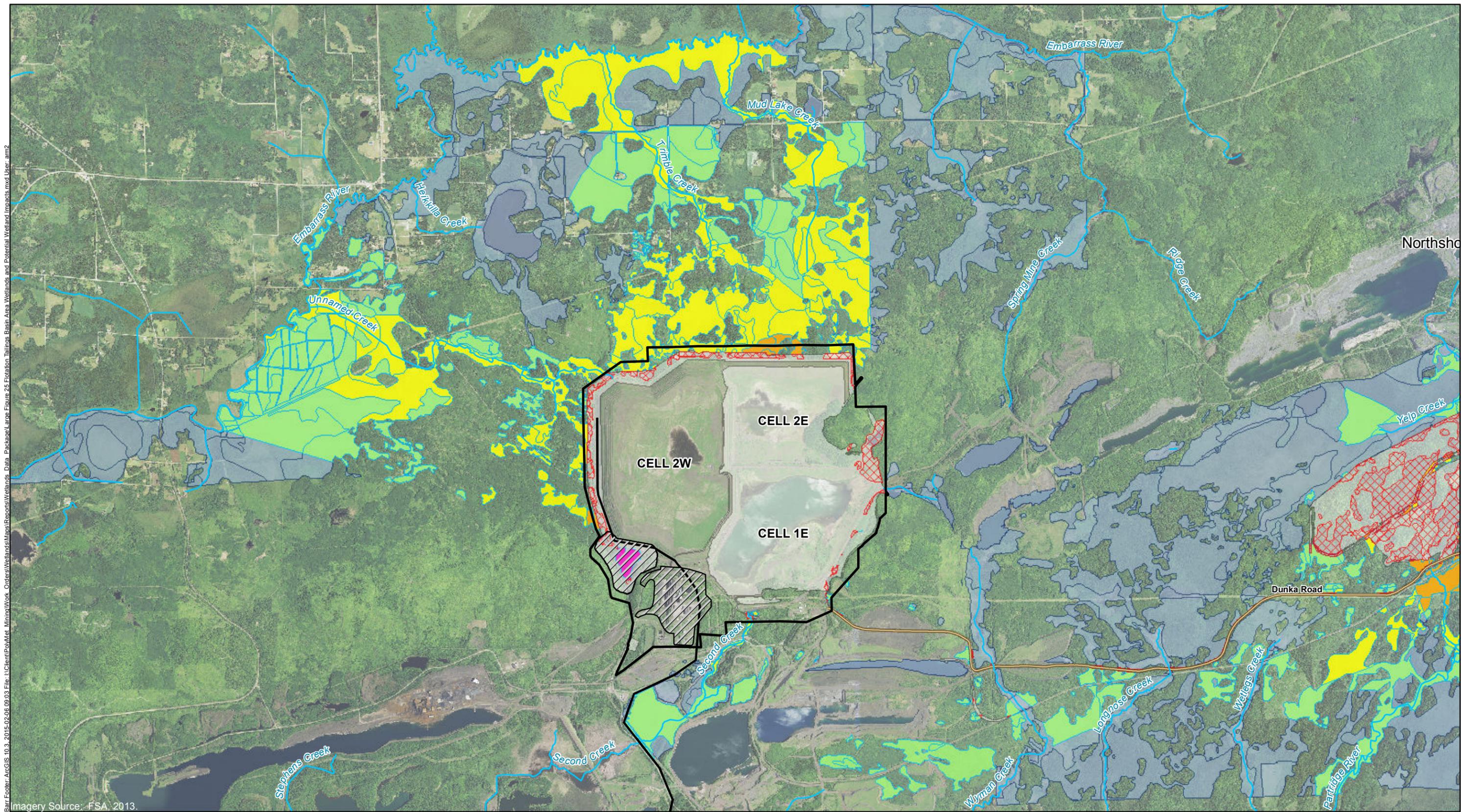
Imagery Source: FSA, 2013.

- Dunka Road and Utility Corridor
- Dunka Road
- Treated Water Pipeline
- Areas Disturbed by Proposed Project Features
- Direct Wetland Impacts

- Potential Wetland Indirect Impact Factor Rating
- 4
 - 3
 - 2
 - 1
 - No Impact



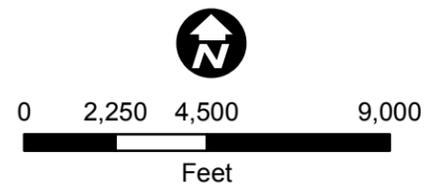
Large Figure 24
**DUNKA ROAD AND UTILITY CORRIDOR WETLANDS
 AND POTENTIAL WETLAND IMPACTS**
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota



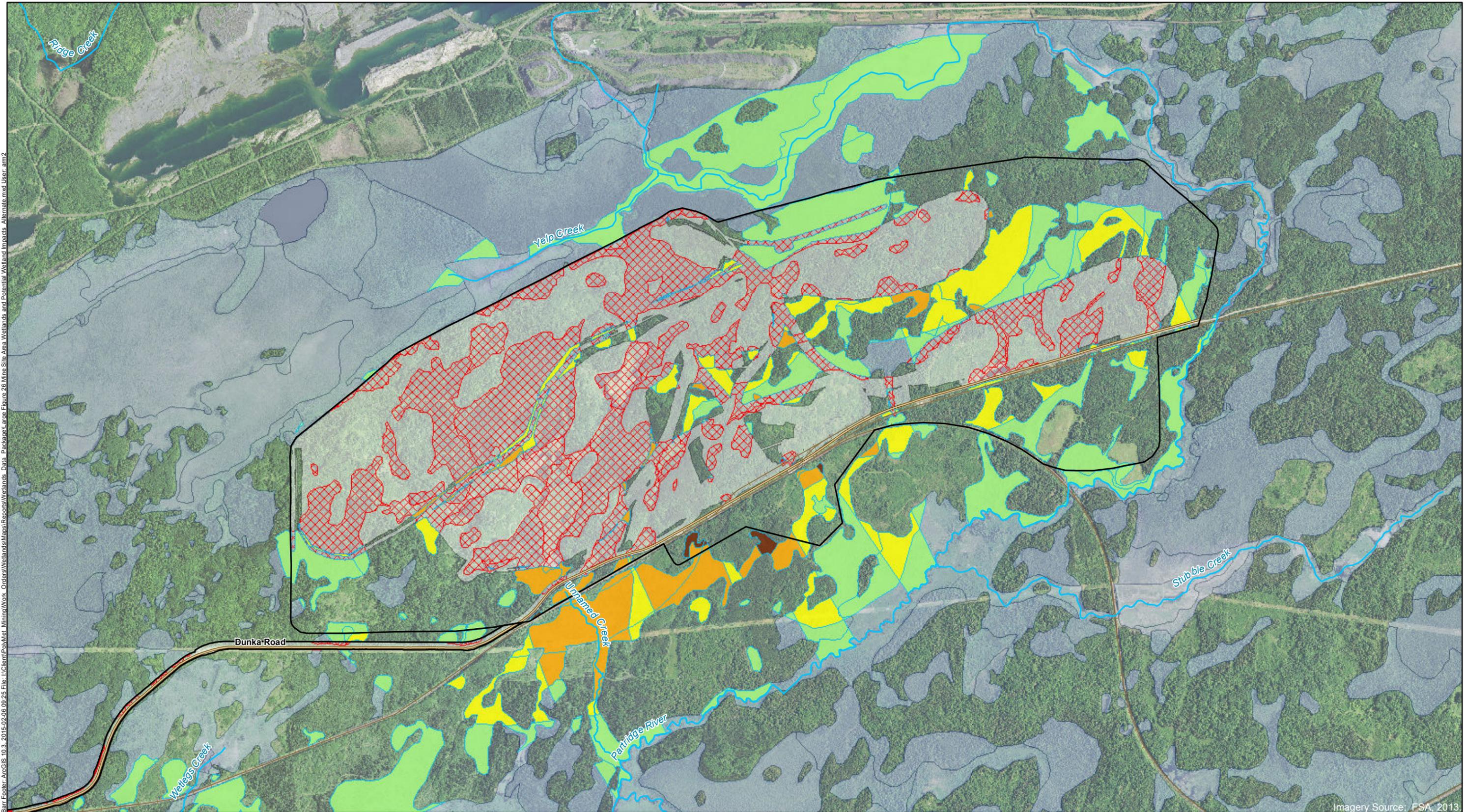
Bar Footer: ArcGIS 10.3, 2015-02-06 09:03 File: L:\Client\PolMet_Minima\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 25 Flotation Tailings Basin Area Wetlands and Potential Wetland Impacts.mxd User: am2

Imagery Source: FSA, 2013.

- | | |
|--|--|
| Tailings Basin | Potential Wetland Indirect Impact Factor Rating |
| Areas Excluded from Tailings Basin Boundary | 5 |
| Areas Disturbed by Proposed Project Features | 4 |
| Dunka Road | 3 |
| Direct Wetland Impacts | 2 |
| | 1 |
| | Exempt |



Large Figure 25
 FLOTATION TAILINGS BASIN AREA WETLANDS
 AND POTENTIAL WETLAND IMPACTS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota



Bar Footer: ArcGIS 10.3, 2015-02-06 09:25 File: I:\Client\PolMet_Mining\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 26 Mine Site Area Wetlands and Potential Wetland Impacts_Alternate.mxd User: am2

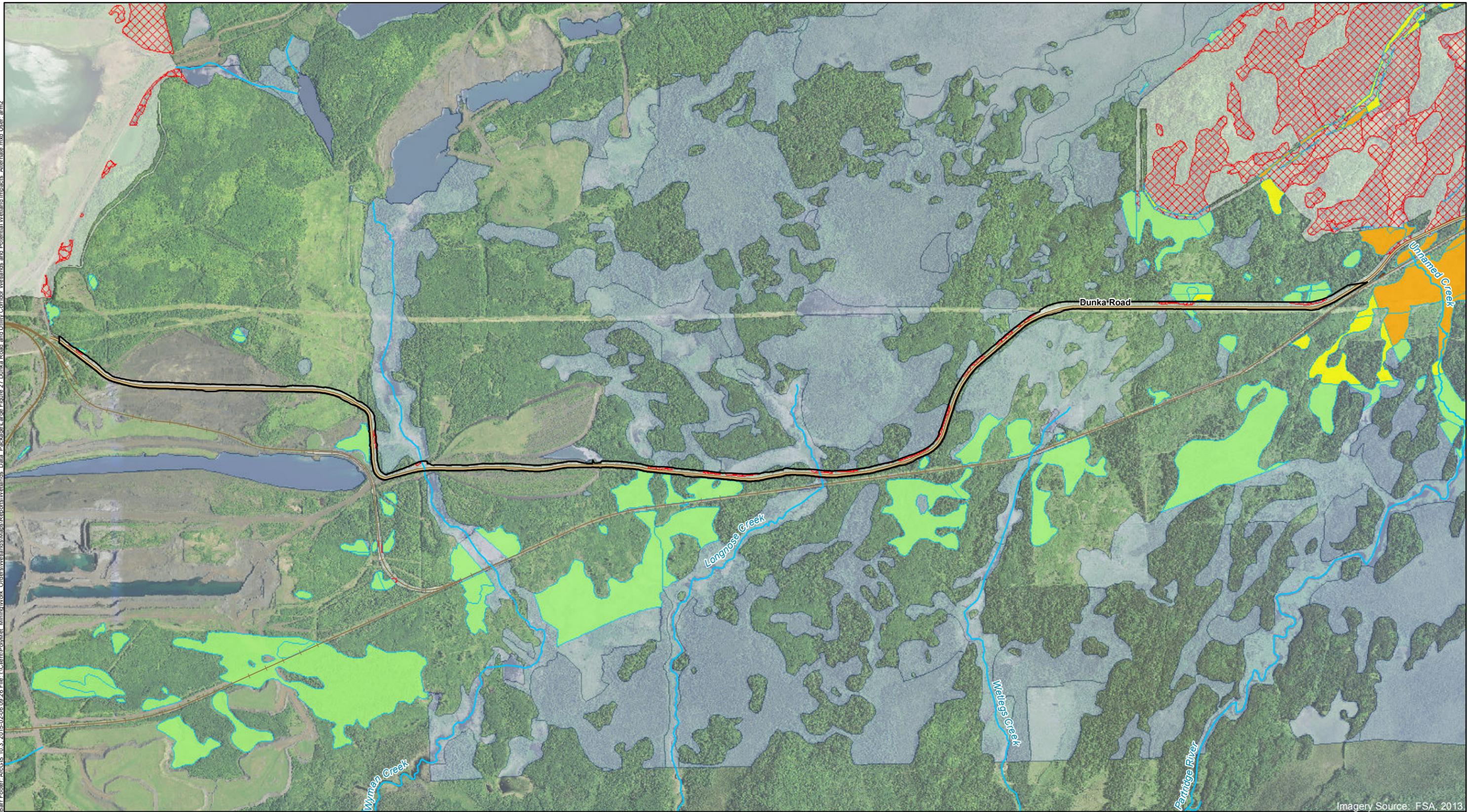
Imagery Source: FSA, 2013

Mine Site	Potential Wetland Indirect Impact Factor Rating
Areas Disturbed by Proposed Project Features	5
Dunka Road	4
Direct Wetland Impacts	3
	2
	1
	No Impact

0 1,000 2,000 4,000
 Feet

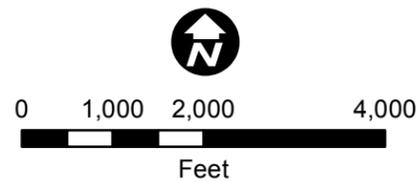
Large Figure 26
 MINE SITE AREA WETLANDS AND
 POTENTIAL WETLAND IMPACTS -
 ALTERNATE METHOD
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Bar Footer: ArcGIS 10.3, 2015-02-06 09:26 File: L:\Client\PolMet_Minima\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 27 Dunka Road and Utility Corridor Wetlands and Potential Wetland Impacts - Alternate.mxd User: arm2



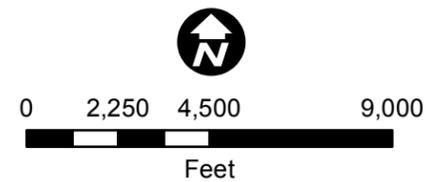
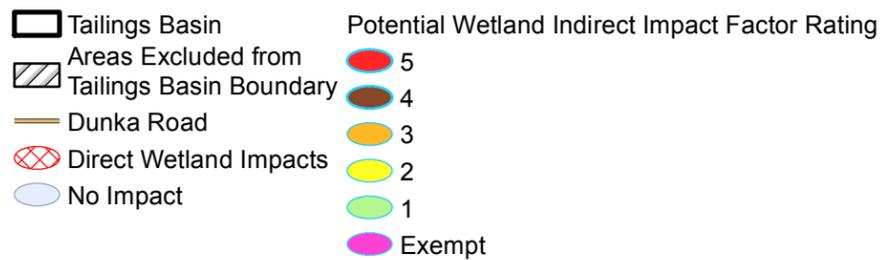
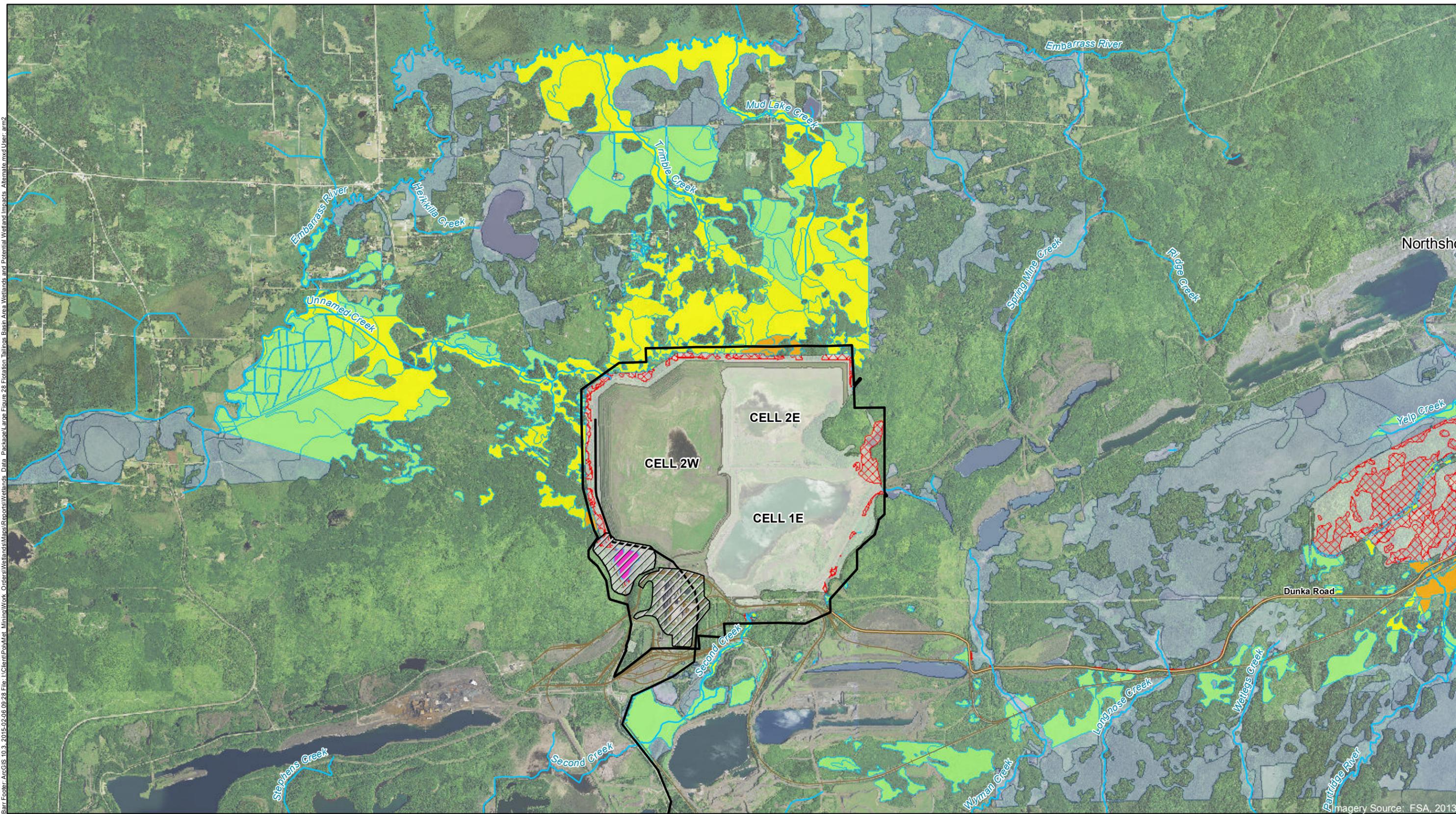
Imagery Source: FSA, 2013

- | | |
|--|---|
| Dunka Road and Utility Corridor | Potential Wetland Indirect Impact Factor Rating |
| Areas Disturbed by Proposed Project Features | 4 |
| Dunka Road | 3 |
| Direct Wetland Impacts | 2 |
| | 1 |
| | No Impact |



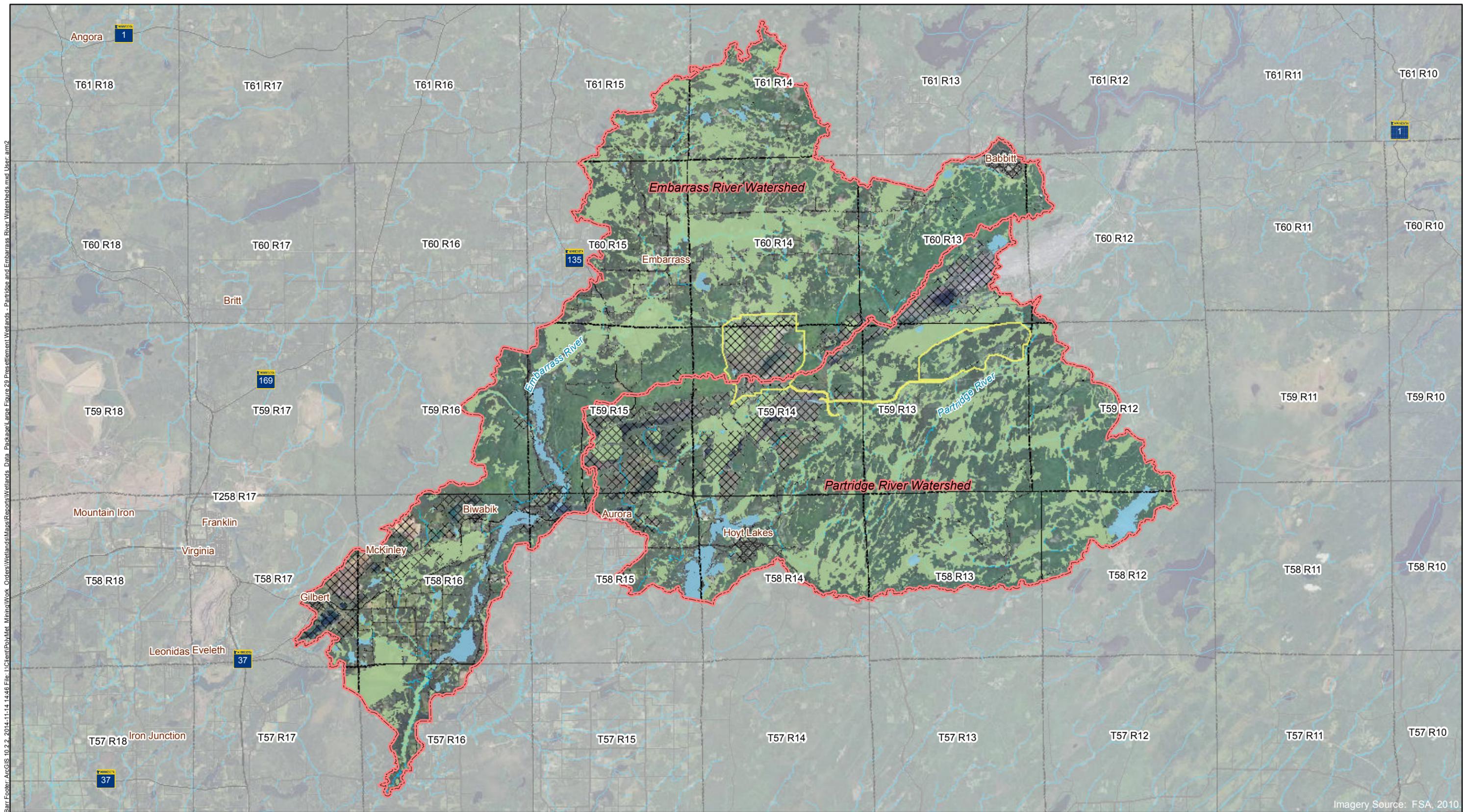
Large Figure 27
 DUNKA ROAD AND UTILITY CORRIDOR WETLANDS
 AND POTENTIAL WETLAND IMPACTS -
 ALTERNATE METHOD
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Bar Footer: ArcGIS 10.3, 2015-02-06 09:28 File: L:\Client\PolMet_Minima\Work Orders\Wetlands\Maps\Reports\Wetlands Data Package\Large Figure 28\Flotation Tailings Basin Area Wetlands and Potential Wetland Impacts Alternate.mxd User: arm2



