4.0 AFFECTED ENVIRONMENT

4.1 INTRODUCTION

Pursuant to the requirements of NEPA regulations at 40 CFR 1502.15 and *Minnesota Rules*, part 4410.2300, Chapter 4 describes the affected environment of the NorthMet Project Proposed Action and Land Exchange Proposed Action. The information within this chapter provides context to the analyses of the environmental consequences addressed in Chapter 5. Resource topics were identified through scoping for both the NorthMet Project Proposed Action and Land Exchange Proposed Action, development of the DEIS and SDEIS, and public comments. Refer to Chapter 2 for more information on the EIS development process. The discussion of the affected environment is limited to those resources that may be subject to potential environmental effects from either the NorthMet Project Proposed Action or Land Exchange Proposed Action.

Table 4.1-1 lists the structure of Chapter 4 with respect to the NorthMet Project Proposed Action and Land Exchange Proposed Action. Section 4.2 describes the existing conditions for the natural and human environment that may be affected, directly or indirectly, by the NorthMet Project Proposed Action. Section 4.3 describes the existing conditions of the same natural and human environment resources as in Section 4.2, but specific to the areas that may be affected, directly or indirectly, by the Land Exchange Proposed Action or Land Exchange Alternative B.

As previously indicated, the land exchange acreages used in the Project Description section are described in GLO acreages, while the acreages used in the Affected Environment and Environmental Consequences sections are described in GIS acreages. GLO acres represent the acreages associated with the legal descriptions of the parcels based on original surveys performed by GLO surveyors between 1858 and 1907. As such, GLO acreages are being used as part of the project description and would also be used to define the real estate transaction if the Land Exchange Proposed Action were approved. The affected environment presented in Section 4.3 is based upon GIS data. GIS values indicate the size of the federal and non-federal parcels as computed geometrically using mapping software, which may be different than the GLO legal acreage. Unless noted as GLO acres, all values shown are derived from GIS data.

The proposed lands to be exchanged are described below in Section 4.3; however, the final proposed configuration of land would be determined after the market value of the parcels is determined by appraisals and the environmental analysis has been completed. This information will be presented in the USFS ROD.

Table 4.1-1 Resource Topic Areas Discussed in Chapter 4

Resource Topic	NorthMet Project Proposed Action	Land Exchange Proposed Action
Land Use	4.2.1	4.3.1
Water Resources	4.2.2	4.3.2
Wetlands	4.2.3	4.3.3
Vegetation	4.2.4	4.3.4
Wildlife	4.2.5	4.3.5
Aquatic Species	4.2.6	4.3.6
Air Quality	4.2.7	4.3.7
Noise and Vibration	4.2.8	4.3.8
Cultural Resources	4.2.9	4.3.9
Socioeconomics	4.2.10	4.3.10
Recreation and Visual Resources	4.2.11	4.3.11
Wilderness and Special Designation Areas	4.2.12	4.3.12
Hazardous Materials	4.2.13	4.3.13
Geotechnical Stability	4.2.14	4.3.14

4.2 NORTHMET PROJECT

4.2.1 Land Use

This section describes the lands that may be affected by the NorthMet Project Proposed Action. Local, federal, and tribal management frameworks regulate the use of the lands. The Mine Site, Transportation and Utility Corridor, Plant Site, and non-federal lands fall within the 1854 Ceded Territory. The Mine Site and a portion of the Transportation and Utility Corridor fall within the Superior National Forest and are managed by the Forest Plan.

The Plant Site and existing LTVSMC Tailings Basin are located in a brownfield area dominated by the existing facilities and infrastructure of the former LTVSMC processing plant. In 2002, Cliffs Erie conducted a Phase I Environmental Site Assessment (Phase I ESA) of the former LTVSMC processing plant and identified 62 potential AOCs. The Legacy Contamination discussion in Section 4.2.1.4.2 elaborates on the status of AOCs.

4.2.1.1 Regulatory Considerations

The lands that may experience direct or indirect effects from the NorthMet Project Proposed Action (as well as the non-federal lands evaluated in Section 4.3.1) are located within the following jurisdictions:

- The cities of Babbitt and Hoyt Lakes;
- The 1854 Treaty Authority (including the 1854 Ceded Territories Conservation Code);
- Fond du Lac Tribal Conservation Codes for 1854 Ceded Territories;
- St. Louis, Lake, and Cook counties; and
- Superior National Forest.

County and municipal land use controls are described in Section 4.2.1.1.1; federal and tribal management frameworks are described in Section 4.2.1.1.2. Table 4.2.1-1 summarizes the relationship between these land use controls and project components.

Table 4.2.1-1 Land Use Controls Affecting the NorthMet Project Proposed Action

	Mine Site	Plant Site	Transportation and Utility Corridor
City of Hoyt Lakes Zoning Ordinance		X	X
City of Babbitt Zoning Ordinance	X		X
City of Babbitt Comprehensive Land Use Plan	X		X
St. Louis County Comprehensive Land Use Plan	X	X	X
Land and Resource Management Plan for Superior National Forest	X		X
1854 Treaty Authority	X	X	X

4.2.1.1.1 Local Land Use Management

Land use is regulated by municipal or county zoning ordinance, while comprehensive land use plans provide additional guidance for future development (League of Minnesota Cities 2011). A zoning designation identifies a list of allowed uses. If a proposed activity is one of these allowed uses, then it can be developed "as of right." If a potential use is not specifically allowed, the zoning ordinance will indicate that a variance or some similar action is required. The lands potentially directly affected by the NorthMet Project Proposed Action are in areas currently zoned for mining and/or industrial use. Some of these areas have already been affected by historic mining activity.

The federal lands are within the Partridge River Watershed, which is a tributary of the Upper St. Louis River. While St. Louis County Comprehensive Land Use Plan does not apply to federal lands, it would if the lands were acquired by PolyMet through the Land Exchange Proposed Action or Land Exchange Alternative B. In addition, other non-federal lands within the watershed are covered by the Comprehensive Land Use Plan's guidance. The Plan emphasizes active management of development in the watershed to promote preservation and improvement of water quality, recreational opportunities, ecological health, and archaeological resources (St. Louis County 2013).

4.2.1.1.2 Federal and Tribal Land Use Management

The Mine Site, Transportation and Utility Corridor, Plant Site, and non-federal lands are within the territory ceded by the 1854 Treaty between the U.S. Government and the Chippewa of Lake Superior. Hunting, fishing, gathering, and other traditional uses under the 1854 Treaty are exercised on public lands within this territory, and on private lands with the permission of the land owner.

In addition, a portion of the Mine Site and Transportation and Utility Corridor are within the Superior National Forest. As such, they are governed by the Forest Plan. The Forest Plan uses the management area framework to define the management approach for the Superior National Forest. The Forest Plan provides direction on desired conditions for forestry resources, mineral resources and extractive activity, vegetative communities, wildlife management, public recreation opportunities, and visual character, among other characteristics (USFS 2004b).

4.2.1.2 Mine Site

The federal lands, comprising 6,495.4 acres, are located in St. Louis County, approximately 70 miles north of the City of Duluth, 20 miles south of the BWCAW, 6 miles south of the City of Babbitt, and approximately a mile south of the Northshore Mine. The federal lands are bounded on the south by the Transportation and Utility Corridor.

Except for an area south of the Transportation and Utility Corridor (see Section 4.2.1.3 below), the Mine Site is contained within the federal lands on part of the Superior National Forest and within the municipal limits of the City of Babbitt (see Figure 4.2.1-1). Most of the Mine Site and adjoining federal lands are part of the General Forest – Longer Rotation Management Area, while the remainder is within the General Forest Management Area (see Figure 4.3.1-1).

The General Forest – Longer Rotation Management Area is characterized by a diverse array of land and resource management uses, goods and services (including commercial goods), scenic quality, developed and dispersed recreation opportunities, and habitat for wildlife and fish. Roads open to public travel in this management area provide access to resources and road recreation opportunities. Non-motorized recreation opportunities also exist. The USFS allows exploration, development, and production of mineral resources on National Forest lands used for timber production under conditions where the activities "are conducted in an environmentally sound manner so that they may contribute to economic growth and national defense" (USFS 2004b).

The characteristics and use of the General Forest Management Area are similar to the General Forest – Longer Rotation Management Area, except that timber harvests are more frequent, more uniform in age, and more extensive. The General Forest Management Area has the highest amount of young forest and the largest sized timber harvest units.

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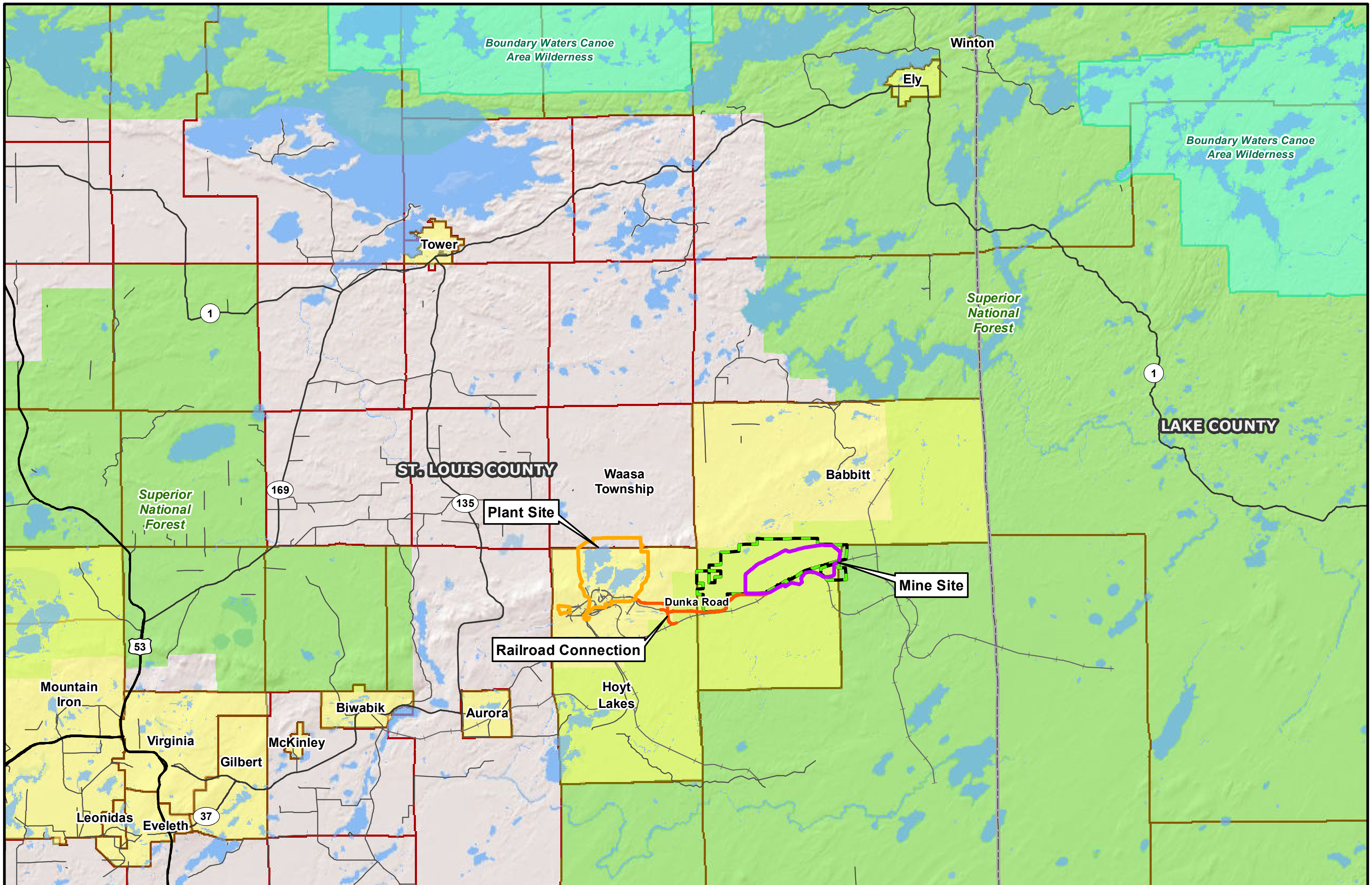

Plant Site
Mine Site
Transportation and Utility Corridor
Federal Lands
Municipal Boundary
Township Boundary
Boundary Waters Canoe Area Wilderness
National Forest
Existing Road
Existing Railroad

0 1.5 3 6 Miles

Figure 4.2.1-1
Area Municipalities
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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Federal lands designated for the Mine Site have been subject to mineral exploration since 1969. As of 2011 (the most recent year for which data were available), this exploration included 123 exploration drill sites, soil borings, and the construction of approximately 0.5 mile of temporary road access. Final reclamation of the closed portions of the temporary access roads has been completed (USFS 2011a). There is no known existing contamination by hazardous materials at the Mine Site.

The federal lands are a part of the territory ceded by the Chippewa of Lake Superior to the United States in 1854 (1854 Treaty Authority 2006). The Chippewa reserve rights to hunt, fish, and gather on public lands (and on private land with permission) in the 1854 Ceded Territory. Tribal harvest levels and other activities are governed by either individual tribal entities (in the case of the Fond du Lac Band) or the 1854 General Codes and subsequent Amendments under the 1854 Treaty Authority (in the case of the Grand Portage and Bois Forte Bands [MDNR 2011o]).

The City of Babbitt's zoning ordinance classifies the Mine Site area as a Mineral Mining district. This allows for existing and potential mineral mining, processing, and tailings and waste disposal, as well as accessory and support activities needed for the proper operation of mining activities outside the limits of open pit and ore formations. The zoning ordinance falls within the city's broader Comprehensive Land Use Plan, which was revised in 2014 (Arrowhead 2014). The draft plan includes goals and objectives in support of mining-related economic development opportunities.

Use of the area surrounding the Mine Site is varied. The area to the north/northwest of the Mine Site is within the City of Babbitt Mineral Mining district. The district includes part of the Plant Site and the Transportation and Utility Corridor, and the Northshore Mine (City of Babbitt 1996). The area to the east of the Mine Site is Superior National Forest land that is within the General Forest – Longer Rotation Management Area. The area to the south of the federal lands is within the City of Babbitt's Mineral Mining district and is a mix of private use (railroad and buffer area), Superior National Forest land within the General Forest Management Area, and state-owned lands.

4.2.1.3 Transportation and Utility Corridor

The Transportation and Utility Corridor connects the Plant Site and Mine Site, and includes Dunka Road, and a railroad connection. The corridor traverses an area that straddles the boundary between the City of Babbitt and City of Hoyt Lakes (see Figure 4.2.1-1). The corridor passes through private, state, and Superior National Forest lands, some of which were previously mined. The private lands are within the City of Babbitt Mineral Mining zoning district and the City of Hoyt Lakes Mineral Mining district. The Superior National Forest areas are within the General Forest – Longer Rotation Management Area.

Dunka Road is a private road, with segments owned and leased by Cliffs Erie, PolyMet, and Minnesota Power. It serves as the access point for USFS Roads 125, 108, and 109, which are used for forest maintenance in the area of the Mine Site. Dunka Road also provides access to an existing electrical transmission line that runs parallel to and south of the road. The railroad is privately owned and in operating condition, but has not been extensively used since operations at LTVSMC ceased in 2001.

The Transportation and Utility Corridor crosses over Wyman, Longnose, and Wetlegs Creeks, which drain to the Partridge River, a tributary of the Upper St. Louis River (see Figure 3.2-1). This feature of the NorthMet Project Proposed Action therefore also falls within the jurisdiction of the St. Louis County Comprehensive Land Use Plan in the management of the St. Louis River Watershed (see Section 4.2.1.1 above).

4.2.1.4 Plant Site

4.2.1.4.1 Summary of Land Use Conditions

The Plant Site is west of the Mine Site, in an area dominated by the existing facilities and infrastructure of the former LTVSMC processing plant and Tailings Basin, along with additional acreage purchased for the purpose of plant upgrade and buffer zones. The site is characterized by historical heavy industrial use, with extensive mechanical facilities, rail lines, mine workings, tailings storage, and closed pits. The majority of the Plant Site is located within the incorporated limits of the City of Hoyt Lakes and governed by the City of Hoyt Lakes Zoning Ordinance, last updated in 2010 (Hoyt Lakes Planning Commission 2010). The City does not have a comprehensive land use plan. The Hoyt Lakes portion of the Plant Site is in the City's Mineral Mining district, which identifies areas of existing and potential mineral mining, processing, tailings and waste disposal, and related activities, outside of the boundaries of the open mine pit and ore formations themselves.

The northern section of the Tailings Basin within the Plant Site is located within unincorporated Waasa Township (see Figure 4.2.1-1) and governed by the St. Louis County Comprehensive Land Use Plan. This area of the county is zoned for industrial use (the IND-4 zoning district; St. Louis County 2011). This district designates land for mining and quarrying, manufacturing, mineral exploration and evaluation, and a number of other related activities.

The Plant Site is accessible by Dunka Road from the east and from County Road 666 from the south. The Plant Site drains to the Partridge and Embarrass rivers, tributaries of the Upper St. Louis River. It therefore is within the jurisdiction of the St. Louis County Comprehensive Land Use Plan in the management of the St. Louis River Watershed (see Section 4.2.1.1 above).

The NorthMet Project Proposed Action includes the use of an existing water pipeline that runs from the northernmost section of Colby Lake northward to the Plant Site. The pipeline corridor is within the City of Hoyt Lakes Mineral Mining district. Colby Lake is an in-stream lake within the Partridge River. The corridor therefore is within the jurisdiction of the St. Louis County Comprehensive Land Use Plan in the management of the St. Louis River Watershed.

4.2.1.4.2 Legacy Contamination

In 2002, Cliffs Erie commissioned a Phase I ESA of the former LTVSMC processing plant and improvements (NTS 2002), which identified 62 potential AOCs. Designation as an AOC means that these areas require further investigation, but does not necessarily mean that contamination occurred in the past or is currently present.

As shown in Table 4.2.1-2, PolyMet would assume responsibility for 29 of the 62 AOCs upon acquiring the property from Cliffs Erie (Barr 2007e). Of the 29 AOCs to be acquired, four have been closed or received a no further action letter from the MPCA; one is a permitted former landfill under post-closure monitoring pursuant to the Minnesota solid waste landfill requirements; and 14 require further investigation, including AOC #8, another closed permitted landfill, which requires further investigation to assess a groundwater plume. Table 4.2.1-2 summarizes the potential issues and status of these AOCs. PolyMet intends to continue the VIC program initiated by LTVSMC and continued by Cliffs Erie, and would investigate and remediate as necessary these AOCs on a schedule approved by the MPCA.

All historic and any potentially operational AOCs not already addressed by the start of mine closure would be investigated and remediated as necessary. The MDNR has indicated that any associated cleanup costs for the legacy AOCs would be included in the financial assurance requirements for any Permit to Mine issued to PolyMet for the NorthMet Project Proposed Action (Boreal, Pers. Comm., April 13, 2009).

The status of the remaining 33 AOCs for which PolyMet does not have any responsibility are as follows:

- Eleven sites have been closed through the VIC program;
- Five sites have been closed through the Petroleum Remediation Program;
- Four sites have completed initial investigations, sampling plans in place, and are awaiting MPCA review;
- Nine sites have not yet been investigated;
- One site has a status that is unknown or not readily available;
- One site has a limited no action determination;
- One site is being managed through the NPDES program; and
- One site would likely require additional remediation (i.e., Pellet Plant).

Table 4.2.1-3 summarizes the potential issues and status of these AOCs.

Additionally, the LTVSMC Tailings Basin seeps are being managed under the Cliffs Erie Consent Order using short-term measures until long-term mitigation measures are determined.

Table 4.2.1-2 NorthMet Project Proposed Action Area of Concern Summary List for Voluntary Investigation and Cleanup Program

AOC	Location	Site Description	Identified Potential Issues	Status
1	Area 1	Area 1 Shops and Reporting	Domestic septic systems and drain field.	*No actions have been taken with regard to this site.*
6	Area 1	Oily Waste Disposal Area	Waste from general shop area floor drains.	No actions have been taken with regard to this site.
7	Area 1	Bull Gear Disposal Area	One time 1970s disposal of heavy lubricant.	No actions have been taken with regard to this site.
8	Area 1	Private Landfill	Permitted industrial waste landfill that operated until 1993. Identified presence of groundwater plume.	The closed LTVSMC Private Landfill exists within the site of active permitted Industrial Waste Landfill (SW-619). Monitoring activities for the closed LTVSMC Private Landfill are incorporated into the active SW-619 permit (held by Cliffs Erie). Work plan submitted to MPCA to define the extent of the facility's groundwater plume, assess the stability of the groundwater, and assess the ability of the gas vents to aid in the remediation of the groundwater plume.
9	Area 1	Area 1 RR Panel Yard	Railroad tie disposal area co-mingled with scrap metal, wood, and demolition debris.	Scrap and trash were disposed. Some items remain to be removed. A SAP was submitted to the MPCA and was implemented. A historic release was identified. Further recommendations for cleanup are ongoing to the MPCA.
10	Area 1	Area 1 Airport	Some areas of soil staining.	No actions have been taken with regard to this site.
11	Area 1	Stoker Coal Ash Disposal	Disposal area until 1980s with marginal cover.	No actions have been taken with regard to this site.
12	Area 1	Mill Rejects Area	Solid waste from concentrator building.	Site closed: No Further Action required.
13	Area 2/2E/3	2001 Storage Area	Some areas of soil staining.	No actions have been taken with regard to this site.
14	Area 2/2E/3	Large Equipment Paint Area	Buildup of blasting sand.	No actions have been taken with regard to this site.
24	Area 5	Area 5 Reporting	Scrap and salvage area with some stained soils.	Site closed through the VIC program in letter dated 7/30/08.
25	Area 5	Area 5 Loading Pocket & Storage	Some areas of stained soils along rail siding.	Site closed through the VIC program in letter dated 7/30/08.
35	Plant Site	Dunka WWTP Sludge Staging Area	Little evidence of any residue remaining.	Water treatment plant sludge residue removed.

AOC	Location	Site Description	Identified Potential Issues	Status
36	Plant Site	Coal Ash Landfill	Cover appears to be in good condition.	Permitted Landfill. Closed and subject to post-closure monitoring.
37	Plant Site	Line 9 Area 5 Petroleum Contaminated Soil	Permitted petroleum land application site with 25,000 cubic yards of soils.	The MPCA sent a closure letter for this site on February 24, 2006.
38	Plant Site	Area 2 Shops	Contains a locomotive fueling station and a septic system.	*Petroleum impacted soil excavation has been completed. Additional evaluation of non-petroleum contamination needed.*
40	Plant Site	Heavy Duty Garage	Formerly used for equipment maintenance.	Building and one UST removed. Site reuse planned. Further investigation at PolyMet closure. *No actions have been taken with regard to this site.*
42	Plant Site	Bunker C Tank Farm	Large ASTs which previously contained #4 and #6 fuel oil.	*Petroleum Remediation closed the site January 2012. Contamination remains at the site.*
43	Plant Site	Administration Building	One heating oil UST was abandoned in place.	Facility still in use. Further investigation at PolyMet closure. *No additional actions have been taken with regard to this site.*
44	Plant Site	Main Gate Vehicle Fueling Area	Contains several AST used for fueling trucks.	Facility still in use. Further investigation at PolyMet closure. *No additional actions have been taken with regard to this site.*
46	Plant Site	Plant Site Proper/General Shops	Former taconite processing area – no specific issues identified.	Reuse planned. Further investigation at PolyMet closure. *No additional actions have been taken with regard to this site.*
47	Tailings Basin	Tailings Basin Reporting	Septic system remains.	Two USTs removed. *No additional actions have been taken with regard to this site.*
48	Tailings Basin	Transformers	Several transformers present, but records indicate that they do not contain PCBs.	No actions have been taken with regard to this site.
49	Tailings Basin	Coarse Crusher Petroleum Contaminated Soil Stockpile	Contained floor sweepings (containing oil).	All contaminated soil was removed in 1990s.
50	Tailings Basin	Emergency Basin	Received water from process sumps in the Concentrator during power outages and emergency conditions, and storm water outfall.	A SAP was submitted to the MPCA and was implemented. *MPCA VIC program is waiting for an investigation report summarizing the work.*
51	Tailings Basin	Salvage and Scrap Areas	Some areas of soil staining.	No actions have been taken with regard to this site.
52	Tailings Basin	Cell 2W Salvage Area	Several small stained soil areas as well as the remnants of a mobile AST.	No actions have been taken with regard to this site.
53	Tailings Basin	Cell 2W Horrnfels waste rock	Sulfide waste rock disposed under a MPCA/MDNR approved plan.	NPDES monitoring ongoing.

AOC	Location	Site Description	Identified Potential Issues	Status
59	Colby Lake	Colby Lake Pumping Station	One transformer remaining.	One heating oil AST removed in 1970. Reuse planned, further investigation at PolyMet closure. *No additional actions have been taken with regard to this site.*

Sources: NTS 2002; PolyMet., Pers. Comm., August 8, 2012; ERM, Pers. Comm., October 21, 2014.

Notes:
Italic text in Table 4.2.1-2 indicates that the "Identified Potential Issues" and "Status" have been updated since the SDEIS.
PCB = Polychlorinated biphenyl
PRP = Potentially Responsible Party
SAP = Sampling and Analysis Plan
UST = Underground storage tank

Table 4.2.1-3 Non-NorthMet Project Areas of Concern Status

AOC	Responsible Party	Site Description	Issues	Status
2	Mesabi Nugget	Area 1 petroleum contaminated soil	Petroleum contaminated soil.	*SAP submitted and approved. MPCA waiting for results report.*
3	Mesabi Nugget	Sludge site	Sludge contaminated soil.	*No actions have been taken with regard to this site.*
4	Mesabi Nugget	1004 storage area	Soil staining and debris.	*Workplan submitted November 2013. MPCA waiting for results report.*
5	Mesabi Nugget	Roofing disposal site	Roofing debris.	*Workplan submitted November 2013. MPCA waiting for results report.*
15	Cliffs Erie	Railroad storage area	Debris.	No action to date.
16	Cliffs Erie	Area 2 vibratory loading pocket		*Limited No Action Determination for Soil sent May 20, 2008.*
17	Cliffs Erie	Area 2 truck fueling		*Petroleum release L#16490 closed.*
18	Cliffs Erie	Area 2 superpocket		*Petroleum release evaluated and L#16490 closed.*
19	Mesabi Nugget	Area 2WX reporting		Site closed through the VIC program in letter dated 7/31/08.
20	Mesabi Nugget	Area 2WX shovel salvage		Site closed through the VIC program in letter dated 7/31/08.
21	Mesabi Nugget	Area 2WX truck fueling		Site closed through the VIC program.
22	Mesabi Nugget	Area 2WX vibratory loading pocket		Site closed through the VIC program in letter dated 7/31/08.
23	Mesabi Nugget	Area 2WX superpocket		Site closed through the VIC program.
26	Mesabi Nugget	Area 6 truck fueling		Site closed through the VIC program.
27	Mesabi Nugget	Area 6 misfired blast		Site closed through the VIC program.
28	Mesabi Nugget	Area 9S former Aurora dump site	Debris.	*No actions to date.*
29	Mesabi Nugget	Stockpile #9021	Debris related to Aurora dump site.	*Workplan has been approved. MPCA is waiting for investigation report.*
30	Mesabi Nugget	Pre-taconite plant	Debris.	*Closed in VIC and Petroleum Remediation programs.*
31	Mesabi Nugget	Area 9N vibratory loading pocket	Septic tank and drain field.	Unknown.
32	Duluth Metals	Dunka shops and reporting	Demolition debris, closed leak site.	*No actions have been taken with regard to this site.*
33	Duluth Metals	North loading pocket – Dunka	Abandoned wells and septic	*No actions have been taken with regard to this site.*

AOC	Responsible Party	Site Description	Issues	Status
			system.	
34	Duluth Metals	South loading pocket – Dunka	Abandoned wells and septic system.	*No actions have been taken with regard to this site*.
39	Cliffs Erie	Knox Railroad fueling station		*Petroleum contaminated soil excavated and soil to land treatment area. Site is closed.*
41	Cliffs Erie	Oxygen plant		*Closed in VIC and Petroleum Remediation programs.*
45	Cliffs Erie	Pellet storage area and load-out	Soil staining and petroleum residue.	No action to date.
54	Cliffs Erie	Taconite Harbor marine fueling ASTs		*Approximately 2500 cubic yards of petroleum contaminated soil excavated and disposed. L#12252 closed.*
55	Cliffs Erie	Taconite Harbor oil track		*Petroleum contaminated soil removed from tracks. L#12252 closed.*
56	Cliffs Erie	Coal ash landfill - Taconite Harbor		Managed through *Solid Waste and/or* NPDES permit, no VIC action.
57	Cliffs Erie	Murphy City	Soil staining, well and septic system.	*Closed petroleum L#6423. No VIC action to date.*
58	Cliffs Erie	Rail lubricators	Stained soil.	No action to date.
60	Cliffs Erie	Brick recycling area		Site closed through the VIC program.
61	Cliffs Erie	PCB ditch investigation (pellet plant)		Site closed through the VIC program.
62	Cliffs Erie	Pellet plant	Soil staining and debris.	*No actions have been taken with regard to this site*.

Sources: NTS 2002; PolyMet, Pers. Comm., August 8, 2012; ERM, Pers. Comm., October 21, 2014.

Notes:
Italic text in Table 4.2.1-2 indicates that the “Identified Potential Issues” and “Status” have been updated since the SDEIS.
PCB = Polychlorinated biphenyl
PRP = Potentially Responsible Party
SAP = Sampling and Analysis Plan
UST = Underground storage tank

Cliffs Erie received a permit (SW-625) in 2006 from the MPCA to locate two individual land treatment sites within Cell 2W of the existing LTVSMC Tailings Basin. This facility is being used to land farm petroleum-contaminated (i.e., diesel fuel) soils excavated from AOCs #38 (Area 2 Shops) and #39 (Knox Railroad fueling station).

In May 2009, Cliffs Erie conducted a detailed assessment of both surface and groundwater quality at the existing LTVSMC Tailings Basin, including testing for volatile organic compounds (VOCs), SVOCs, PCBs, and other parameters to determine if there was any organic contamination that could be transported off site via stormwater runoff or groundwater seepage. The laboratory analyses showed no evidence of organic contamination leaving the site (Cliffs Erie 2009). Based on the investigations and laboratory analyses to date, which include sampling at seven monitoring wells, 14 surface discharges, 12 internal waste streams, and six downstream surface water monitoring stations, and visual observation and limited field analyses at 33 seeps at or near the existing LTVSMC Tailings Basin, no off-site contamination has been documented. The extent of on-site contamination from the legacy sites appears to be limited to localized soils and groundwater.

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4.2.2 Water Resources

This section describes the existing groundwater and surface water hydrology and water quality within the Partridge River and Embarrass River watersheds because these watersheds are expected to be affected by the NorthMet Project Proposed Action. The Partridge River and Embarrass River are headwaters to the St. Louis River. The Mine Site, Transportation and Utility Corridor, the former LTVSMC processing plant, and a small portion of the existing LTVSMC Tailings Basin drain to the Partridge River Watershed (see Section 4.2.2.2), while most of the Tailings Basin and the Emergency Basin drain to the Embarrass River Watershed (see Section 4.2.2.3).

4.2.2.1 Regional Setting

4.2.2.1.1 Meteorological Conditions

The NorthMet Project area is located near the headwaters of the Partridge River and Embarrass River watersheds at an approximate elevation of 1,600 ft amsl. Meteorological data are available for the NorthMet Project area from two weather stations operated by the National Weather Service. The Babbitt 2SE weather station is located approximately 5 miles from the Mine Site and has 39 years of records. The Hoyt Lakes 5N weather station is located approximately 1 mile from the Plant Site and has 27 years of records (see Figure 4.2.2-1).

Table 4.2.2-1 shows the monthly and annual average air temperature and precipitation for the two National Weather Service stations. Precipitation averages approximately 28 inches annually. Snowfall in the NorthMet Project area typically occurs between October and April. Estimates of annual average evaporation for northern Minnesota range from 18 inches (Siegel and Ericson 1980) to 22 inches (SCS 1975).

Table 4.2.2-1 Normal Monthly and Annual Average Air Temperature and Precipitation Near the NorthMet Project

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Air Temperature (°F)													
Babbitt 2 SE	5.5	12.3	23.8	39.2	52.8	61.5	66.5	64.4	54.5	44.4	27.1	11.8	38.7
Hoyt Lakes 5N	1.5	9.0	22.4	37.5	50.6	59.0	64.6	61.9	52.3	41.8	25.3	9.5	36.3
Precipitation (inches)													
Babbitt 2 SE	0.91	0.74	1.07	1.99	3.17	4.17	3.67	3.98	3.40	2.60	1.73	1.04	28.47
Hoyt Lakes 5N	0.95	0.66	1.23	2.08	3.23	3.96	3.86	3.86	3.36	2.75	1.25	0.97	28.16

Source: WRCC 2012.

Notes:
°F = Degrees Fahrenheit
Period of Record: Babbitt = 1948 to 1986; Hoyt Lakes = 1958 to 1984.

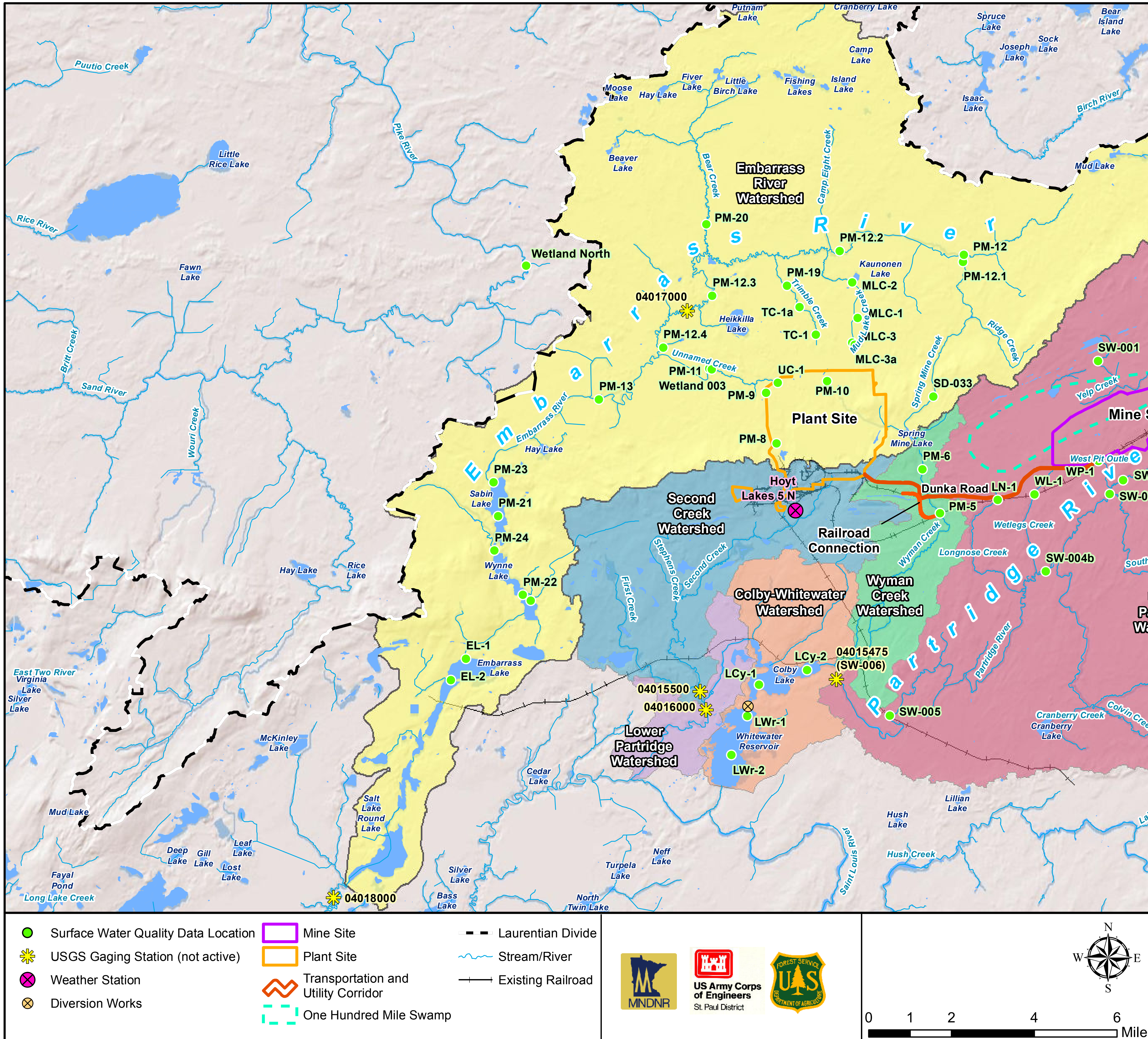

Figure 4.2.2-1
Watersheds, Streams and Data Collection Sites
NorthMet Mining Project and Land Exchange FEIS
Minnesota

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4.2.2.1.2 Water Resource Use Classifications

A key element of water quality management is "use classification," which identifies beneficial uses for which a waterbody must be protected. The State of Minnesota has adopted a framework that identifies a broad range of potential uses, including:

- Domestic consumption – Class 1;
- Aquatic life and recreation – Class 2;
- Industrial consumption – Class 3;
- Agriculture and wildlife – Class 4;
- Aesthetics and navigation – Class 5;
- Other uses – Class 6; and
- Limited resource value – Class 7.

These classes can be further divided into subclasses with letter designations. The use classifications are not intended to imply a priority rank to the uses.

<u>Groundwater</u>

Following *Minnesota Rules,* part 7060.0200, it is the policy of the State of Minnesota to consider the actual or potential use of groundwater for potable water supply as constituting the highest priority use and, as such, to provide maximum protection to all underground waters. Therefore, all groundwater is considered to have one beneficial use, domestic consumption (Class 1).

The MDNR has water allocation priorities defined under statute 103G.261 as follows:

(a) The commissioner shall adopt rules for allocation of waters based on the following priorities for the consumptive appropriation and use of water:

> (1) first priority, domestic water supply, excluding industrial and commercial uses of municipal water supply, and use for power production that meets the contingency planning provisions of section 103G.285, subdivision 6;
>
> (2) second priority, a use of water that involves consumption of less than 10,000 gallons of water per day;
>
> (3) third priority, agricultural irrigation, and processing of agricultural products involving consumption in excess of 10,000 gallons per day;
>
> (4) fourth priority, power production in excess of the use provided for in the contingency plan developed under section 103G.285, subdivision 6;
>
> (5) fifth priority, uses other than agricultural irrigation, processing of agricultural products, and power production, involving consumption in excess of 10,000 gallons per day; and
>
> (6) sixth priority, nonessential uses.

(b) For the purposes of this section, "consumption" means water withdrawn from a supply that is lost for immediate further use in the area.

(c) Appropriation and use of surface water from streams during periods of flood flows and high water levels must be encouraged subject to consideration of the purposes for use, quantities to be used, and the number of persons appropriating water.

(d) Appropriation and use of surface water from lakes of less than 500 acres in surface area must be discouraged.

(e) The treatment and reuse of water for non-consumptive uses shall be encouraged.

Principal groundwater resources in the NorthMet Project area are contained in bedrock geologic units and overlying surficial glacial deposits; the latter are also referred to as unconsolidated deposits. The water table is located primarily within the unconsolidated deposits; however, it is also likely located within the bedrock in areas of local bedrock highs. This means that saturated conditions exist within the unconsolidated deposits and in the underlying bedrock. Aquifer recharge to the bedrock is by infiltration of precipitation in outcrop areas and leakage from the overlying surficial aquifer (Siegel and Ericson 1980).

Surface Water

All surface waters in Minnesota are classified and protected for multiple beneficial uses. *Minnesota Rules,* part 7050.0470 lists individual waters and their associated use classifications. However, only a limited subset of all waters are actually listed, which include trout waters, surface waters protected for drinking water use, outstanding resource value waters, and Class 7 limited-resource-value waters. All of the remaining surface waters of the State, which include most of the waters of the State, are considered "unlisted waters." These unlisted surface waters are uniformly classified as Class 2B (cold or warm water sport or commercial fishing), 3C (industrial cooling and materials transport), 4A (irrigation use), 4B (livestock and wildlife use), 5 (aesthetics and navigation), and 6 (other uses) waters.

Most of the rivers and streams are unlisted in the NorthMet Project area with the exceptions of Colby Lake and Wyman Creek, both of which are listed. Colby Lake, which is used for domestic consumption by the City of Hoyt Lakes, is designated as Classes 1B (treated with simple chlorination for domestic consumption) and 2Bd (cool or warm water sportfish and drinking water) waters as well as the other default Classes 3C, 4A, 4B, 5, and 6. Wyman Creek, which is a designated trout stream, is designated as Classes 1B as well as 2A (aquatic life and recreation), 3B (industrial consumption-moderate treatment), as well as the other default classes 3C, 4A, 4B, 5, and 6 (*Minnesota Rules*, part 7050.0470).

All NorthMet Project area waters are also designated Outstanding International Resource Waters (*Minnesota Rules*, parts 7050.0460 and 7052.0300), which prohibits any new or expanded point source discharges of bioaccumulative substances of immediate concern (i.e., mercury) unless a nondegradation demonstration is completed and approved by the MPCA.

In addition to the above water use classifications for establishment of state water quality standards (*Minnesota Rules*, parts 7050 and 7052), certain waters of the state are also classified by the MDNR as Public Waters. Public Waters are all water basins, wetlands, and watercourses that meet the criteria set forth in Minnesota Statutes, section 103G.005, subdivision 15, and that are identified on Public Water Inventory maps authorized by Minnesota Statutes, section 103G.201 (see Figure 4.2.2-2). Any proposed activity that alters the course, current, or cross section of a mapped Public Water is subject to a variety of state regulations (*Minnesota Rules*, Chapter 6115), depending on the proposed activity. The Public Waters program does not regulate water quality.

Impaired Waters

The federal CWA requires states to adopt water quality standards to protect waters from pollution. These standards, which are typically based on the beneficial use classifications described above, define how much of a pollutant can be in the water and still meet beneficial uses, such as drinking water, fishing, and swimming. Water quality standards are the fundamental tools used to assess the quality of all surface waters. States must monitor and assess the water quality of their waters to identify those that are "impaired" (i.e., not fully supporting their beneficial uses).

Section 303(d) of the CWA requires states to publish and update a list of impaired waters for which a Total Maximum Daily Load (TMDL) Study is needed. This list, known as the "303(d) List" or "TMDL List" is updated every two years via assessment of water quality data and an extensive public participation process. The final 2012 TMDL List (MPCA 2012n) was developed by the MPCA and approved by the USEPA in July 2013. If the extent of the violations of standards for any water exceeds the guidelines described in the Guidance Manual (MPCA 2014g), those surface waters are considered to be "impaired." The goal of the MPCA is to protect high-quality waters and improve the quality of impaired waters so water quality standards are met and beneficial uses are maintained and restored, where these uses are attainable. A current map of Minnesota's impaired waters can be found on the Minnesota Pollution Control Agency's website.

Table 4.2.2-2 shows the waters within the Embarrass River and Partridge River watersheds that are on the final 2012 TMDL List (see Figure 4.2.2-1).

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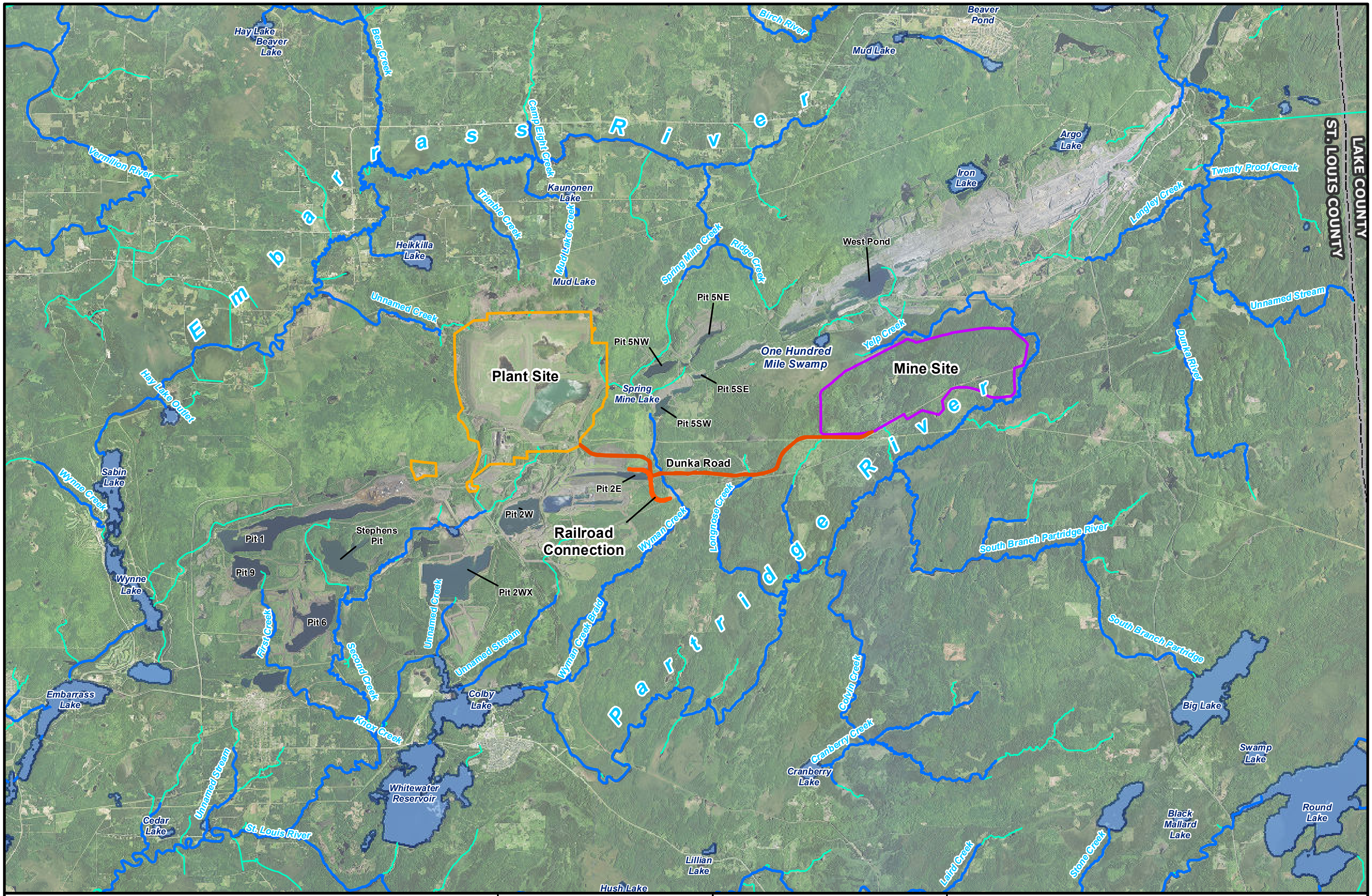

MDNR Designated Public Waters Inventory (PWI) Stream/River

Non MDNR Designated Public Waters Inventory (PWI) Stream/River

MDNR Designated Public Waters Inventory (PWI) Lake/Wetland

Mine Site

Plant Site

Transportation and Utility Corridor

MNDNR

US Army Corps of Engineers St. Paul District

0 0.5 1 2 3 Miles

Figure 4.2.2-2

MDNR-Designated Public Waters

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Table 4.2.2-2 Impaired Waters within the Embarrass River and Partridge River Watersheds

Water Name	Affected Designated Use	Pollutant/Stressor	TMDL Target Date
Embarrass River: headwaters to Embarrass Lake	Aquatic Life	Fishes Bioassessments	2015
Sabin/Wynne Lake (MDNR designated as one Lake)	Aquatic Consumption	Mercury in fish tissue	2025
Embarrass Lake	Aquatic Consumption	Mercury in fish tissue	2015
Esquagama Lake	Aquatic Consumption	Mercury in fish tissue	2025
Wyman Creek: headwaters to Colby Lake	Aquatic Life	Fishes Bioassessments	2015
Colby Lake or Whitewater Reservoir[1]	Aquatic Consumption	Mercury in fish tissue	2025
St. Louis River: Partridge River To Embarrass River	Aquatic Consumption	Mercury in fish tissue	2025
Spring Mine Creek: from Ridge Creek to Embarrass River	Aquatic Life	Fishes Bioassessments; Aquatic Macroinvertebrates Bioassessments	2015

Note:
1 Both Colby Lake and Whitewater Reservoir are included on the 2012 Inventory of All Impaired Waters List; however, only Colby Lake is on the final 2012 TMDL List. Whitewater Reservoir has a USEPA Category of 4A, meaning fish tissue levels are low enough that it is included under the Statewide Mercury TMDL and no further TMDL is needed.

The “mercury in fish tissue” pollutant listed in Table 4.2.2-2 indicates that the mercury content in sampled fish tissue from these waters was found to be above the state’s human health chronic standard. See Section 4.2.6.4 for additional information about mercury in water and fish. The pollutants listed in the table as “Fishes Bioassessments” or “Aquatic Macroinvertebrates Bioassessments” reflect an impaired fish and/or benthic macroinvertebrate population, based on Index of Biological Integrity (IBI) monitoring and assessment, without a specific cause, or stressor, yet being identified. The MPCA has developed fish and invertebrate IBI scores to assess the aquatic life use of rivers and streams in Minnesota. Monitoring the aquatic community, via biological and chemical monitoring, is a direct way to assess aquatic life use support. The aquatic community integrates the cumulative effect of pollutants, habitat alteration, and hydrological modification of a waterbody over time. The IBI incorporates multiple attributes of the aquatic community, called metrics, which are used to create a cumulative IBI score for each sample location. The MPCA has developed assessment thresholds or biocriteria for aquatic use. In general, an IBI score above the assessment threshold indicates aquatic life use support, while a score below indicates non-support (MPCA 2014g). When stressors become known through further investigations and studies, the TMDL can be completed and consideration can be given to permit conditions for individual projects, as warranted.

4.2.2.1.3 Wild Rice

Wild rice is an important resource in terms of its economic and environmental values, as well as having significant cultural value to the native Ojibwe people, which includes the Bands. This section provides baseline information on the importance of wild rice, its habitat requirements, and presence within the NorthMet Project area. Section 4.2.9 discusses the cultural importance of wild rice to the tribes in further detail.

Importance of Wild Rice

The Ojibwe people have a special cultural and spiritual tie to natural wild rice. Their migration story describes how they undertook a westward migration from eastern North America, which tribal prophets had foretold would continue until the Ojibwe people found "the food that grows on water" (Benton-Banai 1988). That food was wild rice, known as manoomin, and it is revered to this day by the Ojibwe as a special gift from the Creator. Natural wild rice remains a mainstay of traditional foods for the Ojibwe community and offers significant nutritional value. The tradition of hand harvesting natural wild rice continues to this day among both tribal and non-tribal cultures. It is estimated that more than 3,000 tribal members participate in wild rice harvesting statewide along with about 1,500 non-tribal individuals (MDNR 2008c).

Wild rice also represents an important food source for both migrating and resident wildlife. Wild rice has been listed as one of the 10 most important sources of food for ducks throughout the United States and Canada. In Minnesota, research conducted at Chippewa National Forest found that natural wild rice was the most important food for mallards during the fall, although many other species of duck also use beds of wild rice. The stems of wild rice provide nesting material for several species and critical brood cover for waterfowl. The entire wild rice plant provides food during the summer for herbivores. In addition, rice worms and other insect larvae feed heavily on natural wild rice. These insects provide a rich source of food for various birds. In the spring, decaying rice straw supports a diverse community of invertebrates and thus provides an important source of food for a variety of wetland wildlife. As a result, many species of wildlife use wild rice lakes and streams for reproduction and foraging areas, including 17 species listed in the MDNR Comprehensive Wildlife Conservation Strategy (MDNR 2006d) as Species of Greatest Conservation Need (SGCN).

In addition to its importance for wildlife, natural wild rice has other ecological values. Emergent aquatic plants like wild rice protect shorelines from erosion, provide habitat for fish, and temporarily sequester nutrients during the growing season, thereby reducing the potential for stream and lake eutrophication and turbidity.

Natural wild rice is an important component of tribal and local economies in Minnesota. In 2007, nearly 0.3 million pounds of unprocessed natural wild rice were purchased from the Leech Lake Band of Ojibwe-licensed harvesters generating more than $400,000 of income for tribal members (MDNR 2008c).

Minnesota was the world's first producer of cultivated wild rice in the 1950s and remains one of the world's leading producers of cultivated wild rice, producing 4 to 6 million pounds annually (MCWRC 2012). Cultivated wild rice, which depends on natural wild rice to an important degree in maintaining genetic diversity, plays an important role in Minnesota's economy (MDNR 2015e).

Preferred Habitat and Life Cycle

The historic range of natural wild rice is believed to have encompassed all of Minnesota (Moyle 1945), although it was most common in areas of glacial moraines in central and northern Minnesota. Based on a recent inventory, natural wild rice is still found in 55 counties in Minnesota (MDNR 2008c).

The distribution and abundance of natural wild rice is dependent on its habitat requirements, which include the following (MDNR 2008c):

- Surface water hydrology – some moving water, with rivers, flowages, and lakes with inlets and outlets being optimal areas for growth;
- Seasonal water depths – water levels that are relatively stable or decline gradually during the growing season are preferred, with optimal depths of 0.5 to 3.0 ft of water;
- Substrate – although wild rice may occur in a variety of lake bottoms, the most consistently productive stands are those with soft, organic sediments;
- Water clarity – clear to moderately colored (stained) water is preferred as darkly stained water can limit sunlight penetration and hinder early plant development; and
- Water chemistry – wild rice grows within a wide range of chemical parameters; however, productivity is highest in water with a pH of 6.0 to 8.0 and alkalinity greater than 40 mg/L.

Wild rice stands require nitrogen and phosphorus, although excess levels of some nutrients, especially phosphorus, can adversely affect productivity.

Wild rice is an annual plant that develops in the spring from a seed that drops off the plant to bottom sediments during the previous fall. The seed requires a dormancy period of 3 to 4 months in 35°F or colder water before germinating in the spring when water temperatures reach 40°F. The plant goes through several distinct growth phases during its lifecycle. During the submerged leaf stage in late May to early June, a cluster of underwater leaves forms. The floating leaf stage typically begins in mid-June as floating leaves develop and lay flat on the water surface. This stage is when wild rice is most susceptible to being uprooted by rapidly rising water levels or waves generated by high winds.

Aerial shoots typically begin to develop by the end of June and grow to a height of 2 to 8 ft above the water surface by August. Wild rice begins to flower in late July and the seeds develop in August and September. The wild rice seeds on the same plant mature across a staggered time period, ensuring that some seeds survive environmental conditions to perpetuate the stand. Some seeds may remain dormant in the bottom sediment for many years to several decades if conditions are not suitable for germination, allowing wild rice populations to survive through time periods with less than optimal conditions and reduced productivity. The time period from germination to dropping of mature seeds typically requires about 110 to 130 days, depending upon environmental conditions. Even under ideal growing conditions, wild rice stands undergo approximately 3- to 5-year cycles in which productivity varies. A typical cycle includes a highly productive year followed by a low productive year, which is followed by a gradual recovery.

Two primary factors that can impact wild rice productivity are changes in hydrology and water quality. Wild rice typically occurs in shallow water and is sensitive to varying water levels, especially during the floating leaf stage in early summer when abruptly rising water levels can uproot the plant. Wild rice will stop growing or become less productive if water becomes too deep (Dore 1969). A recent survey of wild rice harvesters (Norrgard et al. 2007) identified water level as the highest management priority. MDNR wildlife managers have hired trappers to remove beavers from some wild rice lakes to protect wild rice from rising water levels resulting from beaver dam activity.

Regulations Applying to Waters that Contain Wild Rice

Minnesota Rules part 7050.0224 identifies a Class 4A water quality standard of 10 mg/L for sulfate concentrations "…applicable to water used for the production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels." The MPCA has developed a draft staff recommendation that the 10 mg/L sulfate standard is applicable to portions of the Partridge River and Embarrass River used for the production of wild rice (MPCA 2012a). The MPCA is overseeing a variety of studies relating to sulfate and wild rice, with the goal of informing decisions about state water quality standards. All information provided was considered when the MPCA made their recommendation. Should the application of the standard change, it would be addressed at that time.

Presence of Wild Rice within the NorthMet Project Area

Prior to the NorthMet Project Proposed Action, the existing number, location, extent, and health of wild rice stands within the Partridge River and Embarrass River were unknown. As part of development of the EIS, PolyMet conducted a review of available historic and cultural information, including the report *Natural Wild Rice in Minnesota* (MDNR 2008c), United States Geological Survey (USGS) topographic maps, and a wild rice list provided by the 1854 Treaty Authority. PolyMet also analyzed historic (2004 to 2008) infrared aerial photographs and consulted with persons and groups knowledgeable about wild rice to identify potential wild rice locations along the Partridge River and Embarrass River, including: Wyman Creek, a tributary of the Partridge River; Spring Mine Creek, a tributary of the Embarrass River; and downstream on the St. Louis River. They also surveyed Hay Lake and Little Rice Lake, which are not in the Embarrass River or Partridge River watersheds, but were included as potential control sites for future monitoring of wild rice presence and health. Based on this analysis, field surveys were conducted in potential wild rice areas during August and September 2009 using a protocol adapted from the 1854 Treaty Authority. The location and both qualitative and quantitative estimates of density and crop acreage were recorded. Qualitative estimates recorded approximate stand density using a density factor with a scale of 1 (low density) to 5 (high density), similar to a method used by the 1854 Treaty Authority. Quantitative estimates of wild rice density and coverage were determined by sampling representative grids. Sulfate monitoring was also conducted during the wild rice survey (Barr 2011a; Barr 2012a; Barr 2013l). The 2009 survey was followed by surveys in 2010, 2011, 2012, 2013, and 2014.