Large Figure 28
FLOTATION TAILINGS BASIN AREA WETLANDS AND POTENTIAL WETLAND IMPACTS - ALTERNATE METHOD
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

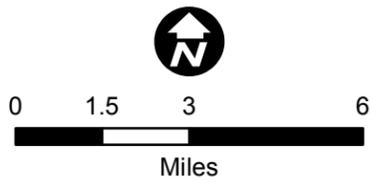
imagery Source: FSA, 2013



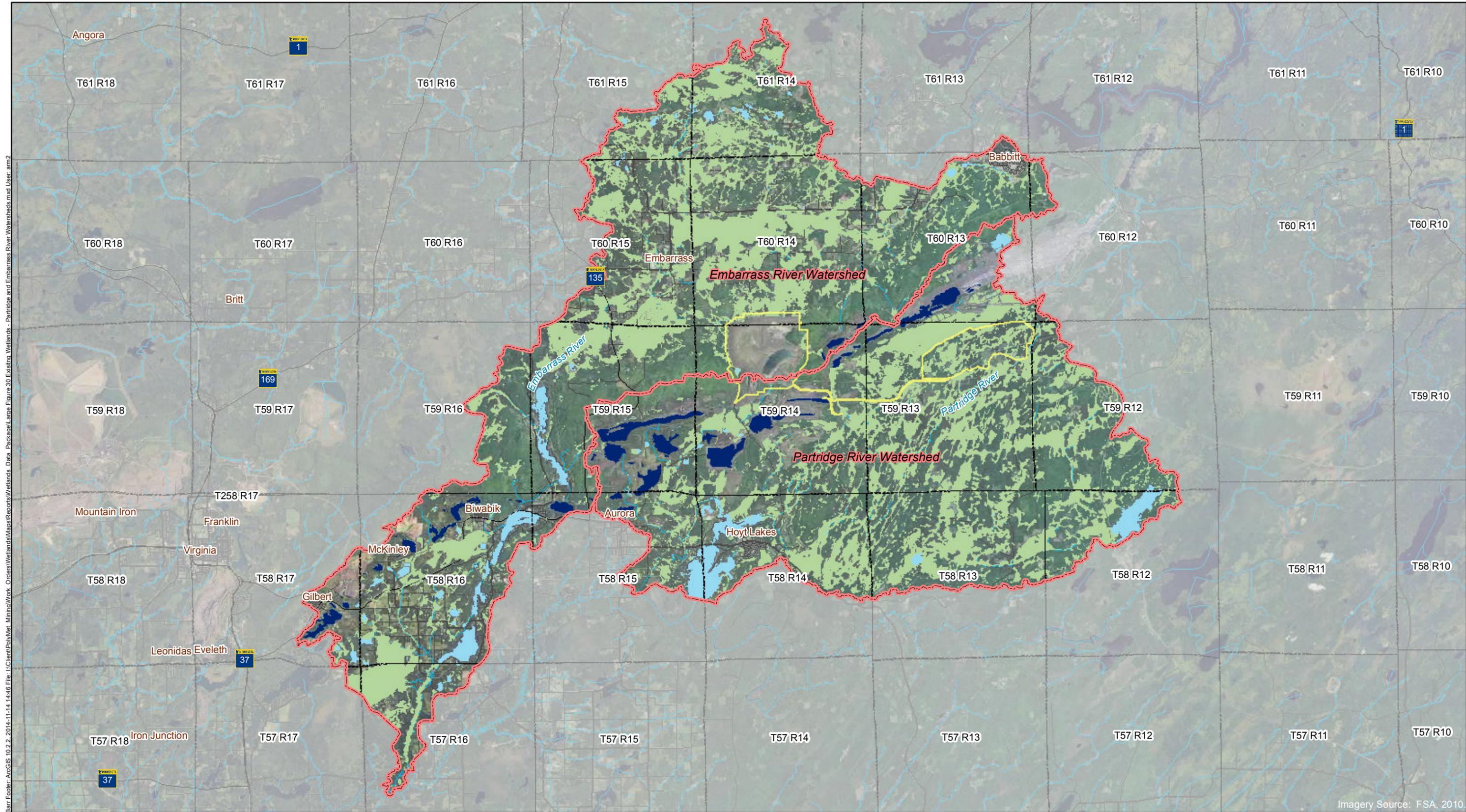
Bar Footer: ArcGIS 10.2.2: 2014-11-14 14:46 File: I:\Client\PolyMet_Mining\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 29 Pre-settlement Wetlands - Partridge and Embarrass River Watersheds.mxd User: am2

Imagery Source: FSA, 2010

- Pre-settlement Wetland
- Pre-settlement Lake
- Study Area
- Project Boundaries
- Disturbance Areas
- Township Boundary
- Rivers & Streams



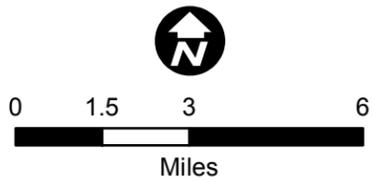
Large Figure 29
PRE-SETTLEMENT WETLANDS - PARTRIDGE
AND EMBARRASS RIVER WATERSHEDS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota



Bar Footer: ArcGIS 10.2.2, 2014-11-14 14:46 File: I:\Client\PolyMet_Mining\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure 30 Existing Wetlands - Partridge and Embarrass River Watersheds.mxd User: arm2

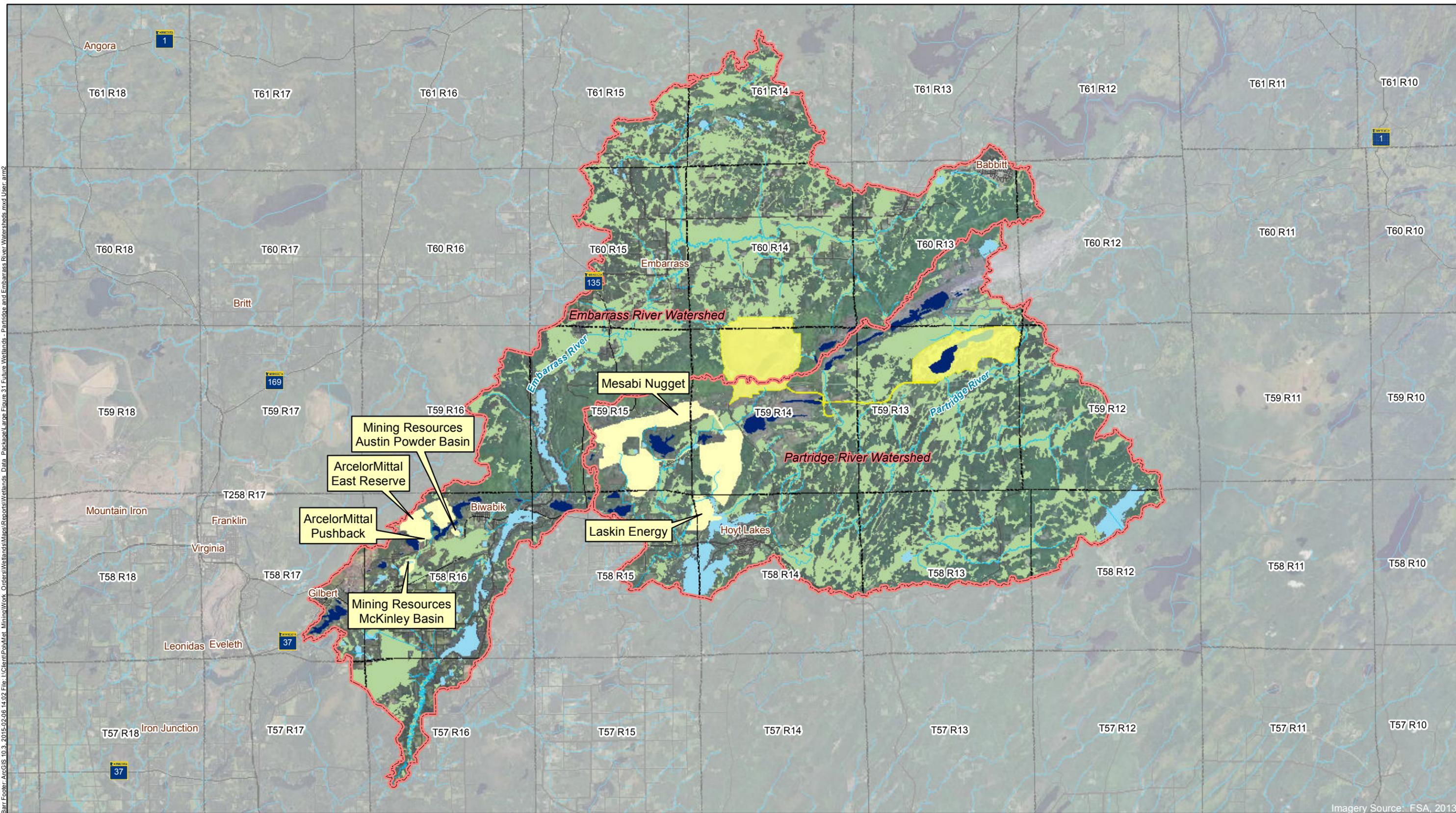
Imagery Source: FSA, 2010

- Existing Wetland
- Existing Lake
- Existing Deepwater Habitat
- Study Area
- Project Boundaries
- Township Boundary
- Rivers & Streams



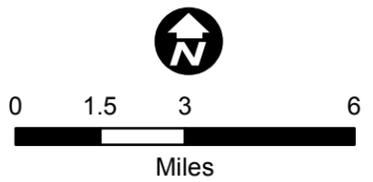
Large Figure 30
 EXISTING WETLANDS - PARTRIDGE
 AND EMBARRASS RIVER WATERSHEDS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Bar Footer: ArcGIS 10.3, 2015-02-06 14:02 File: L:\Client\PolMet_Minima\Work_Orders\Wetlands\Map\Reports\Wetlands_Data_Package\Large Figure 31 Future Wetlands - Partridge and Embarrass River Watersheds.mxd User: arm2



Imagery Source: FSA, 2013

- Future Wetland
- Future Lake
- Future Deepwater Habitat
- Study Area
- Project Boundaries
- Other Project Areas
- Township Boundary
- Rivers & Streams



Large Figure 31
FUTURE WETLANDS - PARTRIDGE
AND EMBARRASS RIVER WATERSHEDS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Attachments

Attachment A

NorthMet Wetland Analysis Work Plan v3



POLYMET
MINING

NorthMet Project
Wetland Analysis Work Plan

Version 3

October 13, 2011

NorthMet Project
Wetland Analysis Work Plan
Version 3

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1. Project

This document is the Work Plan for wetland analysis for the NorthMet Project (Project) as specified in Wetland Resources IAP Final Summary Memo and Co-lead Agency Final Work Plan Preparation Guidance of July 1, 2011 (Guidance Document) and the Wetland IAP Work Plan Compiled Comments dated August 30, 2011.

The project that will be modeled is the project described in the Co-lead Agency Draft Alternative Summary as amended in September, 2011. The Project Footprint that will be used for this analysis has been defined and detailed in the NorthMet Project Project Description (Reference 1).

2. Background

Wetland impacts for the Project were previously evaluated for the DEIS and included direct, potential indirect, and cumulative impacts. Using the wetland types and acreages identified in the report entitled: *NorthMet Project Baseline Wetland Typing Evaluation* (Barr 2011), direct, potential indirect, and cumulative impacts will be evaluated as described in the following sections. The results of the wetland analysis in this Work Plan will be presented in the Wetland Data Package.

3. Direct Wetland Impacts

Direct wetland impacts will result from filling and excavation. The analysis performed for the SDEIS will duplicate the analysis performed for the DEIS (Section 4.2 of Reference 2) using the current Project Footprint described in Reference 1.

Wetlands within the Project Footprint will be identified using the Eggers and Reed (1997) community classification system. The wetland types and acreages for each wetland were identified in the report entitled: *NorthMet Project Baseline Wetland Typing Evaluation* (Barr 2011), which was discussed with the Wetland IAP Workgroup and approved by the Co-lead Agencies on March 30, 2011.

The analysis output for the direct wetland impact will include:

1. A summary table will provide information for each wetland within the Project Footprint and include:
 - a. The wetland type, wetland acreage, and direct impact will be calculated using GIS.
 - b. The type of direct impact (fill, excavation, etc.) will be identified.
 - c. The quality of each wetland will be identified.
2. For each Eggers and Reed (1997) wetland type, a summary table will provide the total acreage and total acres of direct impact for the following Project Areas - Mine Site, railroad corridor, Dunka Road and utility corridor, Plant Site, Flotation Tailings Basin, Hydrometallurgical Residue Facility, and the Colby Lake water pipeline corridor.
 - a. Figures for each of the Project Areas will be created that show the areas with direct wetland impacts.
3. The total direct wetland impact acreage for the Project Footprint will be provided.

4. Potential Indirect Wetland Impacts

The analysis of potential indirect wetland impacts will be completed using the Guidance Document. The purpose of this analysis is to provide an estimate of potential indirect wetland impacts.

Potential indirect wetland impacts will be assessed based on: changes in wetland watershed areas (during operation and post-closure); groundwater drawdown resulting from open pit mine dewatering; groundwater mounding/drawdown resulting from operation of the Flotation Tailings Basin including groundwater seepage interception wells; changes in stream flow near the Mine Site and Flotation Tailings

Basin and associated impacts to wetlands abutting the streams (during operation and post-closure); wetland fragmentation from Project elements such as open pits, stockpiles, haul roads, etc.; and changes in wetland water quality. If/when the Project is permitted, an indirect wetland impact monitoring plan will be implemented as part of the Section 404 permit conditions.

The analysis will be completed for the Mine Site, the Flotation Tailings Basin, and the transportation corridors (railroad and Dunka Road).

4.1 Mine Site

4.1.1 Wetland Identification

Wetlands within the Mine Site will be identified using the Eggers and Reed (1997) community classification system. The wetland types and acreages for Area One (which includes the Mine Site) were identified in the report entitled: *NorthMet Project Baseline Wetland Typing Evaluation* (Barr 2011), which was discussed with the Wetland IAP Workgroup and approved by the Co-lead Agencies on March 30, 2011.

Wetland acreage by wetland type will be calculated using GIS within 500-foot radius increments beginning at the mine pits and continuing out to a total radius of 10,000 feet (for a total of 20 increments). The area of evaluation will only include wetlands within Area One where wetland type information has been developed and it will not include wetlands identified as directly impacted in Section 3.0. In addition, wetlands in the Peter Mitchell open pit taconite mine and areas north of this mine will be excluded from evaluation as described in the Guidance Document.

1. A detailed table will be provided for each increment identifying the wetland type and acreage for each wetland.
2. A summary table will be provided for each increment identifying the total acreage and total acres of direct impact for each Eggers and Reed (1997) wetland type.
3. For each wetland that will be directly impacted, the acreage for the portion of the remaining wetland will be calculated and included in a table.
4. A figure will be provided showing the increments and identifying the Eggers and Reed (1997) wetland types within each increment.

4.1.2 Potential Indirect Wetland Impacts Resulting from a Change in Watershed Area

For each wetland that will not be directly impacted by fill or excavation, but will have Project elements impacting its watershed, an estimate of the change in watershed area (acreage and percent gain or loss) will be calculated.

The change (acreage and percent gain or loss) in watershed areas and the wetland area found within each watershed will be identified for the following conditions: pre-Project, during operation when the maximum amount of watershed has been removed, and at closure.

An estimate of potential indirect wetland impacts (wetland acres by wetland type and type of indirect impact) will be calculated for non-directly impacted wetlands that will have changed watershed areas (during operation and post-closure) for each watershed that was identified as changed in the previous paragraph, using the following steps:

1. Determine the tributary acres per wetland acre for the pre-Project, during operation, and after closure conditions.
2. Determine the equivalent watershed yield (ac-ft/yr) for the pre-Project, during operation, and after closure conditions. The existing watershed yield will be calculated based on available gage data from Section 4.4.1 of Reference 3. This rate would be applied to each watershed to

convert the tributary ratio in Step 1 to an equivalent yield (or equivalent average contributing net precipitation), expressed as acre-feet/year (ac-ft/yr) per acre of wetland.

3. The range in the equivalent yield (inches/year) estimated over the life of the Project will be evaluated relative to pre-Project yield to calculate a maximum percent change in yield. The estimated relative change in yield will be evaluated on a case-by-case basis, taking into account factors such as wetland type, to determine the potential for indirect impacts (e.g., groundwater fed wetlands may be less susceptible to changes in surface watershed).

4.1.3 Potential Indirect Wetland Impacts Resulting from Wetland Fragmentation

For remaining wetlands not directly impacted or indirectly impacted by watershed area changes, an estimate of potential indirect wetland impacts (wetland acres by wetland type, and type of impact) from wetland fragmentation by Project features (open pits, stockpiles, haul roads, etc) will be determined, using the following steps:

1. For each portion of a remaining wetland, excluding indirect impacts from watershed changes, the potential area of indirect impacts will be determined based on an analysis of the various factors that may contribute to potential fragmentation. Based on this analysis, the identifying factor(s) contributing to potential fragmentation (change in size of wetland, surrounded by Project features, change in function and values of wetland e.g. wildlife habitat, etc.) will be identified. [Note: noise and dust do not cause fragmentation impacts according to the U.S. Army Corps of Engineers, May 16, 2011 conference call.]

4.1.4 Potential Indirect Wetland Impacts Resulting from Changes in Hydrology

An estimate of potential indirect wetland impacts (wetland acres by wetland type, and type of indirect impact) due to groundwater drawdown from open pit mine dewatering, based on the Co-lead Agency guidance for estimating potential indirect wetland impacts from groundwater drawdown near open pit mines as provided on July 1, 2011 will be determined, using the following steps.

1. Use the information provided by the Groundwater IAP Group and other available and relevant hydrogeologic data to justify whether to use or modify the provided analogue information which is based upon comparisons of the existing regional and site specific geologic data (such as bedrock faults, bedrock joint systems, bedrock topography, glacial till hydraulic conductivities, etc.), site specific engineering controls such as the Category 1 Waste Rock Stockpile seepage containment system, and the geologic settings of the analogue information sites and the Mine Site.
2. Use the guidelines provided by the Corps Memorandum (CEMVP-OP-R) Distinguishing Between Bogs That Are Entirely Precipitation Driven Versus Those with Some Degree of Mineral Inputs from Groundwater and/or Surface Water Runoff to identify minerotrophic and ombrotrophic coniferous and open bogs.

The potential indirect wetland impact from glacial aquifer drawdown will be based on the analogue impact zone with the greater potential drawdown (zone closer to the open pit mine) for wetlands that lie on both sides of the analogue distance boundary. The analogue distances are described below in steps 1, 2, 3 and 4.

1. For all wetlands, provide a table and figure identifying type and acreage of wetlands located within 0 feet to 1,000 feet from the pit edge. The table will also identify the type of indirect wetland impact for each indirectly impacted wetland. Identify the likelihood of wetland hydrology impact based on wetland type.
 - a. High Likelihood – includes coniferous swamp, hardwood swamp, sedge/wet meadow, shrub-carr, and alder thicket

- b. Moderate Likelihood – deep marsh, shallow marsh, and shallow open water
 - c. Low Likelihood – minerotrophic coniferous bog and open bog
 - d. No Impact anticipated as identified in Guidance Document – ombrotrophic coniferous bog and open bog
2. For all wetlands, provide a table and figure identifying type and acreage of wetlands located within >1,000 feet to 2,000 feet from the pit edge. The table will also identify the type of indirect wetland impact for each indirectly impacted wetland. Identify the likelihood of wetland hydrology impact based on wetland type.
 - a. Moderate Likelihood – coniferous swamps, hardwood swamps, sedge/wet meadow, shrub-carr, and alder thicket
 - b. Low Likelihood – deep marsh; shallow marsh, and shallow open water
 - c. No Impact anticipated as identified in Guidance Document – minerotrophic and ombrotrophic coniferous bog and open bog
 3. For all wetlands, provide a table and figure identifying type and acreage of wetlands located within >2,000 feet to 3,500 feet from the pit edge. The table will also identify the type of indirect wetland impact for each indirectly impacted wetland. Identify the likelihood of wetland hydrology impact based on wetland type.
 - a. Low Likelihood – coniferous swamp, hardwood swamp, sedge/wet meadow, shrub-carr, alder thicket
 - b. No Impact anticipated as identified in Guidance Document – deep marsh, shallow marsh, shallow open water, coniferous bog, open bog
 4. For all wetlands, provide a table and figure identifying type and acreage of wetlands located within >3,500 feet to 10,000 feet from the pit edge (within the wetland evaluation area). The table will also identify the type of indirect wetland impact for each indirectly impacted wetland.
 - a. No Impact anticipated as identified in Guidance Document – all wetland types

A general discussion will be provided regarding the potential indirect wetland hydrology drawdown impacts to each wetland type based on the wetland sensitivity class tables for falling groundwater tables found in the Crandon mine project document titled *Wetland Impact Assessment Technical Memorandum – Appendix B* (Peterson Environmental Consulting, Inc. 2002).

1. A qualitative discussion of the types of potential indirect wetland impacts that might occur will be provided based on hypothetical hydrologic drawdown levels. Potential indirect wetland impacts might include: conversion to other wetland community types, a change in vegetation without a change in community type, conversion to uplands, or other impacts, which will be categorized using the Eggers and Reed (1997) wetland classification system.

4.1.5 Potential Indirect Wetland Impacts for Wetlands Abutting the Partridge River

Estimate of potential indirect wetland impacts (wetland acres by wetland type, and type of impact) for wetlands abutting the Partridge River as a result of changes in river flow resulting from the Project (during operation and post-closure), using the following steps.

1. Identify in GIS the wetlands abutting the Partridge River within Area One. A table will identify the wetland ID, type and acreage for each wetland (only within the area previously characterized for wetlands).

2. Provide the change in flow and water levels in the Partridge River using the model developed in Section 5.6 of Reference 3.
3. Identify whether the changes in flow (and therefore stage) resulting from the Project are within the observed natural variation for the Partridge River (Section 4.4.1 of Reference 3).
4. If the changes in flow and water levels are not within the observed natural variation for the Partridge River, identify the potential indirect impacts for the wetlands abutting the Partridge River.

4.1.6 Potential Indirect Wetland Impacts Resulting from Water Quality Changes

An estimate of potential indirect wetland impacts (wetland acres by wetland type, and type of impact) for remaining wetlands not directly impacted or indirectly impacted by previously evaluated causes in Sections 4.1.2 through 4.1.5 that would be impacted by water quality changes (such as from sulfide-bearing dust deposition, ore spillage, seepage from stockpiles, etc.) will be completed using the following steps:

1. Fugitive Dust Emissions
 - a. The air emissions from all surface fugitive dust sources at the Mine Site will be modeled using an EPA approved air dispersion model with a deposition algorithm (AERMOD version 11103). This is the same model that has been proposed to be used for assessing air impacts in Class II areas in the draft NorthMet Air Modeling Work Plan (version 1, May 9, 2011) which was developed in response to the Air Impacts Assessment Planning Summary Memo dated May 6, 2011. Comments have been received on this draft Work Plan, with no objections to the proposed model, so this model is expected to be specified in the final Work Plan. Emission rates and particle size distributions will be based on total particulate matter. Receptors will be placed on all delineated wetlands within the Project ambient air boundaries that have not been identified as directly impacted. The receptor grid will also initially extend 5 kilometers beyond the ambient air boundaries with a grid spacing of 500 meters. The receptor grid may be adjusted based on preliminary modeling results. Other modeling details would generally follow those specified in the Class II modeling protocols for the Mine Site as defined by the Air IAP and/or generally excepted modeling practice.
 - b. The modeled dust sources at the Mine Site will include ore and waste rock truck loading and unloading outside of the pits, railcar loading, dust generation from traffic on unpaved roads on the surface (i.e. not in the pits), and overburden and other construction rock screening and/or crushing as defined by the Air IAP.
 - c. Rock handling and roads within the pits will not be included in the analysis because:
 - a) "pit-trapping" would greatly reduce the potential for dust to impact areas outside of the pits and
 - b) Barr's past experience which indicates that the AERMOD "open pit" algorithm is incompatible with the AERMOD deposition algorithm.
 - d. The output of the model will be deposition rate (grams per square meter) on an annual basis. The model results will be compared to background values such that contours where the modeled deposition is small relative to the background value can be developed. This can be considered a conservative assessment of how far away potential impacts to wetlands from dust may occur from fugitive dust sources. This should be considered a screening level analysis such that it would identify an upper bound for the potential range of distances at which impacts might occur, but the results will not identify actual impacts. This range of distances could be used to

estimate the extent of potential indirect impacts to guide development of monitoring plans to document actual indirect impacts. Based on the results of the screening analysis, PolyMet may propose a more refined approach to assess the distance at which potential impacts may occur.

2. Metals and Sulfide Dust Emissions

- a. The potential for sulfur deposition was evaluated for the DEIS Mine Plan in Screening Analysis of the Potential for Fugitive Dust Emissions Associated with Sulfide Rock Handling at the NorthMet Project Mine Site to Increase Sulfur Deposition to Nearby Wetlands (Barr, January 28, 2010). This analysis included dust emissions from the handling of Category 2, 3, and 4 waste rock and ore. Lean ore handling emissions were also modeled, but lean ore has been eliminated as a rock classification in the updated Mine Plan.
- b. The handling activities associated with Category 2, 3 and 4 waste rock and ore located outside of the pits will be included in the metals and sulfur analysis for the Mine Site. This includes truck loading and unloading with waste rock and ore and railcar loading with ore. Note: the potential for wind erosion from the stockpiles has been evaluated, and it has been determined that wind erosion would not occur through the use of EPA approved wind erosion calculations procedures in Section 13.2.5 of Reference 4. The calculations are described in the Mine Site Emission Inventory Spreadsheet (Version 2 Submitted August 1, 2011). This spreadsheet references the detailed calculations based on five years of meteorological data provided to MPCA via FTP site on May 9, 2011.
- c. Modeling will be conducted for the included sources in the same manner as described for dust modeling. The dust modeling and metals and sulfide modeling may be conducted in separate model runs or in the same run utilizing the model's source grouping capabilities.
- d. For air dispersion/deposition modeling, the total particulate emission rates (grams per second) will be speciated and converted to metals and sulfur emission rates based on data on the chemical composition of each material generating dust. Metals for evaluation, associated with rock and soils, would be: arsenic, cadmium, chromium, lead, manganese, nickel and selenium.
- e. Mercury will not be evaluated at the Mine Site for dust deposition because the concentration of mercury in the rock to be mined is very low (Sections 5.0 and 5.8 of Reference 3) and not considered to be environmentally significant in this medium.
- f. The model-estimated sulfur and metals deposition rates (grams per square meter) will be compared to background values to determine distance contours beyond which the deposition rate is insignificant compared to background. As with the dust analysis, this would be a screening level evaluation that could be used to identify a range of distances from a source beyond which impacts would be unlikely to occur. This range of distances could be used to estimate the extent of potential indirect wetland impacts to guide development of monitoring plans to document actual indirect impacts. PolyMet may choose to propose a more refined approach depending on the results of the screening level analysis. A more refined approach could take into account such factors as the potential for metals and/or sulfur to be liberated from the rock particles depending on the rock chemistry, environmental chemistry and general conditions in the ecosystem where the deposition is predicted to occur.

3. Ore spillage – see the Section 4.3.2.

4. Leakage from stockpile will be evaluated using the following steps:
 - a. Quantify the amount of stockpile leakage water that discharges to surface water and wetlands, down gradient of the stockpiles based on the results of the water quality modeling.
 - b. Identify the wetlands (type, acreage) within the surficial aquifer groundwater flowpaths from mine features using boundaries used in the water quality modeling (as shown in the Groundwater IAP Summary document).
 - c. Categorize the wetlands within the flowpaths in Step ii into groundwater-fed and precipitation-fed wetlands using guidance from the Corps “Bog Memo” and evaluate the potential for indirect impacts based on potential water quality changes from the mine features.

4.1.7 Potential Indirect Wetland Impacts to Wildlife Utilization of Nearby Habitats From Project Noise

Provide a general discussion regarding the potential indirect wetland impact to wildlife utilization of nearby habitats from project noise using the following steps:

1. Identify the potential sources of project noise and the range of emitted noise levels.
2. Identify wildlife species that are found within the area, as well as their preferred habitats using wildlife surveys previously conducted for the NorthMet Project (Section 4.4 of Reference 2).
3. Qualitatively discuss the potential impacts and possible short- and long-term reactions of wildlife species to the potential project noise levels.

4.2 Flotation Tailings Basin

4.2.1 Wetland Identification

Wetlands around the Flotation Tailings Basin will be identified using the Eggers and Reed (1997) community classification system. The wetland types and acreages for Area Two (which includes the Flotation Tailings Basin) were identified in the report entitled: *NorthMet Project Baseline Wetland Typing Evaluation* (Barr 2011), which was discussed with the Wetland IAP Workgroup and approved by the Co-lead Agencies on March 30, 2011.

Wetland acreage by wetland type will be calculated using GIS within 500-foot radius increments beginning at the Flotation Tailings Basin and continuing out to the Embarrass River. The area of evaluation will only include wetlands within Area Two where wetland type information has been developed and it will not include wetlands identified as directly impacted in Section 3.0.

1. A detailed table will be provided for each increment identifying the wetland type and acreage for each wetland.
2. A summary table will be provided for each increment identifying the total acreage and total acres of direct impact for each Eggers and Reed (1997) wetland type.
3. For each wetland that will be directly impacted, the acreage for the portion of the remaining wetland will be calculated and included in a table.
4. A figure will be provided showing the increments and identifying the Eggers and Reed (1997) wetland types within each increment.

4.2.2 Potential Indirect Wetland Impacts Resulting from Changes in Hydrology

An estimate of potential indirect wetland impacts (wetland acres by wetland type, and type of impact) from hydrologic changes (groundwater upwelling and resulting surface water flow in wetlands and/or groundwater drawdown near the groundwater seepage interception wells) resulting from groundwater seepage and/or interception well pumping will be determined.

1. Quantify the amount of Flotation Tailings Basin groundwater seepage water that discharges to surface water features, including wetlands, down gradient of the Flotation Tailings Basin. A MODFLOW model developed for the Flotation Tailings Basin will be used in conjunction with a GoldSim probabilistic model to estimate the quantity of seepage that discharges to surface water features.
2. Identify all the wetlands (type, acreage) within the surficial aquifer groundwater flowpaths downgradient of the Flotation Tailings Basin using boundaries used in the water quality modeling (as shown in the Groundwater IAP Summary document).
3. Using the wetlands identified in step 2, categorize the wetlands into groundwater-fed and precipitation-fed wetlands using guidance in the Corps Memorandum (CEMVP-OP-R) *Distinguishing Between Bogs That Are Entirely Precipitation Driven Versus Those with Some Degree of Mineral Inputs from Groundwater and/or Surface Water Runoff* and evaluate the potential for indirect impacts resulting from groundwater seepage and/or interception well pumping.

Provide a general discussion regarding the potential indirect wetland hydrology impacts to each wetland type based on the wetland sensitivity class tables for rising groundwater tables found in the Crandon mine project document titled *Wetland Impact Assessment Technical Memorandum – Appendix B* (Peterson Environmental Consulting, Inc. 2002).

1. A qualitative discussion of the types of potential indirect wetland impacts that might occur will be provided based on hypothetical hydrologic drawdown or surcharge levels. Potential indirect wetland impacts might include: conversion to other wetland community types, a change in vegetation without a change in community type, conversion to uplands, or other impacts, which will be categorized using the Eggers and Reed (1997) wetland classification system.

4.2.3 Potential Indirect Wetland Impacts for Wetlands Abutting Trimble Creek and the Two Unnamed Creeks

An estimate of potential indirect wetland impacts (wetland acres by wetland type) in wetlands abutting the three streams north and west of the Flotation Tailings Basin (Trimble Creek and the two unnamed creeks as shown in Figure 3 of the Water Resources IAP – Surface Water Summary Memo) as a result of changes in stream flow resulting from operation of the Flotation Tailings Basin will be determined using the following steps:

1. Identify in GIS the wetlands abutting the west Unnamed Creek (Mud Lake Creek), Trimble Creek, and the east Unnamed Creek within Area Two. A table will identify the wetland ID, type and acreage for each wetland (only within the area previously characterized for wetlands).
2. Provide the change in flow in the three streams using the GoldSim probabilistic model developed in Reference 6 and the method described in Section 4.4 of Reference 2. Estimate a corresponding change in stage based on available rating curves or simple hydraulic equations (e.g. Manning's equation).

3. Identify whether the changes in flow (and by extension, stage) are within the estimated natural variation for the three streams based on observed data or unit-area relationships extrapolated from gage data (Section 4.4.1 of Reference 5 and Page 3 of Reference 6).
4. If the changes in flow and water levels are not within the observed natural variation for the three streams, identify the potential indirect impacts for the wetlands abutting the three streams.

4.2.4 Potential Indirect Wetland Impacts Resulting from Water Quality Changes

An estimate of potential indirect wetland impacts (wetland acres by wetland type, and type of impact) for wetlands that would be impacted by water quality changes (such as from sulfide-bearing dust deposition from the Flotation Tailings Basin, Flotation Tailings Basin groundwater seepage, etc.) will be completed using the following steps:

1. Fugitive Dust Emissions

- a. The air emissions from all surface fugitive dust sources at the Flotation Tailings Basin site will be modeled using an EPA approved air dispersion model with a deposition algorithm (AERMOD version 11103). This is the same model that has been proposed to be used for assessing air impacts in Class II areas in the draft NorthMet Air Modeling Work Plan (version 1, May 9, 2011) which was developed in response to the Air Impacts Assessment Planning Summary Memo dated May 6, 2011. Comments have been received on this draft Work Plan, with no objections to the proposed model, so this model is expected to be specified in the final Work Plan. Emission rates and particle size distributions will be based on total particulate matter. Receptors will be placed on all delineated wetlands within the Project ambient air boundaries that have not been identified as directly impacted. The receptor grid will also initially extend 5 kilometers beyond the ambient air boundaries with a grid spacing of 500 meters. The receptor grid may be adjusted based on preliminary modeling results. Other modeling details would generally follow those specified in the Class II modeling protocols for the Plant Site as defined by the Air IAP and/or generally excepted modeling practice.
- b. The modeled dust sources at the Flotation Tailings Basin will include LTV Steel Mining Company (LTVSMC) tailings loading and unloading, unpaved road traffic, and wind erosion from dams constructed of LTVSMC tailings and beaches composed of NorthMet tailings.
- c. The output of the model will be deposition rate (grams per square meter) on an annual basis. The model results will be compared to background values such that contours where the modeled deposition is small relative to the background value can be developed. This can be considered a conservative assessment of how far away potential impacts to wetlands from dust may occur from fugitive dust sources. This should be considered a screening level analysis such that it would identify an upper bound for the potential range of distances at which impacts might occur, but the results will not identify actual impacts. This range of distances could be used to estimate the extent of potential indirect impacts to guide development of monitoring plans to document actual indirect impacts. Based on the results of the screening analysis, if model-estimated particle deposition is equal to current background deposition (i.e., 100 percent of current background; i.e., a potential doubling of deposition), PolyMet may propose a more refined approach to assess the distance at which potential impacts may occur.

2. Metals and Sulfide Dust Emission

- a. At the Flotation Tailings Basin wind erosion from the embankment and beaches as well as truck traffic on roads composed of LTVSMC tailings will be included in the analysis.
 - b. Modeling will be conducted for the included sources in the same manner as described for dust modeling. The dust modeling and metals and sulfide modeling may be conducted in separate model runs or in the same run utilizing the model's source grouping capabilities.
 - c. For air dispersion/deposition modeling, the total particulate emission rates (grams per second) will be speciated and converted to metals and sulfur emission rates based on data on the chemical composition of each material generating dust. Proposed metals for evaluation, associated with rock and soils, will include: arsenic, cadmium, chromium, lead, manganese, nickel, and selenium.
 - d. Because the NorthMet ore is low in mercury, the tailings, which includes roughly 98 percent of the ore, will also be low in mercury, and in fact pilot study data shows that the mercury preferentially goes to the flotation concentrate. The mercury in the tailings is also expected to be strongly bound within the mineral matrix. This is also true of the LTVSMC tailings that will be used to construct the Flotation Tailings Basin dams and that may be present on some road surfaces. Therefore, any mercury present in dust from the Flotation Tailings Basin would not be biologically available and we are not proposing to consider mercury in the deposition analysis at the Flotation Tailings Basin. When metal ores are concentrated and heated, such as in taconite mining or in smelting processes, then mercury becomes a metal of interest for air emissions and deposition. For the Project, potential mercury air emissions from ore processing (i.e., potential emissions from the autoclave) are being evaluated for potential local deposition impacts.
 - e. The model-estimated sulfur and metals deposition rates (grams per square meter) will be compared to background values to determine distance contours beyond which the deposition rate is insignificant compared to background. As with the dust analysis, this will be a screening level evaluation that could be used to identify a range of distances from a source beyond which impacts would be unlikely to occur. This range of distances could be used to estimate the extent of potential indirect wetland impacts to guide development of monitoring plans to document actual indirect impacts. If model-estimated sulfur or individual metal deposition is equal to current background deposition (i.e., 100% of current background; i.e., a potential doubling of deposition), PolyMet may propose a more refined approach depending on the results of the screening level analysis. A more refined approach could take into account such factors as the potential for metals and/or sulfur to be liberated from the rock particles depending on the rock chemistry, environmental chemistry and general conditions in the ecosystem where the deposition is predicted to occur.
3. Flotation Tailings Basin Groundwater Seepage
- a. Identify the chemistry from the Flotation Tailings Basin groundwater seepage based on the results of the water quality modeling (Reference 6).
 - b. Identify the wetlands (type, acreage) within the down gradient zone using boundaries used in the water quality modeling (as shown in the Groundwater IAP Summary document).
 - c. Categorize the wetlands within the flowpaths in Step ii into groundwater-fed and precipitation-fed wetlands using guidance from the Corps Memorandum (CEMVP-

OP-R) *Distinguishing Between Bogs That Are Entirely Precipitation Driven Versus Those with Some Degree of Mineral Inputs from Groundwater and/or Surface Water Runoff* and evaluate the potential for indirect impacts based on potential water quality changes from the Flotation Tailings Basin.

4.2.5 Potential Indirect Wetland Impacts to Wildlife Utilization of Nearby Habitats From Project Noise

Provide a general discussion regarding the potential indirect wetland impact to wildlife utilization of nearby habitats from project noise using the following steps:

1. Identify the potential sources of project noise and the range of emitted noise levels.
2. Identify wildlife species that are found within the area, as well as their preferred habitats using wildlife surveys previously conducted for the NorthMet Project (Section 4.4 of Reference 2).
3. Qualitatively discuss the potential impacts and possible short- and long-term reactions of wildlife species to the potential project noise levels.

4.3 Transportation Corridors

4.3.1 Wetland Identification

Wetlands around the Flotation Tailings Basin will be identified using the Eggers and Reed (1997) community classification system. The wetland types and acreages for Area Two (which includes the Flotation Tailings Basin) were identified in the report entitled: *NorthMet Project Baseline Wetland Typing Evaluation* (Barr 2011), which was discussed with the Wetland IAP Workgroup and approved by the Co-lead Agencies on March 30, 2011.

The wetlands abutting the Dunka Road and the railroad corridor within Area One and Area Two will be identified using GIS. The wetland ID, type and acreage for each wetland (only within the area previously characterized for wetlands) will be identified in a table.

4.3.2 Potential Indirect Wetland Impacts Resulting from Water Quality Changes

An estimate of potential indirect wetland impacts (wetland acres by wetland type, and type of impact) for wetlands that will be impacted by water quality changes (such as from sulfide-bearing dust deposition, ore spillage, etc.) will be completed using the following steps:

Mine to Plant Rail

The potential release of dust from railcars transporting ore from the Mine Site to the Plant Site was addressed in the May 6, 2011 Air Impact Assessment Planning Summary Memo, “The air IAP group concluded that there would be minimal air impacts from any dust generated from ore hauled in the railcars due to the coarse nature of the ore.” Based on this conclusion, air modeling of potential release of dust from railcars will not be performed because the potential wetland impacts will not be significant.

The air IAP group concluded that any dust generated from ore hauled in railcars would be coarse in nature (i.e., relatively large particles). These larger particles would tend to deposit near the railcar and not be dispersed to any great extent. An estimate of the spillage of ore fines along the rail corridor is shown in Section 8.5.3 of Reference 7. Assuming that all spillage of the coarse material would occur in a 2 meter wide strip on both sides of the centerline of the railway (total width = 4 meters) over the entire haul distance after loading (~ 8 miles; ~13,000 meters), results in approximately 0.11 Kg/square meter of ore fines annually or 2.14 Kg/square meter for the 20 year Project. This equates to 0.002 inch of depth annually or 0.05 inches for the 20 year Project.

Using the geochemical modeling methods described in Reference 7 for the Ore Surge Pile, the quality of water infiltrating through this material will be estimated on a per-unit area basis which will also be on a per unit length of the rail corridor. If the water quality is found to have a greater than 10 percent likelihood of exceeding water quality standards as defined in Table 1-3 of Reference 8, the unit area required to provide sufficient precipitation to dilute the water to meet standards will be calculated and converted to a distance to be added to the 2 meters from the centerline of the rail corridor that will be a potential dust impact corridor. Any wetlands identified in the above paragraph of this section that are within the potential dust impact corridor will be considered to be potentially indirectly impacted.

Dunka Road

Loaded mine haul trucks will not travel on the Dunka Road. Empty mine haul trucks will only travel on the Dunka Road when they are in need of maintenance at the Area 1 Shop. It is estimated that each truck will travel to Area 1 twice per year. The total one-way trips per year are estimated at 44. Given the low traffic volumes (< 1 trip per week on average) a quantitative assessment of impacts from ore particle discharge from haul trucks travelling down the Dunka Road is not warranted.

Product Shipping

Products produced in the hydrometallurgical plant (AU/PGM concentrate, mixed hydroxide precipitate) will be loaded into super sacks (i.e. large industrial sacks used to transport solid material) and then loaded onto trucks or railcars. There is little or no potential for spillage with this method of shipping. With respect to flotation concentrate, as stated in the project description (Reference 1) "Each filtered concentrate would be conveyed to separate stockpiles within an enclosed 10,000 ton storage facility for loading into covered rail cars. The storage facility would store about 7 to 10 days of production capacity when flotation concentrate would be directed to Concentrate Dewatering/Storage. The storage facility would have a concrete floor and provisions to wash wheeled equipment leaving the facility to prevent concentrates from being tracked out of the facility." The flotation concentrate is similar material to that which caused issues at the Red Dog Mine in Alaska (zinc concentrate transported in truck trailers), which has been cited as an example of potential consequences of product transport at mining operations. Some issues at Red Dog were driven by road dust and port activities which do not apply to the Project. Best Management Practices adopted at Red Dog - enclosed storage and loading, covered cars, and vehicle wash facilities - are proposed for use at the NorthMet project. Because the common carrier route (i.e. the rail line used to transport products) is not known (ultimate customer not known and could change), there is no way to assess impacts along the common carrier route. PolyMet will be paid on tons received by customers so it has a vested interest in not losing any concentrate. The covered rail cars will be inspected for holes and any holes repaired before concentrate loading.

4.3.3 Potential Indirect Wetland Impacts Resulting from Wetland Fragmentation

For remaining wetlands not directly impacted or identified in 4.3.2, an estimate of potential indirect wetlands (wetland acres by wetland type, and type of indirect impact) from wetland fragmentation by Project features will be completed using the following steps:

1. For each portion of a remaining wetland, excluding indirect impacts identified in 4.2.3, the potential area of indirect impacts would be determined based on an analysis of the various factors that may contribute to potential fragmentation. Based on the analysis, the identifying factor(s) contributing to potential fragmentation (change in size of wetland, surrounded by Project features, change in function and values of wetland e.g. wildlife habitat, etc.) would be identified. [Note: noise and dust do not cause fragmentation impacts according to the U.S. Army Corps of Engineers, May 16, 2011 conference call.]

4.3.4 Potential Indirect Wetland Impacts to Wildlife Utilization of Nearby Habitats From Project Noise

Provide a general discussion regarding the potential indirect wetland impact to wildlife utilization of nearby habitats from project noise using the following steps:

1. Identify the potential sources of project noise and the range of emitted noise levels.
2. Identify wildlife species that are found within the area, as well as their preferred habitats using wildlife surveys previously conducted for the NorthMet Project (Section 4.4 of Reference 2).
3. Qualitatively discuss the potential impacts and possible short- and long-term reactions of wildlife species to the potential project noise levels.