Results of the 2009, 2010, and 2011 sulfate monitoring are shown in Figure 4.2.2-3. Wild rice survey and water quality monitoring results for each waterbody are provided in Table 4.2.2-3 for survey years 2009 to 2012 (Barr 2010a; Barr 2011a; Barr 2012a; Barr 2013l; Barr 2013p).

Waterbodies at least partially surveyed during these surveys include the upper Embarrass River and its tributaries (Spring Mine, Trimble, and Unnamed creeks), the Embarrass River chain of lakes (including Sabin, Wynne, Embarrass, Lower Embarrass, Unnamed, Cedar Island, Fourth and Esquagama lakes), the lower Embarrass River, the upper Partridge River, Colby Lake, the lower Partridge River and tributaries to the Partridge River (including Wyman and Second Creeks). The results over the years of the surveys indicate some variability in the location and density of observed wild rice and in associated water column sulfate concentrations between survey years. The 2012 survey showed generally fewer and less dense stands of wild rice than were observed in the 2009 to 2011 surveys.

To identify which of these waters within the NorthMet Project area were to be considered as water used for production of wild rice to which the current 10 mg/L wild rice sulfate water quality standard applies, MPCA had previously developed a draft staff recommendation (MPCA 2012b) that specified the following waters:

- Embarrass Lake;
- The northernmost tip of Wynne Lake (Embarrass River inlet);
- The segment of the Embarrass River from MN Highway 135 bridge to the inlet of Sabin Lake;
- The portion of Upper Partridge River from river mile approximately 22 just upstream of the railroad bridge near Allen Junction to the inlet to Colby Lake;
- The portion of Lower Partridge River from the outlet of Colby Lake to its confluence with the St. Louis River; and
- The portion of Second Creek from First Creek to the confluence with Partridge River.

This draft MPCA staff recommendation was developed in anticipation of eventual NPDES/SDS permitting. Since the development of the draft staff recommendations, the MPCA has conducted preliminary evaluations of data collected as part of its legislatively mandated wild rice study and has identified conceptual approaches to revising both the numeric sulfate water quality standard of 10 mg/L and the identification of what waters would be subject to any revised standard (for wild rice waters). These conceptual approaches will continue to evolve, eventually resulting in a proposed rule. The proposed rule will also likely evolve during the rulemaking process. Because the final outcome of the evaluations and rulemaking is uncertain, this FEIS relies on the current sulfate water quality standard of 10 mg/L that is being applied to the waters specifically identified in the previously developed draft MPCA staff recommendations for its analysis of potential impacts in this FEIS.

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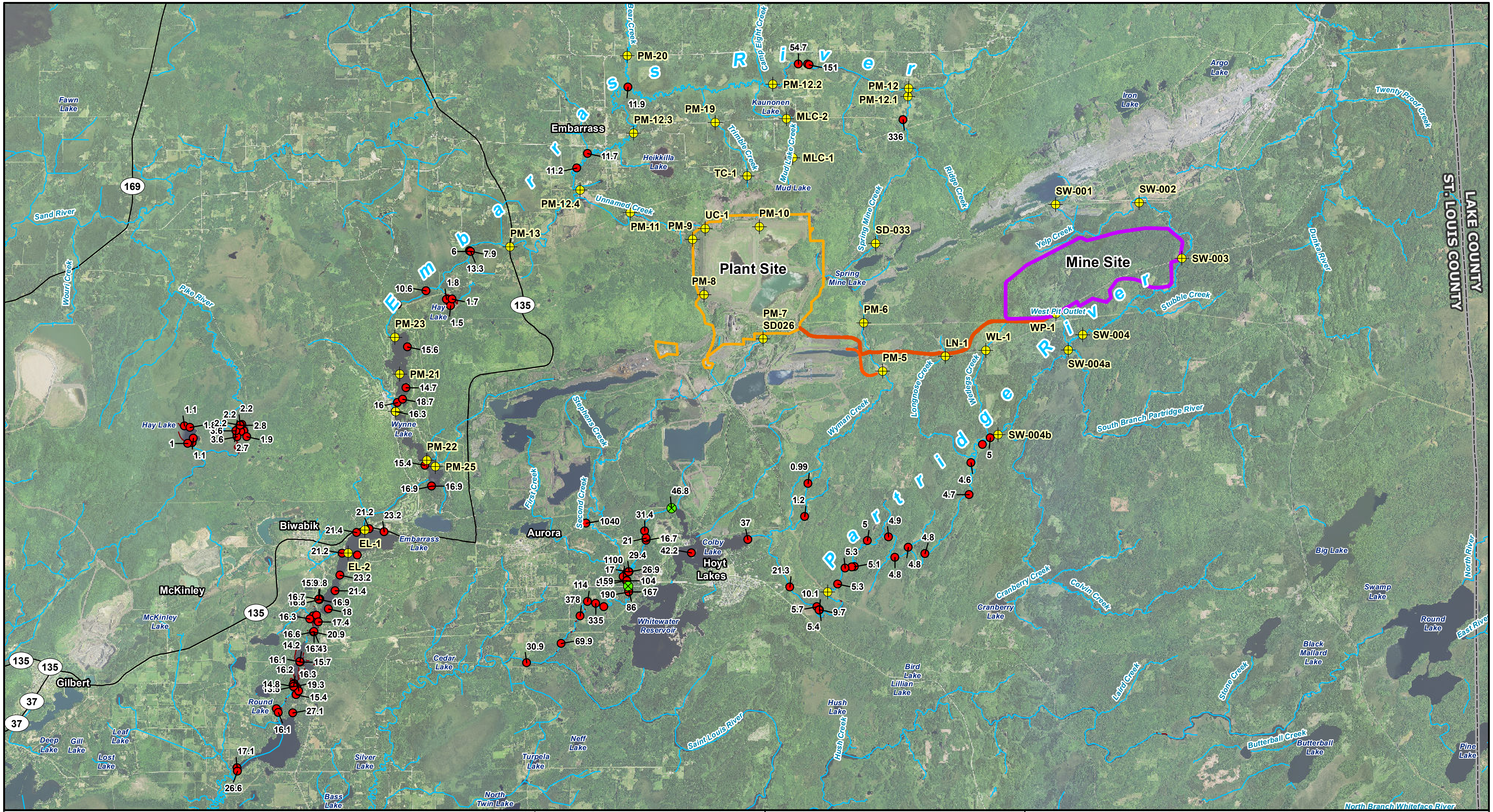

Mine Site	Surface Water Monitoring Station
Plant Site	Mesabi Nugget Surface Water Monitoring Data - Aug. 19, 2009 (values are for sulfate concentration in mg/L)
Transportation and Utility Corridor	2009-2013 Wild Rice Surveys Sulfate Sampling Locations with Sulfate Listed in mg/L
Stream/River	

MNDNR

US Army Corps of Engineers St. Paul District

0 0.5 1 2 3 4 Miles

Figure 4.2.2-3
Sulfate Sampling Locations

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Table 4.2.2-3 Wild Rice Survey and Water Quality Monitoring Results

Locations Surveyed	Survey Year	Wild Rice Found?[1]	Density Factor[2] (Scale 1-5)	Sulfate Range[3] (mg/L)
Partridge River Watershed				
Upper Partridge River (above Colby Lake, portions)	09, 10, 11, 12	Yes (isolated)	1–3	5–21
Colby Lake	09, 10	No	---	37–42
Lower Partridge River (below Colby Lake)	09, 10, 11, 12	Yes	1–5	17–411
Wyman Creek	11, 12	No	---	---
Second Creek (portions)	09, 10, 11, 12	Yes (near mouth)	1–4	1,100
Embarrass River Watershed				
Upper Embarrass River (Spring Mine Creek to Sabin Lake)	09, 10, 11, 12	Yes (isolated)	1	6–151
Sabin - Wynne Lakes	09, 10, 11, 12	Yes (isolated)	1	15–16
Chain of Lakes (including Embarrass, Lower Embarrass, Cedar Island, Esquagama, Unnamed, and Fourth)	09, 10, 11, 12	Yes	1–5	14–27
Lower Embarrass River (Esquagama Lake to CR 95)	09, 10	No	---	---
Spring Mine Creek (portions)	09, 10, 11, 12	No	---	---
Trimble and Unnamed Creeks (portions)	10, 11, 12	No	---	---

Sources: Barr 2010c; Barr 2011a; 2012a; Barr 2013l; Barr 2013p.

Notes:
[1] "Yes" indicates that wild rice was observed in at least one of the survey years. Simply finding wild rice in a survey is not the same as being designated a water used for the production of wild rice.
[2] Informal observational scale of relative wild rice density (1 – low density to 5 – high density)
[3] Range of water column sulfate concentration taken at time of wild rice survey. Samples were only taken when and where wild rice was observed. Values rounded to nearest 1 mg/L. Sample sizes were low resulting in relatively large variability within some individual waterbodies.

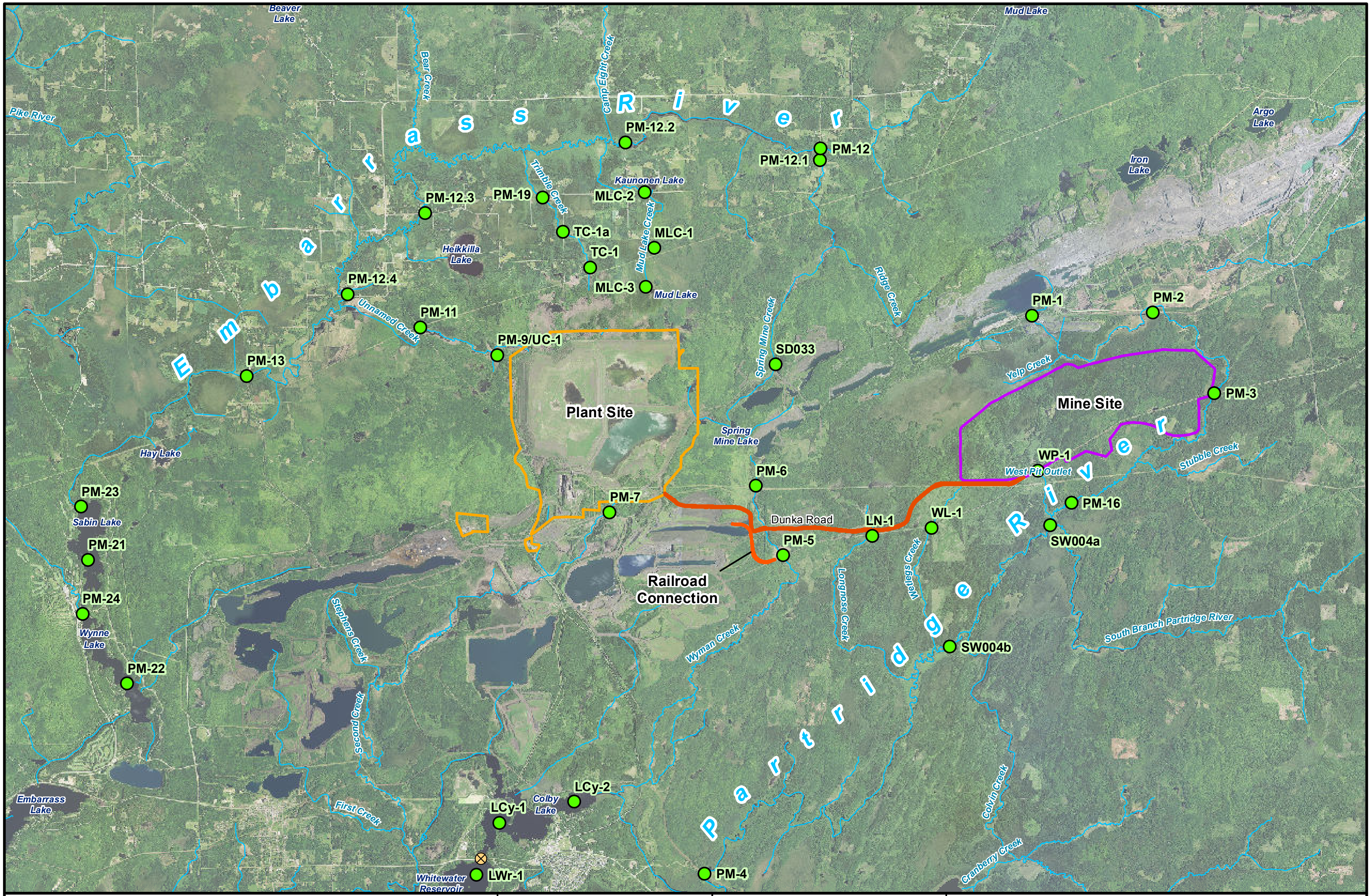
Surveys of the St. Louis River from Brookston to Lake Superior were conducted in 2009 and from the NorthMet Project area to the St. Louis Estuary in 2010. Wild rice was identified on the St. Louis River for a short distance downstream from its confluence with the Partridge River. The most dense stand (density factor of 2) was located just upstream of Highway 100, and a few sparse stands were also located approximately 500 and 1,000 ft further downstream (see Figure 4.2.2-3). Sulfate concentrations in 2010 in the St. Louis River near Highway 100 averaged 17.7 mg/L.

4.2.2.1.4 Mercury

Based on sampling done for the NorthMet Project Proposed Action from 2004 to 2013, total mercury concentrations in the Upper Partridge River average about 3.3 ng/L (Barr 2014m). At monitoring station SW-005, total mercury concentrations range from below the analytical detection limit to a maximum of 18.4 ng/L, with an average concentration of 4.3 ng/L. In Colby

Lake, total mercury concentrations are between 4.6 and 8.7 ng/L, averaging 6.0 ng/L. Total mercury concentrations are similar in the Embarrass River, averaging 5.1 ng/L at monitoring station PM-12 and 4.3 ng/L at monitoring station PM-13 from 2004 to 2013 (see Table 4.2.2-4). Methylmercury concentrations in the Partridge River at SW-005 average 0.41 ng/L (see Table 4.2.2-14) and in the Embarrass River average 0.53 ng/L at PM-12 and 0.38 ng/L at PM-13 over the same period (see Table 4.2.2-30). In addition, mercury monitoring has occurred at other locations in and near the existing LTVSMC Tailings Basin (see Table 4.2.2-4 and Figure 4.2.2-4). Generally, total mercury concentrations are consistent with baseline levels, averaging less than 2.0 ng/L. Sample locations in and near the existing LTVSMC Tailings Basin were well below average concentrations in precipitation (approximately 13 ng/L; PolyMet 2015m).

A QA/QC review was conducted to assess the monitoring performance which includes monitoring for mercury. This review was performed in accordance with Barr Engineering Standard Operating Procedure for data validation, which is based on *The National Functional Guidelines for Inorganic and Organic Data Review* (USEPA 2004b and 2005b). Both laboratory and field sampling procedures were examined in the review of the data for the respective sampling events. Field sampling procedures were examined utilizing field blank and equipment blank analysis and blind field duplicate data. Laboratory procedures were evaluated by examining recommended holding times and preservation, laboratory blank analyses, laboratory control samples and laboratory control sample duplicates, duplicate analysis, matrix spikes and matrix spike duplicates, and laboratory duplicate data (PolyMet 2015m; PolyMet 2015j).



- Surface Water Monitoring Location
- Diversion Works
- Stream/River
- Mine Site
- Plant Site
- Transportation and Utility Corridor

MNDNR
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

N W E S

0 0.5 1 2 3 Miles

Figure 4.2.2-4
Additional 2009 Baseline Monitoring Stations for Sulfate and Mercury
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Table 4.2.2-4 Summary of Total Mercury Concentrations in the Partridge River and Embarrass River Watersheds near the Mine Site and Plant Site

			Mercury Concentrations		
Location[1]	**Dates**	**# of Detections**	**Mean[2] (ng/L)**	**Range (ng/L)**	**# Exceeding 1.3 ng/L[3]**
Partridge River					
SW-001	2004, 2006, 2008	5 of 10	2.3	<1–<5	5
SW-002	2004, 2006, 2012, 2013	10 of 15	2.7	<2–<5	12
SW-003	2004, 2006–2008, 2012, 2013	19 of 31	2.8	<1–7.8	24
SW-004	2004, 2006–2008, 2010, 2012, 2013	23 of 33	3.3	<0.25–8.7	27
SW-004a	2010, 2012, 2013	11 of 11	4.1	0.79–12.5	8
SW-004b	2010, 2012, 2013	11 of 11	5.4	0.82–18.5	10
SW-005	2004, 2006– 2008, 2010, 2012, 2013	22 of 33	4.3	<0.25–18.4	28
Creeks, Partridge River Watershed					
LN-1	2011–2013	13 of 13	3.5	1.2–9.2	12
WP-1	2011–2013	6 of 6	13.9	5.1–28.1	6
WL-1	2011–2013	12 of 12	5.0	2.1–9.8	12
PM-5	2004, 2011–2013	22 of 27	1.2	<0.25–3.4	9
PM-6	2004, 2013	4 of 5	3.5	<0.25–7.9	3
Lakes (Surface), Partridge River Watershed					
Colby Lake	2008, 2013	9 of 9	6.0	4.6–8.7	9
LTVSMC Tailings Basin Surface Water Seepage					
PM-9	2001–2006	12 of 65	1.8	0.7–4.1	6
PM-10	2001–2007	14 of 66	1.4	0.6–2.3	7
SD-004	2002–2009	23 of 23	1.4	<0.25–4.5	6
SD-005	2001–2004	2 of 18	1.6	1.2–2	1
PM-8	2001–2006	13 of 17	1.7	0.5–4.6	7
WS013	2001–2005	7 of 29	2.1	0.9–6.3	2
Cell 1E	2002–2003	3 of 25	0.2	<0.1–1	0
Cell 2E	2001–2003	3 of 20	0.35	<0.1–3.6	1
Cell 2W	2001	0 of 8	<0.1	NA	0
Emergency Basin	2001–2005	12 of 41	0.7	<0.1–4.2	10
West Seep	2001–2003	1 of 17	0.23	<0.1–<1.25	0
Embarrass River					
PM-13	2004, 2006–2008, 2012, 2013	23 of 35	4.3	<1–12.4	29
PM-12	2004, 2006–2008, 2012, 2013	28 of 34	5.1	<1–<10	33
Creeks, Embarrass River Watershed					
PM-11	2004, 2006, 2008, 2011–2013	24 of 30	2.5	<0.25–<10	19
PM-19	2011–2013	26 of 26	1.5	0.5–5.1	7
PM-20[(4)]	2009	8 of 8	2.5	1.3–4	7
TC-1	2012	1 of 1	1.1	1.1–1.1	0
TC-1A	2012, 2013	4 of 4	2.5	0.9–5.1	2
MLC-1	2011–2013	7 of 7	2.2	1.1–4	6
MLC-2	2011–2013	14 of 14	3.1	0.9–6.5	12
MLC-2/MLC-3A	2012	1 of 1	0.99	0.99–0.99	0

Location[1]	Dates	# of Detections	Mercury Concentrations Mean[2] (ng/L)	Range (ng/L)	# Exceeding 1.3 ng/L[3]
Lakes (surface), Embarrass River Watershed					
PM-23/Sabin Lake	2009	5 of 5	3.19	1.9–4.8	5
PM-21/Sabin Lake	2009	5 of 5	3.26	2.1–5.5	5
PM-22/Wynne Lake	2009	5 of 5	3.12	2–5	5
PM-24/Wynne Lake	2009	5 of 5	3.56	3.2–4.3	5
PM-25	2009	3 of 3	6.47	4.9–8.1	3
Wetlands					
Wetland 003	2002–2005	7 of 12	2.2	<1 to 4.4	7
Wetland North	2002–2005	8 of 11	3.6	<1 to 6.7	8

Sources: Barr 2007h; Barr 2006f; Barr 2009c; Barr 2010c; Barr 2014d.

Notes:
1 See Figures 4.2.2-1, 4.2.2-4, 4.2.2-11, 4.2.2-13, and 4.2.2-15.
2 Where non-detects occur, the mean was calculated using half the detection limit.
3 Minnesota Class 2B Lake Superior standard for mercury.
4 Dissolved mercury concentrations are presented in the table for PM-20, as only dissolved samples were collected and analyzed for this sample location.

The MDNR has additionally conducted numerous research studies regionally and in the St. Louis River watershed specifically. The river and its tributaries frequently have mercury concentrations that exceed the 1.3 ng/L standard, especially in the weeks following major storm events. The vast majority of the mercury carried in the river is bound to dissolved organic carbon that is derived from wetland areas and riparian soils (summarized in Berndt et al. 2014).

4.2.2.2 Partridge River Watershed

This section describes the baseline hydrology and water quality for the groundwater and surface water within the Partridge River Watershed portion of the NorthMet Project area. This includes all of the Mine Site and the Transportation and Utility Corridor, as well as the former LTVSMC processing plant and a small portion of the Tailings Basin.

4.2.2.2.1 Groundwater Resources

This section describes the geology and hydrogeology of the NorthMet Project area and the groundwater resources at the Mine Site that could be affected by the NorthMet Project Proposed Action. Since the publication of the DEIS, additional groundwater monitoring wells were installed and data collected to better describe the groundwater resources at the Mine Site.

In total, 24 monitoring wells were installed in the surficial aquifer and 9 in bedrock (see Figure 4.2.2-8). Six or more groundwater samples have been collected for chemical analysis from each of those wells, except one surficial aquifer well that was dry after the first sampling (so it only provided a single sample) and three bedrock wells that were also sampled once only. A statistical analysis indicated that the total number of groundwater quality samples was sufficient to satisfy the USEPA’s request that an uncertainty range around the estimate of average concentration for each solute could be identified such that there was a less than 5 percent probability that the actual average would be outside of this range (Barr 2012p).

This section describes available baseline data on the hydraulic properties of the rocks and sediments at the Mine Site, the rationale for assessing its adequacy, and a summary of specific values for Mine Site baseline aquifer characteristics.

Geology of the Mine Site

The surficial materials overlying the bedrock at the Mine Site are 0 to 60 ft thick and include glacial deposits. The glacial deposits consist of two layers of glacial till, outwash, and reworked glacial sediments (collectively referred to as “drift”). There are also extensive wetlands and the potential for limited alluvium. The upper till (the Rainy Lobe till) has been described at a regional scale as an unsorted sandy loam mixture with pebbles, cobbles, and boulders (Jennings and Reynolds 2005). Soil borings collected from within the Mine Site are generally consistent with this description, indicating that the upper till has a composition ranging from very dense clay to well-sorted sand. In some of the borings, a second till was encountered at depth, and is sometimes separated from the upper till by outwash sand. Neither the outwash nor the lower till are laterally continuous (PolyMet 2015m). For additional details on the tills encountered at the Mine Site, see PolyMet 2015m. Figure 4.2.2-5 shows the Mine Site’s surficial geology.

The NorthMet Deposit is below the till in the layered mafic intrusive rocks of the Partridge River Intrusion, which are part of the Duluth Complex. The north edge of the Duluth Complex within the Mine Site contacts the Virginia Formation, (see Figure 3.2-10). The Virginia Formation lies above the Biwabik Iron Formation, which hosts several large taconite iron ore mines.

More than 10 copper-nickel-PGE zones of mineralization have been identified along the northern margin of the Duluth Complex. Those deposits consist of disseminated copper-nickel-iron sulfides, with minor local massive sulfides, hosted in layered troctolitic (plagioclase and olivine with minor pyroxene) rocks that are located at the base of the Duluth Complex. Drilling within the Partridge River Intrusion (over 1,100 drill holes) has identified seven igneous stratigraphic rock units dipping southeast within the Partridge River Intrusion (see Figure 3.2-10). Unit 1, which hosts much of the NorthMet economic sulfide mineralization, is the oldest and lower-most layer.

The footwall rocks below the NorthMet Deposit consist of metamorphosed Paleoproterozoic sedimentary rocks. The youngest of these metasedimentary rocks is the Virginia Formation, which directly underlies the intrusive Unit 1 across all of the NorthMet Project area (i.e., the Duluth Complex contacts only the Virginia Formation – it does not contact the older sedimentary formations). The Virginia Formation consists of a thinly bedded sequence of metamorphosed argillite and greywacke. During mining operations, the Virginia Formation would be exposed along the northern wall of the East Pit.

Underlying the Virginia Formation is the Biwabik Iron Formation, which is the source of taconite iron ore. That formation also hosts an important water resource tapped by residential and community wells in the region. Current drilling and interpolation of geology between drill holes in the NorthMet deposit indicates that the mine pits at their final phase of development would retain an approximate 130 to 150 ft separation from the Biwabik Iron Formation (PolyMet 2014q). The oldest of the sedimentary rocks present in the proposed mining area is the Pokegama Quartzite. These sedimentary rocks are underlain by Archean granite of the Giants Range batholith and associated metamorphic rocks.

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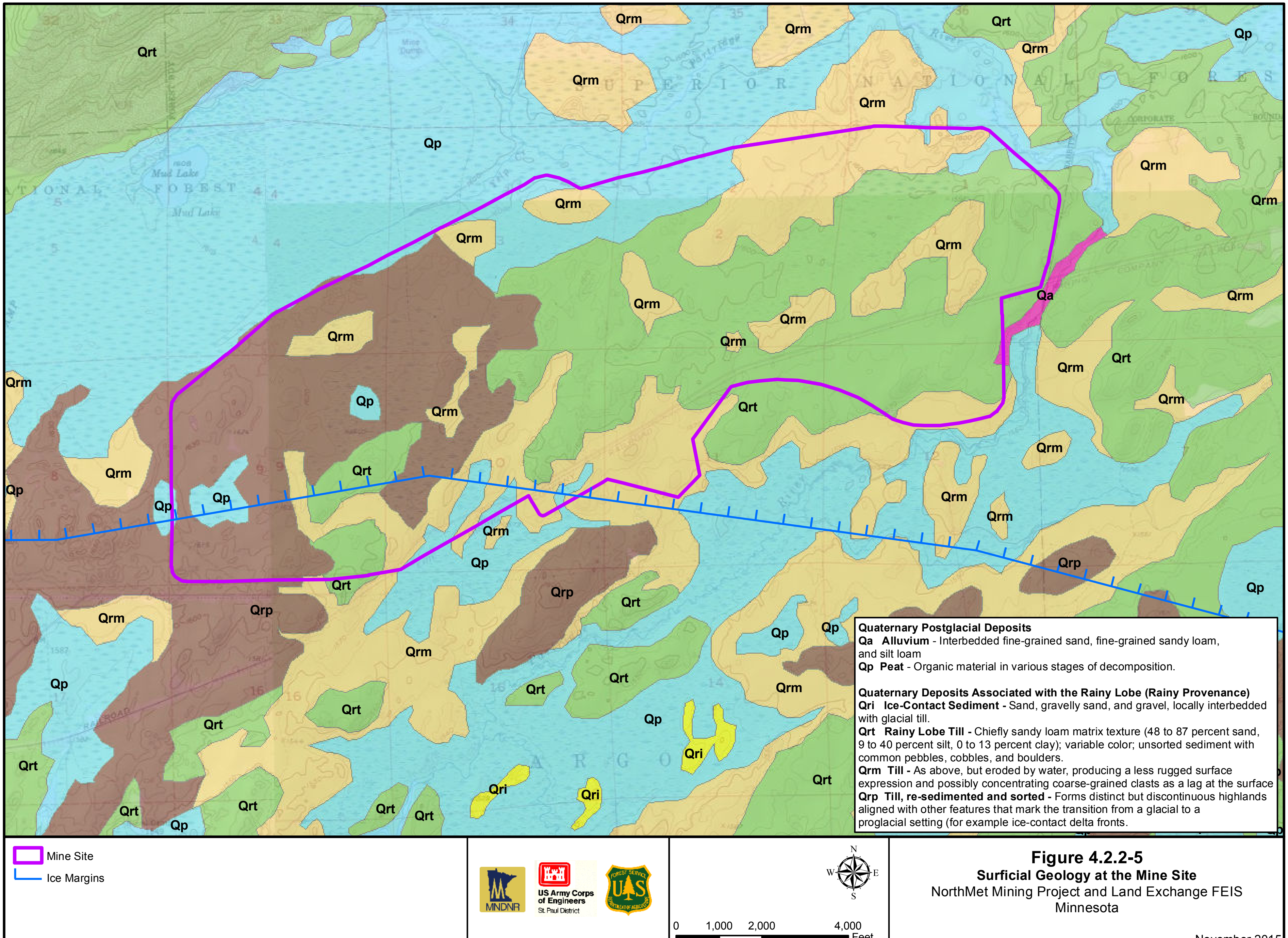

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Figure 4.2.2-5
Surficial Geology at the Mine Site
NorthMet Mining Project and Land Exchange FEIS
Minnesota

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Hydrogeology of the Mine Site Surficial Deposits and Bedrock Units

The bouldery till of the Rainy Lobe that covers the majority of the Mine Site has an estimated hydraulic conductivity range of 0.1 to 30 ft/day (Siegel and Ericson 1980). Lab permeameter tests on the silty sand from drill core and test trenches at the Mine Site found the hydraulic conductivity values to be 0.00043 to 0.0081 ft/day; however, these tests were conducted on reconstituted and compacted material, and are not considered representative of the in situ condition of the Mine Site surficial deposits. Field testing of the various unconsolidated deposits found a range of hydraulic conductivity values from 0.012 to 31 ft/day (Barr 2006b).

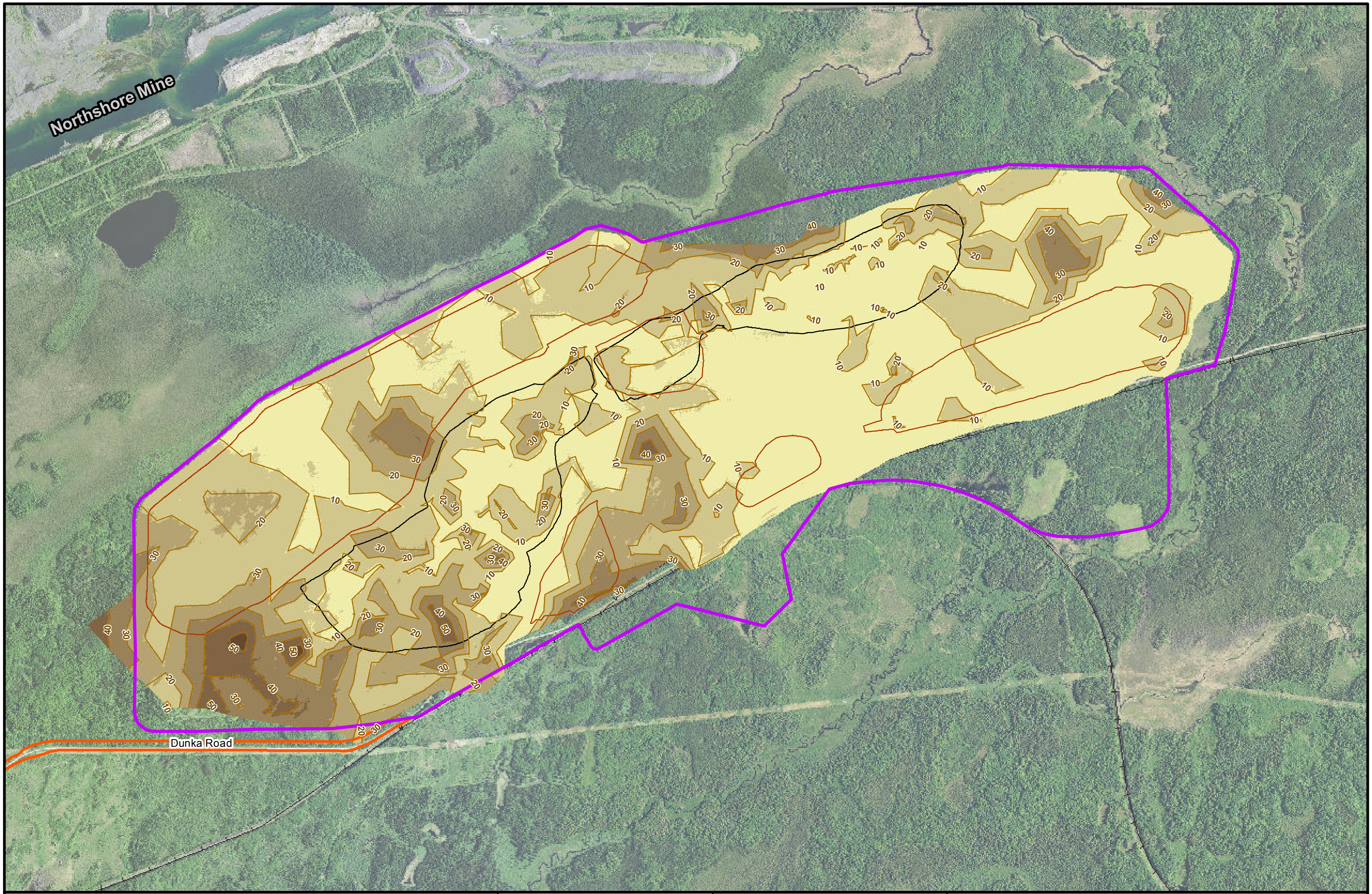
The Biwabik Iron Formation has a relatively high permeability, whereas the Virginia Formation and Duluth Complex are less permeable (Siegel and Ericson 1980). PolyMet conducted several aquifer tests to characterize the hydraulic conductivity and specific storage values for the bedrock units underlying the Mine Site (see Table 4.2.2-5). No hydraulic testing of the Biwabik Iron Formation was done within the NorthMet Project area. However, the tests conducted outside the NorthMet Project area (see Table 4.2.2-5) and the ongoing use of the Biwabik Iron Formation as a source of water in the region document that it is characterized by the highest bedrock hydraulic conductivity, followed by the Virginia Formation, with the Duluth Complex having conductivity at least one order of magnitude lower.

Hydraulic characteristics of these various geologic units in the Mine Site were determined from the following series of aquifer pumping tests (PolyMet 2015m):

- Ten aquifer tests conducted using borings in the surficial aquifer (including three borings that were turned into permanent monitoring wells; see PolyMet 2015m);
- Ten aquifer performance tests conducted using boreholes completed in the Duluth Complex bedrock (PolyMet 2015m);
- Four aquifer tests conducted on the Virginia Formation bedrock (conducted using wells P1 through P4, with monitoring in six observation wells, Ob-1, Ob-2, Ob-3, Ob-3a, Ob-4, and Ob-5, plus a water supply well; see PolyMet 2015m);
- One long-term (30-day) aquifer test conducted using bedrock well P-2, with water levels monitored in wetland piezometers located north of the pumping well (PolyMet 2015m); and
- Specific capacity tests conducted using P-3 and P-4, which are open exclusively in the Virginia Formation (PolyMet 2015m).

A range of specific storage values for the bedrock (i.e., 2.3×10^{-5} to 5.5×10^{-7} ft^{-1}) was determined using the aquifer tests' time-drawdown data collected from the observation wells. The specific capacity tests conducted using two wells indicated that the upper portion of the Virginia Formation is more permeable than its lower portion (Barr 2007a). This is interpreted to indicate higher density of fractures and joints in the bedrock closer to the surface.

In Northeastern Minnesota, groundwater flow within the bedrock is primarily through fractures and other secondary porosity features as the rocks have low matrix hydraulic conductivity. Typically, groundwater in the shallow bedrock is hydraulically connected with the overlying surficial deposits, resulting in similar flow directions, both in bedrock and surficial deposits (Barr 2007c). For the NorthMet Project site, this connection is in many instances weak or non-existent (PolyMet 2015m). Figure 4.2.2-6 shows the depth to bedrock at the Mine Site. Because of the shallow water table and the generally thin layer of surficial deposits, flowpaths within the surficial deposits are generally thought to be short, with groundwater recharge areas located not far from the discharge areas.



Mine Site
Transportation and Utility Corridor
Proposed Stockpile
Proposed Mine Pit
10-ft Contour

Depth to Bedrock (ft)

0 - 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 58

Existing Railroad

MNDNR
US Army Corps of Engineers
St. Paul District

N
W E
S

0 750 1,500 3,000 Feet

Figure 4.2.2-6
Mine Site Depth to Bedrock
NorthMet Mining Project and Land Exchange FEIS
Minnesota

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Table 4.2.2-5 Bedrock and Surficial Aquifer Hydraulic Conductivity Estimates at the Mine Site

		Hydraulic Conductivity (ft/day)	
Aquifer	**Test Methods**	**Range**	**Geometric Mean**
Surficial	Lab permeability tests on silty sand samples	$4.3x10^{-4}$ to $8.1x10^{-3}$(1)	NA
	Single-well tests	$1.2x10^{-2}$ to $3.1x10^{1}$	NA
Duluth Complex	Single-well tests on exploratory borings (5 tests in southern portion of West Pit; 5 tests close to contact with Virginia Formation)	$2.6x10^{-4}$ – $4.1x10^{-2}$(2)	$2.3x10^{-3}$
Virginia Formation - Upper Portion	4 pumping wells with observation wells	$2.4x10^{-3}$ - 1.0(3)	0.17
Virginia Formation - Lower Portion	Single well aquifer tests on 2 wells	NA(4)	0.047
Biwabik Formation	Region-specific capacity pumping tests (not at Mine Site)	0.9(5)	

Sources: [1] Appendix B in RS22, Draft 03, Barr 2008d; [2] RS02, Barr 2006b; [3] RS10, Barr 2006c; [4] RS10A, Barr 2007a; [5] Siegel and Ericson 1980; PolyMet 2015m.

Note:
ft/day = feet per day

Concerns have been raised that fractures, including faults and fracture zones, may exist that could permit transmission of groundwater through the bedrock over considerable distances. Such fractures have been identified elsewhere on the Canadian Shield. Foose and Cooper (1978; 1981) investigated fracturing and faulting in the Duluth Complex. They inferred numerous faults and fractures in their surface mapping of the Harris Lake area (which is about 36 miles from the NorthMet Project area). They used truncations in igneous stratigraphy to infer faults (i.e., lateral offset of anorthosite layers). Truncations such as these have more recently been interpreted to be the edges of irregularly oriented and erratic blocks of anorthosite that were entrained into the magma body (Miller and Weiblen 1990; Namur et al. 2011; and Ripley 2014). This current explanation for Foose and Cooper's (1981) field relationships does not support a theory that widespread faulting and fracturing is prevalent in the Duluth Complex.

The Duluth Complex at NorthMet consists of geotechnically good to excellent quality rock with very few fractures (Barr 2014b). Despite the general competency of Duluth Complex rock, brecciated intervals (up to several feet thick) and fault gouge mineralization was noted in the exploration cores from the NorthMet Project area. Specific correlations between boreholes could not be delineated, but the locations of these zones may correlate with several high-angle normal faults identified by geologic offsets in the footwall (PolyMet 2007b). The footwall faults generally trend to the northeast across the site and have downward offset to the southeast, which is consistent with the Mid-Continent Rift. One exploration borehole at the Minnamax prospect encountered groundwater at a depth of 1,390 ft in the Duluth Complex that had artesian flow for a period of 6 days (Barr 1976). However, none of the other 12 exploration borings completed on the prospect encountered similar conditions, indicating that the artesian conditions were localized, and that there is not extensive hydrogeological interconnection of bedrock fracture or fault zones across the area of that prospect. No artesian flows were encountered in any of the boreholes completed within the NorthMet Project area. Repeated glaciation over the past two million years eroded and removed the highly weathered upper zone of bedrock (the "regolith")

(Farvolden et al. 1988). However, increased groundwater flow likely occurs through shallow bedrock that is more fractured than deeper bedrock

Over 14,000 rock quality designation (RQD) measurements for the Duluth Complex were taken using rock cores obtained from hundreds of Mine Site boreholes. RQD is a measure of fracture density in a segment of rock drill core, where 100 percent indicates no breaks and 0 percent indicates that all pieces of core within a core run are less than 10 centimeters long. The collected RQD data indicate that the upper 5 to 15 meters of bedrock tend to be more fractured and have higher hydraulic conductivity than deeper bedrock (Barr 2014b).

The overlying surficial deposits at the Mine Site are poorly sorted and range from very dense clay to well-sorted sand with boulders and cobbles (Barr 2006b; Golder 2007). Hydraulic testing indicates that these deposits may contain layers of relatively low hydraulic conductivity. Shallow well testing, however, documented a much higher average hydraulic conductivity than underlying bedrock (see Table 4.2.2-5). Shallow borings and test trenches at the Mine Site encountered bedrock at depths ranging from 3.5 to 17 ft below ground surface.

The site exploration drilling database, drilling logs, and electrical resistivity data were used to develop an estimated depth-to-bedrock isopach map (Golder 2007). The picture presented on that map is consistent with the more limited boring and trenching data. These data indicate that surficial deposits at the Mine Site are less than 20 ft thick over more than 75 percent of the area, and less than 30 ft in thick over 92 percent of the area. The isopach contouring indicates the presence of local depressions in the bedrock surface where surficial deposits may be up to 60 ft thick. However, no laterally continuous bodies of highly permeable outwash sands and gravel were identified that might serve as preferential groundwater conduits through the surficial deposits.

The Mine Site is covered by extensive wetlands. In some areas, many wetlands have only minimal hydraulic connection to the underlying groundwater. This interpretation is based on well logs, soil borings, available soil mapping, and the results of wetland characterization field investigations. In particular, a 2010 field survey focused on identifying the fraction of wetlands in the NorthMet Project area that were "ombrotrophic bogs." These bogs form when sphagnum peat accumulation rises above the groundwater table, which reduces inputs of minerals and nutrients from groundwater. Thus, ombrotrophic bogs are wetlands almost entirely fed (with water and minerals) from direct precipitation; they have little hydraulic connection to underlying groundwater (Eggers 2011a).

This reclassification was carried out consistent with guidelines provided by the USACE (Eggers 2011a; PolyMet 2015b). The field survey (that was conducted along a representative cross section through the NorthMet Project area) recorded those parameters that distinguish the ombrotrophic bogs from the more hydraulically connected wetlands. The survey recorded vegetation species, percent areal cover of Sphagnum mosses (high sphagnum cover is associated with bogs), pH, and specific conductivity (ombrotrophic bogs tend to have lower pH and conductivity than hydraulically connected wetlands). The survey results indicated that wetlands within the Mine Site are ombrotrophic (Eggers 2011a). The other wetland communities at the Mine Site include shrub swamps, coniferous swamps, shallow marsh, wet/sedge meadows, open bogs, and hardwood swamps, which may receive some portion of their water from groundwater.

Water table elevations document that surficial and bedrock groundwater south of the Mine Site generally flows south to southeast, toward the Partridge River, which is the major discharge point for the area (see Figure 4.2.2-7). MDNR well records within the NorthMet Project area indicate that water table levels vary seasonally between 3 and 10 ft bgs. At the Mine Site, depth to groundwater is generally less than 5 ft bgs (Barr 2006a). Three nested well pairs at the Mine Site (MW-6S/MW-6D, MW-08S/MW-08D, and MW-10S/MW-10D) allow for evaluation of vertical hydraulic gradients in the surficial deposits. For the nested pairs at MW-6 and MW-8, the vertical hydraulic gradients are small (approximately 0.02 ft/ft) and indicate either upward or downward groundwater flow. At MW-10, the vertical gradient is larger (approximately 0.1 ft/ft) (PolyMet 2015m). This higher vertical gradient is likely indicative of low vertical K between the measurement points rather than higher vertical flow.

Groundwater elevations measured by PolyMet in Mine Site bedrock boreholes show the hydraulic gradients within bedrock are similar to that of the overlying surficial deposits, which supports the concept of some hydraulic connection between the surficial deposits and bedrock units (PolyMet 2015m). The Regional Copper-Nickel Study (Siegel and Ericson 1980) concluded that recharge to the bedrock is from direct precipitation where bedrock outcrops at the surface, and from seepage through surficial deposits where the top of bedrock is buried (Siegel and Ericson 1980). This study also reported that the upper 200 to 300 ft of the Duluth Complex formation appeared to be fractured and jointed more extensively than at greater depths, so that the upper portion of the bedrock should have greater hydraulic conductivity. More detailed analyses indicate that the hydraulic connection between surficial deposits and the underlying bedrock, although present, is weak or non-existent. Water-table monitoring during a 30-day pumping test at bedrock well P-2 showed only a small amount of drawdown in the nearest deep wetland piezometer, and no detectable drawdown at other water table or deep wetland piezometers (PolyMet 2015m; Barr 2007a).

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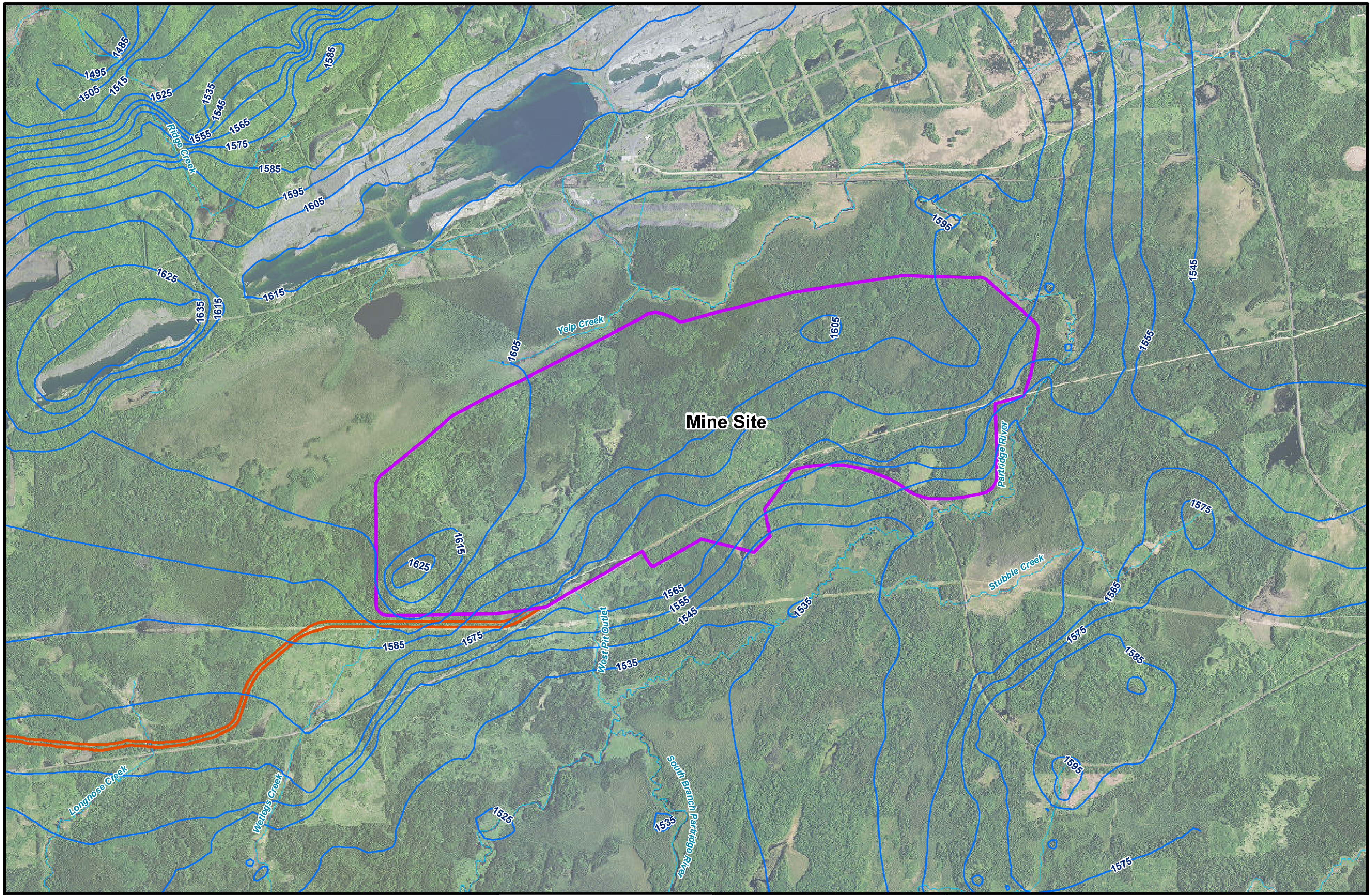

Mine Site
Transportation and Utility Corridor
* Water Table Elevation in Surficial Aquifer (Ft AMSL)
Stream/River

* Source: PolyMet 2015j

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N W E S

0 0.25 0.5 1 Miles

Figure 4.2.2-7
Estimated Existing Groundwater Contours - Mine Site
NorthMet Mining Project and Land Exchange FEIS
Minnesota

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Because of the shallow water table and the generally thin layer of surficial deposits, flowpaths within the surficial deposits south of the Mine Site are generally thought to be short, with groundwater recharge areas located not far from the discharge areas. The water table is generally a "subdued replica" of the topographic surface, and as a result, surficial groundwater divides generally coincide with surface water drainage divides (PolyMet 2015m, Section 4.3.3.1). Groundwater flow in the surficial aquifer is affected by bedrock outcrops, which cause deviations in the local groundwater flow directions (Siegel and Ericson 1980).

The hydraulic connection between surficial deposits and bedrock is controlled by the vertical hydraulic conductivity of surficial deposits, which is not zero. At the regional scale, the vertical hydraulic conductivity is large enough to create similar hydraulic heads in surficial deposits and upper bedrock. As a consequence, bedrock groundwater flows have similar directions as groundwater in the overlying surficial deposits (PolyMet 2014m; Section 4.3.3.2). Topographic divides are expected to approximate the locations of groundwater flow divides in bedrock.

As recognized in other studies (MDNR 2004; Siegel and Ericson 1980), aquifer testing showed that the ability of the surficial deposits to transmit water was highly variable and depended upon location and thickness of those deposits (see Table 4.2.2-5). No data were available regarding the storage parameters for the surficial deposits.

Baseline Groundwater Quality

Baseline groundwater quality at the Mine Site is characterized using the data collected by PolyMet (PolyMet 2015m) at the following locations (see Figure 4.2.2-8):

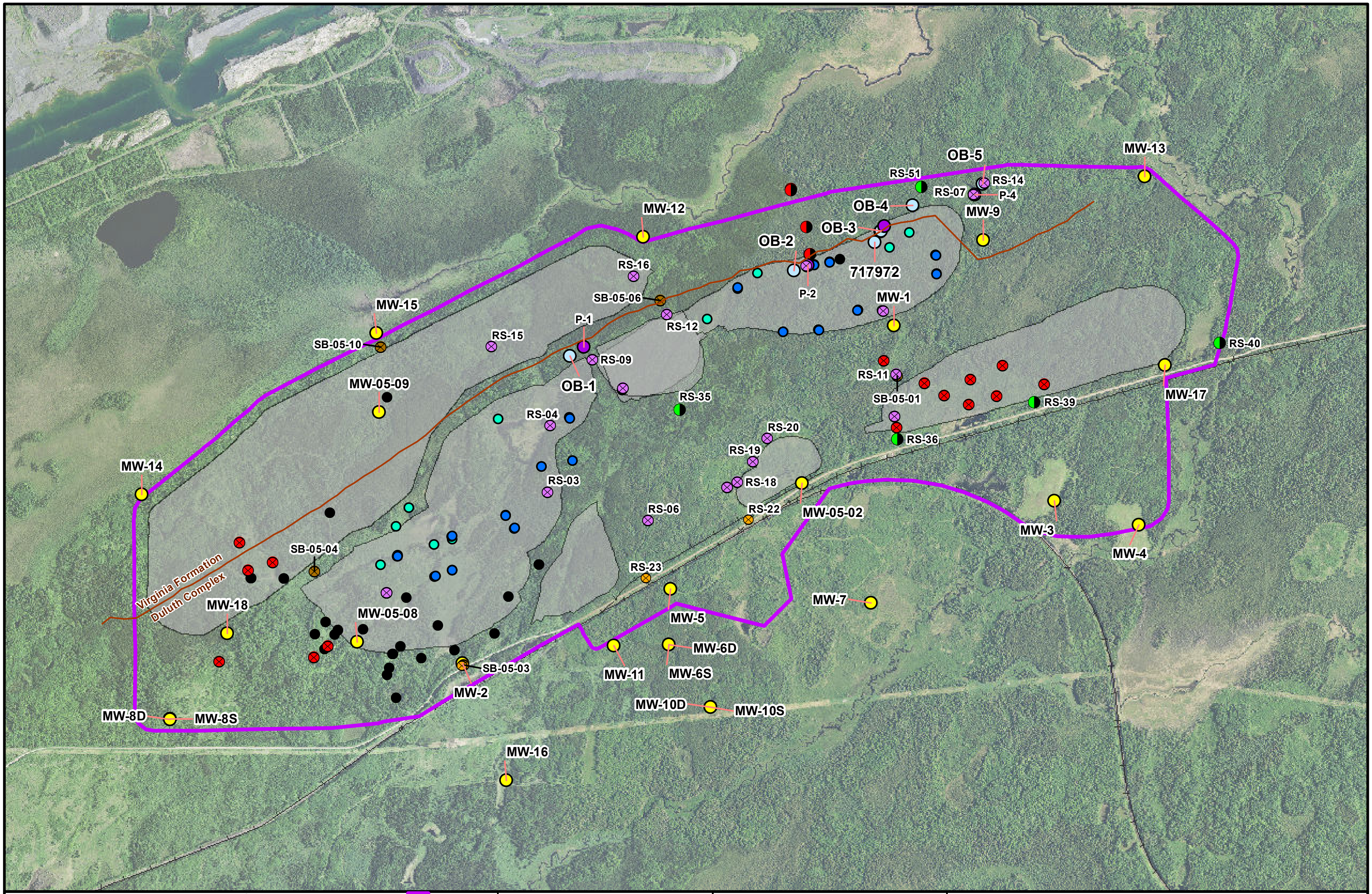
- Three older monitoring wells in the surficial aquifer (MW-05-02, MW-05-08, and MW-05-09), sampled from 2005 through 2013;
- Twenty-one newer wells installed in the surficial aquifer in 2011 and 2012 (MW-1, MW-2, MW-3, MW-4, MW-5, MW-6S, MW6D, MW7, MW-8S, MW-8D, MW-9, MW-10S, MW-10D, MW-11, MW-12, MW-13, MW-14, MW-15, MW-16, MW-17, and MW-18), sampled from 2011 through 2013;
- Five observation wells in the upper 100 ft of the bedrock (ob-1 through ob-5), sampled from 2006 through 2013 (two of those wells are completed in the Duluth Complex and three in the Virginia Formation); and
- Four bedrock wells (P-1, P-2, P-3, and P-4) completed to depths ranging from 485 to 610 ft below grade, which were sampled during aquifer testing in 2005 and 2006.

These samples were subject to standard quality controls (e.g., trip blanks, field blanks, laboratory control and laboratory control duplicates, matrix spike, and matrix spike duplicates, and assessment of holding times) and were acceptable for use in the SDEIS and this FEIS (PolyMet 2015m; Section 4.5.2.1.3). A statistical analysis of the samples from these wells through the end of 2013 was used to estimate baseline groundwater quality in the bedrock unit and surficial deposits, which subsequently was used as input into the Mine Site water quality model. Baseline groundwater quality results are summarized in Table 4.2.2-6.

Surficial Deposits

Water samples collected from the 24 wells completed in surficial deposits at the Mine Site indicate that shallow groundwater generally meets evaluation criteria for all solutes except for aluminum (total and dissolved), beryllium (total), iron (total and dissolved), and manganese (total and dissolved) (see Table 4.2.2-6). Overall pH levels tended toward a circumneutral range (mean of 7.0). The metals exceeding groundwater evaluation criteria (see Section 5.2.2.1) probably reflect natural conditions; there is no record of any historic activities at the Mine Site that could have caused elevated concentrations of these constituents.

These results are generally consistent with the findings presented in the Regional Copper-Nickel Study, which identified concentrations of total cadmium, iron, manganese, and nickel at concentrations above the FEIS groundwater evaluation criteria (see Table 4.2.2-6, with data from Siegel and Ericson 1980). Results from the analysis of water samples collected from the existing USGS and USFS wells completed in the surficial deposits indicate that dissolved concentrations in some locations were at or higher than the groundwater evaluation criteria for aluminum, cadmium, cobalt, iron, manganese, and nickel (see Table 4.2.2-6). Siegel and Ericson (1980) noted that higher concentrations of copper, cobalt, nickel, and sulfate are potentially correlated with proximity to the mineralized contact zone between the Duluth Complex and older rocks, as is the case with the NorthMet Project area, and is probably related to the oxidation of sulfide minerals.