5. Cumulative Wetland Impacts

Analysis of cumulative wetland impacts will be done using accepted tools and protocols. The analysis performed for the DEIS is described and summarized in Section 4.3 of Reference 1. The analysis performed for the SDEIS will generally duplicate that effort using the revised direct and potential indirect wetland impact acreage, along with updated watershed information. The assessment will be conducted for both the Partridge River watershed and the Embarrass River watershed. The following steps will provide acreage for wetland and water resources for the pre-settlement, existing and foreseeable future conditions. Tables and figures will be developed to present the information.

5.1 Presettlement Wetland and Water Resources

The pre-settlement conditions time period represents wetlands, lakes, and deepwater resources as they existed prior to mining and urban development in the late 1800s to early 1900s. An estimate of pre-settlement wetland, lakes, and deepwater acreage within the Partridge River and Embarrass River watersheds will be developed in GIS using the following steps:

1. The acreage of wetland and water resources estimated for the pre-settlement period will be developed using the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) and the original survey maps developed using data from the original Government Land Surveys along with other historical surveys and sources, generally from the late 1800s.
2. The NWI mapping efforts were generated from interpretations of black-and-white aerial photographs completed in the late 1970s to early 1980s. The NWI is a more accurate depiction of historic wetland resources where human disturbance has been limited. Therefore, the NWI will be used as a base wetland map and available delineation data will be substituted to improve the accuracy of the wetland mapping.
3. The original survey maps will be obtained from the MDNR GIS Data Deli maps at <http://deli.dnr.state.mn.us/>. The original survey maps identify water resources as marshes, bottoms, swamps, lakes, ponds, and rivers, as documented in early land surveys. The original survey maps are a more accurate depiction of historic wetland resources where human disturbance is present. The water resources within the areas of human disturbance in each watershed will be digitized and presented on a figure.
4. The wetland and water resources mapped on the original survey maps will be digitized for one township, with minimal disturbance (roads, railroads, mining areas, etc.) located within and adjacent to the Partridge River watershed and for one township located within the Embarrass River watershed. It is assumed that if there is a minimal amount of disturbance in a township, the NWI mapping would be representative of pre-settlement wetland and water resources conditions. Therefore the data from each township will be used to develop a relationship between the NWI and original survey data.

5. The total wetland and water resources acreage for the two data sets will be compiled and the ratio of NWI to original survey map wetland and water resources will be calculated for each township. This ratio will indicate the percent of wetland and water resources identified on the NWI maps compared the original survey maps. This ratio will be used as an adjustment factor to conform the original survey data to the standards and scales of the NWI data for estimating the pre-settlement wetland resources within the disturbed areas of the watershed. The selected townships and data used to determine the adjustment factor will be presented in a table.
6. For the human disturbance areas, the NWI wetlands and water resources located within the human disturbance polygon boundaries will be removed using a GIS clipping tool. The NWI within these disturbance areas do not accurately reflect pre-settlement conditions because the NWI either included wetlands that have since been eliminated because of disturbance activities or did not include wetlands that had already been eliminated when the NWI was completed (e.g., reservoir development permanently flooded the wetlands). Because the NWI does not accurately map these types of areas, it does not accurately represent pre-settlement conditions; therefore the NWI wetlands in the disturbed areas will be replaced with wetlands mapped on the original survey maps. The total area of wetland and water resources within those polygons will be corrected using the adjustment factor. The total acreage of pre-settlement wetlands and water resources will be estimated for the two watersheds.

5.2 Existing Wetland and Water Resources

The existing conditions time period represents wetland, lake, and deepwater resources as they exist today, prior to the development of the Project. An estimate of existing wetland, lake, and deepwater acreage within the Partridge River and Embarrass River watersheds will be developed in GIS using the following steps:

1. Existing wetland, lake, and deepwater resources will be estimated using: wetland delineations completed in the area (as available); lake or lacustrine water body acreages will be estimated using the USGS National Hydrograph Dataset and the NWI datasets; deepwater or mine pit water body acreages will be estimated using a combination of the MDNR Mesabi Mining Features (2008) and interpretation of 2003, 2008, 2009, and 2010 FSA aerial photographs; and NWI mapping.
2. A “composite” wetland and water resources layer will be developed by deleting all of the NWI polygons from areas in which more detailed mapping had been completed and replacing them with the delineated wetland, lake, and deepwater resources.

5.3 Projected Future Wetland and Water Resources

An estimate of future wetland acreage within the Partridge River and Embarrass River watersheds will be completed considering reasonably foreseeable future project wetland impacts, both direct and potential indirect. Reasonably foreseeable future projects are defined as those that have been permitted and those that have had permit applications submitted and/or are undergoing environmental review by regulatory agencies.

The future conditions time period represents wetland, lake, and deepwater resources expected to be present following conclusion and reclamation of the Project. It is assumed that the future conditions follows some time after conclusion of the future projects such that the mine pit will have filled with water.

Relevant public officials from city, county, state and federal agencies will be contacted to identify reasonably foreseeable future actions within the study area. Agency officials will be asked to identify reasonably foreseeable future projects that may occur during the life of the Project. Contacts will include

the City of Babbitt, St. Louis County, MDNR, Minnesota Board of Water and Soil Resources, the U.S. Forest Service, and the Iron Range Resources and Rehabilitation Board (IRRRB).

Future projects will be identified in the Partridge River watershed and the Embarrass River watershed that may impact wetland, lake, and deepwater resources. For the projected future conditions, the acreage of wetland, lake, and deepwater resources will be estimated by subtracting the future projected wetland impacts and adding the future projected development of wetland, lake, and deepwater resources to the existing resource totals. This information will be provided as a table.

5.4 Qualitative Analysis of Cumulative Wetland Impacts for the St. Louis River below the Ordinary High Water Mark From Its Confluence with the Embarrass River to Lake Superior

A qualitative analysis of cumulative wetland impacts for the St. Louis River below the ordinary high water mark from its confluence with the Embarrass River to Lake Superior will be developed based on a qualitative estimate of flow changes in the river.

A qualitative estimate of flow changes in the St. Louis River will be developed from the results of the Partridge River hydrologic modeling described in Section 7.1.1 of Reference 3. The estimated flow changes in the St. Louis River will be evaluated relative to gage data to determine if the changes are expected to be within the natural variation of flow within the St. Louis River will be developed using the following steps:

1. If the evaluation of the estimated flow changes in the St. Louis River is within the natural variation of average annual flow in within the St. Louis River observed at USGS gage 04016500 (St. Louis River near Aurora), no further analysis will be conducted. This location is the most upstream location of the St. Louis River affected by the NorthMet Project, and will therefore show the greatest impact.
2. If the evaluation of the estimated flow changes in the St. Louis River is not within the natural variation of flow in within the St. Louis River, the following analysis will be conducted.
 - a. An estimate of existing wetland acreage and wetland types below the ordinary high water mark of the St. Louis River from its confluence with the Embarrass River to Lake Superior will be made using the National Wetland Inventory.
 - b. An estimate of future wetland acreage and wetland types below the ordinary high water mark of the St. Louis River will be made from its confluence with the Embarrass River to Lake Superior.

5.5 Quantitative Analysis of Cumulative Wetland Impacts

5.5.1 Partridge River and Embarrass River Watersheds

A quantitative analysis of cumulative impacts for the Partridge River and Embarrass River watersheds will be developed using the following steps:

1. The acreage of wetland, lake, and deepwater resources for the pre-settlement, existing and reasonably foreseeable future conditions will be provided as a table. The foreseeable future conditions will include evaluation of a No Action Alternative and the Proposed Action.
 - a. The acreage of wetland, lake, and deepwater resources will be compared and discussed for the pre-settlement, existing and reasonably foreseeable future conditions.
 - b. The project's effect on the wetland, lake, and deepwater resources will be discussed and compared for the study area. This includes a discussion of changes in acreage,

water quality, unique habitat, adjacency to stream resources, and cumulative effects of projects within each watershed.

5.5.2 The St. Louis River below the Ordinary High Water Mark From Its Confluence with the Embarrass River to Lake Superior

A quantitative analysis of cumulative impacts for wetlands located below the ordinary high water mark of the of the St. Louis River from its confluence with the Embarrass River to Lake Superior will be developed using the following steps:

1. If the evaluation of the estimated flow changes in the St. Louis River is within the natural variation of flow in within the St. Louis River, no further analysis will be conducted.
2. If the evaluation of the estimated flow changes in the St. Louis River is not within the natural variation of flow in within the St. Louis River, determine the change in wetland acreage from existing to future conditions based on a qualitative estimate of flow changes in the St. Louis River.

5.6 Climate Change

A qualitative analysis of estimated climate change impacts (to be coordinated with the climate change evaluation being conducted for the air impacts chapter of the SDEIS) on cumulative wetland impacts in the Partridge River Watershed, the Embarrass River Watershed, and below the ordinary high water mark of the of the St. Louis River from its confluence with the Embarrass River to Lake Superior.

The qualitative assessment of the potential impacts of climate change on wetlands will be included in the Climate Change Evaluation Report developed by the Air IAP. No additional assessment will be conducted.

6. References

Reference 1 NorthMet Project Project Description, Version 3, September 13, 2011

Reference 2 NorthMet Project Draft Environmental Impact Statement. U.S. Army Corps of Engineers and Minnesota Department of Natural Resources. October 2009.

Reference 3 NorthMet Project Water Modeling Data Package – Volume 1 (Mine Site) Version 5

Reference 4 Compilation of Air Pollutant Emission Factors, AP-42 5th edit. Volume I Stationary Point and Area Sources, Section 13.2.5. Updated November 2006. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina.

Reference 5 NorthMet Project Water Modeling Data Package – Volume 2 (Plant Site) Version 2

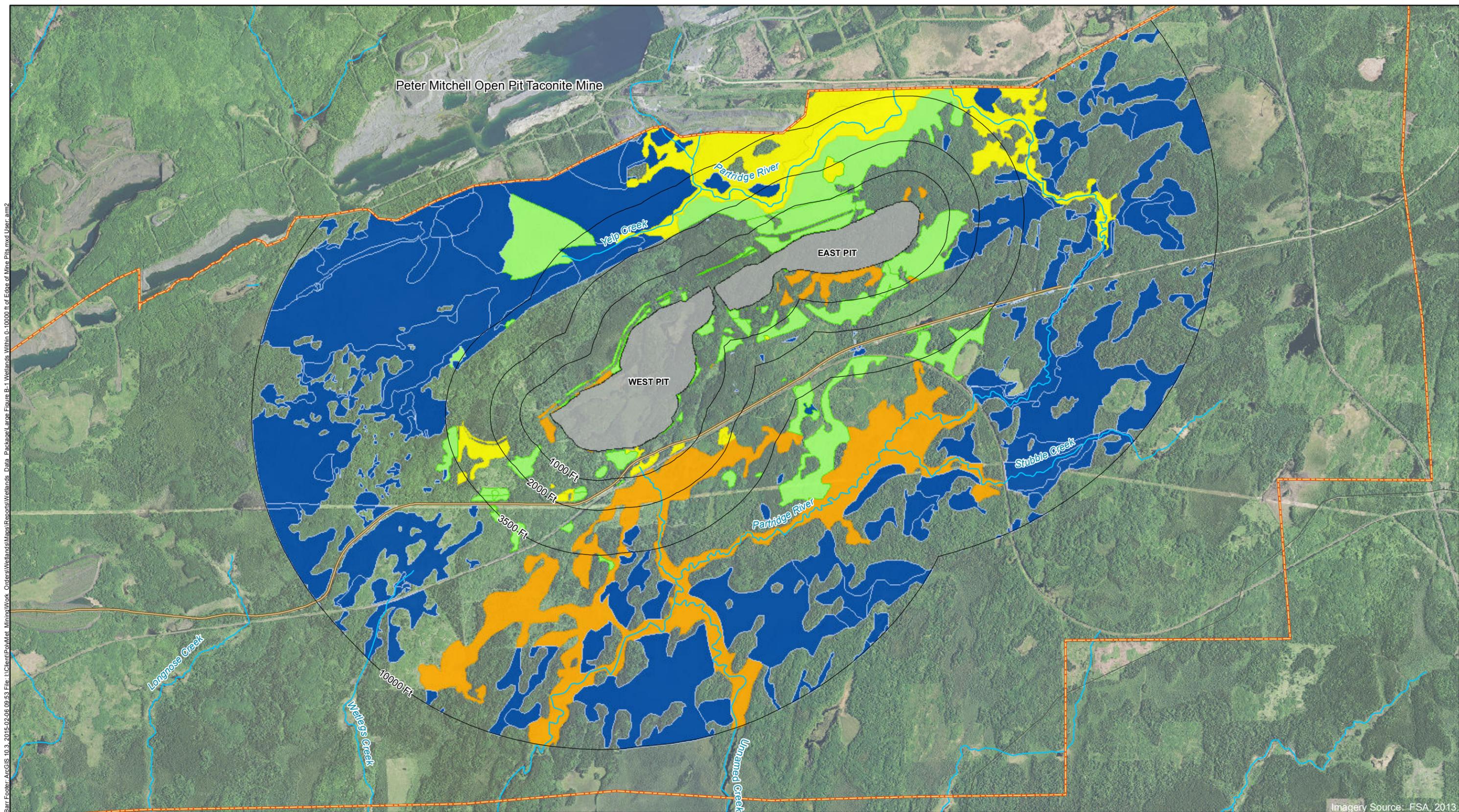
Reference 6 Surface Water IAP Group Summary Document, Date: May 20, 2011.

Reference 7 NorthMet Project Waste Characterization Data Package Version 5

Reference 8 NorthMet Mine Site Water Modeling Work Plan Version 2

Attachment B

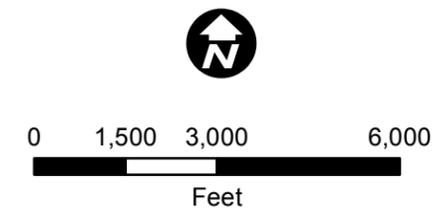
Wetlands within Analog Zones – Mine Site



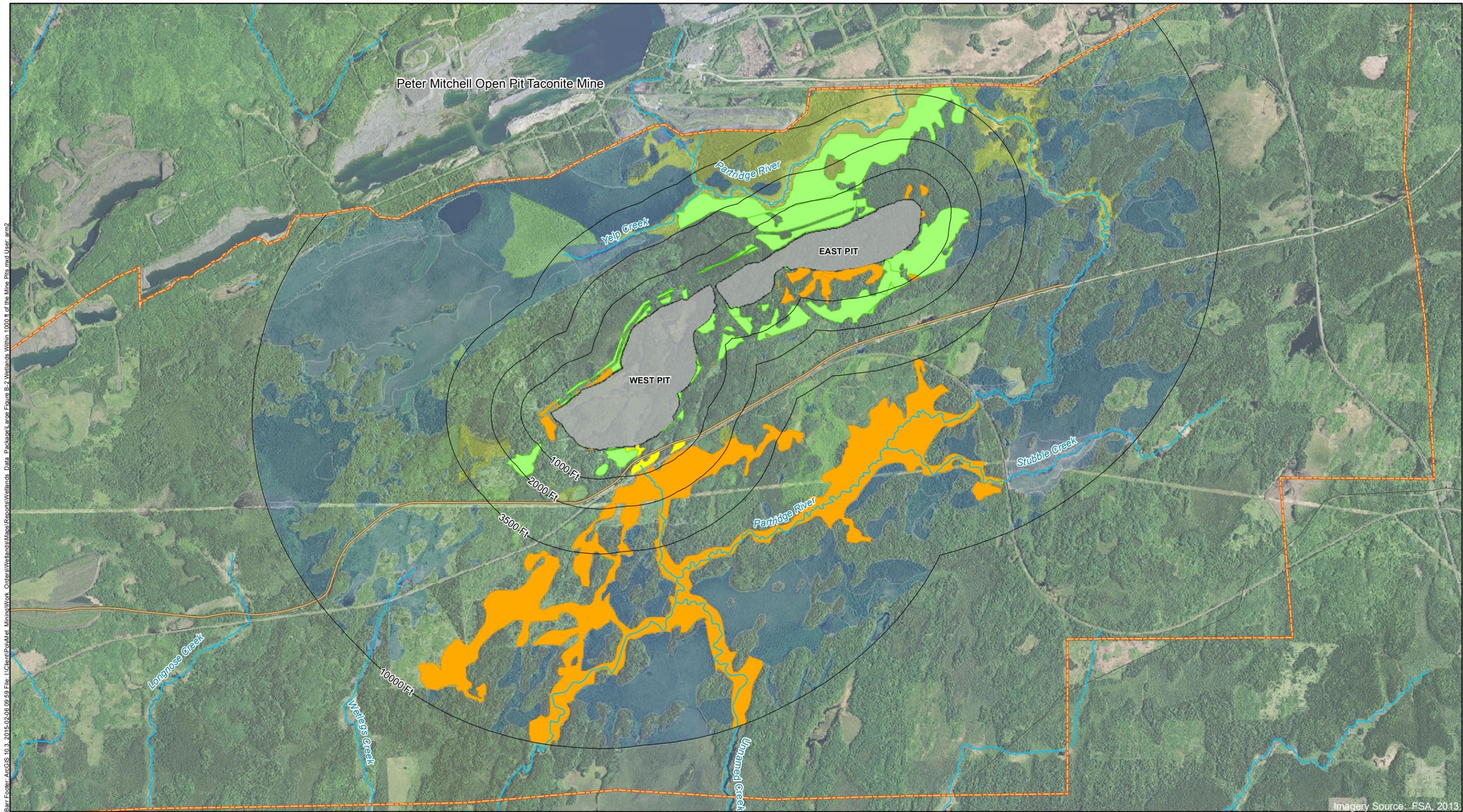
Bar Footer: ArcGIS 10.3, 2015-02-06 09:53 File: L:\Client\PolMet_Minima\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure B-1 Wetlands Within 0-10000 Ft of Edge of Mine Pits.mxd User: am2

Imagery Source: FSA, 2013

- | | |
|---|---|
| Pits - Mine Year 20 | Likelihood of Wetland Hydrology Impact |
| Baseline Type Evaluation Study Area One | High Likelihood |
| Analogue Impact Zones (Feet) | Moderate Likelihood |
| Dunka Road | Low Likelihood |
| Rivers & Streams | No Impact |



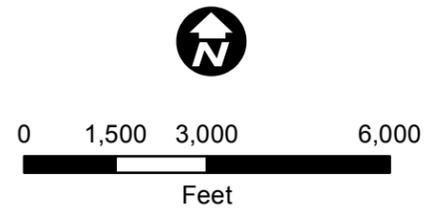
Large Figure B-1
 WETLANDS WITHIN 0 - 10,000 FEET
 OF EDGE OF MINE PITS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota



Bar Footer: ArcGIS 10.3, 2015-02-06 09:59 File: I:\Client\PolMet_Minim\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure B-2 Wetlands Within 1000 ft of the Mine Pits.mxd User: arm2

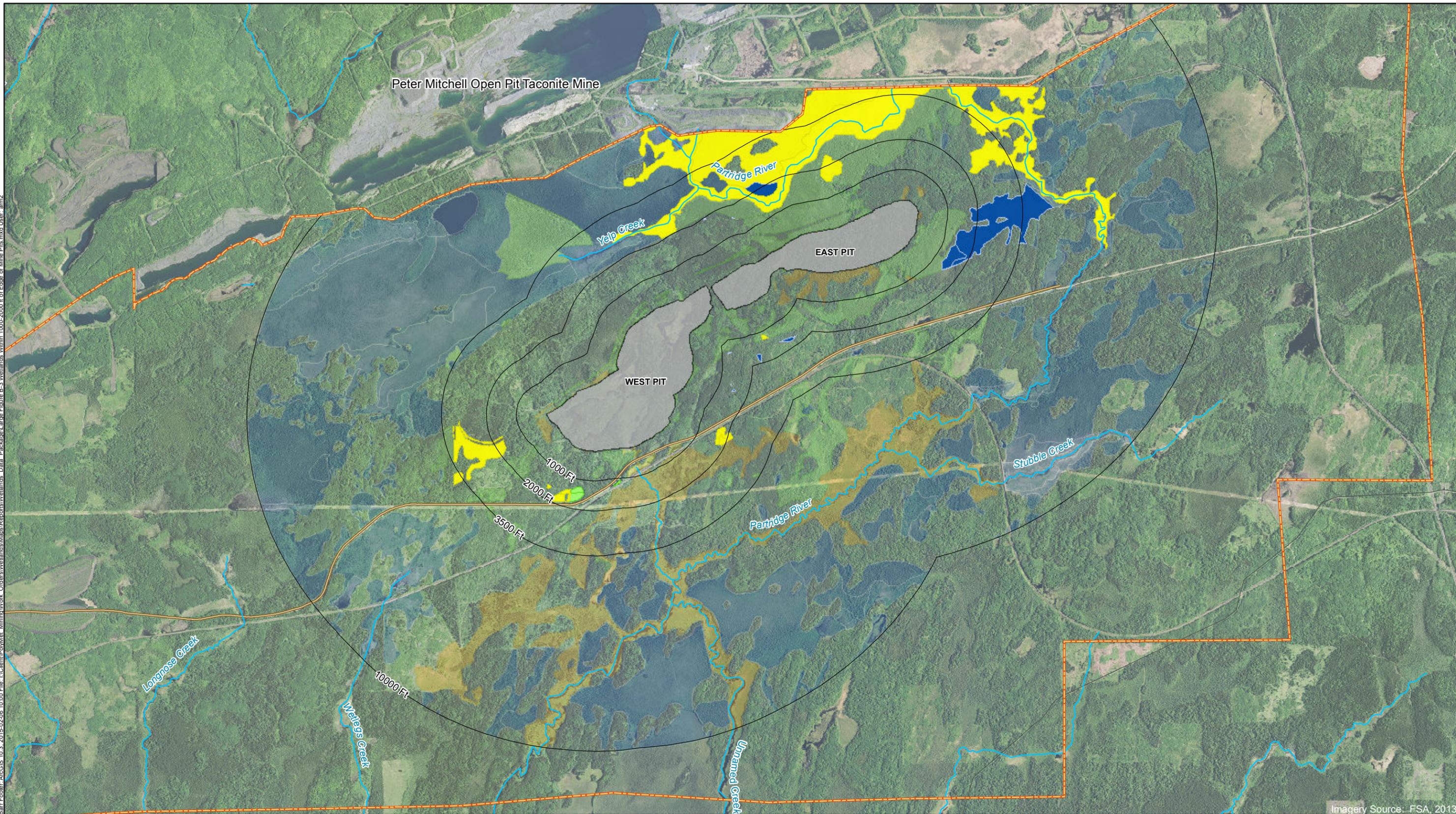
Imagery Source: FSA, 2013

- | | |
|---|---|
| Pits - Mine Year 20 | Likelihood of Wetland Hydrology Impact |
| Baseline Type Evaluation Study Area One | High Likelihood |
| Analogue Impact Zones (Feet) | Moderate Likelihood |
| Dunka Road | Low Likelihood |
| Rivers & Streams | No Impact |