Phase I

- Bedrock Aquifer Testing Location - 2005
- Soil Borings - 2005

Phase II

- Overburden Geochem/Geotech Boring - 2008
- Exploratory Borehole Sump Logging Location - 2010
- Bedrock Groundwater Elevation Measurement - 2006
- Sorption Samplin Location - 2009
- Golder Test Trench - 2006
- Pumping Test Wells - 2005/2006
- Observation Wells - 2005/2006
- Phase III - Wetland Piezometer - 2006
- Rotasonic Borings - 2001/2012
- Surface Monitoring Well
- Mine Site
- Unit Boundary
- Existing Railroad

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N W E S

0 800 1,600 3,200 Feet

Figure 4.2.2-8

Groundwater Sampling at the Mine Site

NorthMet Mining Project and Land Exchange FEIS

Minnesota

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Table 4.2.2-6 Summary of Existing Groundwater Quality Monitoring Data for the NorthMet Mine Site

Parameters	Units	Groundwater Evaluation Criteria	Surficial Aquifer				Surficial Aquifer Northeast MN Baseline[5]	Surficial Aquifer Cu-Ni Study Baseline	Bedrock			
			Detection	Mean[1]	Range	# Exceed	Range	Range	Detection	Mean[1]	Range	# Exceed
General												
Alkalinity	mg/L	--	318 of 320	63.1	<5–263	NA	30–427	--	45 of 48	65.8	<5–115	NA
Ammonia as Nitrogen	mg/L	--	97 of 320	0.25	<0.025–3.5	NA	--	--	9 of 48	0.25	<0.025–0.27	NA
Calcium	mg/L	--	320 of 320	15.3	2.4–38.8	NA	0.2–115	6.0–150	49 of 49	15.9	4.2–32.5	NA
Chloride	mg/L	250	173 of 320	0.71	<0.25–13.2	0	0.3–89	0.1–35	39 of 48	1.1	<0.25–93.1	0
Fluoride	mg/L	2	82 of 320	0.07	<0.05–0.52	0	0.20–1.1	--	27 of 48	0.09	<0.05–1.1	0
Hardness	mg/L	--	320 of 320	66.2	10.3–164	NA	--	--	48 of 48	70.2	15.0–151	NA
Magnesium	mg/L	--	320 of 320	6.8	0.89–18.9	NA	0.1–64.5	1.1–64	48 of 49	7.5	<1–21.6	NA
pH	s.u.	6.5–8.5	318 of 318	7.0	5.0–10.4	**115**	6.0–8.5	5.7–8.0	48 of 48	7.1	6.0–10.4	**15**
Potassium	mg/L	--	320 of 320	1.7	0.27–8.6	NA	<0.12–7.5	--	49 of 49	1.7	0.73–3.44	NA
Sodium	mg/L	--	318 of 320	5.4	<1–29.8	NA	1.7–188	--	39 of 49	5.8	<1–43.9	NA
Sulfate	mg/L	250	310 of 320	9.0	<0.5–104	0	<0.3–377	0.7–450	47 of 48	14.1	<0.5–1,200	**1**
TDS	mg/L	500	310 of 311	144	<5–6,080	**1**	28–1,010	--	30 of 30	126	51.0–214	0
Metals - Total												
Aluminum	µg/L	200	27 of 27	**5,751**	31.6–32,300	**22**	<0.061–870	--	38 of 49	989	<10–6,950	**20**
Antimony	µg/L	6	1 of 27	0.54	<0.25–<1.5	0	<0.01–0.09	--	4 of 49	0.63	<0.25–<1.5	0
Arsenic	µg/L	10	14 of 27	1.8	<0.25–5.8	0	<0.01–42	--	22 of 49	2.3	<0.25–24.1	**3**
Barium	µg/L	2,000	318 of 320	33.5	<5–615	0	1.6–191	--	35 of 49	6.7	<5–32.4	0

Parameters	Units	Groundwater Evaluation Criteria	Surficial Aquifer				Surficial Aquifer Northeast MN Baseline[5]	Surficial Aquifer Cu-Ni Study Baseline	Bedrock			
			Detection	Mean[1]	Range	# Exceed	Range	Range	Detection	Mean[1]	Range	# Exceed
Beryllium	µg/L	0.08	25 of 320	**0.13**	<0.1–1.6	BDL[2]	<0.01–0.41	--	3 of 49	**0.11**	<0.1–0.36	**49**
Boron	µg/L	1,000	17 of 320	27.2	<17.5–99.4	0	<13–709	--	10 of 49	53.2	<25–518	0
Cadmium	µg/L	4	6 of 27	0.15	<0.1–0.56	0	<0.02–0.24	--	4 of 49	1.1	<0.1–48.0	**1**
Cobalt	µg/L	--	22 of 27	3.5	<0.1–23.0	NA	0.02–2.6	--	31 of 49	2.5	<0.1–23.3	NA
Copper	µg/L	1,000	27 of 27	21.7	0.80–99.6	0	<5.5–530	--	36 of 49	7.4	<0.25–46.3	0
Iron	µg/L	300	27 of 27	**6,980**	54.3–44,400	**22**	<3.2–20,207	--	47 of 49	**7,161**	<25–44,300	**36**
Lead	µg/L	--	77 of 320	0.80	<0.25–16.7	NA	<0.03–25	--	10 of 49	0.55	<0.25–2.9	NA
Manganese	µg/L	50	26 of 27	**267**	<15–1,770	**22**	0.9–1,462	--	46 of 49	**112**	<5–383	**26**
Mercury	ng/L	2,000	181 of 320	2.7	<0.25–87.6	0	--	--	25 of 51	0.82	<0.25–4.9	0
Methylmercury	ng/L	--	6 of 26	0.091	<0.0125–0.52	NA	--	--	5 of 51	0.040	<0.0125–0.11	NA
Nickel	µg/L	100	25 of 27	10.6	<1–47.0	0	<6.0–20	--	38 of 49	43.5	<0.25–445	**9**
Selenium	µg/L	30	2 of 27	0.61	<0.5–<1	0	<1.0–11	--	1 of 49	1.0	<0.5–<5	0
Silver	µg/L	30	0 of 27	0.23	<0.1–<1	0	<0.01–0.11	--	0 of 49	0.21	<0.1–<0.5	0
Thallium	µg/L	0.6	16 of 320	0.12	<0.0085–<1	**6**	<0.005–0.032	--	0 of 49	0.37	<0.1–<1	**14**
Zinc	µg/L	2,000	13 of 27	15.5	<3–64.5	0	<2.7–1102	--	21 of 49	17.0	<3–125	0
Metals-Dissolved/Filtered												
Aluminum	µg/L	200	134 of 319	63.9	<10–910	**31**	--	0–280	6 of 49	20.2	<10–127	0
Antimony	µg/L	6	0 of 292	0.26	<0.25–<2.5	0	--	--	--	--	--	--
Arsenic	µg/L	10	140 of 307	0.79	<0.25–6.7	0	--	--	7 of 25	0.57	<0.25–2.5	0
Barium	µg/L	2,000	3 of 4	7.3	<5–11.1	0	--	--	11 of 11	1.4	0.58–3.7	0
Boron	µg/L	1,000	0 of 8	25.0	<25–<25	0	--	--	2 of 15	29.8	<25–65.9	0
Cadmium	µg/L	4	4 of 319	0.10	<0.015–<1	0	--	0–8.4	3 of 48	0.12	<0.1–0.92	0
Cobalt	µg/L	--	165 of 293	0.90	<0.1–8.6	NA	--	--	4 of 11	1.0	<0.1–5.0	NA
Copper	µg/L	1,000	252 of 319	2.6	<0.25–49.0	0	--	0.2 to 190[(4)]	29 of 49	1.4	<0.25–3.5	0
Iron	µg/L	300	157 of 307	**1,910**	<25–25,600	**92**	--	--	11 of 25	**633**	<25–3,240	**8**

Parameters	Units	Groundwater Evaluation Criteria	Surficial Aquifer				Surficial Aquifer Northeast MN Baseline[5]	Surficial Aquifer Cu-Ni Study Baseline	Bedrock			
			Detection	Mean[1]	Range	# Exceed	Range	Range	Detection	Mean[1]	Range	# Exceed
Lead	µg/L	--	0 of 1	0.25	<0.25–<0.25	NA	--	--	0 of 11	0.25	<0.25–<0.25	NA
Manganese	µg/L	50	304 of 310	**288**	<0.25–3,280	**200**	--	--	28 of 30	**81.3**	<5–218	**12**
Nickel	µg/L	100	229 of 319	2.1	<0.25–20.5	0	--	0.7–120	37 of 49	24.1	<0.25–158	**8**
Selenium	µg/L	30	2 of 319	0.54	<0.1–<5	0	--	--	0 of 48	0.64	<0.5–<1	0
Silver	µg/L	30	0 of 319	0.11	<0.1–<1	0	--	--	0 of 48	0.21	<0.1–<0.5	0
Vanadium	µg/L	50	34 of 292	3.8	<2.5–<25	0	--	--	--	--	--	--
Zinc	µg/L	2,000	60 of 319	4.6	<3–44.4	0	--	0.7–620	19 of 48	14.9	<3–134	0

Sources: Barr 2006b; Barr 2006c; Barr 2007b; MPCA 1999a; Siegel and Ericson 1980; Barr 2014d.

Notes:
s.u. = Standard Unit
< less than indicated reporting limit.
Values in bold exceeds evaluation criteria.
1 Where non-detects occur, the mean was calculated using half the detection limit. Results of field duplicates were averaged.
2 Below detection limit.
3 Barr 2014d data (2005-2013) is from the following wells: MW-05-02, MW-05-08, MW-05-09, MW-1, MW-2, MW-3, MW-4, MW-5, MW-6S, MW-6D, MW-7, MW-8S, MW-8D, MW-9, MW-10S, MW-10D, MW-11, MW-12, MW-13, MW-14, MW-15, MW-16, MW-17, and MW-18.
4 May reflect contamination (as cited in Siegel and Ericson 1980).
5 Data include all quaternary aquifers in MPCA 1999a.

Bedrock

Groundwater samples have been collected from nine bedrock (i.e., Duluth Complex and Virginia Formation) monitoring wells (i.e., pumping wells P1 through P4 and observation wells Ob1 through Ob5), one water supply well, and two exploratory boreholes at the Mine Site. The average water quality in the bedrock at the Mine Site was generally found to meet groundwater evaluation criteria except for aluminum, beryllium, iron, manganese, and thallium (see Table 4.2.2-6). The pH of the bedrock water samples from the Duluth Complex tended toward basic (i.e., greater than 7.0 to 9.0), while samples from the Virginia Formation were, with one exception, more acidic (i.e., less than 7.0). Sample pHs were near or slightly above 10 in a few wells; but pHs tended to be lower in later samples, suggesting that cement or other reagents used for well installation and completion may have increased pH in the vicinity of these wells.

Occasional exceedances of groundwater quality standards were detected for arsenic and nickel. Ammonia was detected in nine samples, which is unusual because ammonia is not typically found in bedrock. The presence of ammonia in at least two of these samples is attributed to either collection or laboratory error (Barr 2006a). Nitrite or nitrate (both are the forms of nitrogen to which ammonia converts) was found in four samples. This result is not unprecedented as the MPCA study in northeastern Minnesota reported that nitrate was detected in two of the 20 collected samples (MPCA 1999a).

Groundwater Use

No domestic wells exist between the Mine Site and the Partridge River. However, there are several MDNR water appropriation permits in effect for mine pit dewatering that affect the Mine Site, including the Northshore Mine permit (Permit 1982-2097). The permit authorizes Northshore Mining Company to withdraw up to 36,000 gpm (80 cubic ft per second [cfs]), of which a maximum of 13,000 gpm (29 cfs) can be discharged to the Partridge River, a maximum of 12,000 gpm (27 cfs) can be discharged to Langley Creek, and a maximum of 11,000 gpm (25 cfs) can be discharged to Unnamed Creek.

4.2.2.2.2 Surface Water

This section describes the existing surface water resources for the Mine Site that could be affected by the NorthMet Project Proposed Action. These resources include the Upper Partridge River, the Upper Partridge River tributary streams, Colby Lake, Second Creek, Whitewater Reservoir, and the Lower Partridge River below Colby Lake downstream to its confluence with the St. Louis River. For purposes of this FEIS, the Partridge River upstream of Colby Lake is referred to as the Upper Partridge River, while the segment downstream of Colby Lake is referred to as the Lower Partridge River (see Figure 4.2.2-1). For this FEIS, new XP-SWMM model predictions were made to estimate Partridge River flow parameters without effects of discharge from the Northshore Mine, and additional surface water quality data has been collected at many locations. These new data are summarized to better describe existing conditions as inputs for modeling potential surface water impacts.

Upper Partridge River

This section describes the baseline surface water hydrology and water quality of the mainstem of the Partridge River upstream of Colby Lake.

Upper Partridge River Hydrology

Partridge River headwaters originate just south of the Northshore Mine, although historically its source was further upstream. It flows approximately 32 river miles to its confluence with the St. Louis River, draining a total of approximately 161 square miles, as measured at Aurora, Minnesota, approximately 3 miles from the St. Louis River confluence (see Figure 4.2.2-1). The Upper Partridge River refers to the segment of the Partridge River upstream of Colby Lake. The Upper Partridge River Watershed is primarily a mix of upland forest (39 percent), lowlands and aquatic environments (27 percent), shrubland (22 percent), and cropland/grassland (2 percent), with some development (10 percent). There are several active and inactive mines within the watershed including the active Northshore Mine in the headwaters area, as well as the inactive and former LTVSMC mine. About 5 miles of the Partridge River run around the northern and eastern perimeter of the proposed NorthMet Mine Site. Seeps from the southern portion of the existing LTVSMC Tailings Basin (south side of Cell 1E) naturally flow to Second Creek, a tributary of the Partridge River in the Lower Partridge Watershed (see Figure 4.2.2-1); however, a portion of the seeps is presently being captured and pumped back to the Tailings Basin under the Consent Decree between the MPCA and Cliffs Erie. The Partridge River varies from sluggish marshy reaches, to large open ponds, to boulder rapids.

Flow data are most valuable when there is an extended term of record because the data are less likely to be skewed by dry or wet climate in an atypical year or two (Robson 2000). Data from four USGS gaging stations within the Partridge River Watershed (see Figure 4.2.2-1) are available, but the three that reflect flow from the NorthMet Project area have all been impacted by mining operations (see Table 4.2.2-7). The Partridge River above Colby Lake (USGS Station #04015475) is the gaging station that best represents flows from the NorthMet Project area because it is the most upstream station that captures all flow from the proposed Mine Site, with data available for the period from October 1978 through September 1988. The use of these flow data, although about 25 years old, is reasonable as there has not been any substantial land cover or other changes in the watershed over the intervening years that would raise into question the applicability of these data. PolyMet also assessed a similar watershed in the region, the Kawishiwi River, using a flow record from October 1971 to September 2010 to determine if there were long-term trends in flow in this geographic area. No discernable trend in flow was detected, reinforcing that the use of the existing data for Partridge River above Colby Lake is reasonable (PolyMet 2015m). A recently installed flow gage at the Dunka Road is closer to the Mine Site, crossing near its southeast corner (monitoring location SW-003); however, these data may be influenced by Northshore discharges and are therefore unreliable for purposes of estimating groundwater baseflow for impact assessment modeling (MDNR et al. 2015b).

The available flow records indicate that streamflow is generally very low from late fall through the winter, rising sharply during spring snowmelt, and receding during the summer, except for occasional heavy storms. This pattern of receding summer streamflow is characteristic of streams draining extensive bogs (Brooks 1992). Natural flow is very low during the winter because of the relatively thin surficial deposit over the bedrock, and because little groundwater recharge occurs since most precipitation falls as snow and is not available for infiltration or runoff until it melts (Siegel and Ericson 1980). The discharge statistics for the USGS Station above Colby Lake (USGS Station #04015475) are presented in Table 4.2.2-7. The modeled XP-SWMM flows at seven locations (SW-002, SW-003, SW-004, SW-004a, SW-004b, SW-005, and SW-006) on the Partridge River (see Figure 4.2.2-9) are presented in Table 4.2.2-8.

The Northshore Mine is located at the headwaters of the Partridge River (see Figure 4.2.2-9). Discharges from Northshore to the headwaters of the Partridge River have occurred sporadically since 1956, with limited pumping records available prior to 1988, when record keeping became required by the State. These discharges from the Peter Mitchell Pit can have an impact on the flow regime of the Upper Partridge River, particularly in the winter during low-flow conditions (see Figure 4.2.2-10 and Section 6.2.2).

Following closure of the Northshore Mine, discharge to the Partridge River Watershed would cease as the Northshore pit is allowed to flood with water. After the Northshore pit lake is flooded, it would discharge towards the Dunka River, effectively removing the Northshore pit watershed from the Partridge River Watershed. Discharge from the Northshore Mine is planned to end in approximately 2070 (PolyMet 2015m).

For the DEIS, an XP-SWMM hydrologic/hydraulic model of the Partridge River was developed to estimate flows upstream of the USGS Station #04015475. The model was calibrated to gage data from 1984 and 1985 and validated against the 1978-1988 observed flow record. No correction was made in the DEIS model calibration for Northshore Mine discharge, as dewatering data were not available at the time (PolyMet 2015m).

In an effort to account for the Northshore Mine discharge in this FEIS, different methods were evaluated. The method chosen was to recalculate the scale factors used to calibrate the XP-SWMM model to data from the USGS gage data, using data collected when the Northshore Mine was not discharging water into the Partridge River (October 1986 to September 1988). A more detailed description of the XP-SWMM model calibration can be found in the Mine Site Water Modeling Data Package (PolyMet 2015m).

Table 4.2.2-7 Monthly Statistical Flow Data (cfs) for USGS Gaging Stations in the Partridge River Watershed

Station:	04015475 Partridge River Above Colby Lake[1]			04015500 Second Creek Near Aurora			04016000 Partridge River Near Aurora		
Period of Record:	1978-1988			1955-1980			1942 – 1982		
Drainage Area:	106.0 mi^2			29.0 mi^2			161.0 mi^2		
Contributing Drainage Area:	100.0 mi^2			22.4 mi^2			147.7 mi^2		
Month	**Monthly Average**	**Daily Minimum**	**Daily Maximum**	**Monthly Average**	**Daily Minimum**	**Daily Maximum**	**Monthly Average**	**Daily Minimum**	**Daily Maximum**
October	116[1]	14	775	24	1.2	134	97	3.3	1,140
November	63	13	468	20	4.0	103	71	4.0	308
December	20	4.1	95	12	2.2	35	34	5.7	116
January	7.5	1.4	23	9.2	1.5	30	21	2.3	61
February	6.4	1.0	26	8.9	1.5	28	17	2.3	41
March	16	0.6	209	16	2.0	84	41	3.0	1,560
April	242	4.0	1,960	47	5.0	233	271	6.5	2,580
May	220	11	874	34	1.7	126	333	37	3,190
June	105	5.9	568	29	1.4	95	210	17	2,920
July	104	0.5	866	23	3.1	90	101	11	950
August	55	0.7	480	20	2.6	130	64	5.2	459
September	87	2.0	383	24	1.9	100	81	3.2	438

Source: Statistical data from USGS 2015.

Notes:
All values in cfs unless otherwise noted.
[1] Station data may be influenced by Northshore Mine pit dewatering up to October 1986.

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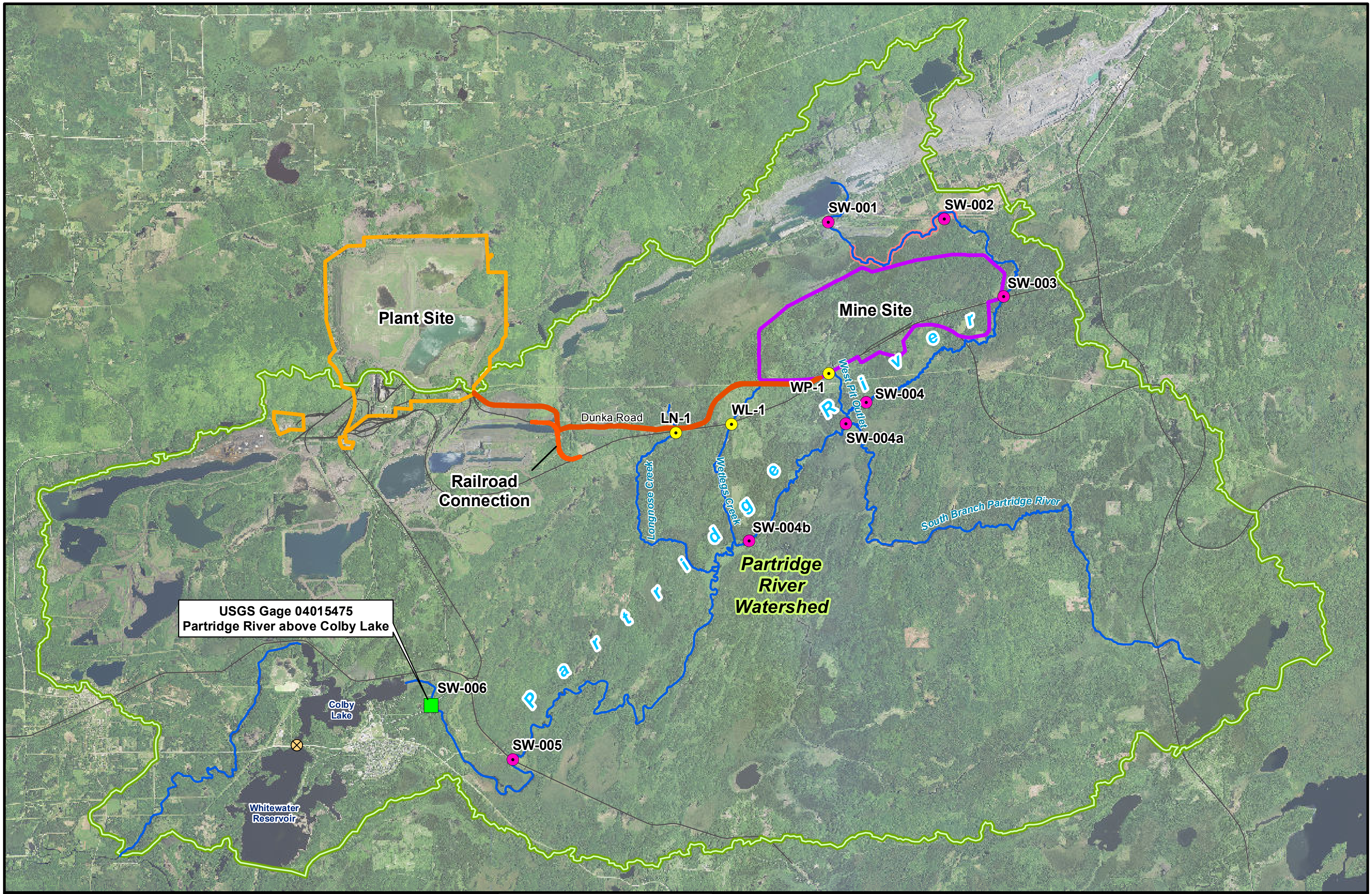

Surface Water Modeling/ Monitoring Location
Surface Water Monitoring Location
Area of Streambank Erosion/Channel Widening
Partridge River Watershed
USGS Gage Station
Diversion Works
Stream/River
Existing Railroad
Mine Site
Plant Site
Transportation and Utility Corridor

MNDNR
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

0 0.5 1 2 3 Miles

Figure 4.2.2-9
Surface Water Monitoring and Modeling Locations within the Partridge River Watershed
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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Proposed Mine Site Boundary
Monitoring Location
Stream/River

N
W E
S

0 250 500 1,000 1,500 2,000
Feet

Figure 4.2.2-10
Northshore Hydrology
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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Table 4.2.2-8 Modeled Flow Statistics for Various Locations along the Upper Partridge River under Natural Conditions

	Station						
Statistic (Unit)	**SW-002(1)**	**SW-003(1)**	**SW-004(1)**	**SW-004a(1)**	**SW-004b(1)**	**SW-005(1)**	**SW-006(1)**
Drainage Area (acres)2	3,838	4,880	9,896	29,887	44,995	58,395	61,386
Annual Daily Mean (cfs)	6.09	7.35	13.97	38.33	57.61	74.77	78.87
October Mean (cfs)	22.76	27.58	52.43	144.03	216.09	278.61	294.02
November Mean (cfs)	4.59	5.80	11.68	31.61	49.19	66.08	68.93
December Mean (cfs)	1.70	2.29	4.43	12.85	19.71	26.61	27.72
January Mean (cfs)	0.57	0.73	1.37	3.95	5.97	7.73	8.11
February Mean (cfs)	1.06	1.27	2.40	6.59	9.88	12.73	13.42
March Mean (cfs)	1.44	1.70	3.10	8.50	12.50	15.16	16.12
April Mean (cfs)	30.58	36.89	71.41	200.60	300.54	390.47	410.56
May Mean (cfs)	7.36	9.05	17.52	49.01	75.47	102.88	108.04
June Mean (cfs)	11.55	13.54	25.56	67.75	101.13	127.93	135.19
July Mean (cfs)	5.97	7.09	13.54	35.56	54.55	75.93	80.42
August Mean (cfs)	3.00	3.57	6.40	16.71	24.79	31.89	33.98
September Mean (cfs)	8.93	10.84	20.14	52.93	79.31	103.64	110.01
10-year3 High Flow (cfs)	117.79	132.12	214.83	678.28	895.16	1,080.60	1,126.55
Average Annual 1-day Max (cfs)	82.15	93.30	156.05	467.64	630.96	737.26	761.75
Average Annual 3-day Max (cfs)	71.62	82.84	149.39	423.15	593.08	722.50	748.85
Average Annual 7-day Max (cfs)	54.13	63.57	120.31	337.99	490.93	623.57	651.79
Average Annual 30-day Max (cfs)	23.59	28.25	54.01	150.46	223.95	288.80	303.66
Average Annual 90-day Max (cfs)	13.71	16.52	31.66	87.78	131.81	170.99	180.10
10-year3 Low Flow (cfs)	0.35	0.45	0.72	1.72	2.84	3.58	3.90
Average Annual 1-day Min (cfs)	0.40	0.52	0.85	2.08	3.36	4.32	4.69
Average Annual 3-day Min (cfs)	0.39	0.51	0.84	2.05	3.30	4.28	4.65
Average Annual 7-day Min (cfs)	0.40	0.51	0.86	2.11	3.38	4.32	4.68
Average Annual 30-day Min (cfs)	0.41	0.51	0.92	2.44	3.81	4.91	5.28
Average Annual 90-day Min (cfs)	0.63	0.80	1.46	3.87	5.87	7.61	8.10
Date of Max 1-day Mean4 (cfs)	168.85	168.85	169.26	168.95	169.16	169.77	169.77
Date of Min 1-day Mean4 (cfs)	211.94	211.94	195.10	201.64	208.29	203.28	200.39
Number of Zero Flow Days/year	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7-day Minimum/Annual Mean5	0.06	0.06	0.05	0.05	0.05	0.05	0.05
No of High Pulses6/yr	15.17	13.80	10.54	9.00	8.23	6.51	6.34
Mean Duration of High Pulses (days)	4.97	5.46	7.15	8.42	9.19	11.61	11.93
Total High Pulse Duration/yr (days)	69.23	69.31	69.23	69.61	69.53	69.53	69.53
No of Low Pulses7/yr	3.63	3.57	2.72	2.61	2.72	1.97	1.97
Mean Duration of Low Pulses (days)	19.04	19.15	26.30	27.34	26.37	37.26	37.31
Total Low Pulse Duration/yr (days)	70.89	70.27	73.46	73.38	73.64	75.50	75.59

Statistic (Unit)	Station						
	SW-002(1)	SW-003(1)	SW-004(1)	SW-004a(1)	SW-004b(1)	SW-005(1)	SW-006(1)
Avg. Hydrograph Increase (cfs/day)	3.94	4.69	6.93	20.61	28.11	24.65	26.33
Avg. Hydrograph Decrease (cfs/day)	1.49	1.63	2.46	7.06	9.38	10.19	10.23
No of Flow Reversals/yr	54.84	49.75	38.43	38.49	38.80	34.02	38.86

Source: PolyMet 2015m, Appendix J

Notes:

1 Based on existing-conditions XP-SWMM model results adjusted using scale factors listed in Table 4-7 of the Mine Site Water Modeling Data Package (PolyMet 2015m).

2 Based on existing conditions Partridge River Tributary Areas listed in Table 1-18 of the Mine Site Water Modeling Data Package (PolyMet 2015m).

3 Annual instantaneous peak with a 10-year recurrence interval.

4 Mean Julian date of each annual 1-day maximum or minimum flow.

5 Mean value of the 7-day minimum flow divided by the mean annual flow of that year.

6 The number of times per year the mean daily flow increases above the 75th-percentile of all recorded/simulated mean daily flows.

7 The number of times per year the mean daily flow falls below the 25th-percentile of all recorded/simulated mean daily flows.

Upper Partridge River Groundwater Baseflow

Estimating the groundwater contribution to flow in the Upper Partridge River is necessary for modeling future impacts because: 1) groundwater is an important component of the river water balance (particularly during winter low-flow conditions), and 2) groundwater reaching the river could be chemically affected by mining operations. The flow contribution to the Partridge River from groundwater is referred to as groundwater baseflow and represents a somewhat uniform source of water to the river although the actual amount may vary from year to year. Groundwater baseflow is also important information used to develop the MODFLOW groundwater flow model. Estimated baseflow is used as an observation during calibration of the MODFLOW model and directly affects model inputs such as surficial deposit horizontal hydraulic conductivity and the conductance of the river cells simulating the Partridge River. Recharge was not adjusted during calibration of the MODLOW model, but the recharge values used in the model were based directly on the baseflow estimates. MODFLOW recharge values were set such that the total recharge applied to the SW-004 surface watershed area was equal to the estimate of baseflow at SW-004.

To evaluate Partridge River groundwater baseflows, which are specific to river location, PolyMet used all available data from USGS gaging station #04015475, located at Partridge River station SW-006, for the period of record lasting from October 1, 1978 to September 30, 1988. In terms of water years (WYs), the period of record covered WY1979 through WY1988. It was recognized that low (winter) flows in the river could be affected by both groundwater baseflows and pumped/seepage discharges from the Northshore Mine, and this added complexity to the interpretation of groundwater baseflow. To estimate groundwater baseflow at each Partridge River evaluation location, the following procedure was used by PolyMet:

- Average annual 30-day low flow at the USGS gage, with minimal Northshore pumping, was assumed to be a reasonable approximation of groundwater baseflow at SW-006.

- The lowest 30-day average flow for each of the 10 water years between WY1979 through WY1988 was averaged from the USGS gage record, unadjusted. The result was 5.12 cfs at the USGS gage (SW006).
- The XP-SWMM surface water model was calibrated to gage data from WY1985, which had periods when Northshore was not discharging, and validated against the remaining period of record (WY1979 through WY1988).
- A scale factor for 30-day low flow parameter was calculated by comparing the observed 30-day low flows at the USGS gage in WY1987 and WY1988 (2 years when Northshore was not discharging) to the XP-SWMM-modeled 30-day low flows for those same water years.
  - The average observed 30-day low at SW-006 was 4.98 cfs in WY1987 and WY1988.
  - The average XP-SWMM estimated 30-day low flow at SW-006 was 5.15 cfs in WY1987 and WY1988.
  - A scale factor (observed over modeled) was computed to be 0.97.
- The lowest 30-day average flow at SW-006 from each of the 10 water years between WY1979 through WY1988, as estimated by XP-SWMM, was averaged, resulting in an average modeled 30-day low flow of 5.45 cfs.
- The average modeled 30-day low flow estimated by XP-SWMM (5.45 cfs) was multiplied by the scale factor (0.97) to arrive at the gage-adjusted estimated average 30-day low flow at SW-006, 5.27 cfs, which was taken to represent groundwater baseflow at SW-006.
- The estimated average 30-day low flows (groundwater baseflows) at all Partridge River stations upstream of SW-006 were computed in a similar manner; first calculating the average modeled 30-day low flow estimated by XP-SWMM over the entire 10 WY period, and multiplying that value by the 0.97 scale factor.
- At SW-003 for example, the XP-SWMM-modeled average 30-day low flow was 0.53 cfs. Multiplied by the scale factor of 0.97, the gage-adjusted estimated average 30-day low flow at SW-003 was 0.51 cfs, and this was taken to represent groundwater baseflow at SW-003.

The PolyMet-estimated groundwater baseflows for the Upper Partridge River are listed in Table 4.2.2-9.

The MDNR directly measured low flows at several locations along the Partridge River during the winters of 2008, 2010, and 2011; however, these flow measurements were likely affected by discharges from the Northshore Mine and were not indicative of groundwater baseflows only.

The only other available gaging data that could be used for estimation of baseflow are from a station installed in 2011 at SW-003 on the Partridge River. However, interpretation of groundwater baseflow at SW-003 is not reliable for use in the GoldSim modeling of groundwater baseflow (discussion of modeling is provided in Section 5.2.2) due to the complicating effects of Peter Mitchell Pit (Northshore) pumped discharges, seepage from the Northshore West Pond, and complex storage and release mechanisms in the wetlands that receive these flows.

Table 4.2.2-9 Estimated Partridge River Groundwater Baseflows

Station	Estimated Groundwater Baseflow (cfs)
SW-002	0.4
SW-003	0.5
SW-004	0.9
SW-004a	2.4
SW-004b	3.8
SW-005	4.9
SW-006	5.3

Source: XP-SWMM Data: PolyMet 2015m.

Upper Partridge River Stream Geomorphology

A Level I Rosgen Geomorphic Survey (Rosgen 1996) was conducted for the Partridge River from its headwaters to Colby Lake, a distance of about 28 miles (Barr 2005). A Level I Survey is a physical classification of a stream channel to determine its geomorphic characteristics based on the relationship of its physical geometry and hydraulic characteristics. The purpose of a geomorphic survey is to evaluate the stability of a stream under existing conditions, to determine its sensitivity to hydrologic change, and to indicate how restoration may be approached if a portion of the stream becomes unstable. This survey is included in this FEIS because it assesses erosion and/or channel widening caused by changes in flow that may occur from current or future mine water discharge, and is thus helpful in assessing project-specific or cumulative effects. This broad level characterization was performed using 2003 aerial photography, USGS 7.5 minute quadrangles with a 10-ft contour interval, available ground photographs, and two site visits.

The survey results indicated that approximately 54 percent of the Partridge River is a Type C channel, 31 percent is a Type E channel, and 13 percent is a Type B channel. Type C channels are characterized as moderately sinuous (meandering), having a mild slope and a well-developed floodplain, and being fairly shallow relative to their width. Type E channels are similar to Type C, except that they tend to be more sinuous and deeper relative to their width. Type B channels are steeper, straighter, and have less floodplain available than Type C or E channels. Type B channels tend to be less sensitive to impact than Type C or E channels and are dominated by boulder material on the Partridge River.

The Rosgen field survey found the Partridge River to be stable, with no evidence of erosion except in its headwaters (see Figure 4.2.2-9). In general, the Partridge River has well vegetated stream banks for nearly its entire length, and a very well-developed floodplain for all but the Type B reaches. There are many beaver dams along the entire length of the Partridge River, particularly at the head of rapids sections, which create wide pools. Because its steep reaches are well-armored and the flatter reaches tend to have well vegetated shorelines, the Partridge River is considered to be a robust stream. The limited erosion and/or channel widening found in the headwaters may be attributable to pit dewatering discharges from the Northshore Mine, which has a maximum permitted discharge rate of 29 cfs, and the historic straightening of the river channel for construction of a railroad (Barr 2005).

Two additional Rosgen surveys were conducted on Unnamed Creek and two stream reaches in the upper Partridge River. A Level I Rosgen Geomorphic Survey (Rosgen 1996) was conducted on Unnamed Creek in November 2011 using survey-grade GPS and ground photographs. The survey results indicated that Unnamed Creek is consistent with Type C and E channels with no evidence of erosion, downcutting, or channel widening at any of the surveyed locations and well-developed floodplains, substantial bank vegetation, and cobbles in the steeper riffle sections. Water levels in Unnamed Creek are likely controlled by beaver dams in the surrounding wetlands as the baseflow to the creek from groundwater is low. Unnamed Creek is likely to withstand moderate changes in hydrology with no degradation as it has well-developed floodplains and substantial bank vegetation (Barr 2013o).

A level II Rosgen Classification was conducted for two stream reaches on the upper Partridge River in July (East Reach) and August 2009 (West Reach). A Level II classification (Rosgen 1996) consists of a survey of the channel profile and cross-sections of the channel and floodplain as well as sampling of the stream bed material. The survey results indicated that both reaches are consistent with Type E channels with no evidence of erosion, downcutting, or channel widening at either of the surveyed reaches; both reaches have well-developed floodplains and vigorous bank vegetation. As with Unnamed Creek, the water levels in both reaches are likely controlled by beaver dams in the surrounding wetlands as the baseflow to the reaches from groundwater is low. These reaches are likely to withstand moderate changes in hydrology with no degradation as they have well-developed floodplains and substantial bank vegetation (Barr 2013q).

Partridge River Surface Water Withdrawals and Discharges

There are several mines, the City of Hoyt Lakes WWTP, and Minnesota Power’s Laskin Energy Center (a power plant) that have withdrawn or discharged water in the past, and/or are currently withdrawing or discharging water that affects flows in the Partridge River (see Figure 4.2.2-11). Table 4.2.2-10 summarizes the NPDES/SDS discharges to and surface water withdrawals from the Partridge River and its tributaries. Most of these outfalls do not discharge continuously, and many, although still “active” in terms of permit status, have not discharged for many years (i.e., various mine pit dewatering discharges).

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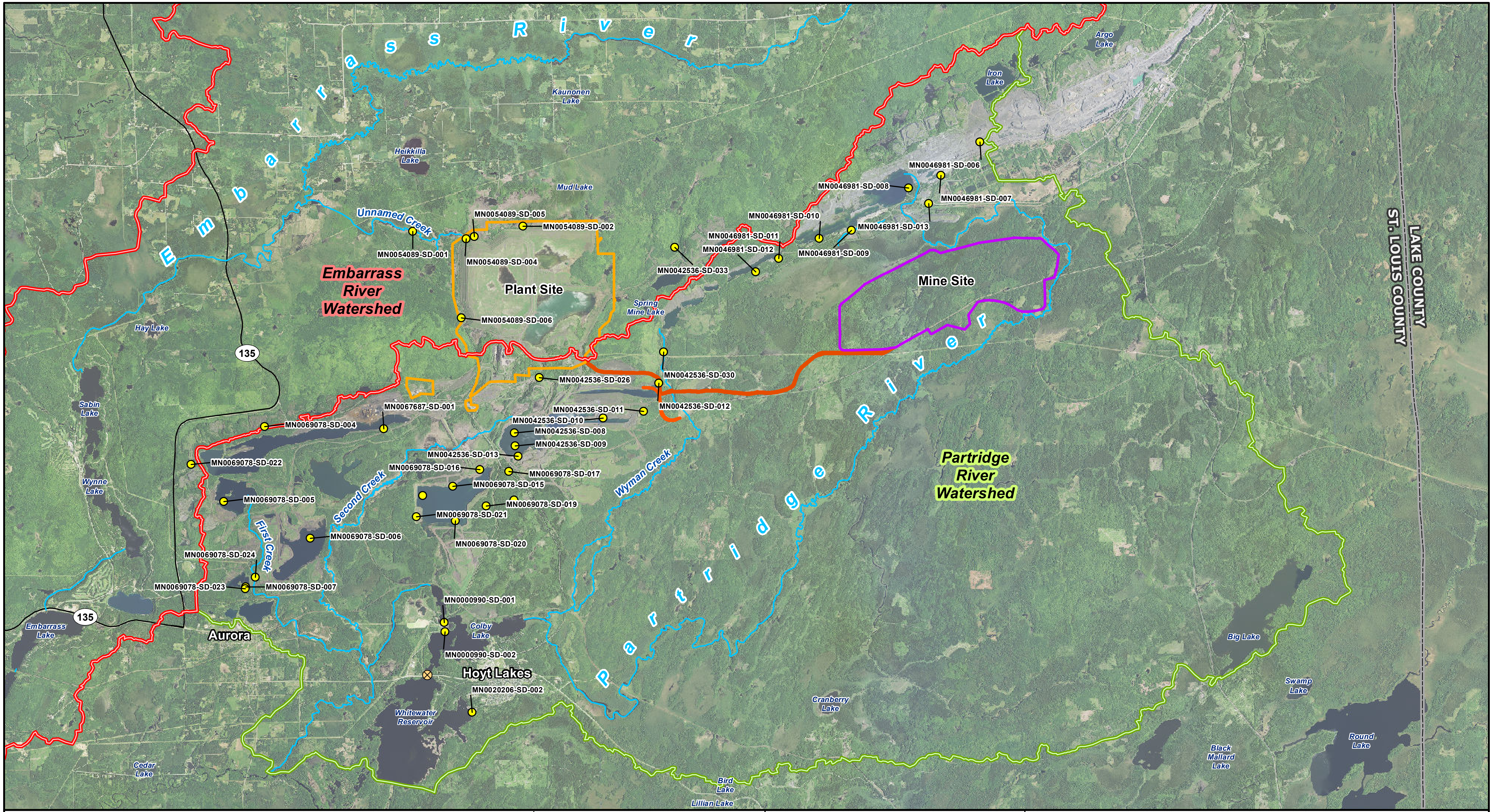

MPCA Water Quality Stations or NPDES Discharge Points
Diversion Works
Embarrass River Watershed
Partridge River Watershed
Stream/River
Mine Site
Plant Site
Transportation and Utility Corridor
Existing Road

MNDNR | US Army Corps of Engineers St. Paul District | Forest Service

0 0.5 1 2 3 Miles

N W E S

Figure 4.2.2-11
Past and Current NPDES Discharges into the Partridge and Embarrass Rivers
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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Table 4.2.2-10 Discharges to and Surface Water Withdrawals from the Partridge River Watershed

NPDES Permit Number	Discharge ID	Outfall Description	Receiving Waters	Authorized Flow (cfs) Avg.	Max.
MN0069078 Mesabi Mining LLC[1]	MN0069078-SD-001	Pit 2WX, Composite SD-018 to SD-021	Colby Lake	NA	NA
	MN0069078-SD-004	Pit 1 dewatering pipe	Unnamed creek tributary to Wynne Lake	8.4	18.3
	MN0069078-SD-005	Pit 9 dewatering pipe	First Creek	7.8	11.1
	MN0069078-SD-006	Pit 6 dewatering pipe	Second Creek	15.5	22.3
	MN0069078-SD-007	Pit 9S dewatering pipe	First Creek	16.7	22.3
	MN0069078-SD-014	Pit 2WX dewatering pipe	Second Creek (via wetlands)	7.8	11.2
	MN0069078-SD-015	Pit 2WX dewatering pipe	Second Creek (via wetlands)	7.8	11.2
	MN0069078-SD-016	Pit 2WX dewatering pipe	Second Creek (via wetlands)	7.8	11.2
	MN0069078-SD-017	Pit 2WX dewatering pipe	Second Creek (via wetlands)	7.8	11.2
	MN0069078-SD-018	Pit 2WX dewatering pipe	Tributary to Colby Lake	7.8	11.2
	MN0069078-SD-019	Pit 2WX dewatering pipe	Tributary to Colby Lake	7.8	11.2
	MN0069078-SD-020	Pit 2WX dewatering pipe	Tributary to Colby Lake	7.8	11.2
	MN0069078-SD-021	Pit 2WX dewatering pipe	Tributary to Colby Lake	7.8	11.2
	MN0069078-SD-022	Pit 9 dewatering pipe	Unnamed creek tributary to Wynne Lake	7.8	11.2
	MN0069078-SD-023	Pit 9S dewatering pipe	First Creek	16.7	22.3
	MN0069078-SD-024	Pit 6 dewatering pipe	First Creek	--	11.2
MN0042536 Cliffs Erie LLC[2]	MN0042536-SD-008	Pit 2W dewatering pipe	Second Creek	7.8	11.2
	MN0042536-SD-009	Pit 2W dewatering pipe	Second Creek	7.8	22.3
	MN0042536-SD-010	Pits 2/2E/3 dewatering pipe	Wetland to Wyman Creek	7.8	11.2
	MN0042536-SD-011	Pits 2/2E/3 dewatering pipe	Wetland to Wyman Creek	7.8	11.2
	MN0042536-SD-012	Pit 3 overflow channel	Wyman Creek	7.8	11.2
	MN0042536-SD-013	Pit 2W dewatering pipe	Tributary to Colby Lake	11.1	22.3
	MN0042536-SD-026	Cell 1E seepage/stormwater	Second Creek	0.6	1.4
	MN0042536-SD-030	Pit 5S overflow	Wyman Creek	--	--
		Stormwater from Area/Shops	Second Creek	--	--
		Stormwater from Plant Area	Second Creek	--	--

NPDES Permit Number	Discharge ID	Outfall Description	Receiving Waters	Authorized Flow (cfs) Avg.	Authorized Flow (cfs) Max.
MN0067687 Mesabi Nugget Delaware	MN0067687-SD-001	Pit 1 overflow	Second Creek	2.3	9.0
MN0046981 Northshore Mining Co. Northshore Mine	MN0046981-SD-006	185S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-007	223S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-008	258S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-009	280/292S pit dewatering	Partridge River headwaters	11.5	50.8
	MN0046981-SD-010	360S pit dewatering	Partridge River headwaters	0.3	50.8
	MN0046981-SD-011	380S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-012	430S pit dewatering	Partridge River headwaters	Inactive	50.8
	MN0046981-SD-013	Crusher 2 sanitary outfall	Partridge River headwaters	Inactive	0.07
	MN0046981-SD-016	Crusher 2 area discharge	Partridge River headwaters	0.01	0.14
MN0020206 Hoyt Lakes WWTP	MN0020206-SD-002	Main Facility Discharge	Whitewater Reservoir	0.39	1.1
MN0000990 MN Power Laskin Energy Center	MN0020206-SD-001	Main Discharge	Colby Lake	194	212
	MN0020206-SD-002	Ash Pond Discharge	Colby Lake	0.6	2.2
Water Appropriation Permittee	**Permit Number**	**Intake Description**	**Water Source**	**Flow (cfs) Avg.**	**Flow (cfs) Max.**
MN Power/Cliffs Erie LLC	1949-0135	Mining process water	Colby Lake	--	26.7(3)
MN Power (Laskin)	1950-0172	Cooling Water	Colby Lake	--	224(4)
Hoyt Lakes	1954-0036	Municipal Water Supply	Colby Lake	0.5	2.3(5)

Sources: MPCA 2014g; MDNR 2013e.

Notes:
Most of these outfalls do not discharge continuously, and many, although still "active" in terms of permit status, have not discharged for many years (i.e., various mine pit dewatering discharges). The actual total discharge to the river is far less than the sum of the average flows.

1 Permit remains active for closure purposes only; no active dewatering occurring. Pit 6 (SD-006) filled with water and has groundwater outflow to Second Creek.
2 Permit remains active for closure purposes only; no active dewatering occurring. Pit 3 (SD-012) filled with water and has passive outflow to Wyman Creek averaging 1.1 cfs. Pit 5S (SD-030) filled with water and has unmeasured passive outflow to Wyman Creek. Pit 2W filled with water and has outflow to Second Creek averaging approximately 8 cfs.
3 Historically used for pellet plant makeup water; no present active pumping. Represents instantaneous peak withdrawal; permit also includes a maximum average withdrawal rate of 26.7 cfs for any continuous 60-day period or up to 33.4 cfs with prior written commissioner's approval.
4 Includes a maximum 4.2 cfs consumptive use for evaporative losses.
5 Represents instantaneous peak withdrawal, permit also includes an annual maximum withdrawal rate of 2.3 cfs.

Although mine discharges have occurred at least periodically in the NorthMet Project area since 1956 when the Northshore Mine began operations, there are few readily available mine pumping records prior to 1988 when the state began requiring water appropriation permit holders to report this information. Pumping records for the Northshore Mine from 1976 to approximately 1986 are available and show an annual average discharge of between 6.8 and 15.1 cfs. Since 1988, the highest reported average monthly discharge from the Northshore Mine to the Partridge River was 34 cfs (Barr 2008f). However, monthly averages obscure the nature of the Northshore Mine discharges to the Partridge River, which are sporadic. They can have a considerable impact on the flow regime of the Upper Partridge River, particularly in the winter during low-flow conditions.

In addition, former LTVSMC Pits 3 and 5S are currently overflowing into Wyman Creek (MPCA 2014d), which flows south into the Partridge River (RS74A, Barr 2008a). Average monthly outflow from Pit 3 (SD-012), as reported to the MPCA for permit compliance during 2009 through 2011, was about 0.7 cfs. Average winter outflow was 0.1 cfs. There are no discharge records for outflow from Pit 5S (SD-030) because the outflow is dispersed through a wide area of broken rock. The number and volume of these combined discharges, when compared to average and especially low flow in the Partridge River, indicate that the Northshore Mine and former LTVSMC pit discharges have the potential to significantly affect flows. Lack of historical information regarding actual dates of discharge complicates interpreting the flow record.

Upper Partridge River Water Quality

Recent water quality data (collected by PolyMet in 2004, 2006, 2007, 2008, 2010, 2011, 2012, and 2013) and historic water quality data (back to 1956) are available for various constituents in various locations along the Partridge River, which are summarized in Table 4.2.2-11. Most of these water quality data represent grab samples and the frequency of sampling does not allow a detailed assessment of water quality trends, seasonal effects, or relationship to flow. Nevertheless, collectively, the data can be used to generally characterize water quality in the watershed and draw some comparisons with surface water quality standards.

Table 4.2.2-11 Surface Water Quality Data in the Partridge River Watershed (see Figure 4.2.2-1)

Sample Location	Sampling Period
SW-001	2004, 2006, 2008
SW-002	1974–1976, 1978, 2001-2002, 2004, 2006, 2012–2013
SW-003	1974-1978, 2001-2004, 2006–2008, 2010, 2012–2013
SW-004	2004, 2006–2008, 2010–2013
SW-004a	2010, 2012–2013
SW-004b	2010, 2012–2013
SW-005	1976–1977, 2004, 2006–2008, 2010–2013
Colby Lake	1976–1977, 1988, 2001–2003, 2008, 2010
Whitewater Reservoir	1972, 1985, 2001, 2010
USGS gage #04016000/CN122	1956–1966, 1976–1977, 1979
USGS gage #04015475	1979
Tributaries	
West Pit Outlet Creek, WP-1	2011–2013
S. Branch, USGS gage #04015455	1973–1976
Colvin Creek, CN124	1973–1976
Wetlegs Creek, WL-1	2011–2013
Longnose Creek, LN-1	2011–2013
Wyman Creek, PM-5 / PM-6	2004 (PM-5, PM-6), 2011–2013 (PM-5), 2013 (PM-6)
Second Creek, PM-7, PM-17, PM-18	2004, 2006–2007

Sources: Barr 2007h; Barr 2008f; Barr 2007i; Siegel and Ericson 1980; Barr 2009c; Barr 2014d.

In general, ambient water quality is similar across the watershed, although a few parameters (e.g., aluminum and copper) appear to reflect a slightly increasing trend downstream (see Table 4.2.2-12). Comparing 1970s data from the Regional Copper-Nickel Study with recent (post-2000) PolyMet data collected at three monitoring stations common to both data sets (SW-002, SW-003, and SW-005) shows that some parameters appear to have decreased in concentration (e.g., sulfate at SW-003 and SW-005), but the water sampled at these stations in the 2000s is generally similar to the quality measured in the 1970s. Although a few individual samples exceeded surface water quality standards, overall instream water quality meets state water quality standards. The only consistent exceedance of water quality standards was dissolved oxygen near the headwaters of the Partridge River (SW-002, Figure 4.2.2-3). Sufficient information is not available to interpret this exceedance, but the dissolved oxygen exceedances are localized and are not found at other upstream or downstream locations. The Upper Partridge River is not listed as an impaired waterbody on the 303(d) list. At SW-005, mean sulfate concentrations exceed the 10 mg/L wild rice standard that is applicable in this location.

There are limited water quality data available from the mainstem of the Partridge River that predate the operation of the Northshore Mine beginning in 1956 that can be used to characterize relatively “undisturbed” conditions. There are six samples that were collected during the Regional Copper-Nickel Study in 1976 and 1979 along the South Branch of the Partridge River at USGS Gaging Station #04015455 (see Figure 4.2.2-1). These samples were unaffected by mining and most potential significant sources of contamination, thus they can provide some insights on “undisturbed condition” water quality in the Partridge River for several key parameters (see Table 4.2.2-13). As these few samples indicate, water quality generally met water quality standards for the parameters monitored, except aluminum. In addition, mercury cannot be assessed due to the high detection limit (500 ng/L) used in the 1970s samples.

Table 4.2.2-12 Comparison of Historic and Recent Mean Water Quality Data for Selected Parameters at Common Monitoring Stations along the Partridge River

							SW-002		SW-003		SW-005	
			Detection		Range		Mean					
General Parameters	**Units**	**Evaluation Criteria[10]**	**1970s**	**2000s[9]**	**1970s**	**2000s[9]**	**1970s**	**2000s[9]**	**1970s**	**2000s[9]**	**1970s**	**2000s[9]**
Dissolved Oxygen	mg/L	>5.0	41 of 41	97 of 98	3.3–11.6	<0.05–13.9	6.7	7.6	9.1	9.4	8.0	7.9
Hardness	mg/L	500	94 of 94	122 of 122	16–204	16.9–228	115	141	117	98.5	85	71.2
pH	s.u.	6.5-8.5	186 of 186	119 of 119	6.2–8.7	6.0–8.5	7.0	7.1	7.3	7.4	7.2	7.4
Sulfate	mg/L	--[7]	93 of 93	117 of 122	3.0–76	<0.5–83.1	20.1	30.8	18.9	15.1	**18.9**	**10.1**
Metals – Total												
Aluminum	µg/L	125	27 of 30	86 of 101	0.50–205	<10–1,550	43.6	31.3	76	51.8	123	**129[5]**
Arsenic	µg/L	53	15 of 30	39 of 74	0.50–5.0	<0.25–3.0	3.8	0.48	3.2	0.90	0.8	1.0
Cobalt	µg/L	5	3 of 55	40 of 112	0.50–2.0	<0.1–<12.5	0.6	0.30	0.5	0.33	0.6[1]	1.2
Copper	µg/L	9.3[2]	67 of 68	94 of 118	0.25–8.0	<0.25–3.0	1.3	0.76	1.3	1.0	2.4	1.6
Iron	µg/L	--	78 of 78	80 of 80	400–7,200	1.3–30,700	1,085	3,125[3]	1,365	1,570[4]	1,528	2,264[6]
Lead	µg/L	3.2[2]	44 of 68	21 of 92	0.10–10.0	<0.15–12.3	0.6	0.29	0.8	0.27	0.7	0.41[8]
Manganese	µg/L	--	69 of 70	86 of 86	0.03–1,400	15.5–1,100	112	254	153	135	160	138
Nickel	µg/L	52[2]	19 of 64	73 of 118	0.50–9.0	<0.25–4.9	1.4	0.71	1.5	1.1	1.0[1]	1.7
Zinc	µg/L	120[2]	34 of 66	26 of 118	0.50–18.0	<0–82.9	5.6	5.5	4.4	8.7	2.0	10.5

Sources: Barr 2007h for 1970s data; Barr 2014d for 2000s data.

Notes:
1 Based on fewer than five samples.
2 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
3 Excludes single outlier value of 1.27 µg/L from values included in Barr 2014d.
4 Excludes single outlier value of 1.45 µg/L from values included in Barr 2014d.
5 Excludes single outlier value of 1,550 µg/L from values included in Barr 2014d.
6 Excludes single outlier value of 2.03 µg/L from values included in Barr 2014d.
7 Sulfate standard of 10 mg/L applies to designated waters supporting the production of wild rice (SW-005).
8 Excludes single outlier value of 12.3 µg/L from values included in Barr 2014d.
9 For non-detects, means were calculated at half the detection limit.
10 Section 5.2.2 includes a detailed discussion of evaluation criteria.

Table 4.2.2-13 Baseline Water Quality from the South Branch of the Partridge River[1]

Constituent	Units	Surface Water Standard	# of Samples	S. Branch Partridge R. Mean Concentration	S. Branch Partridge R. Range of Concentrations
General Parameters					
Chloride	mg/L	--	5	1.4	<0.1–3.2
Fluoride	mg/L	--	5	0.2	0.1–0.3
Hardness	mg/L	500	1	37	37
pH	s.u.	6.5–9.0	5	7.0	6.8–7.3
Sulfate	mg/L	--	5	5.2	1.4–8.9
Metals					
Aluminum	µg/L	125	2	150	100–200
Arsenic	µg/L	53	2	<1.0	<1.0
Iron	µg/L	--	5	856	320–1,400
Manganese	µg/L	--	2	40	30–50
Mercury	ng/L	1.3	2	<500	<500

Source: MPCA 2013a.

Note:
[1] Based on water quality monitoring data from 1976 and 1979.

PolyMet averaged available ambient water quality data from 2004 to 2013 to document existing conditions against which to evaluate impacts from the NorthMet Project Proposed Action at several locations, as shown in Figure 4.2.2-8, along the Partridge River (see Table 4.2.2-14). Average existing water quality concentrations were below standards for most parameters listed in Table 4.2.2-14. At SW-005, where the standard applies, the wild rice sulfate standard is exceeded. The aluminum evaluation criterion is exceeded at SW-004, SW-004b, and SW-005; the thallium evaluation criterion is exceeded at SW-001; and the mercury evaluation criterion is exceeded at all sites.

Table 4.2.2-14 Average Existing Water Quality Concentrations in the Partridge River

Parameter	Units	Evaluation Criteria[6]			SW-001	SW-002	SW-003	SW-004	SW-004a	SW-004b	SW-005
			Detection	Range				Mean			
General											
Alkalinity	mg/L		143 of 144	<0–853	94.6	101	83.2	97.3	76.6	59.8	56.5
Calcium	mg/L	--	230 of 230	3.9–45.9	24.6	29.8	22.9	21.1	21.8	16.9	15.3
Chloride	mg/L	230	224 of 224	0.7–55.2	1.6	25.7	10.3	9.2	9.3	5.7	5.7
Fluoride	mg/L	--	59 of 97	<0.05–<2.5	0.14	0.11	0.09	0.10	0.11	0.10	0.30
Hardness	mg/L	500	230 of 230	16.9–228	97.0	141	98.5	92.1	97.8	78.9	71.2
Magnesium	mg/L	--	230 of 230	2.7–29.1	10.4	16.7	10.3	9.7	10.6	8.9	8.1
pH	s.u.	6.5–8.5	218 of 218	5.6–8.73	8.3	7.1	7.4	7.4	7.2	7.2	7.4
Potassium	mg/L	--	84 of 85	<1.25–5.2	2.7	3.0	2.4	2.2	2.5	1.7	1.4
Sodium	mg/L	--	95 of 95	1.2–40.4	4.8	14.5	6.5	6.7	10.2	6.7	4.4
Sulfate	mg/L	10[1]	223 of 230	<0.5–83.1	21.8	30.8	15.1	13.9	15.9	11.3	**10.1**
TDS	mg/L	700	222 of 222	56–395	119	235	161	155	171	153	143
Metals											
Aluminum	µg/L	125	170 of 196	<5–4600	18.0	31.3	51.8	**193**	119	**127**	**129**[4]
Antimony	µg/L	31	0 of 104	<0.25–<1.5	1.5	0.53	0.53	0.53	0.25	0.25	0.53
Arsenic	µg/L	53	96 of 154	<0.25–11.7	6.5	0.48	0.90	1.1	0.95	0.96	1.0
Barium	µg/L	--	44 of 70	<5–36	5.0	17.3	11.3	9.6	12.0	8.9	8.7
Beryllium	µg/L	--	0 of 70	<0.1–<0.1	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Boron	µg/L	500	79 of 95	<17.5–435	96.0	148	94.8	93.0	116	75.9	51.4
Cadmium	µg/L	2.5[2]	6 of 80	<0.01–<0.1	0.10	0.10	0.10	0.09	0.08	0.07	0.09
Cobalt	µg/L	5.0	94 of 212	<0.1–<12.5	0.45	0.30	0.33	0.57	0.42	0.43	1.16
Copper	µg/L	9.3[2]	186 of 222	<0.25–9.1	1.6	0.8	1.0	1.5	1.5	1.5	1.6
Iron	µg/L	--	161 of 163	<15–30700	30.0[5]	3,125[7]	1,570[8]	2,653[9]	2,031	2,402	2,264[10]
Lead	µg/L	3.2[2]	38 of 183	<0.015–12.3	0.30	0.29	0.27	0.32	0.22	0.26	0.41[11]
Manganese	µg/L	--	171 of 173	<5–6480	7.9	254	135	339	170	148	138

Parameter	Units	Evaluation Criteria[6]			SW-001	SW-002	SW-003	SW-004	SW-004a	SW-004b	SW-005
			Detection	Range	Mean						
Mercury	ng/L	1.3	101 of 144	<0.25–18.5	**2.3**	**2.7**	**2.8**	**3.3**	**4.1**	**5.4**	**4.3**
Methylmercury	ng/L	--	39 of 42	<0.028–560	0.05	--	0.27	0.39	0.6[3]	0.51	0.41
Nickel	µg/L	52[2]	152 of 42	<0.000028–0.56	1.4	0.71	1.1	1.5	1.2	1.6	1.7
Selenium	µg/L	5.0	13 of 173	<0.1–<5	1.7	0.90	0.90	0.73	0.44	0.64	0.77
Silver	µg/L	1.0[2]	0 of 95	<0.1–<0.5	0.29	0.21	0.21	0.20	0.10	0.10	0.20
Thallium	µg/L	0.56	75 of 179	<0.0002–<1	**0.60**	0.19	0.19	0.16	0.01	0.01	0.15
Vanadium	µg/L	--	0 of 36	<1.5–<1.5	--	1.5	1.5	1.5	1.5	1.5	1.5
Zinc	µg/L	120[2]	48 of 222	<0–82.9	8.9	5.5	8.7	10.3	4.6	4.2	10.5

Source: Barr 2014d.