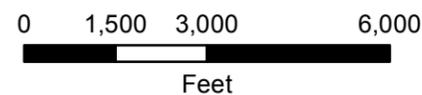
Large Figure B-2
 WETLANDS WITHIN 0 - 1,000 FEET
 OF EDGE OF MINE PITS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Bar Footer: ArcGIS 10.3, 2015-02-06 10:00 File: I:\Client\PolMet_Minima\Work_Orders\Wetlands\Map\Reports\Wetlands_Data_Package\Large Figure B-3 Wetlands Within 1000-2000 ft of Edge of Mine Pits.mxd User: am2

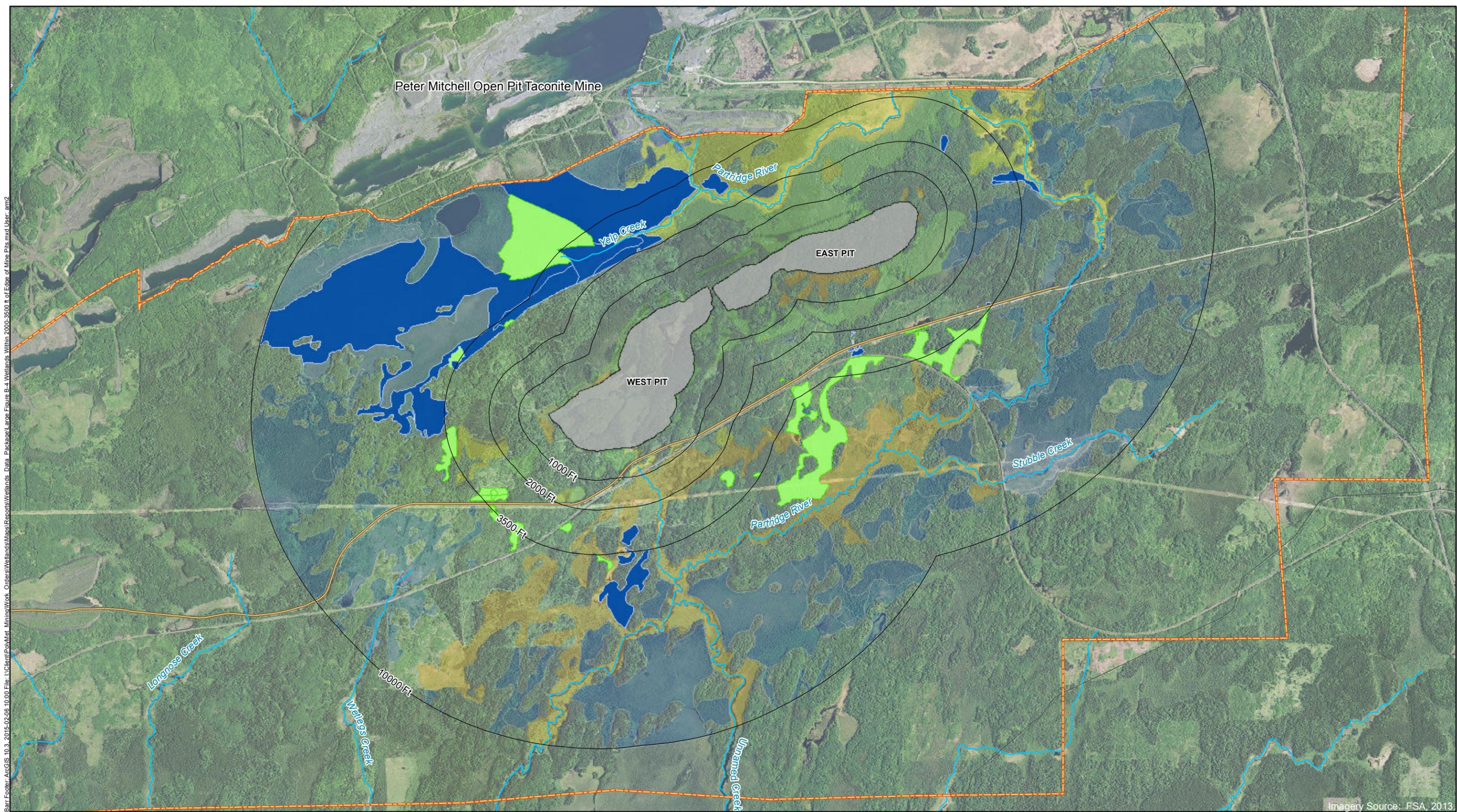


Imagery Source: FSA, 2013

- Pits - Mine Year 20
- Baseline Type Evaluation Study Area One
- Analogue Impact Zones (Feet)
- Moderate Likelihood
- Low Likelihood
- No Impact
- Dunka Road
- Rivers & Streams



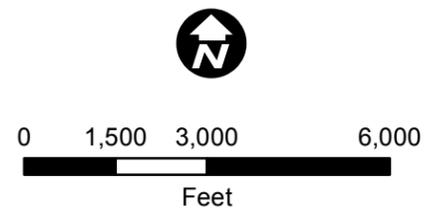
Large Figure B-3
 WETLANDS WITHIN >1,000 - 2,000 FEET
 OF EDGE OF MINE PITS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota



Bar Footer: ArcGIS 10.3, 2015-02-06 10:00 File: I:\Client\PolMet_Minima\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure B-4_Wetlands_Within_2000-3500_Ft_of_Edge_of_Mine_Pits.mxd User: am2

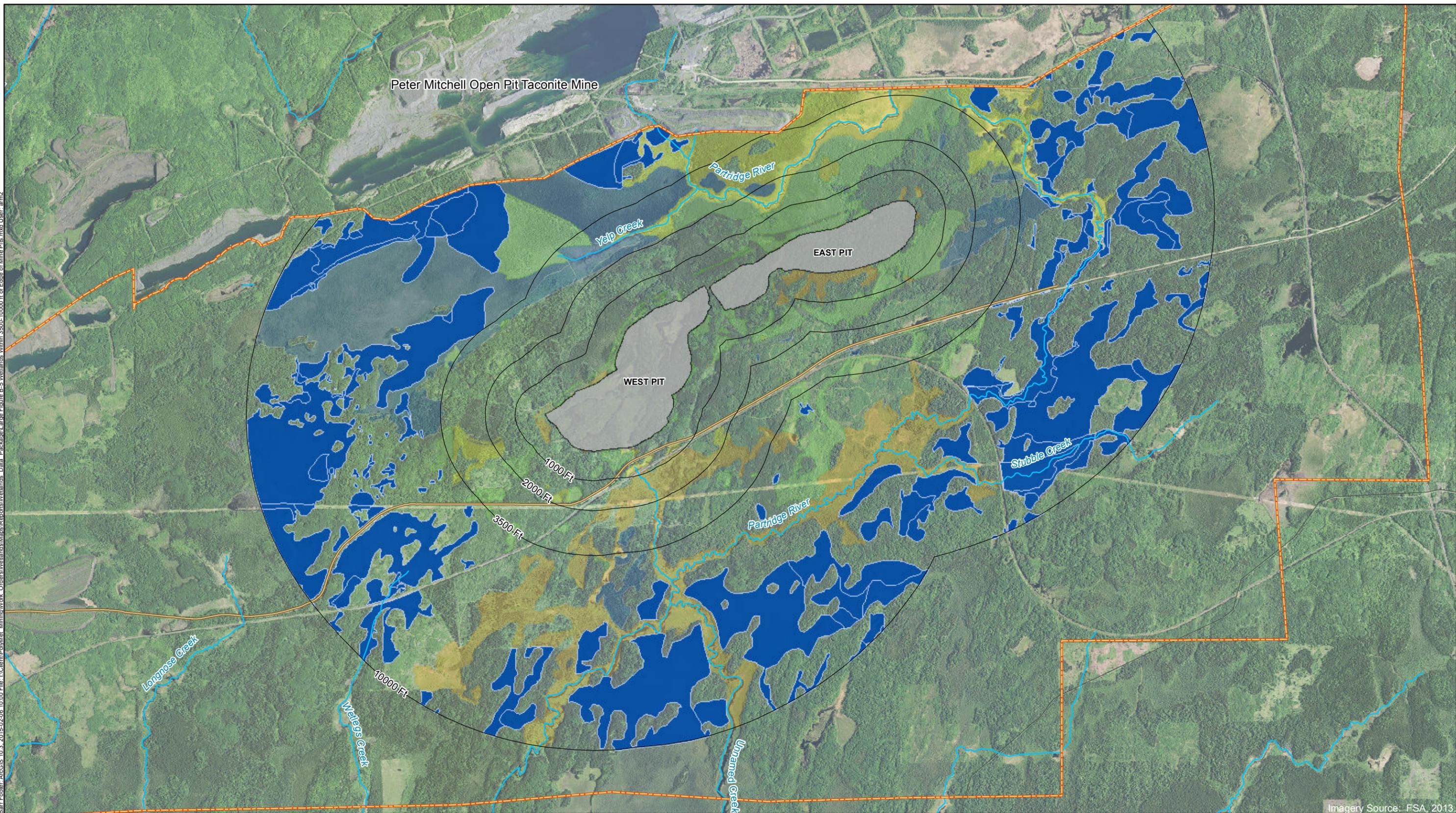
- Pits - Mine Year 20
- Baseline Type Evaluation Study Area One
- Analogue Impact Zones (Feet)
- Dunka Road
- Rivers & Streams

- Likelihood of Wetland Hydrology Impact
- Low Likelihood
 - No Impact



Large Figure B-4
 WETLANDS WITHIN >2,000 - 3,500 FEET
 OF EDGE OF MINE PITS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Bar Footer: ArcGIS 10.3, 2015-02-06 10:00 File: I:\Client\PolMet_Minima\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure B-5 Wetlands Within 3500-10000 ft of Edge of Mine Pits.mxd User: am2

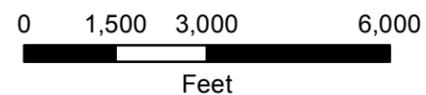


Imagery Source: FSA, 2013

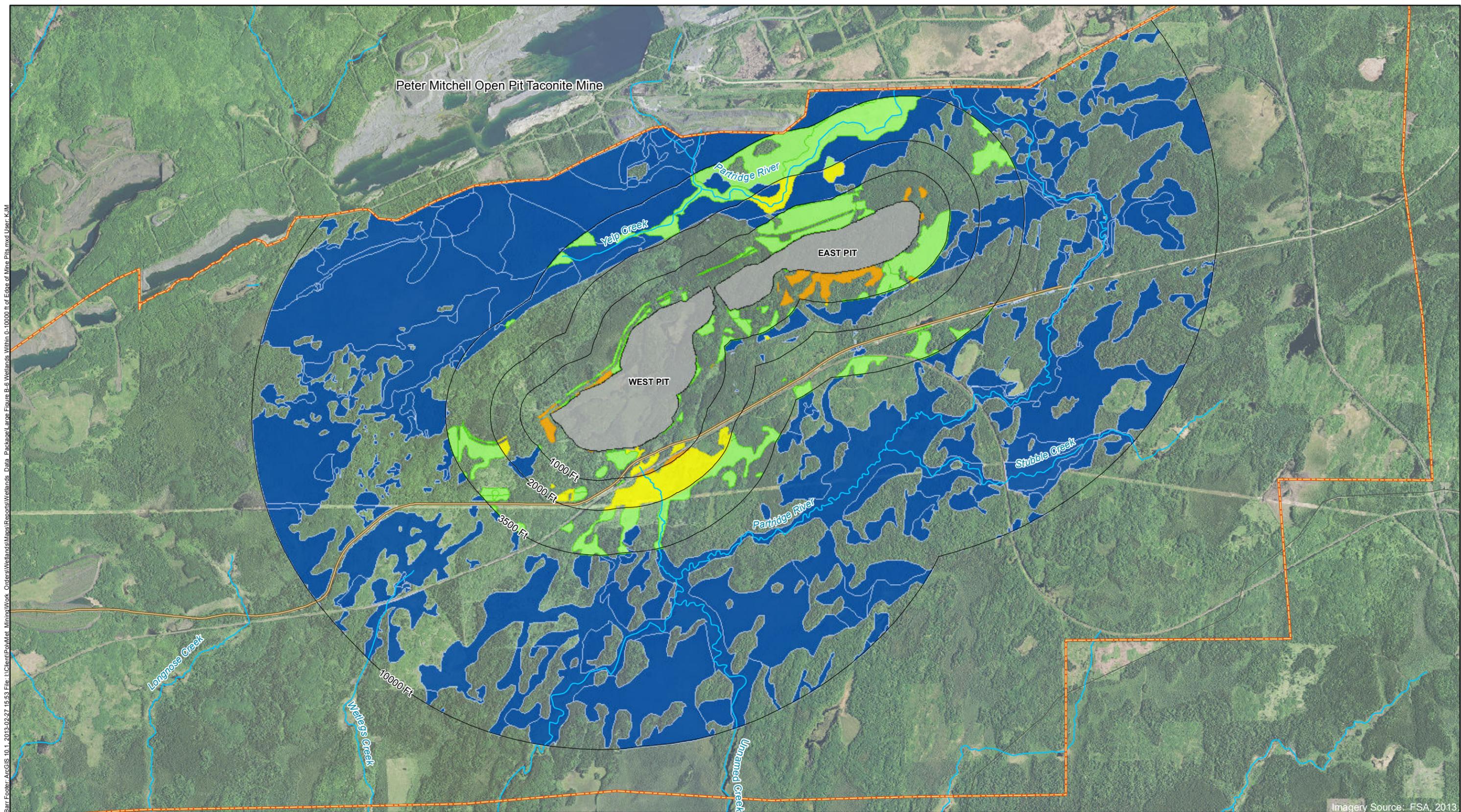
- Pits - Mine Year 20
- Baseline Type Evaluation Study Area One
- Analogue Impact Zones (Feet)
- Dunka Road
- Rivers & Streams

Likelihood of Wetland Hydrology Impact

No Impact



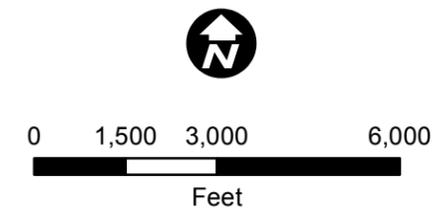
Large Figure B-5
 WETLANDS WITHIN >3,500 - 10,000 FEET
 OF EDGE OF MINE PITS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota



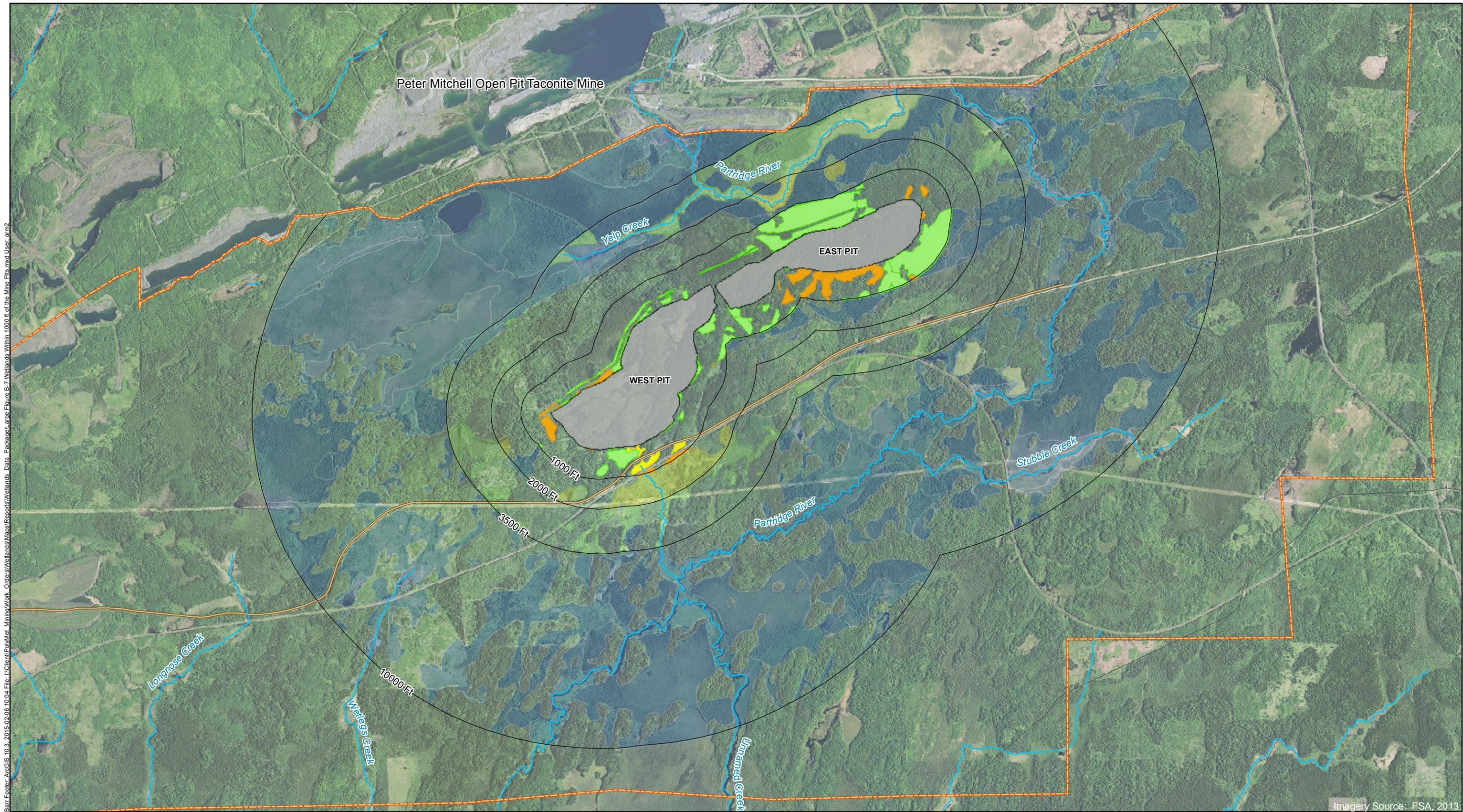
Bar Footer: ArcGIS 10.1, 2013-02-27 15:53 File: L:\Client\PolMet_Minima\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure B-6 Wetlands Within 0-10000 Ft. of Edge of Mine Pits.mxd User: KJM

Imagery Source: FSA, 2013

- | | |
|---|---|
| Pits - Mine Year 20 | Likelihood of Wetland Hydrology Impact |
| Baseline Type Evaluation Study Area One | High Likelihood |
| Analogue Impact Zones (Feet) | Moderate Likelihood |
| Dunka Road | Low Likelihood |
| Rivers & Streams | No Impact |



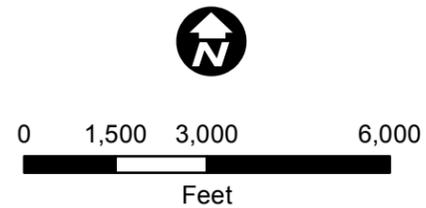
Large Figure B-6
 WETLANDS WITHIN 0 - 10,000 FEET
 OF EDGE OF MINE PITS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota



Bar Footer: ArcGIS 10.3, 2015-02-06 10:04 File: I:\Client\PolMet_Minima\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure B-7 Wetlands Within 1000 ft of the Mine Pits.mxd User: arm2

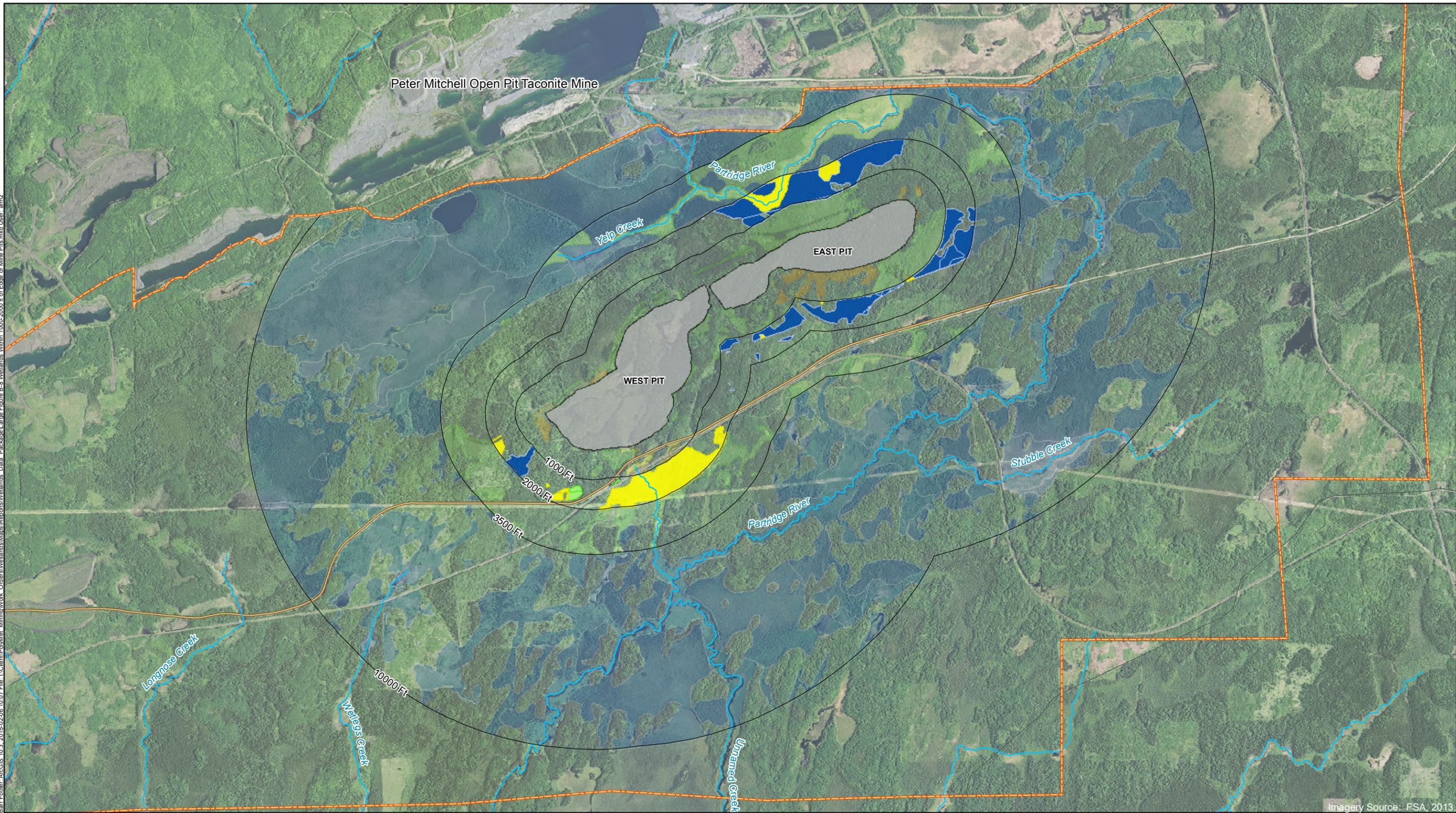
Imagery Source: FSA, 2013

- | | |
|---|---|
| Pits - Mine Year 20 | Likelihood of Wetland Hydrology Impact |
| Baseline Type Evaluation Study Area One | High Likelihood |
| Analogue Impact Zones (Feet) | Moderate Likelihood |
| Dunka Road | Low Likelihood |
| Rivers & Streams | No Impact |



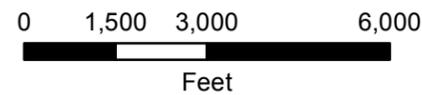
Large Figure B-7
 WETLANDS WITHIN 0 - 1,000 FEET
 OF EDGE OF MINE PITS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Bar Footer: ArcGIS 10.3, 2015-02-06 10:07 File: I:\Client\PolMet_Minima\Work_Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure B-8 Wetlands Within 1000-2000 ft of Edge of Mine Pits.mxd User: am2



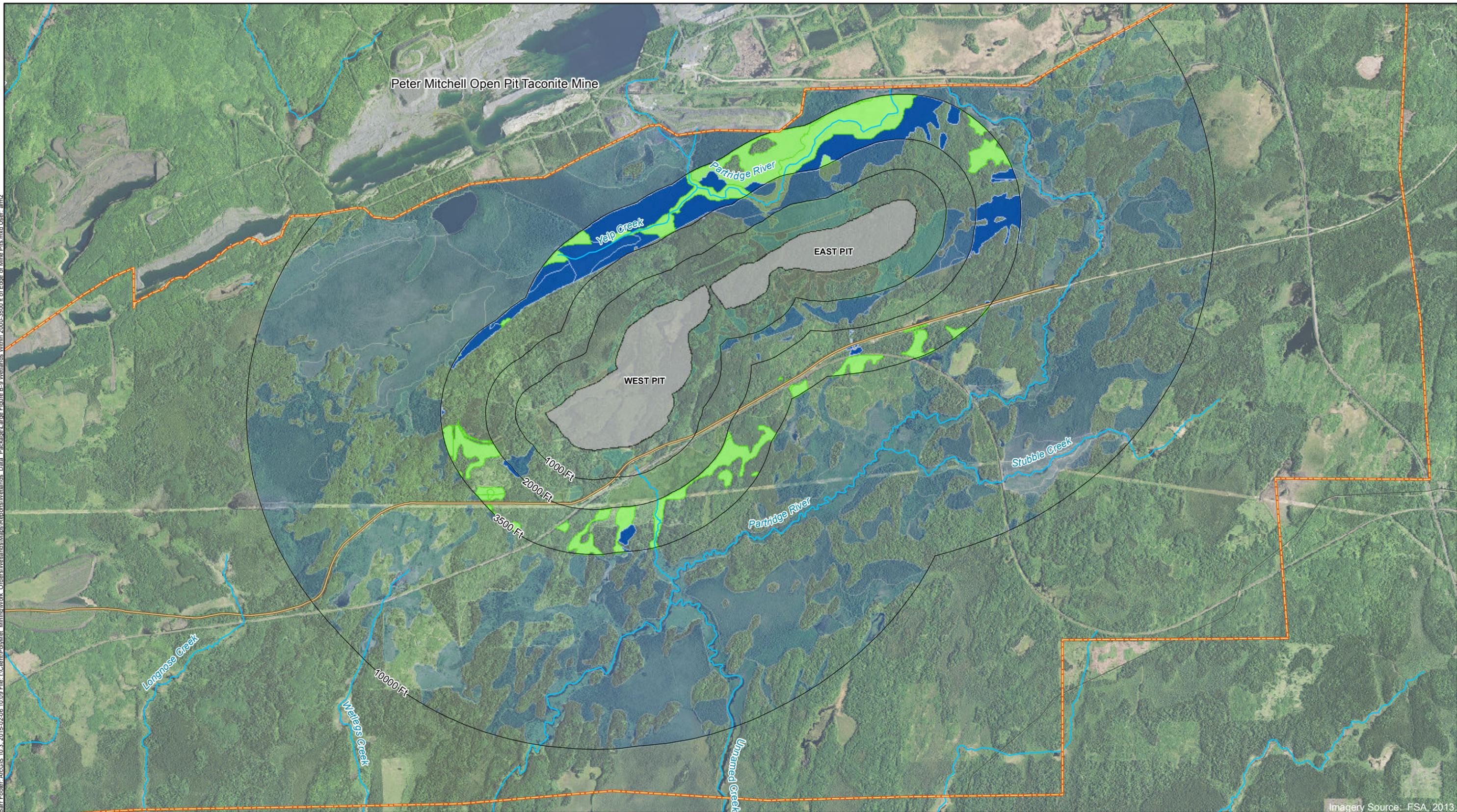
Imagery Source: FSA, 2013

- Pits - Mine Year 20
- Baseline Type Evaluation Study Area One
- Analogue Impact Zones (Feet)
- Moderate Likelihood
- Low Likelihood
- No Impact
- Dunka Road
- Rivers & Streams



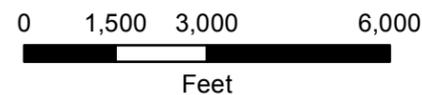
Large Figure B-8
 WETLANDS WITHIN >1,000 - 2,000 FEET
 OF EDGE OF MINE PITS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Bar Footer: ArcGIS 10.3, 2015-02-06 10:09 File: I:\Client\PolMet_Minima\Work Orders\Wetlands\Maps\Reports\Wetlands_Data_Package\Large Figure B-9 Wetlands Within 2000-3500 ft of Edge of Mine Pits.mxd User: am2



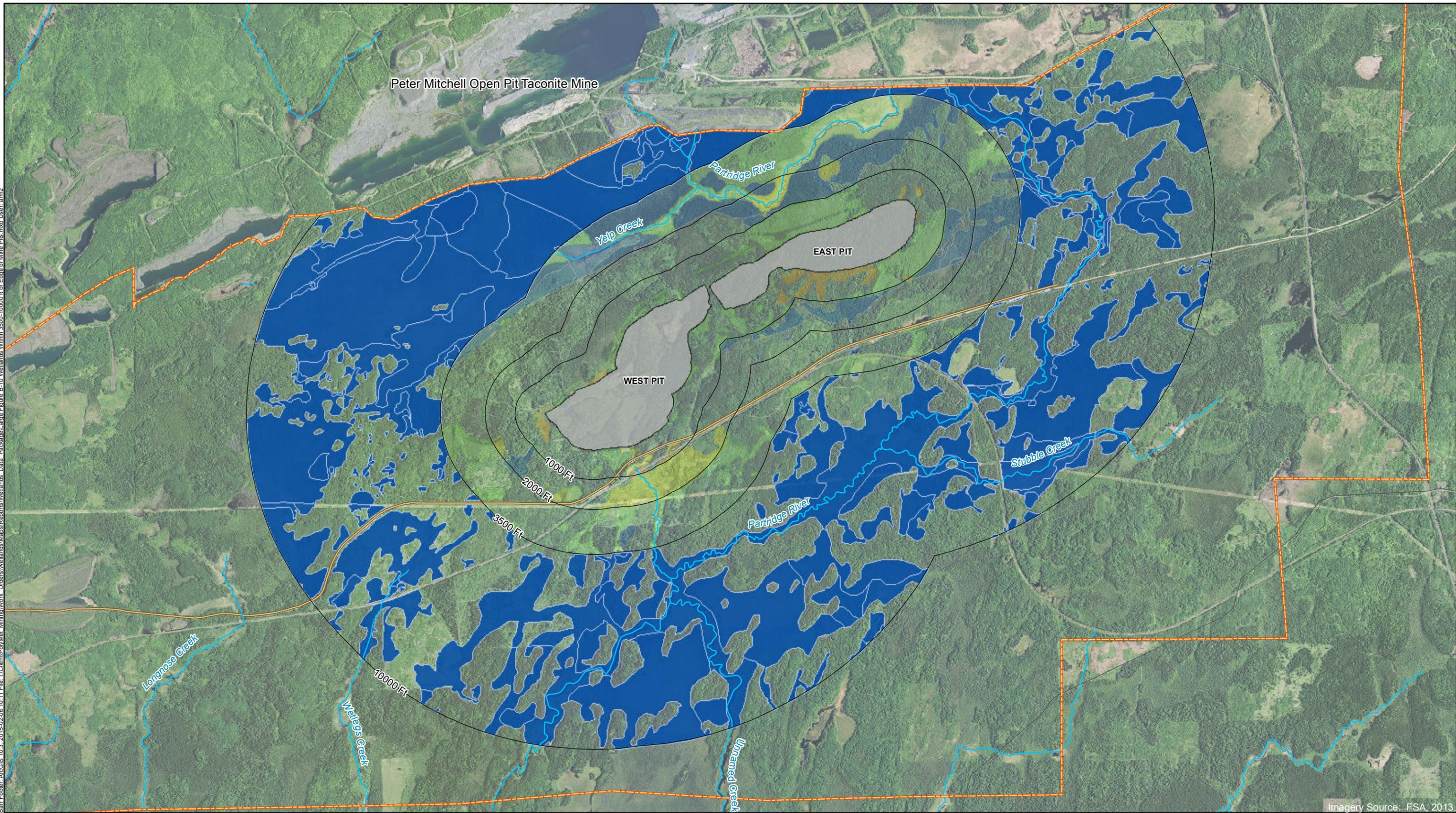
Imagery Source: FSA, 2013

- Pits - Mine Year 20
- Baseline Type Evaluation Study Area One
- Analogue Impact Zones (Feet)
- Dunka Road
- Rivers & Streams
- Likelihood of Wetland Hydrology Impact**
- Low Likelihood
- No Impact



Large Figure B-9
 WETLANDS WITHIN >2,000 - 3,500 FEET
 OF EDGE OF MINE PITS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Bar Footer: ArcGIS 10.3, 2015-02-06 10:11 File: I:\Client\Polymet\Minima\Work Orders\Wetlands\Map\Reports\Wetlands Data Package\Large Figure B-10 Wetlands Within 3500-10000 ft of Edge of Mine Pits.mxd User: amz

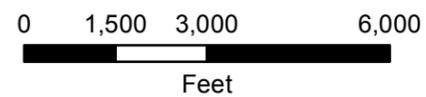


Imagery Source: FSA, 2013

- Pits - Mine Year 20
- Baseline Type Evaluation Study Area One
- Analogue Impact Zones (Feet)
- Dunka Road
- Rivers & Streams

Likelihood of Wetland Hydrology Impact

- No Impact



Large Figure B-10
 WETLANDS WITHIN >3,500 - 10,000 FEET
 OF EDGE OF MINE PITS
 NorthMet Project
 Poly Met Mining Inc.
 Hoyt Lakes, Minnesota

Attachment C

Chemistry of NorthMet Ore, NorthMet Tailings, and LTVSMC Tailings

Table C1-1 Ore and Waste Rock Chemistry Data Used Speciate Dust Deposition

Ore ¹						Category 1 Waste Rock				
Constituent	Center	East	West	Max	99th Percentile	Center	East	West	Max	99th Percentile
	95% UCL	95% UCL	95% UCL	95% UCL		95% UCL	95% UCL	95% UCL	95% UCL	
AS_PPM	18.8	7.84	9.51	18.83	28.1	6.18	5.82	8.48	8.48	13.2
CD_PPM	0.838	0.923	0.814	0.92	2.50	0.513	0.609	0.576	0.61	1.30
CR_PPM	119	124	208	208.46	559	160	178	182	181.85	286
Cu_D	0.286	0.363	0.312	0.36	0.594	0.032	0.0394	0.046	0.0460	0.082
MN_PPM	970	956	911	970.41	1279	846	989	1004	1004.10	1363
Ni_D	0.106	0.0976	0.082	0.11	0.153	0.032	0.0305	0.0343	0.0343	0.056
PB_PPM	9.11	10.6	7.81	10.58	16.8	3.74	5.65	5.33	5.65	12.1
SE_PPM				5.5					8.4	
Sulfur_PPM				9,588.6					n/a	
V_PPM	106	126	96.5	126.29	259	63.8	117	98.2	117.00	168
ZN_PPM	100	104	92.3	104.12	138	80.4	110	86.4	110.17	116
Category 2/3 Waste Rock						Category 4 Waste Rock ²				
Constituent	Center	East	West	Max	99th Percentile	95% UCL	99th Percentile	Max		
	95% UCL	95% UCL	95% UCL	95% UCL						
AS_PPM	7.15	7.10	9.32	9.32	20.8	33.8	86.7			
CD_PPM	0.555	0.708	0.721	0.72	1.60	1.80	3.40			
CR_PPM	130	225	219	224.69	474	159	325			
Cu_D	0.068	0.072	0.100	0.10	0.130	0.0369	0.1290			
MN_PPM	713	1026	964	1025.74	1300	529	1758			
Ni_D	0.033	0.035	0.0362	0.04	0.051	0.0191	0.0470			
PB_PPM	3.25	6.77	6.81	6.81	13.7	12.4	25.1			
SE_PPM				8.38				8.38		
Sulfur_PPM				3,476.5				34,540.0		
V_PPM	49.9	119	124	123.94	280	143	256			
ZN_PPM	73.2	110	83.7	110.08	147	273	555			

PPM = part per million concentration

General Notes:

Values listed are the 95% upper confidence limit (UCL) for the mean for the maximum year in the 20-year projected life of the mine.

Columns labeled "Max Avg." contain the value used in the previous emission inventory submittals for comparison.

95% UCL Values are in PPM except for Cu and Ni which are expressed as percents. Maximum averages are all expressed as PPM (divide by 10,000 to convert PPM to %).

Footnotes:

¹Ore data used in the previous emission inventory submittals was not separated into East and Central pit values.

²Because of the relatively small volume of Category 4 Waste Rock, the statistical analysis was conducted for all data independent of year and pit.

References:

- Geerts, S.D., 1994. Petrography and geochemistry of a platinum group element-bearing mineralized horizon in the Dunka Road prospect (Keweenawan) Duluth Complex northeastern Minnesota: Unpublished M.S. Thesis. University of Minnesota Duluth. 155 p., 8 plates.
- Severson, M.J., 1988. Geology and structure of a portion of the Partridge River intrusion: A progress report: Natural Resources Research Institute, University of Minnesota Duluth, Technical Report, NRR/GMIN-TR-88-08. Duluth, Minnesota. 78 p., 5 plates.
- Severson, M.J., and Hauck, S.A. 1990. Geology, geochemistry, and stratigraphy of a portion of the Partridge River intrusion: Natural Resources Research Institute, University of Minnesota Duluth, Technical Report, NRR/GMIN-TR-89-11. 235 p. 4 plates, 1 diskette.

Table C1-2 Tailings Chemistry Data Used to Speciate Dust Deposition

Metal	Conc. (ppm)	Source	Comments
NorthMet Tailings			
Arsenic	81	2000 Pilot Study [2]	Emission factors calculated from trace metal analysis completed on tailings produced during the pilot study. The results from the -38um fraction was used because this would approximate TSP except when the -10um fraction appeared to produce higher quality data (e.g. lower detection limits). Data for the analysis of the entire tailings size range was also evaluated, but these values were lower, with the exception of boron, and the smaller particle sizes would represent those most likely to become airborne. The data for the entire tailings size range was used for boron, because the size specific data were below the detection limit. With the exception of vanadium, analysis for all of these elements was also performed during the 2005 pilot study. However, the results from 2000 were higher for all elements. 2000 data was used for all elements to be conservative.
Cadmium	0.08	2005/2006 Pilot Study [1]	Emission factor calculated from data obtained during 2005 and 2006 pilot studies. Average value for all parcels calculated. Values below the detection limit assumed to be at the detection limit.
Chromium	310	2000 Pilot Study [2]	Emission factors calculated from trace metal analysis completed on tailings produced during the pilot study. The results from the -38um fraction was used because this would approximate TSP except when the -10um fraction appeared to produce higher quality data (e.g. lower detection limits). Data for the analysis of the entire tailings size range was also evaluated, but these values were lower, with the exception of boron, and the smaller particle sizes would represent those most likely to become airborne. The data for the entire tailings size range was used for boron, because the size specific data were below the detection limit. With the exception of vanadium, analysis for all of these elements was also performed during the 2005 pilot study. However, the results from 2000 were higher for all elements. 2000 data was used for all elements to be conservative.
Copper	547		
Lead	383		
Manganese	1400		
Nickel	510	2000 Pilot Study [2]	Emission factors calculated from trace metal analysis completed on tailings produced during the pilot study. The results from the -38um fraction was used because this would approximate TSP except when the -10um fraction appeared to produce higher quality data (e.g. lower detection limits). Data for the analysis of the entire tailings size range was also evaluated, but these values were lower, with the exception of boron, and the smaller particle sizes would represent those most likely to become airborne. The data for the entire tailings size range was used for boron, because the size specific data were below the detection limit. With the exception of vanadium, analysis for all of these elements was also performed during the 2005 pilot study. However, the results from 2000 were higher for all elements. 2000 data was used for all elements to be conservative.
Selenium	1.2	2005/2006 Pilot Study [1]	Emission factor calculated from data obtained during 2005 and 2006 pilot studies. Average value for all parcels calculated. Values below the detection limit assumed to be at the detection limit.
Sulfur	1,210	Water Modeling Data Package; as of Sept. 04, 2012	1,210 mg S / kg tailings is ~ 0.12% sulfur content.
Zinc	548	2000 Pilot Study [2]	Emission factors calculated from trace metal analysis completed on tailings produced during the pilot study. The results from the -38um fraction was used because this would approximate TSP except when the -10um fraction appeared to produce higher quality data (e.g. lower detection limits). Data for the analysis of the entire tailings size range was also evaluated, but these values were lower, with the exception of boron, and the smaller particle sizes would represent those most likely to become airborne. The data for the entire tailings size range was used for boron, because the size specific data were below the detection limit. With the exception of vanadium, analysis for all of these elements was also performed during the 2005 pilot study. However, the results from 2000 were higher for all elements. 2000 data was used for all elements to be conservative.

Metal	Conc. (ppm)	Source	Comments
			conservative.
Vanadium	210	2000 Pilot Study [2]	Emission factors calculated from trace metal analysis completed on tailings produced during the pilot study. The results from the -38um fraction was used because this would approximate TSP except when the -10um fraction appeared to produce higher quality data (e.g. lower detection limits). Data for the analysis of the entire tailings size range was also evaluated, but these values were lower, with the exception of boron, and the smaller particle sizes would represent those most likely to become airborne. The data for the entire tailings size range was used for boron, because the size specific data were below the detection limit. With the exception of vanadium, analysis for all of these elements was also performed during the 2005 pilot study. However, the results from 2000 were higher for all elements. 2000 data was used for all elements to be conservative.
LTVSMC Tailings Chemistry			
Arsenic	24.6	Waste water modeling report [3]	
Cadmium	0.25	Waste water modeling report [3]	Result reports as < 0.5
Chromium	66.8	Waste water modeling report [3]	
Copper	12.6	Waste water modeling report [3]	
Lead	5.6	Waste water modeling report [3]	
Manganese	4880	Waste water modeling report [3]	
Nickel	4	Waste water modeling report [3]	
Selenium	1.2	NorthMet Data	Data not available for LTVSMC tailings.
Sulfur	1,210	Water Modeling Data Package; as of Sept. 04, 2012	1,210 mg S / kg tailings is ~ 0.12% sulfur content. Sulfur content of NorthMet tailings assumed to the sulfur content of the LTVSMC tailings.
Zinc	15.8	Waste water modeling report [3]	
Vanadium	10.4	LTVSMC tailings data (Aqua Regia tests)	Data submitted to the MDNR in June 2011 via email from P.Hinck (Barr) to M.Olson (MDNR).

[1] Barr Engineering Co. May 2006. Environmental Sampling and Analysis Flotation Process Liquids and Solids Sampling Results Pilot Test – NorthMet Deposit PolyMet Mining, Inc. Table 9 and Barr Engineering Co. July 2006. Draft - Environmental Sampling and Analysis Flotation Process Optimization Test. Table 5.

[2] SGS Lakefield Research Limited. Flotation Pilot Plant Products Environmental Investigation and Air Testing from NorthMet Samples. June 30, 2004. LR10054-003 Progress Report No. 6, Tables B-6 and B-1.

[3] Barr Engineering Co. July 20, 2007. Waste Water Modeling – Tailings; NorthMet Project. Table 5-1 and supporting data set.'

Attachment D

Adjustment of Background Metal Deposition

ATTACHMENT D

Adjustment of Background Metal Deposition

The authors estimated that precipitation was under-estimated by 45% to 70%. An initial review of data (comparison of dry deposition and wet deposition as a percent of total deposition) indicates wet deposition is less than 50% of total deposition for the metals, except selenium (Table C2-1). Wet deposition in rural areas should account for 50% or more of the total deposition. For the Eagle Harbor data, the deposition estimates are considered to be skewed toward dry deposition (except for selenium)

Table D2-1 Comparing Wet Deposition and Dry Deposition to Total Deposition for the Eagle Harbor, Michigan Monitoring Site (Data as reported from Sweet et al. (1998)).

Metal	Dry Deposition	Wet Deposition	Total (wet+dry)	Dry Deposition as a % of Total	Wet Deposition as a % of Total	Comments
	µg/m ² /yr	µg/m ² /yr	µg/m ² /yr			
Vanadium	260	78	338	77%	23%	Wet dep % is low
Chromium	130	78	208	63%	38%	Wet dep % is low
Manganese	1,900	2,300	4,200	45%	55%	
Nickel	570	230	800	71%	29%	Wet dep % is low
Copper	2,400	700	3,100	77%	23%	Wet dep % is low
Zinc	5,300	3,500	8,800	60%	40%	Wet dep % is low
Arsenic	91	78	169	54%	46%	Wet dep % is low
Selenium	52	520	572	9%	91%	
Cadmium	380	78	458	83%	17%	Wet dep % is low
Lead (Pb)	920	550	1,470	63%	37%	Wet dep % is low

µg/m²/yr = micrograms per square meter per year

Because Sweet et al. (1998) indicated that precipitation was under-collected by 45% to 70%, the wet deposition component of their data was adjusted. The mid-range of the under-collection (60%) was used to adjust estimated wet deposition. A factor of 1.6 was applied to the wet deposition reported by Sweet et al. (1998). The adjusted wet deposition was added to the estimated dry deposition reported by Sweet et al. (1998) to derive an “adjusted total deposition” (Table C2-2). The adjusted total deposition from Table C2-2 was used for comparison to the respective modeled metal deposition rates for the Mine Site and Flotation Tailings Basin.