Notes:
Values in bold indicates an exceedance of surface water quality standard, based on the average value of all samples. Means calculated using non-detects at half the detection limit.

[1] MPCA has listed the Partridge River downstream from river mile approximately 22 just upstream of the railroad bridge near Allen Junction as wild rice water, so the 10 mg/L sulfate standard is only applicable to that portion of the Upper Partridge River (SW-005 and SW-006).
[2] Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
[3] Excludes single outlier value of 0.56 µg/L from values included in Barr 2014d.
[4] Excludes single outlier value of 1,550 µg/L from values included in Barr 2014d.
[5] Excludes single outlier value of 0.06 µg/L from values included in Barr 2014d.
[6] Section 5.2.2 includes a detailed discussion of evaluation criteria.
[7] Excludes single outlier value of 1.27 µg/L from values included in Barr 2014d.
[8] Excludes single outlier value of 1.45 µg/L from values included in Barr 2014d.
[9] Excludes single outlier value of 1.41 µg/L from values included in Barr 2014d.
[10] Excludes single outlier value of 2.03 µg/L from values included in Barr 2014d.
[11] Excludes single outlier value of 12.3 µg/L from values included in Barr 2014d.

Upper Partridge River Tributary Streams

The NorthMet Project Proposed Action could affect four small streams that are tributaries to the Partridge River, including the following (see Figure 4.2.2-1):

- Wetlegs Creek – which would be crossed by the Transportation and Utility Corridor that links the Mine Site with the Plant Site.
- Longnose Creek – which would also be crossed by the Transportation and Utility Corridor that links the Mine Site with the Plant Site.
- Wyman Creek – which would also be crossed by the Transportation and Utility Corridor that links the Mine Site with the Plant Site.
- West Pit Outlet Creek – which would receive discharge from the WWTF after closure.

No baseline flow data collection or hydrologic modeling was conducted for Wetlegs, Longnose, and Wyman creeks as the NorthMet Project Proposed Action is not expected to affect the hydrology of these streams. PolyMet used the calibrated XP-SWMM model to estimate selected flow volumes for West Pit Outlet Creek. The XP-SWMM model estimates an average annual flow of 1.2 cfs at the approximate location of the WWTF discharge under existing conditions.

In terms of surface water quality, Wetlegs Creek, Longnose Creek, and the West Pit Outlet Creek drain relatively undisturbed watersheds; whereas Wyman Creek drains an area previously mined by LTVSMC, including Area 3 and Area 5S Pits. Water quality data for various constituents from the two locations on Wyman Creek was collected in 2004, 2011, and 2012 at PM-5, and again in 2013 at both locations. Data collection from Wetlegs Creek, Longnose Creek, and the West Pit Outlet Creek was initiated in spring 2011, with monthly sampling through the end of 2013 (PolyMet 2015m). Water quality data for the four streams are summarized in Table 4.2.2-15. These constituents are generally within the range documented for the main branch of the Partridge River. Parameters with mean concentrations higher than recorded for the Partridge River include iron for Longnose Creek, Wetlegs Creek, and the West Pit Outlet Creek; copper and nickel for Wetlegs Creek and the West Pit Outlet Creek; and manganese and vanadium for all four streams. As with the Partridge River, background concentrations of mercury exceed the 1.3 ng/L standard. Collectively, these data can be used to characterize existing background water quality for these streams.

Table 4.2.2-15 Mean Water Quality Data for Longnose Creek, Wetlegs Creek, Wyman Creek, and West Pit Outlet Creek

Parameter	Units	Detection	Range	Evaluation Criteria(6) (Longnose, West Pit Outlet and Wetlegs)	Longnose Creek(1) LN-1	West Pit Outlet Creek(7) WP-1	Wetlegs Creek(2) WL-1	Evaluation Criteria(5, 6) (Wyman)	Wyman Creek(3) PM-5	Wyman Creek(3) PM-6
					Mean				Mean	
General										
Alkalinity	mg/L	61 of 64	<5–200	--	44.3	21.3	39.8	--	157	100
Calcium	mg/L	101 of 101	2.2–51.1	--	11.1	5.7	10.4	--	35.1	23.2
Chloride	mg/L	66 of 101	<0.25–9.9	230	0.63	0.56	1.0	100	1.7	1.0
Fluoride	mg/L	8 of 23	<0.05–0.19	--	0.050	0.050	0.050	(2.0)	0.091	0.13
Hardness	mg/L	98 of 98	11.8–258	500	48.7	28.8	49.5	250	199	107
Magnesium	mg/L	101 of 101	1.5–36.1	--	4.8	3.3	5.5	--	27.7	14.6
pH	s.u.	99 of 99	5.0–8.3	6.5-8.5	6.8	**5.7**	6.7	6.5–8.5	7.3	7.6
Potassium	mg/L	65 of 67	<0.125–7.0	--	0.63	0.50	0.78	--	5.1	2.1
Sodium	mg/L	52 of 67	<1–17.5	--	1.6	1.3	1.3	--	13.6	6.2
Sulfate	mg/L	74 of 101	<0.5–96.2	--	0.91	2.6	3.9	(250)	67.1	28.1
TDS	mg/L	101 of 101	60.0–352	700	119	152	127	500	270	199
Metals - Total										
Aluminum	µg/L	77 of 95	<10–1,310	125	64.6	**421**	**170**	87	51.8	**102**
Antimony	µg/L	2 of 75	<0.25–<1.5	31	0.25	0.25	0.24	6	0.43	1.5
Arsenic	µg/L	84 of 101	<0.25–6.0	53	1.2	1.9	1.2	2	1.4	0.94
Barium	µg/L	26 of 43	<5–30.6	--	10.4	10.3	10.5	2,000	10.9	10.6
Beryllium	µg/L	0 of 43	<0.1–<0.1	--	0.10	0.10	0.10	4.0	0.10	0.10
Boron	µg/L	12 of 43	<17.5–72.8	500	25.0	25.0	25.0	500	49.5	23.3
Cadmium	µg/L	3 of 43	<0.015–<0.1	2.5(4)	0.070	0.083	0.072	2.5	0.079	0.10
Cobalt	µg/L	60 of 95	<0.1–8.3	5	0.61	1.7	3.7	2.8	0.48	0.50
Copper	µg/L	67 of 95	<0.075–50.9	9.3(4)	0.45	3.6	5.5	9.3(4)	0.68	2.0
Iron	µg/L	101 of 101	237–35,000	--	4,019	7,050	6,372	(300)	1,437	1,872

Parameter	Units	Detection	Range	Evaluation Criteria[6] (Longnose, West Pit Outlet and Wetlegs)	Longnose Creek[1] LN-1	West Pit Outlet Creek[7] WP-1	Wetlegs Creek[2] WL-1	Evaluation Criteria[5, 6] (Wyman)	Wyman Creek[3] PM-5	Wyman Creek[3] PM-6
						Mean			Mean	
Lead	µg/L	21 of 81	<0.01–3.1	3.2[4]	0.24	1.0	0.37	3.2[4]	0.26	0.50
Manganese	µg/L	98 of 98	15.2–4,920	--	708	358	678	(50)	1058	428
Mercury	ng/L	58 of 64	<0.25–28.1	1.3	**3.5**	**13.9**	**5.0**	1.3	1.2	**3.5**
Nickel	µg/L	50 of 95	<0.25–22.4	52[4]	0.62	6.9	5.3	52[4]	0.57	2.5
Selenium	µg/L	2 of 81	<0.1–<1	5.0	0.43	0.48	0.44	5.0	0.52	1.0
Silver	µg/L	0 of 43	<0.1–<0.5	1.0[4]	0.10	0.10	0.10	0.12	**0.20**	**0.50**
Thallium	µg/L	29 of 90	<0.0002–<1	0.56	0.0079	0.013	0.010	0.28	0.15	**1.0**
Vanadium	µg/L	1 of 33	<1.5–9.3	--	3.1	4.3	2.8	--	3.0	--
Zinc	µg/L	15 of 92	<3–134	120[4]	3.0	6.9	10.5	120[4]	3.6	5.0

Source: Barr 2014d.

Notes:
Values in bold indicate an exceedance of surface water quality standard.
1 Based on nine samples collected in 2011, seven samples collected in 2012, and eight samples collected in 2013; Source: Large Table 10, Barr 2014d.
2 Based on eight samples collected in 2011, seven samples collected in 2012, and eight samples collected in 2013; Source: Large Table 10, Barr 2014d.
3 Wyman Creek PM-5 based on four samples collected in 2004, eight samples collected in 2011, nine samples collected in 2012, and 12 samples collected in 2013; PM-6 based on four samples collected in 2004 and one sample collected in 2013.
4 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
5 Values in parentheses indicate Secondary Maximum Contaminant Levels (sMCLs).
6 See Section 5.2.2 for a detailed discussion of the evaluation criteria.
7 West Pit Outlet Creek averages based on four samples collected in 2011, four samples collected in 2012, and seven samples collected in 2013.

Colby Lake and Whitewater Reservoir

This section describes the baseline surface water hydrology and water quality of Colby Lake and Whitewater Reservoir.

Colby Lake and Whitewater Reservoir Hydrology

Colby Lake is located approximately 8 miles southwest from the Mine Site and about 4 miles south of the Plant Site on the Partridge River. It is located approximately 17 river miles downstream from SW-004a (PolyMet 2015m, Appendix C). It is mesotrophic and has a surface area of approximately 539 acres and a maximum depth of approximately 30 ft (see Figure 4.2.2-1). The outlet control of Colby Lake is at an elevation of approximately 1,439 ft amsl. The outflow from the lake stops when water levels drop below this level.

Around 1955, in order to ensure a reliable source of water, Erie Mining Company (precursor to LTVSMC) constructed Whitewater Reservoir and the Diversion Works, which connects Colby Lake and Whitewater Reservoir. This diversion works separates the two waterbodies and allows water to be exchanged between the two. Formerly known as Partridge Lake, this impoundment increased the surface area and depth of the original lake and subjected it to greater annual water level fluctuations. Whitewater Reservoir has a surface area of approximately 1,210 acres and a maximum depth of approximately 73 ft. Water losses due to seepage through the northwest and south dikes can be 15 cfs or more and drain to the Partridge River downstream of Colby Lake (MDNR 2004). The City of Hoyt Lakes WWTP discharges an annual average of 0.39 cfs of treated wastewater effluent into Whitewater Reservoir (see Table 4.2.2-10 and Figure 4.2.2-12).

The Diversion Works contains three 8-ft gates that can be opened to allow the release of water from Colby Lake to Whitewater Reservoir during high flows in the Partridge River. The Diversion Works also contain three high-volume pumps to move water from Whitewater Reservoir back to Colby Lake during low water levels. During operation of the former LTVSMC processing plant, water would typically flow through the Diversion Works gates from Colby Lake to Whitewater Reservoir during the spring runoff and then be pumped back into Colby Lake when needed. Historically, this system was not used as much as expected. When water levels in Colby Lake fall below 1,439.0 ft amsl due to low inflows, the MDNR water appropriation permit (1949-0135) limits withdrawals of water from Colby Lake to the rate that water can be pumped from Whitewater Reservoir to replace the water withdrawn.

After closure of the LTVSMC mine and processing plant in 2001, Minnesota Power purchased the Diversion Works and most of LTVSMC's riparian land around Whitewater Reservoir. This land currently is leased as lake-front property. The water appropriation permit is currently jointly held by Minnesota Power and Cliffs Erie. An agreement has been reached whereby PolyMet would replace Cliffs Erie as the co-permittee. This would enable PolyMet to withdraw water from Colby Lake for use as process makeup water, subject to MDNR approval at the time of permitting. In the 5-year period after LTVSMC stopped its water withdrawals (January 2001 to December 2006) under relatively natural flows (i.e., discharges from the Northshore Mine were only occurring sporadically; see Table 4-5 in Section 4.4.1.2.1 of the Mine Site Water Modeling Data Package [PolyMet 2015m]), water levels in Colby Lake were higher with less fluctuation than when LTVSMC was withdrawing water for its mining operations (see Table 4.2.2-16). Over the same period, Whitewater Reservoir also experienced smaller fluctuations and higher average water levels (see Table 4.2.2-17).

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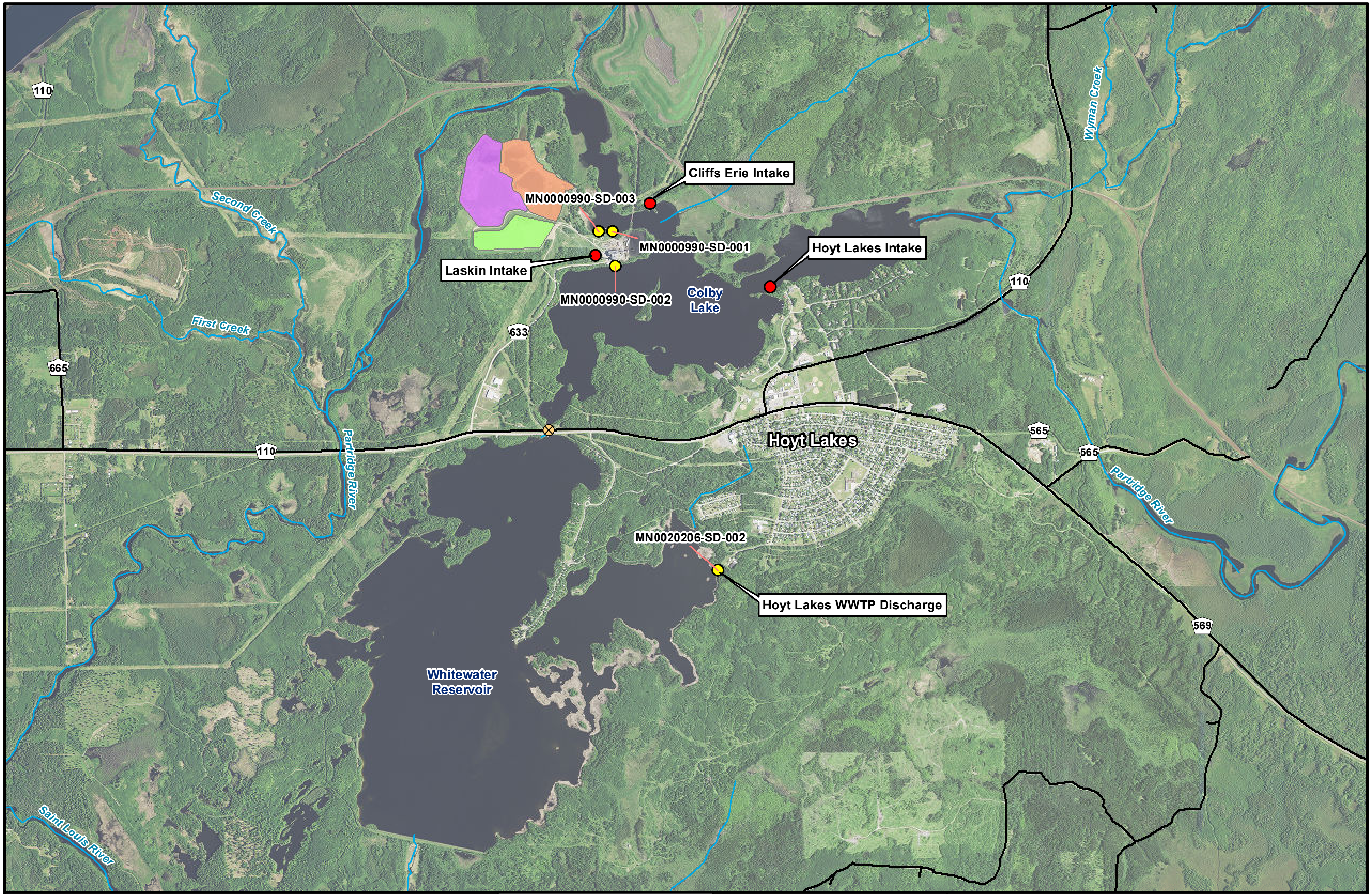

- Water Withdrawals from Colby Lake
- MPCA Water Quality Station 2006/Discharges to Surface Waters NPDES Discharges
- Stream/River
- Existing Road
- Diversion Works
- Ash Pond Cell E
- Ash Pond Cells A and B
- Ash Pond Cells C and D

MNDNR | US Army Corps of Engineers St. Paul District | Forest Service U.S. Department of Agriculture

0 1,000 2,000 4,000 Feet

Figure 4.2.2-12
NPDES Discharges - Colby Lake and Whitewater Reservoir Area
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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Table 4.2.2-16 Comparison of Colby Lake Elevations over Time

Time Period	Represent	Source	Max Annual Fluctuation[1]	% Time below elevation 1,439.0
1937–1954	Pre-mining	Actual measurements	4.6 ft	5.0
1955–1992	During mining[2] (with LTVSMC withdrawals)	Actual measurements	4.1 ft	24.1
1978–1988	During mining[2] (with LTVSMC withdrawals)	Actual predictions	2.7 ft	17
2001–2006	During mining[2] (without LTVSMC withdrawals)	Actual measurements	3.7 ft	7.5
2007–2013	During mining[2] (without LTVSMC withdrawals)	Actual measurements	3.6 ft	0

Source: MDNR 2015c.

Notes:
[1] Maximum annual fluctuation is the maximum difference between annual maximum and minimum water elevations for any single year during the indicated time period.
[2] Includes effects of Northshore Mining operations from 1955 to present.
[3] Data for 2013 are incomplete.

Table 4.2.2-17 Comparison of Whitewater Reservoir Elevations over Time

Time Period	Represent	Source	Max Annual Fluctuation[1]	Average Water Elevation
1937–1954[(3)]	Pre-mining	Actual measurements	2.0 ft	Not Applicable
1955–1980	During mining[2] (with LTVSMC withdrawals)	Actual measurements	14.3 ft	1,437.7 ft
2002–2008	During mining (without LTVSMC withdrawals)	Actual measurements	4.5 ft	1,438.0 ft
2009–2013[4]	During mining (without LTVSMC withdrawals)	Actual measurements	4.2 ft	1,438.1 ft

Source: Actual measurements taken from MDNR 2015d. No data was available between 1980 and 2001.

Notes:
[1] Maximum annual fluctuation is the maximum difference between annual maximum and minimum water elevations for any single year during the indicated time period.
[2] Includes effects of Northshore Mining operations from 1955 to present.
[3] Pre-1955 data is for Partridge Lake. Construction of Whitewater Reservoir, which raised the elevation of Partridge Lake, was not completed until 1955.
[4] Data for 2013 are incomplete.

Colby Lake is currently used as a potable water source for the City of Hoyt Lakes, which is permitted to withdraw a maximum annual average of 0.5 cfs with an instantaneous peak rate of 2.3 cfs. Colby Lake is also used as a cooling water source for Minnesota Power's Laskin Energy Center natural gas power plant. The power plant discharges the once-through, non-contact cooling water (MN0000990 SD-001) to the downstream portion of the lake, but there is up to a 4.2 cfs evaporative loss of water from the cooling tower (see Table 4.2.2-10).

Colby Lake Water Quality

Water quality in Colby Lake is affected by:

- Flow from the Upper Partridge River Watershed (including Northshore Mine discharges);
- Flow from other tributaries to the Upper Partridge River, such as Wyman Creek (including Pits 3 and 5S overflow via Wyman Creek);
- Two permitted discharges from Minnesota Power's Laskin Energy Center (i.e., cooling water discharge and a clarified ash pond discharge);
- Pumping from Whitewater Reservoir during low flows; and
- Stormwater runoff from the City of Hoyt Lakes.

Water quality data are available for Colby Lake from various sources from 1976 to 2013 (PolyMet 2015m). The most recent monitoring data (November 2008, April through September 2010, and June through December 2013) showed elevated concentrations of aluminum, iron, mercury, and manganese (see Table 4.2.2-18). Two exceedances of arsenic and a single exceedance of thallium were observed, although average concentrations of both parameters met surface water quality standards. Colby Lake is on the Minnesota 303(d) TMDL List because of mercury concentrations in fish tissue, but is not included in Minnesota's regional mercury TMDL because the mercury concentrations in the fish are considered too high to be returned to Minnesota's mercury water quality standard using solely the state-wide TMDL approach. Similar to other lakes in Minnesota, the main source of mercury is atmospheric deposition. A TMDL study of Colby Lake is needed to determine what additional actions are required to reduce the mercury concentration in fish, but has not yet been performed.

Sulfate concentrations in Colby Lake from the most recent monitoring data (from 2008, 2010, and 2013) range from 6.6 to 60.7 mg/L with a mean of 27.2 mg/L. This is higher than the concentrations in the Partridge River at SW-005 (mean sulfate concentration of 10.1 mg/L for data from the early-2000s, see Table 4.2.2-12). In addition to what is provided by inflow from the Partridge River, it is interpreted that there are significant other sources of sulfate loading to Colby Lake.

Table 4.2.2-18 Summary of Colby Lake Water Quality Data

			C-N Study (1976–1977)		MPCA Data (1976–2007)			Minnesota Power Data (2002–2003)			Barr Data (2008, 2010, 2013)			
Parameter	**Units**	**Surface Water Evaluation Criteria[2]**	**# Samples**	**Range**	**# Samples**	**Mean**	**Range**	**Detection**	**Mean**	**Range**	**Detection**	**Mean**	**Range**	**# Exceed**
General														
Calcium	mg/L	--	4	11 to 21	14	57.1	21–104	--	--	--	31 of 31	18.4	9.0–29.1	NA
Chloride	mg/L	230	5	6.3–9.4	17	6.1	1.8–9.3	--	--	--	19 of 19	3.6	2.0–5.3	0
Fluoride	mg/L	(2.0)	5	0.1–0.7	10	0.3	0.1–0.4	--	--	--	3 of 5	0.09	<0.05–0.14	0
Hardness	mg/L	500	5	41–83	14	91.2	40–150	--	--	--	31 of 31	81.4	44.4–119	0
Magnesium	mg/L	--	5	3.2–7.3	14	34.1	19–51	12 of 12	11.0	4.4–17.5	31 of 31	8.6	5.3–11.4	NA
pH	s.u.	6.5-8.5	17	6.5–7.8	109	7.1	6.3–8.8	--	--	--	26 of 26	7.6	7.0–8.2	0
Potassium	mg/L	--	4	1.3–1.5	10	1.7	1.4–2.2	--	--	--	9 of 9	1.1	0.84–1.5	NA
Sodium	mg/L	--	4	3.6–4.3	10	6.3	4.7–8.0	--	--	--	9 of 9	4.2	2.9–6.7	NA
Sulfate	mg/L	(250)	15	8.7–140	14	52.9	8.7–140	--	--	--	31 of 31	27.2	6.6–60.7	0
Metals														
Aluminum	µg/L	125	5	180–470	10	307	180–610	12 of 12	171	61–264	31 of 31	113	42.8–243	**9**
Antimony	µg/L	5.5	--	--	--	--	--	0 of 3	3	<3	0 of 9	0.25	<0.25	0
Arsenic	µg/L	2.0	3	0.4–2.1	4	1.4	<0.5–2.1	1 of 3	1.4	<2.0–2.3	26 of 31	0.99	<0.25–2.1	**2**
Barium	µg/L	2,000	--	--	--	--	--	2 of 3	15.7	<10.0–29.1	7 of 9	7.5	<5–11.3	0
Beryllium	µg/L	4	--	--	--	--	--	0 of 3	0.2	<0.2	0 of 9	0.10	<0.1	0
Boron	µg/L	500	--	--	--	--	--	3 of 3	79	54–100	6 of 9	52.1	<25–96.3	0
Cadmium[1]	µg/L	2.5	10	0.02–0.2	15	0.05	0.02–0.20	0 of 3	0.2	<0.2	0 of 9	0.10	<0.1	0
Cobalt	µg/L	2.8	9	<0.3–0.5	6	0.4	<0.3–1.4	2 of 12	0.7	<1.0–1.9	14 of 19	0.31	<0.1–0.67	0
Copper[1]	µg/L	8.0	12	1.6–7.3	15	4.9	1.6–8.0	8 of 12	8.3	<5.0–14.5	19 of 19	3.7	1.6–6	0
Iron	µg/L	(300)	15	190–2,300	15	836	190–2,500	3 of 3	2,103	650–3,030	31 of 31	1,596	451–4,900	**31**
Lead[1]	µg/L	3.2	12	0.2–1.7	14	0.5	0.2–0.9	0 of 3	1.0	<1.0	7 of 19	0.51	<0.25–<1	0

Parameter	Units	Surface Water Evaluation Criteria[2]	C-N Study (1976–1977) # Samples	C-N Study (1976–1977) Range	MPCA Data (1976–2007) # Samples	MPCA Data (1976–2007) Mean	MPCA Data (1976–2007) Range	Minnesota Power Data (2002–2003) Detection	Minnesota Power Data (2002–2003) Mean	Minnesota Power Data (2002–2003) Range	Barr Data (2008, 2010, 2013) Detection	Barr Data (2008, 2010, 2013) Mean	Barr Data (2008, 2010, 2013) Range	# Exceed
Manganese	µg/L	(50)	5	50–90	14	282	63–2,100	3 of 3	123	30–280	31 of 31	106	25.2–390	**23**
Mercury	ng/L	1.3	10	80–400	9	190	<1000–360	--	--	--	9 of 9	6.0	4.6–8.7	**9**
Nickel[1]	µg/L	52	10	0.1–6.0	13	2.7	<1–9.0	1 of 3	3.4	<5.0–5.3	18 of 19	2.2	<1–3.1	0
Selenium	µg/L	5.0	--	--	2	<0.8	<0.8	0 of 12	2.0	<2.0	0 of 19	0.66	<0.5–<2	0
Silver[1]	µg/L	1.0	--	--	--	--	--	0 of 2	1.0	<1.0	0 of 9	0.10	<0.1	0
Thallium	µg/L	0.28	--	--	--	--	--	0 of 3	2.0	<2.0	24 of 31	0.06	<0.0025–0.46	**1**
Vanadium	µg/L	--	--	--	--	--	--	--	--	--	0 of 9	0.94	<0.5–<1.5	NA
Zinc[1]	µg/L	120	12	1–35.3	15	6.9	1.0–50	2 of 3	17.5	<10.0–36.1	2 of 19	4.8	<3–15.8	0

Sources: Barr 2009c; Barr 2014d; Siegel and Ericson 1980.

Notes:
[1] Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L, which approximates the hardness concentration in Colby Lake.
[2] Values in parentheses indicate sMCLs.

Whitewater Reservoir Water Quality

As a result of the Minnesota Statewide Mercury TMDL study, which was approved by the USEPA on April 3, 2008, Whitewater Reservoir was placed on the 2012 inventory of all impaired waters because of mercury concentrations in fish tissue. However, the mercury fish tissue levels are low enough that compliance with applicable standards would be achieved under the statewide TMDL. Therefore, it is not included on the final 2012 TMDL List, and does not need its own TMDL.