However, no adjustment to the selenium wet deposition was made because wet deposition was already accounting for 91% of the total deposition.

Even with the adjustment in wet deposition by a factor of 1.6, the adjusted wet deposition for most metals is less than 50% of total deposition.

Table D2-2 Summary Table of Adjustments in Background Metal Deposition Due to the Under-Collection of Precipitation at the Eagle Harbor, Michigan Monitoring Site (reported data from Sweet et al. 1998.)

Metal	Reported Dry Deposition [1]	Reported Wet Deposition [1]	Adjusted Wet Deposition [2]	Adjusted Total (Dry + Adjusted Wet) [3]	Dry Deposition as a % of Adjusted Total	Adjusted Wet Deposition as a % of Adjusted Total
	µg/m ² /yr	µg/m ² /yr	µg/m ² /yr	µg/m ² /yr		
Vanadium	260	78	125	385	68%	32%
Chromium	130	78	125	255	51%	49%
Manganese	1,900	2,300	3,680	5,580	34%	66%
Nickel	570	230	368	938	61%	39%
Copper	2,400	700	1,120	3,520	68%	32%
Zinc	5,300	3,500	5,600	10,900	49%	51%
Arsenic	91	78	125	216	42%	58%
Selenium	52	520	520 [4]	572 [4]	91% [4]	9% [4]
Cadmium	380	78	125	505	75%	25%
Lead (Pb)	920	550	880	1,800	51%	49%

µg/m²/yr = micrograms per square meter per year

[1] Deposition as reported by Sweet et al. (1998).

[2] Adjusted Wet Deposition = Reported Deposition x 1.6

[3] Adjusted Total Deposition = Reported Dry Deposition + Adjusted Wet Deposition

[4] Selenium wet deposition and total deposition were not adjusted for under-collection of precipitation.

Adjustment in total deposition compared to the deposition reported by Sweet et al. (1998) is summarized in Table C2-3. Overall, the adjustment in wet deposition by a factor of 1.6 (60% increase) results in relatively small increases in total deposition. Because dry deposition is the major component of the total deposition, the adjustment in the wet deposition for under-collection of precipitation does not change the total deposition appreciably and for most of the metals wet deposition is still the smaller component of the total deposition (Table C2-2).

Table D2-3. Change in estimated total deposition from the values originally reported by Sweet et al (1998)

	Initial Data: From Sweet et al. (1998)					
Metal	Reported Dry Deposition	Reported Wet Deposition	Reported Total Deposition (wet + dry)	Adjusted Wet Deposition	Adjusted Total Deposition (adjusted wet + dry)	% Change in Total Deposition (Adjusted Total - Reported Total)/Reported Total
	$\mu\text{g}/\text{m}^2/\text{yr}$	$\mu\text{g}/\text{m}^2/\text{yr}$	$\mu\text{g}/\text{m}^2/\text{yr}$	$\mu\text{g}/\text{m}^2/\text{yr}$	$\mu\text{g}/\text{m}^2/\text{yr}$	%
Vanadium	260	78	338	125	385	14%
Chromium	130	78	208	125	255	23%
Manganese	1,900	2,300	4,200	3,680	5,580	33%
Nickel	570	230	800	368	938	17%
Copper	2,400	700	3,100	1,120	3,520	14%
Zinc	5,300	3,500	8,800	5,600	10,900	24%
Arsenic	91	78	169	125	216	28%
Selenium	52	520	572			
Cadmium	380	78	458	125	505	10%
Lead (Pb)	920	550	1,470	880	1,800	22%

Memorandum

To: Project File
From: Peter Hinck
Subject: NorthMet Mine Site to Plant Site rail impacts modeling
Date: December 21, 2012
Project: 23690862.00

This memorandum documents the water quality modeling assumptions and methods used to estimate the potential indirect impacts to wetlands along the Mine Site to Plant Site rail corridor. The basis for this analysis is described in the Wetland Analysis Work Plan (Reference [1], Section 4.3.2).

Conceptual model

As discussed in Reference [1], the goal of this analysis is to estimate the quality of water contacting spilled ore material along the rail corridor. If the resulting water quality (at Point 1 in Figure 1 below) is found to have a greater than 10 percent likelihood of exceeding surface water quality standards, this analysis seeks to determine the unit area needed (dimension X in Figure 1) to provide sufficient precipitation to dilute the water to meet water quality standards (at Point 2 in Figure 1).

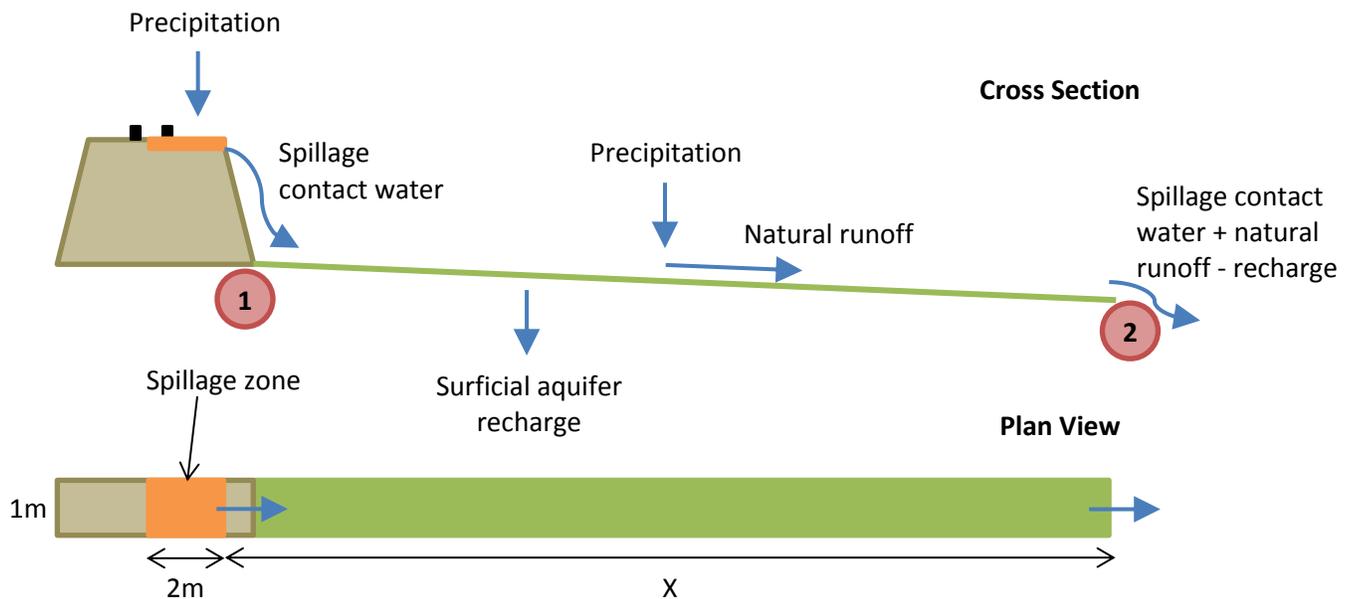


Figure 1 Rail spillage conceptual model schematic

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This modeling was performed using a probabilistic simulation in the GoldSim software, similar to the water quality modeling for the Mine Site. The model was run at a monthly timestep for 100 years, with 500 realizations performed using the GoldSim Monte Carlo simulation package.

Model input parameters

The list below includes all of the input parameters used in this modeling and their references. Any adjustments from the referenced methods or values are documented here.

Geochemical Parameters

- Width of spillage zone: 2 meters on both sides of the centerline of the railway (total width = 4 meters) (Reference [1], Section 4.3.2)
- Mass of spilled ore: 2.14 kg/m² at the end of 20 years, assumed to accumulate linearly from zero mass at time zero (Reference [1], Section 4.3.2)
- Humidity cell release rates: As defined for “ore composites” (Reference [2], Section 8.1)
- Water contact factor: 1.0, assumed complete rinsing (Reference [2], Section 8.4.3)
- Particle size factor: 1.0, assumed particle size distribution identical to humidity cells (Reference [2], Section 8.4.3)
- Temperature factor: uncertainty in annual field temperature and activation energy (Reference [2], Section 8.2.4)
- Acidification: uncertainty in acidification factor and time to acidification, time to acidification assumed to be scaled by the temperature factor (Reference [2], Sections 8.2.5 and 9.4)
- Concentration caps: uncertainty in nonacidic and acidic concentration caps for Duluth Complex Category 2/3/4 waste rock and ore (Reference [2], Sections 8.3.1.6 and 8.3.3)
- Depletion: mass of constituents per unit ore (Reference [2], Sections 8.4.1)

Hydrology Parameters

- Annual and monthly precipitation: uncertainty in annual precipitation (Reference [3], Section 5.2)
- Contact water from spilled ore: uniform range from 40% to 60% of annual precipitation (Reference [3], Section 6.1.3.4.2)
- Runoff from natural areas: uncertainty in summer and winter runoff as a percent of precipitation (Reference [3], Section 6.1.3.3.2)
- Annual surficial aquifer recharge: uniform range from 0.36 to 1.8 inches per year (Reference [3], Section 5.4.1.2)

Water Quality Parameters

- Background runoff water quality: uncertainty in mean runoff concentrations, calibrated to the Partridge River watershed (Reference [3], Section 5.3.2)
- Surface water quality standards: standards applicable to the Partridge River, 100 mg/L hardness assumed for hardness-based standards (Reference [3], Section 2.2)

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Additional modeling assumptions and methods

Constituent release from the spilled ore was modeled using release rates derived from ore composite humidity cells as well as from total metal content to total sulfur ratios from tests on core samples of ore rock (Reference [2], Section 8.1). Sulfate release was modeled using the linear regression to sulfur content developed from humidity cells at a range of sulfur contents (Reference [2], Section 8.1.1). The sulfur content used in this calculation was the currently-modeled sulfur content, with the result that sulfate release rates decrease as the remaining sulfur content decreases in the model. For metals with release rates based on metal to sulfur ratios, this method results in a corresponding decrease in metal release rates.

The water balance for the both the spillage zone and the natural runoff zone was modeled with consideration of the effects of snowmelt. Precipitation during the months of November through March is assumed to be stored on the landscape as snow. The accumulated snow is released as a one-month flow during the month of April. This method reduces the potential for unrealistically high concentrations due to low flows in the winter months, when in reality any water will be frozen in ice and snow.

The defined runoff or contact water from the spillage zone is assumed to be completely mixed with the runoff from natural areas. The only loss of water (and dissolved constituent mass) from this system prior to evaluation of standards compliance is due to recharge into the surficial aquifer. The recharge lost from the system is assumed to flow at the same rate both beneath the ore spillage zone (contact water concentration) and within the natural areas (mixed contact and natural runoff water concentration).

The modeled concentrations of all constituents were compared to surface water quality standards at each timestep during the 100-year simulation at both the edge of the spillage zone (Point 1 in Figure 1) and at the downstream edge of the mixing zone (Point 2 in Figure 1). For every timestep the fraction of the 500 realizations with recorded exceedances of the water quality standards was computed and compared to the stated goal of a less than 10% likelihood of exceeding a standard. For example, if at model time 20.5 years the concentration of copper was above the water quality standard in 75 of the 500 realizations, the simulation would have a 15% (75/500) likelihood of an exceedance and would fail the 10% goal. The model was run multiple times with varying lengths of the dilution zone (dimension X in Figure 1) until the 10% goal was met for all constituents in all timesteps.

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Results

For the majority of the modeled constituents, concentrations are expected to be well below the applicable surface water quality standards at the edge of the spillage zone. No additional dilution from unimpacted surface runoff is necessary, and there is little or no potential for indirect impacts to adjacent wetlands.

Four constituents have modeled concentrations at the edge of the spillage zone that have a greater than 10% likelihood of exceeding surface water quality standards: aluminum, cobalt, copper and nickel. The modeled water quality in the spillage contact water is shown for each of these constituents in Figure 2 through Figure 5; sulfate concentrations are also included for reference in Figure 6.

Background surface runoff has an approximately 20% likelihood of exceeding the water quality standard for aluminum, so no amount of dilution is possible to meet the goal of less than 10% likelihood of exceeding the standard. Therefore aluminum was not carried forward for additional analysis.

For cobalt, the likelihood of exceeding the surface water quality standard at the edge of the seepage zone is a maximum of approximately 90%. Using successive runs of the water quality model it was estimated that 2.5 meters (perpendicular to the rail line) of additional natural background runoff is necessary to reduce the likelihood of exceeding the standard to below 10%. Figure 7 shows the modeled cobalt concentrations at the downstream edge of a 2.5-meter buffer. Figure 8 shows the likelihood of exceedance for cobalt through time for both the edge of the seepage zone (purple line) and at the edge of a 2.5-meter buffer (green line).

For nickel, exceedances of the surface water quality standard at the edge of the seepage zone occurred in all model realizations for a period of about 30 years. Compared to cobalt, a longer buffer of an unimpacted runoff zone is necessary in order to dilute nickel concentrations to below the standard; the required distance is estimated as 30 meters (perpendicular to the rail line) for nickel. Figure 9 shows the modeled nickel concentrations at the downstream edge of a 30-meter buffer. Figure 10 shows the likelihood of exceedance for nickel through time for both the edge of the seepage zone (purple line) and at the edge of a 30-meter buffer (green line).

For copper, the modeled water quality at the edge of the seepage zone is consistently above the surface water quality standard until copper depletion begins to occur after about 40 years. Copper requires the longest buffer of an unimpacted runoff zone in order to have a less than 10% likelihood of exceeding the

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standard; the required distance is estimated as 675 meters (perpendicular to the rail line). Figure 11 shows the modeled copper concentrations at the downstream edge of a 675-meter buffer. Figure 12 shows the likelihood of exceedance for copper through time for both the edge of the seepage zone (purple line) and at the edge of a 30-meter buffer (green line).

Recommendations

Based on this analysis, it is recommended that wetlands with watersheds that contain less than 675 m² of unimpacted areas per meter of rail (one-sided) within the watershed be identified as potentially indirectly impacted due to water quality changes. Wetlands that are physically near the rail corridor but are not hydraulically connected to the rail line (i.e. no rail spillage areas are within the wetland's watershed) should not be considered to be indirectly impacted due to rail spillage effects.

References

- [1] NorthMet Project Wetland Analysis Work Plan. Version 3, October 2011.
- [2] NorthMet Project Waste Characterization Data Package. Version 9, July 2012.
- [3] NorthMet Project Water Modeling Data Package – Volume 1 (Mine Site). Version 10, July 2012.

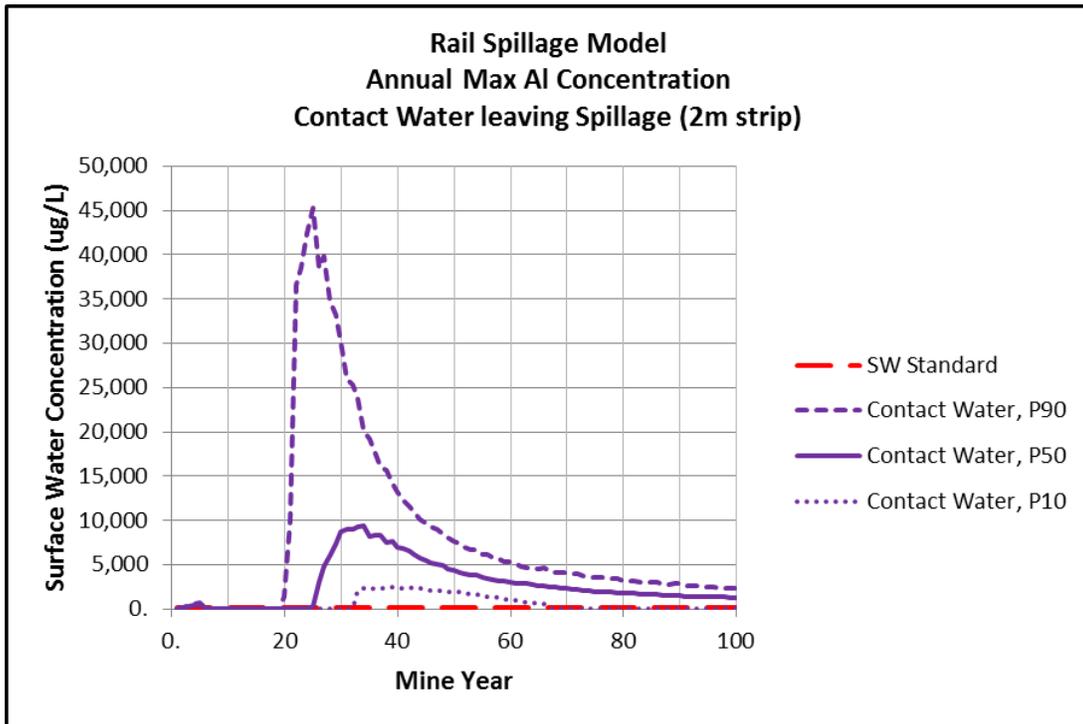


Figure 2 Aluminum concentrations at the edge of the spillage zone

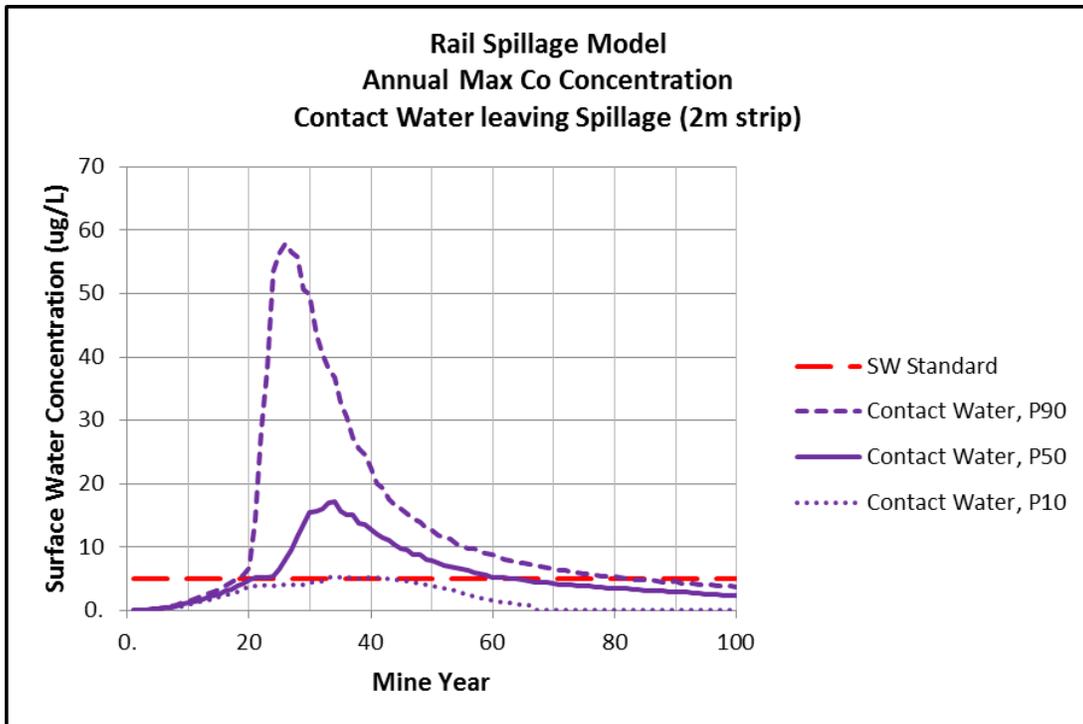


Figure 3 Cobalt concentrations at the edge of the spillage zone

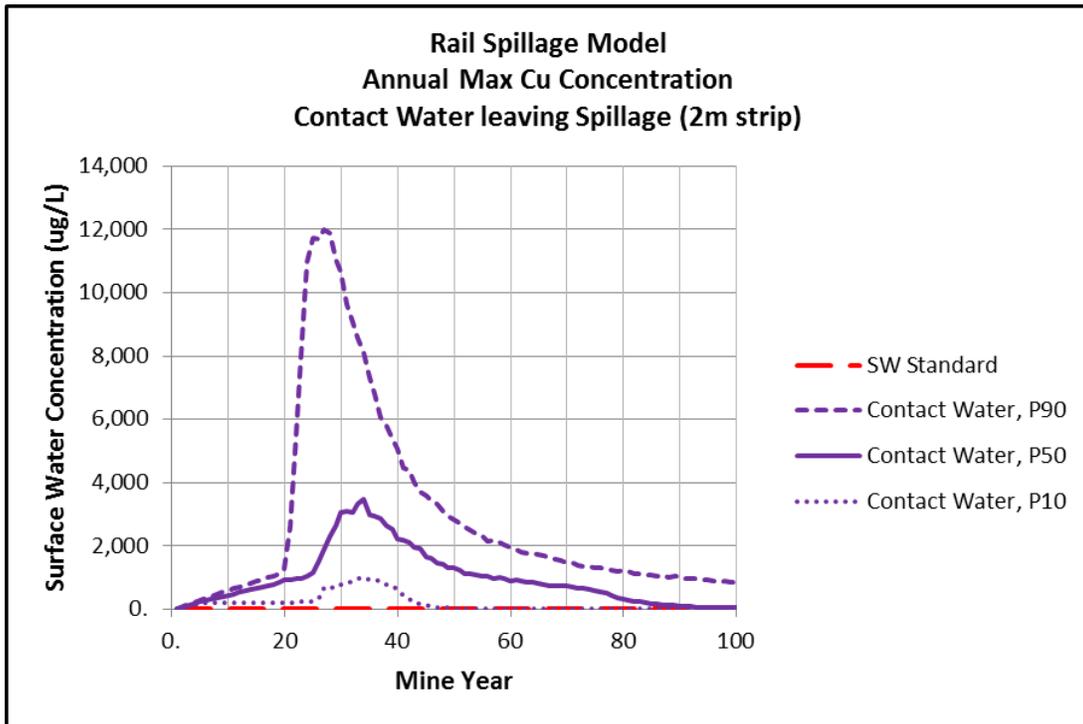


Figure 4 Copper concentrations at the edge of the spillage zone

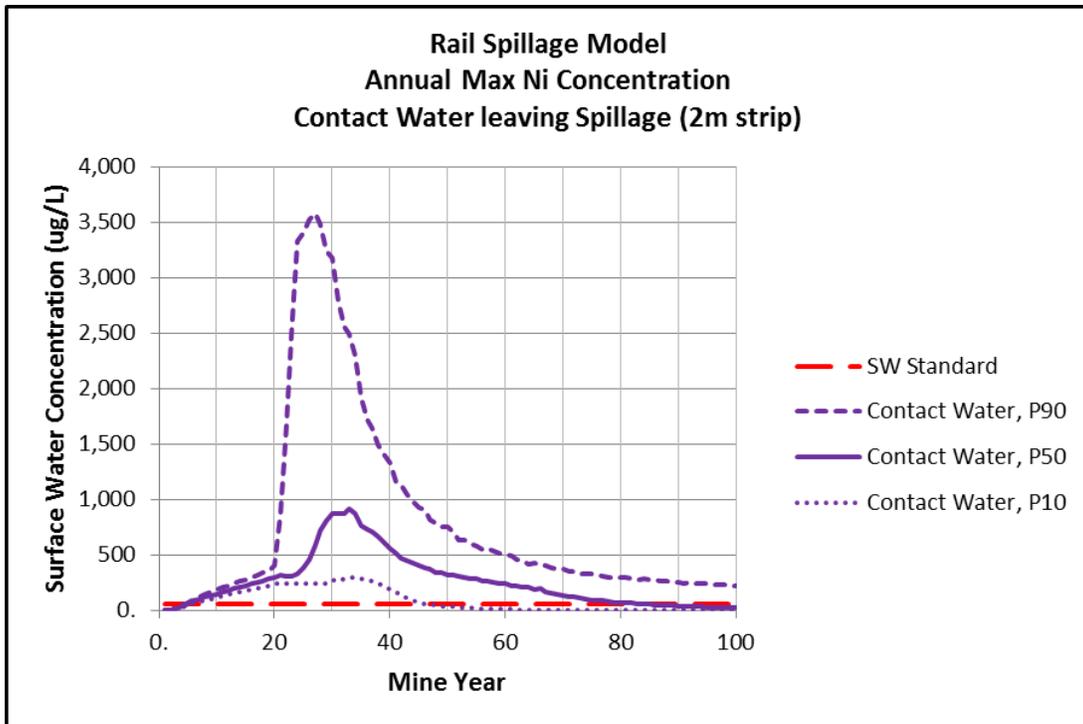


Figure 5 Nickel concentrations at the edge of the spillage zone

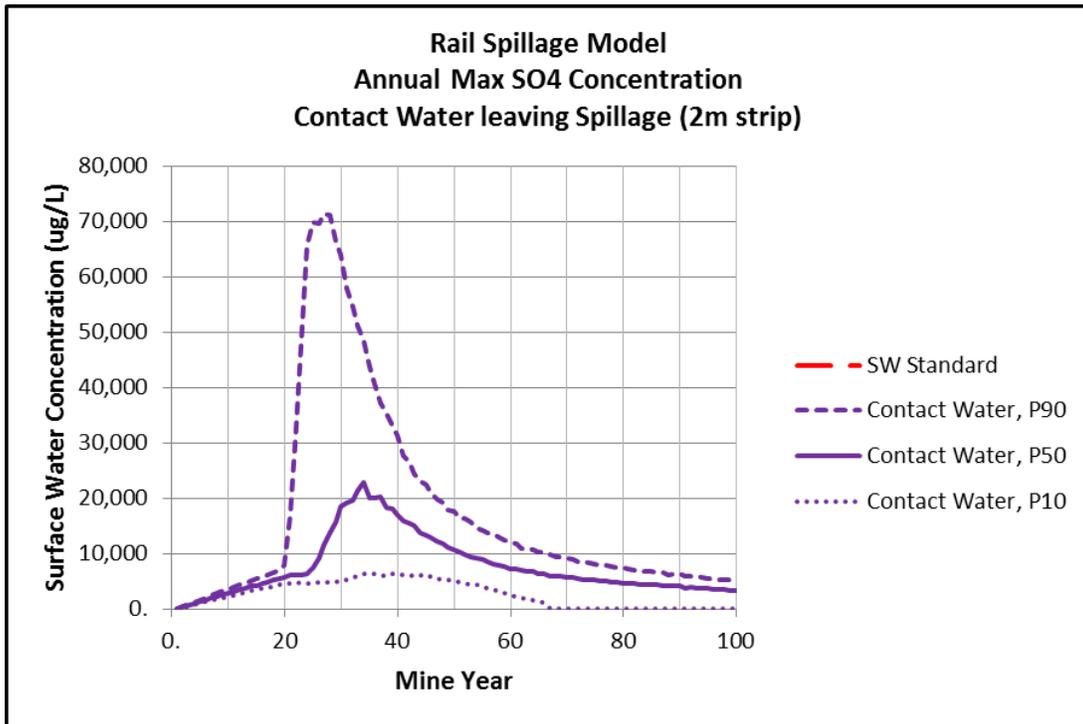


Figure 6 Sulfate concentrations at the edge of the spillage zone

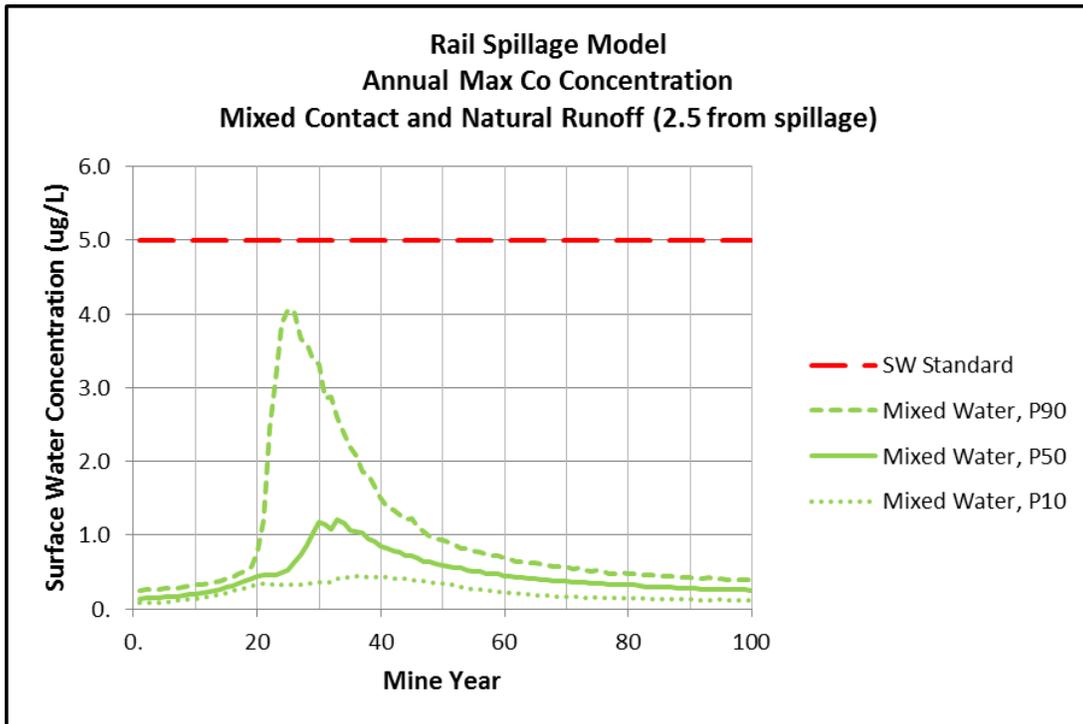


Figure 7 Cobalt concentrations at the edge of a 2.5-m buffer

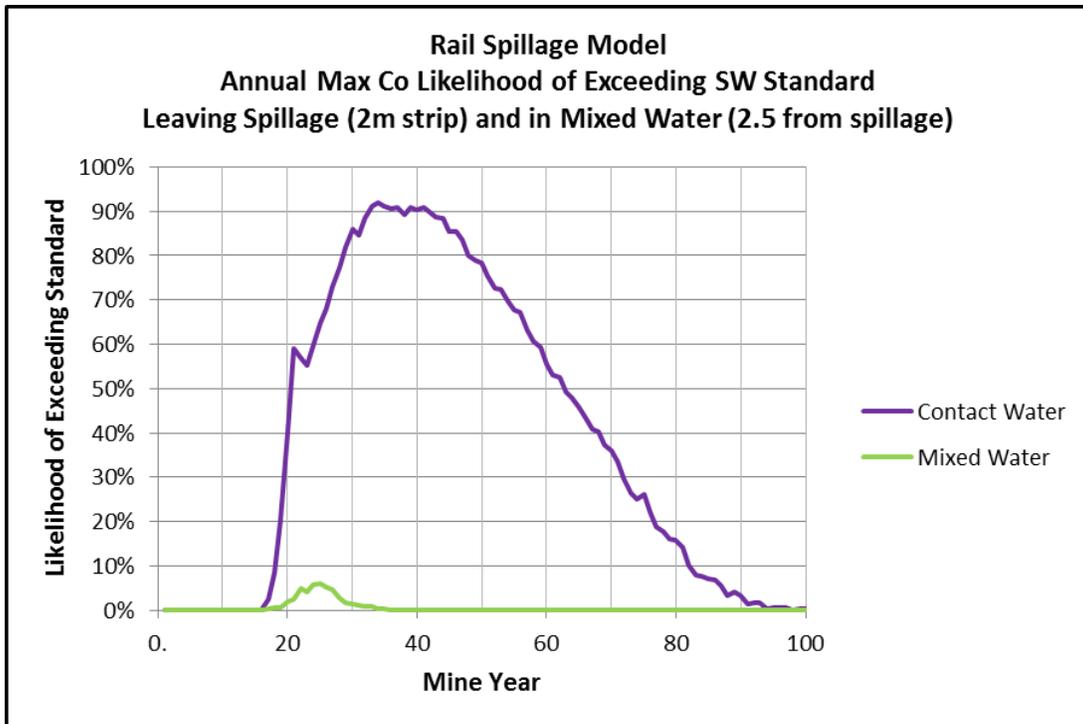


Figure 8 Cobalt likelihood of exceedance

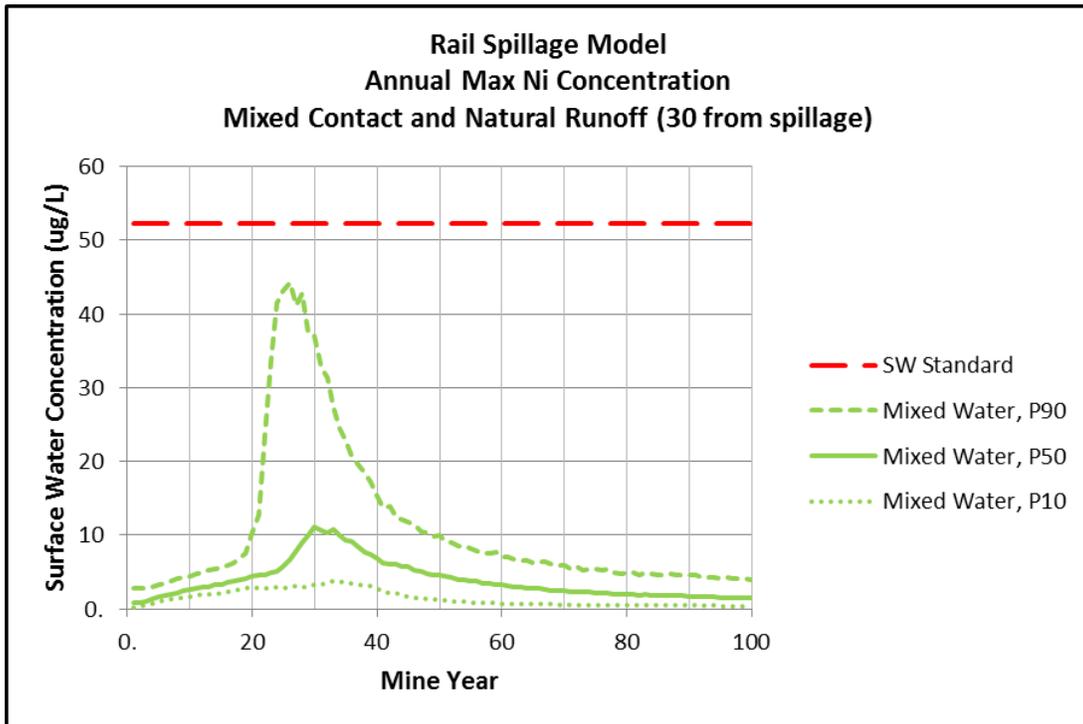


Figure 9 Nickel concentrations at the edge of a 30-m buffer

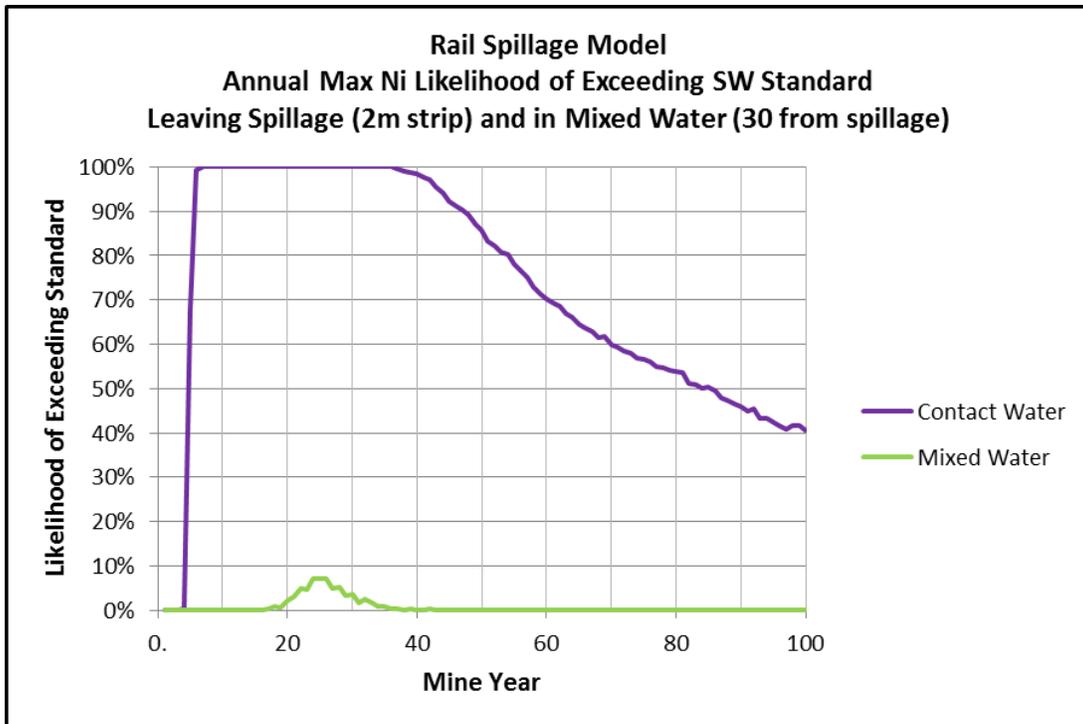


Figure 10 Nickel likelihood of exceedance

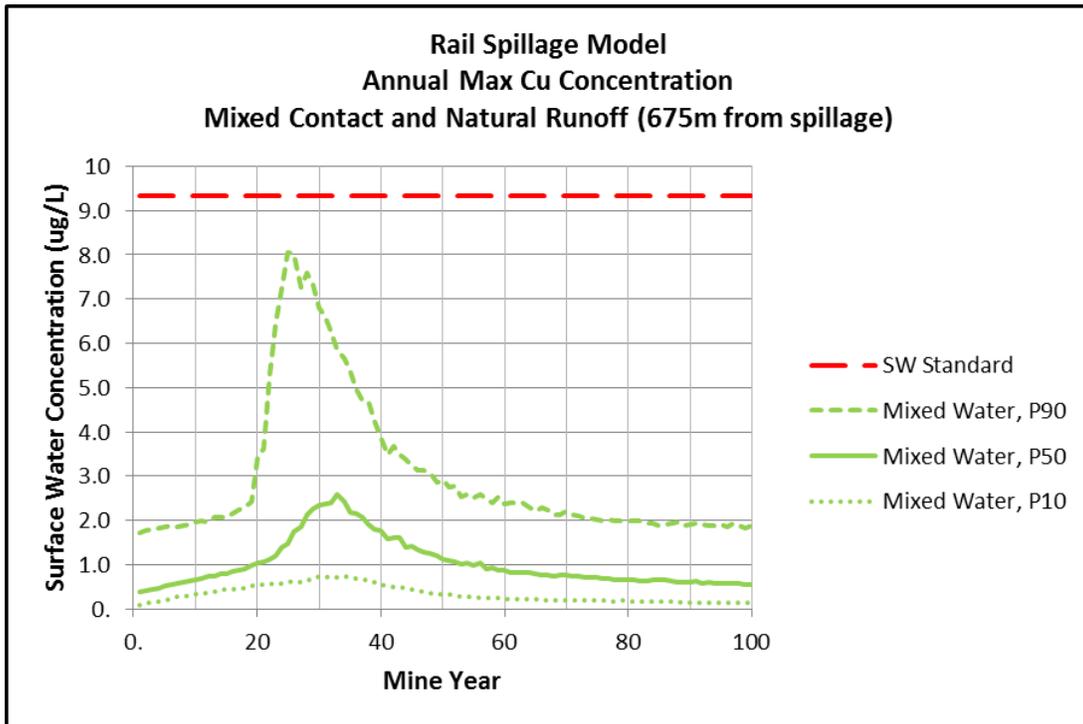


Figure 11 Copper concentrations at the edge of a 675-m buffer

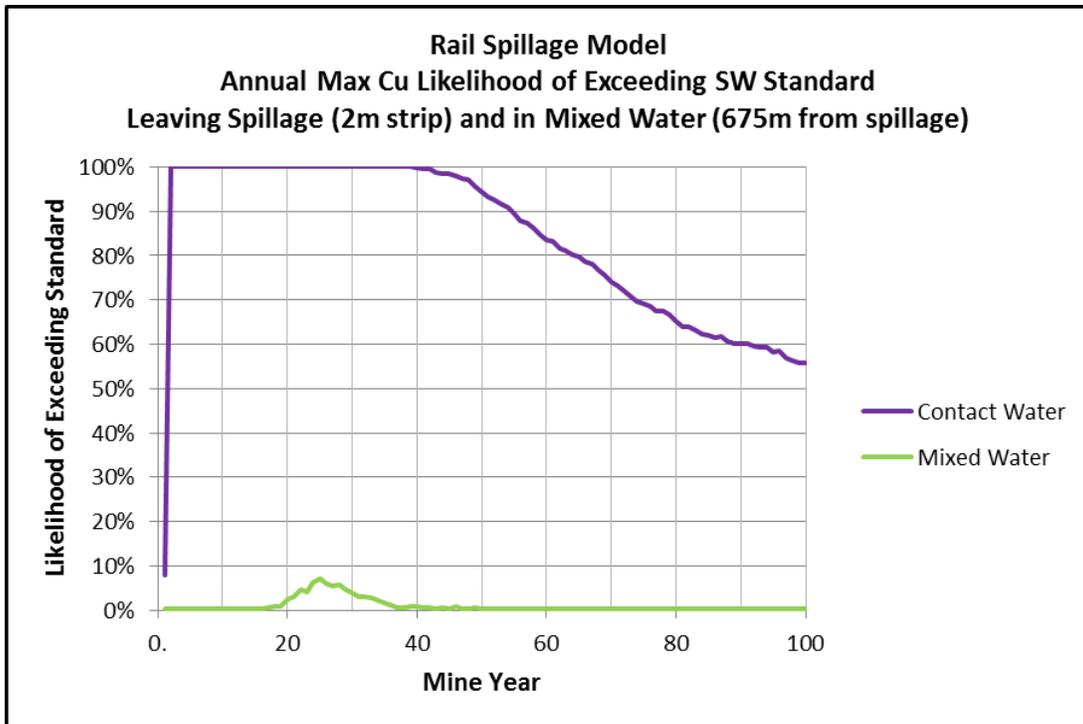


Figure 12 Copper likelihood of exceedance

Attachment F

Foreseeable Future Actions within the Partridge River and Embarrass River Watersheds

1. U.S. Forest Service
 - a. Superior National Forest: Marty Rye
 - i. The Eastern States BLM office has received 33 federal hardrock mineral prospecting permit applications and 21 operating plan proposals for mineral explorations in Superior National Forest. An EIS for the prospecting permits is currently under draft revision to determine where and under what circumstances the lands may be explored. The scope of the DEIS covers 1.7 million acres of land in Superior National Forest. Wetland impacts are unknown at this time but may occur if mineral prospecting permits are accepted.
2. Minnesota DNR
 - a. Lands and Minerals: Anne Jagunich
 - i. The Mesabi Nugget project at the old LTV site will impact wetlands and the Partridge River. No other projects were identified.
 - b. Forestry: Mike Magnuson
 - i. Future wetland impacts are not known at this time.
 - c. Waters: Amy Loiselle
 - i. She referred to St. Louis County planning, MN BWSR, MN DNR staff, USFS staff, the Duluth EPA, MPCA, and Iron Range Resources for information on specific projects in the future.
3. Minnesota DOT
 - a. Website
 - i. The website lists upcoming projects on Highways 135 and 37, which cross the Partridge River watershed. However, project locations are outside the watershed boundaries. No wetland impacts are expected.
 - b. Duluth office: Howard Mackey
 - i. Highway projects are planned no more than 3 years in advance, but long range road plans do not show any highway projects in the watersheds for the next 20 years. Routine culvert replacements will be conducted on highways 135 and 37, but any wetland impacts will be temporary.
4. Minnesota Board of Soil and Water Resources
 - a. Joan Weyandt
 - i. She referred to St. Louis County Landuse and Planning and had no information on projects impacting wetlands.
5. St. Louis County
 - a. Landuse Planning and Zoning, Duluth office: Mark Lindhorst

project described by St. Louis County Public Works.

9. City of Embarrass

a. Town Clerk: Diane Nelmark

- i. Future wetland impacts are not known at this time.

10. City of Gilbert

a. Public Works: Ken Kuitunen

- i. Future wetland impacts are not known at this time.

11. City of Aurora

a. Public Works

- i. Future wetland impacts are not known at this time.

12. City of McKinley

a. Public Works

- i. Future wetland impacts are not known at this time.

13. City of Hoyt Lakes

a. Public Works

- i. Future wetland impacts are not known at this time.

14. Iron Range Resources and Rehabilitation Board (IRRRB)

a. Mining and Mine land Reclamation: Dan Jordan

- i. A number of mining projects may impact wetlands within the Partridge and Embarrass River watersheds. Pending approval, Mesabi Nugget, Twin Metals, Arcelor Mittal, Northshore Mining Company, Encampment Resources, and Teck Resources plan to pursue underground copper-nickel mining operations. All projects are currently in the exploratory and/or permitting phase.
- ii. Cardero Resource Corp. is currently in an “advanced” exploratory phase of an iron-titanium (Ilmenite) mining project just south of Hoyt Lakes at the Longnose property. The plant for this mining operation will likely be located within or adjacent to Hoyt Lakes. See the project summary dated April 12, 2011 at:
http://www.cardero.com/s/minnesota_ferro.asp?ReportID=459547