The City of Hoyt Lakes WWTP discharges an annual average of 0.39 cfs of treated effluent into Whitewater Reservoir (Barr 2008f; Figure 4.2.2-12). The WWTP discharge most likely affects the water quality of Whitewater Reservoir by the addition of nutrients such as phosphorus and nitrogen.

Limited water quality data are available for Whitewater Reservoir (see Table 4.2.2-19). Based on the most recent data collected by PolyMet in 2010, Whitewater Reservoir has significantly lower concentrations of aluminum, iron, and manganese than Colby Lake. It appears that all constituents meet applicable water quality standards, but sampling for a full suite of metals has not been done.

Table 4.2.2-19 Summary of Whitewater Reservoir 2010 Water Quality Data

Parameter	Units	Surface Water Evaluation Criteria[1]	Detection	Mean	Range	# Exceed
General						
Calcium	mg/L	--	12 of 12	20.8	20.1–21.2	--
Hardness	mg/L	500	12 of 12	90.2	85.7–92.8	0
Magnesium	mg/L	--	12 of 12	9.3	8.6–9.7	--
pH	s.u.	6.5-8.5	12 of 12	7.74	7.29–7.81	0
Sulfate	mg/L	(250)	12 of 12	34.3	32.9–35.3	0
Metals						
Aluminum	µg/L	50–200	2 of 12	<25	<25–25.4	0
Arsenic	µg/L	2.0	7 of 12	<0.5	<0.5–0.62	0
Iron	µg/L	(300)	5 of 12	<60	<50–76.5	0
Manganese	µg/L	(50)	12 of 12	10.8	6.9–14.6	0
Thallium	µg/L	0.28	5 of 12	<0.02	<0.002–0.049	0

Source: PolyMet 2015m.

Note:
[1] Values in parentheses indicate sMCLs.

Lower Partridge River

This section describes the baseline surface water hydrology and water quality of the Lower Partridge River downstream of Colby Lake.

Lower Partridge River Hydrology

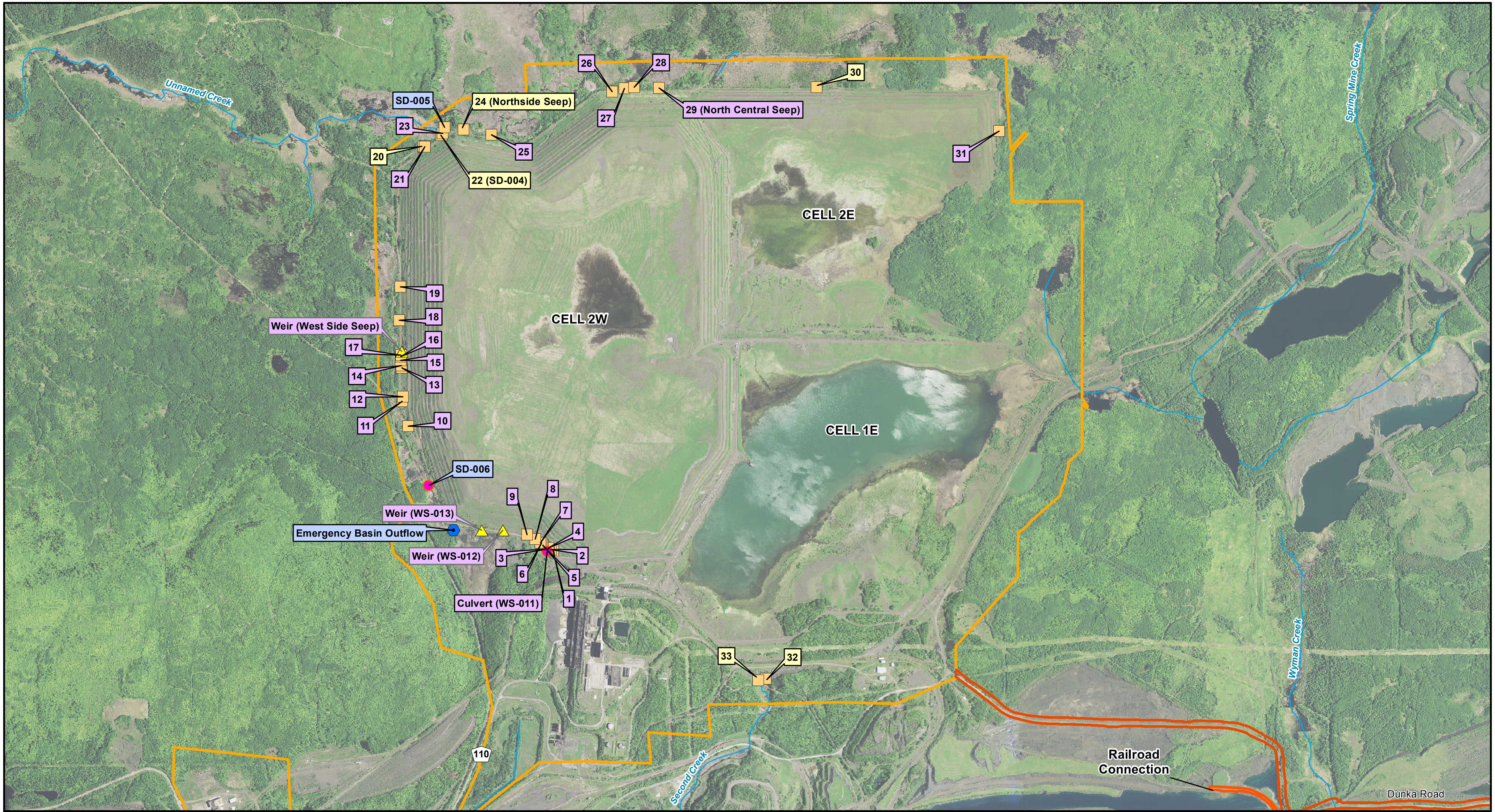
Downstream of Colby Lake, the Partridge River flows approximately four more miles before reaching its confluence with the St. Louis River. Second Creek (also known as Knox Creek) is a tributary of the Partridge River in this segment and until recently was receiving an annual average of 1.2 cfs of surface seepage from the existing LTVSMC Tailings Basin (see Figure 4.2.2-13 for locations of Seeps 32 and 33) (Barr 2008a). A portion of this seepage is now being pumped back into the Tailings Basin, as required by the May 2010 Consent Decree between Cliffs Erie and MPCA. Second Creek is currently receiving seepage from Pit 6. Dewatering flows from Pit 1, as part of the Mesabi Nugget Project (see Table 4.2.2-10, Mesabi Nugget, SD-001) are discharged to Second Creek at a rate up to 9 cfs seasonally (September 1 to March 30) as per their reissued permit. Cliffs Erie is discharging Pit 2/2W water to Second Creek at a rate up to 9.4 cfs.

Lower Partridge River Water Quality

Water quality conditions in the Lower Partridge River, from the outlet of Colby Lake to its confluence with the St. Louis River, result from a mix of Colby Lake outflow, Second Creek inflow, and local runoff. Colby Lake and Second Creek (First Creek is a tributary to Second Creek) water quality is affected by local runoff from the former LTVSMC operations.

Periodic dewatering discharges from Pit 9 (see Figure 4.2.2-2) previously drained to First Creek, but this pit has been abandoned long enough for static water levels to develop. Seepage from Pit 6 currently flows to Second Creek. This seepage has very high sulfate concentrations (greater than 1,000 mg/L). This input of sulfate raises the sulfate concentration in the mainstem of the Partridge River from an average of about 27.2 mg/L as it flows from Colby Lake (see Table 4.2.2-18) to over 160 mg/L downstream of the confluence of Second Creek (Barr 2011a). A summary of existing water quality at several locations follows.

Water quality monitoring as part of the MPCA-issued NPDES Permit MN0042536 (SD-026), as shown in Figure 4.2.2-13, shows that Seeps 32 and 33 were generally consistent with surface water standards (Barr 2011h). Table 4.2.2-20 summarizes the surface water quality monitoring data for Station SD-026 from 2011 to 2013. Surface water quality data from 2011 onwards are representative of existing conditions at the site, as they post-date the installation of the containment system in 2010 that limits flow to Second Creek on the southern side of the Tailings Basin (PolyMet 2015m).



Historical Seeps

- Seeps
- Weirs
- Culvert
- Emergency Basin Outflow
- Plant Site
- Transportation and Utility Corridor
- Stream/River
- Seep: Active Seep
- Seep: Flow Not Measurable or No Flow
- Seep: Surface Discharge

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N W E S

0 1,000 2,000 4,000 Feet

Figure 4.2.2-13
Seeps and Associated Flow Structures at Existing LTVSMC Tailings Basin
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Table 4.2.2-20 Summary of Surface Water Quality Monitoring Data for Station SD-026 (2011–2013)

Constituent	Units	Surface Water Evaluation Criteria	SD-026 Surface Discharge (Seeps 32 and 33)		
General Parameters			**Detection**	**Mean**	**Range**
Calcium	mg/L	--	46 of 46	71.1	58.8–88.3
Chloride	mg/L	230	44 of 44	11.3	6–21.5
Fluoride	mg/L	--	12 of 12	1.1	0.58–1.8
Hardness	mg/L	500	46 of 46	407	210–631
pH	s.u.	6.5–8.5	46 of 46	7.6	7.1–8.3
Sulfate	mg/L	--	44 of 44	178	114–251
TDS	mg/L		44 of 44	637	395–790
Metals – Total					
Aluminum	µg/L	125	42 of 46	14.3	<4–28.9
Antimony	µg/L	5.5	43 of 46	0.10	<0.1–0.1
Arsenic	µg/L	2.0	43 of 46	0.46	<0.1–1
Barium	µg/L	2,000	46 of 46	31.2	16.4–43.3
Beryllium	µg/L	4.0	43 of 46	0.04	<0.04–0.04
Boron	µg/L	500	46 of 46	163	117–236
Cadmium	µg/L	2.5	43 of 46	0.04	<0.04–0.04
Cobalt	µg/L	2.8	42 of 46	0.37	<0.04–0.93
Copper[1]	µg/L	9.3	45 of 46	1.05	<0.14–1.7
Iron	µg/L	--	46 of 46	1,294	325–1,810
Lead[1]	µg/L	3.2	38 of 46	0.10	<0.1–0.10
Manganese	µg/L	--	46 of 46	919	172–2,190
Mercury	ng/L	1.3	39 of 46	0.35	<0.036–0.8
Molybdenum	µg/L		45 of 46	13.4	<2–25
Nickel[1]	µg/L	52	39 of 46	0.31	<0.1–1.58
Selenium	µg/L	5.0	39 of 46	0.20	<0.2–0.2
Thallium	µg/L	0.28	40 of 46	0.01	<0.0004–0.04
Zinc[1]	µg/L	120	43 of 46	6.45	<1.2–13.8

Source: NTS 2009; PolyMet 2015m.

Notes:
< less than indicated reporting limit.
Water quality data for SD-026 collected for PolyMet were supplemented by data from the MPCA website collected as part of the NPDES reporting requirements. Where samples were duplicated due to the inclusion of PolyMet data in the MPCA database, the duplicates were removed and the PolyMet data were used in the event of any inconsistencies.
[1] Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L, which approximates the hardness concentration in Colby Lake.

Limited Lower Partridge River water quality data have also been collected at CR110 (see Figure 4.2.2-1, location 4016000). Table 4.2.2-21 summarizes water quality data from 2008 and 2009 for this location. In general, the concentration of hardness and associated solutes such as calcium, magnesium, and potassium, average two to four times higher in the Lower Partridge River than in the Upper Partridge River at location SW-005. A similar relationship also exists for selected metals such as boron, copper, and nickel, where average concentrations for Lower Partridge River are at least two times those at SW-005. Zinc appears to be an exception, where Lower Partridge River values appear to average about a third of those at SW-005.

Concentrations of sulfate are of special concern because the MPCA staff has provided a draft recommendation that this entire reach of the river from the outlet of Colby Lake to its confluence with the St. Louis River be considered as water used for the production of wild rice (MPCA 2012b). Based on the 2008-2009 data, sulfate concentration in the Lower Partridge River averages about 164 mg/L.

Table 4.2.2-21 Summary of Surface Water Quality Monitoring Data for Station CR110, 2008-2009

Constituent	Units	Surface Water Evaluation Criteria	CR110[(2)]		
General Parameters			**Detection**	**Mean**	**Range**
Calcium	mg/L	--	10 of 10	28.6	13.6–43.7
Chloride	mg/L	230	10 of 10	5.0	2.7–7.7
Fluoride	mg/L	--	10 of 10	0.20	0.11–0.59
Hardness	mg/L	500	10 of 10	291	82.5–546
pH	s.u.	6.5–8.5	12 of 12	7.6	7.3–7.9
Sulfate	mg/L	--	10 of 10	164	43.0–302
TDS	mg/L	500	10 of 10	375	137–650
Metals – Total					
Aluminum	µg/L	125	10 of 10	105	29.3–171
Antimony	µg/L	5.5	7 of 8	0.14	<0.5–0.50
Arsenic	µg/L	2.0	7 of 10	1.3	<2.0
Barium	µg/L	2,000	10 of 10	15.7	8.1–33.0
Beryllium	µg/L	4.0	1 of 8	0.18	<0.20
Boron	µg/L	500	8 of 8	101	59.4–150
Cadmium[1]	µg/L	2.5	1 of 8	0.18	<0.20
Cobalt	µg/L	2.8	8 of 8	0.46	0.28–0.73
Copper[1]	µg/L	9.3	8 of 8	3.4	1.9–4.8
Iron	µg/L	--	10 of 10	942	529–1,640
Lead[1]	µg/L	3.2	6 of 8	0.34	<0.05–0.60
Manganese	µg/L	--	10 of 10	53.4	11.8–106
Mercury	ng/L	1.3	10 of 10	4.4	0.5–7.6
Molybdenum	µg/L	--	10 of 10	1.6	0.73–2.8
Nickel[1]	µg/L	52	8 of 8	3.6	2.7–4.6
Selenium	µg/L	5.0	7 of 8	0.63	0.33–1.0
Thallium	µg/L	0.28	0 of 8	0.40	<0.4
Zinc[1]	µg/L	120	8 of 8	3.5	1.0–6.5

Source: Barr and HC Itasca 2009.

Notes:
< less than indicated reporting limit.
1 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L, which approximates the hardness concentration in Colby Lake.
2 Station CR110 is noted as location MNSW12 in the source file.

4.2.2.4 Embarrass River Watershed

This section describes the baseline hydrology and water quality for the groundwater and surface water within the Embarrass River Watershed portion of the NorthMet Project area. Most of the Tailings Basin and the Emergency Basin are located within the Embarrass River Watershed.

4.2.2.4.1 Groundwater Resources

Geology and Hydrogeology

Bedrock at the Plant Site and Tailings Basin is Precambrian crystalline and metamorphic rock. The uppermost bedrock unit that encompasses most of the area represents Giants Range batholith. However, there are two elevated exposures of bedrock (abutting the southeastern corner of Cell 1E at the Tailings Basin) that consist of sedimentary and volcanic schist. Considering the results of hydraulic testing of bedrock boreholes along the perimeter of the Tailings Basin, bedrock is interpreted to have a significantly lower hydraulic conductivity than the overlying surficial deposits (Barr 2014b). This interpretation is supported by analogy to the bedrock of the Mine Site (Duluth Complex), where hydraulic testing has shown bedrock to have a significantly lower hydraulic conductivity than the surficial deposits. The Giants Range granite is mechanically similar to the Duluth Complex, which is documented to have decreasing hydraulic conductivity with depth. Assuming relatively similar stress, weathering, and erosional histories, it is likely that the Giants Range granite also exhibits decreasing hydraulic conductivity with depth.

Jennings and Reynolds (2005) mapped the surficial deposits around and beneath the Tailings Basin as Rainy Lobe Till, which serves as a shallow, unconfined aquifer. This is generally a sandy loam till with low clay content. However, data from 12 monitoring wells installed north and west of the Tailings Basin indicate the dominating presence in this area of sands with varying amounts of silt and gravel. In a separate geotechnical study of the LTVSMC tailings, several soil borings into the surficial deposits identified the presence of layers of clay and sand, plus cobbles and boulders that prevented recovery of an intact sample (Pint and Dehler 2008). Figure 4.2.2-14 shows the geographic extent of surface geologic features.

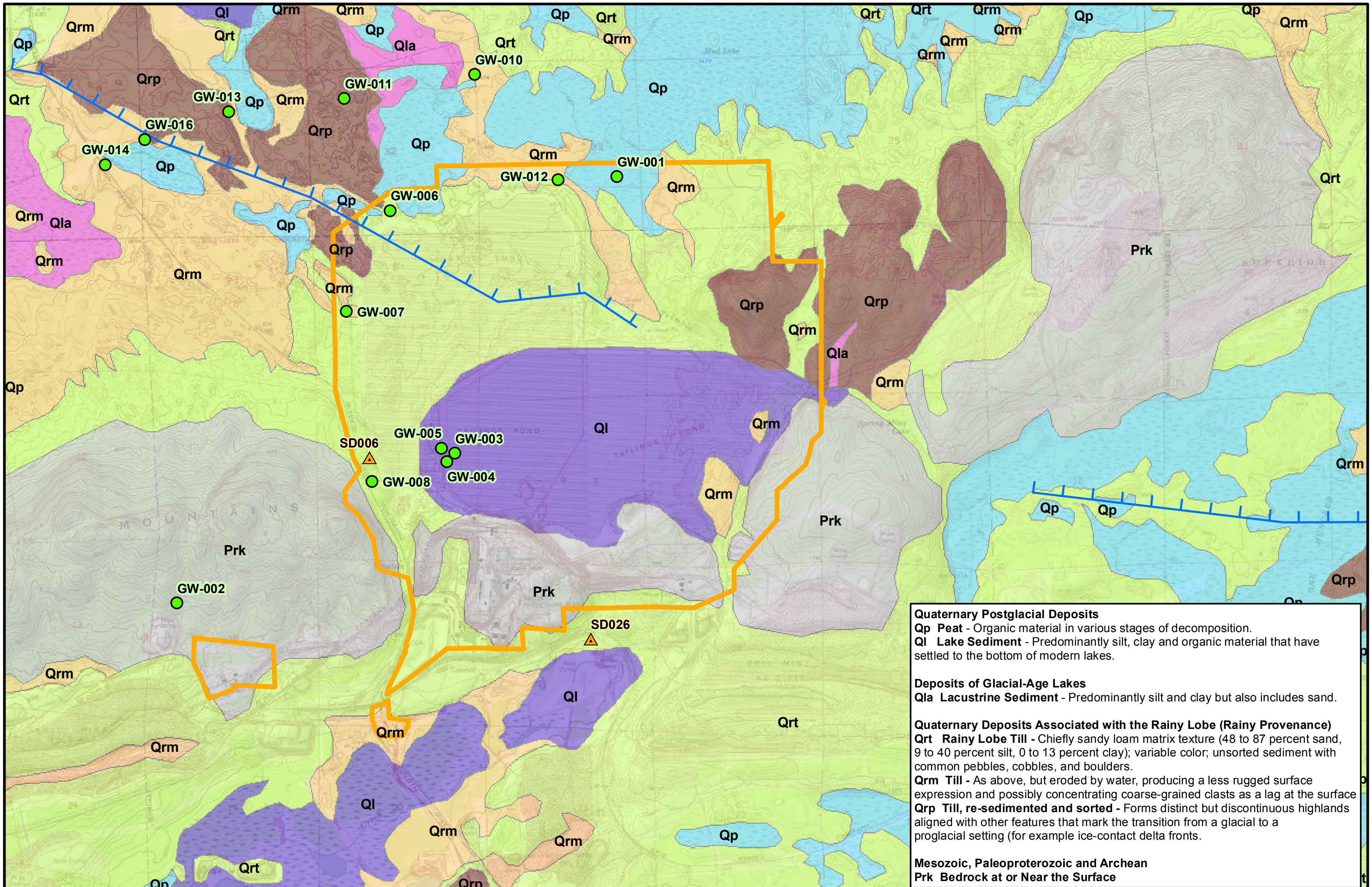
The thickness of surficial deposits (depth to bedrock) along the western, northwestern, and northern sides of the Tailings Basin toe ranges from 3.5 to 42.5 ft as reported in site boring logs (Barr 2014b). The average thickness of surficial deposits along these toes is 19.5 ft. No substantial surficial deposits are present along the southern and much of the eastern sides of the Tailings Basin where the basin abuts against bedrock outcrops. However, an accumulation of surficial deposits is adjacent to the East Embankment on the eastern side of the Tailings Basin. The area farther northwest of the Tailings Basin is believed to be one of the few areas in the region with significant quantities of outwash (sand and gravel) ranging in thickness from 0 ft to greater than 150 ft (Olcott and Siegel 1979) (see Figure 4.2.2-15).

The surficial till is often overlain by wetland/peat deposits. Peat deposits were encountered in some borings, ranging in thickness from less than a foot to several feet, but they are relatively few and discontinuous. Most of the area between the Tailings Basin and the Embarrass River is covered by extensive wetlands and minor surface water features. Unlike the ombrotrophic bogs at the Mine Site, where sphagnum peat has elevated the bog and reduced connection between the surface water and water table (Eggers 2011a), these wetlands between the Tailings Basin and

Embarrass River are likely to represent surficial expressions of the water table (Barr 2012a) and reflect, at least in part, the increase in groundwater and surface water level and flow from LTVSMC tailings seepage.

Regionally, groundwater flows primarily northward toward the Embarrass River, although groundwater in some portions of the Tailings Basin flows to the south to form the headwaters of Second Creek, a tributary of the Partridge River (see Figure 4.2.2-7). Water level data collected from monitoring wells north of the Tailings Basin show an average hydraulic gradient of 0.0039 ft/ft. Recent hydrologic investigations indicate that the total groundwater flow through the aquifer downgradient of the Tailings Basin and toward the west, northwest, and north, is approximately 194 gpm (see Table 5.2.2-39). For groundwater in surficial deposits, aquifer recharge in the areas west, northwest, and north of the Tailings Basin is estimated to be about 0.75 in/yr (PolyMet 2015j). In the area around the Tailings Basin, groundwater flows radially away from it to the west, northwest, and north. There is currently east-to-west groundwater flow towards and under the Tailings Basin from surficial deposits along the embankment on the eastern side of the Tailings Basin.

The existing LTVSMC Tailings Basin consists of three cells. Cell 2W is the largest (1,450 acres) and highest (average fill height of 200 ft) and has been closed and re-vegetated. Cell 1E is located east of Cell 2W and covers approximately 980 acres with an average fill height of 60 ft. Cell 2E, which is located east of Cell 2W and north of Cell 1E, covers approximately 620 acres, and has an average fill height of 60 ft, although it is at a lower elevation than Cell 1E.



Plant Site
Groundwater Monitoring Well
Existing Surface Discharge
Ice Margins

N W E S

0 1,500 3,000 6,000 Feet

Figure 4.2.2-14
Surficial Geology at the Plant Site
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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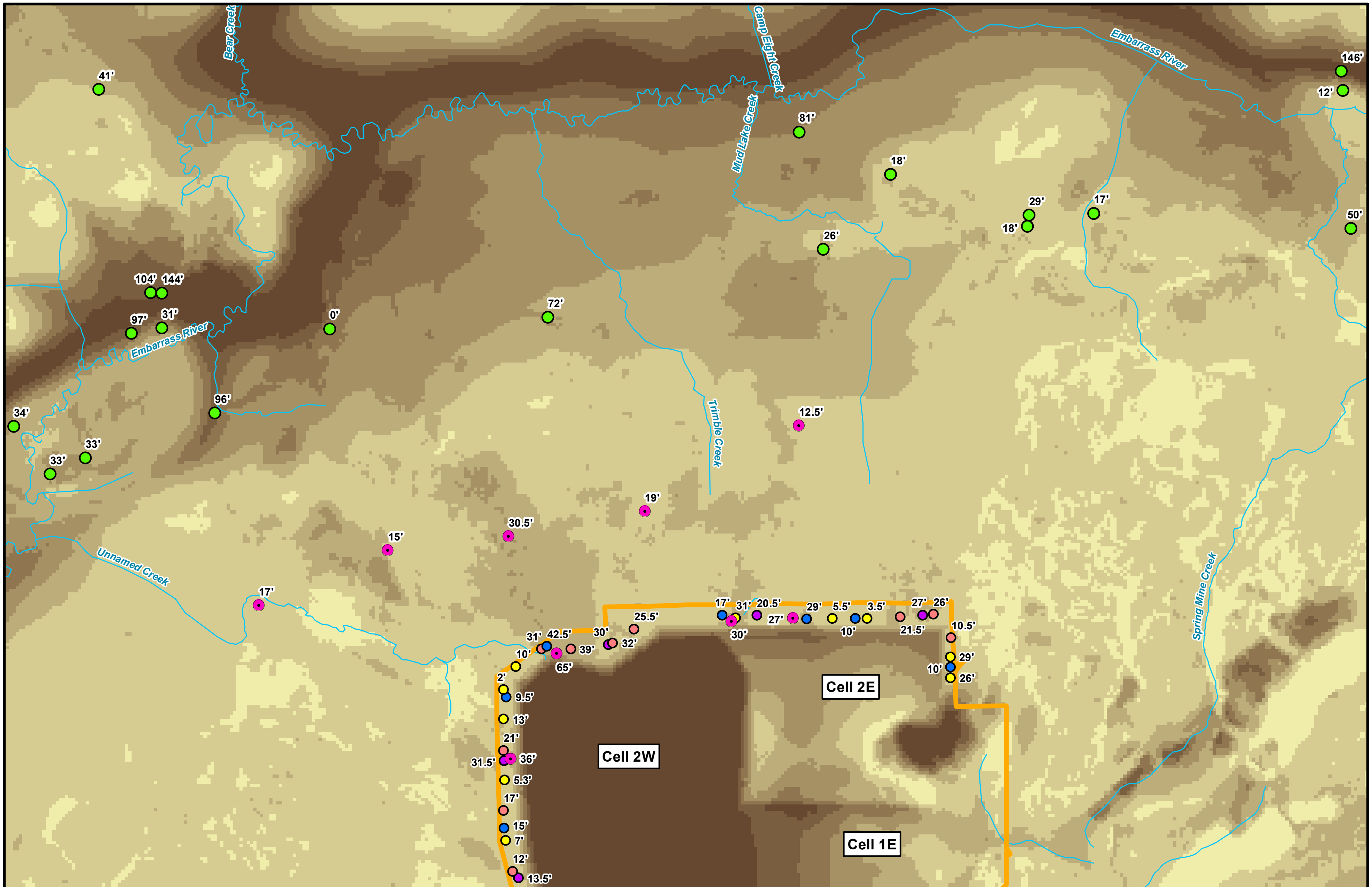

Residential Well from County Well Index (with depth to bedrock)

Groundwater Well - Existing

Rotasonic Location

Rotasonic Location with a Piezometer

Boring Location with Packer

Boring Location

Plant Site

Stream/River

Depth to Bedrock

0' -25'

25' - 50'

50' -75'

75' -100'

100' -125'

> 125'

MNDNR

US Army Corps of Engineers St. Paul District

Forest Service U.S. Department of Agriculture

N W E S

0 1,000 2,000 4,000 Feet

Figure 4.2.2-15

Depth to Bedrock at Tailings Basin Area

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During the LTVSMC operations, the LTVSMC Tailings Basin was built up over time and a groundwater mound formed beneath the basin due to seepage from tailings ponds located within the various cells. Surface seeps initially occurred on the southern, western, and northern sides of the Tailings Basin; however, most surface seeps have dried out since January 2001, when LTVSMC terminated depositing tailings in the basin. Only a few surface seeps remain active, specifically seeps 32 and 33 that drain to the south of the existing LTVSMC Tailings Basin and toward Second Creek (see Figure 4.2.2-13).

The eastern side of the Tailings Basin is bounded by low-permeability bedrock uplands, except for surficial deposits adjacent to the East Embankment. Groundwater flow to the east and south of the Tailings Basin is minimal. Most groundwater flows from beneath the Tailings Basin into the surrounding surficial deposits to the west, northwest, and north towards the Embarrass River. Recent seepage from the existing LTVSMC Tailings Basin towards the Embarrass River was estimated to be approximately 2,590 gpm (PolyMet 2015j; see Table 5.2.2-38). This seepage rate exceeds the capacity of the surficial aquifer to transmit groundwater, resulting in upwelling to the surface of an estimated 2,381 gpm of tailing water (see Table 5.2.2-39). This upwelling and historic surface seepage from the LTVSMC tailings created or expanded wetlands immediately downgradient of the existing LTVSMC Tailings Basin, and inundated these same wetlands (see Section 4.2.3). These hydrologic effects on wetlands diminish to the north.

Groundwater elevations within the surficial aquifer north of the existing LTVSMC Tailings Basin were determined from several years of water-level measurements in 15 wells (see Figure 4.2.2-16). These include eight wells that are adjacent to (or within) the existing LTVSMC Tailings Basin (GW-001 through GW-008), which were installed as part of the NPDES permit and monitored as far back as 2001. Seven other wells located farther from the existing LTVSMC Tailings Basin (GW-009 through GW-015) were installed in 2009 and 2010 by PolyMet to support hydraulic characterization of the NorthMet Project Proposed Action (PolyMet 2015j). The water table within the Tailings Basin showed a systematic decrease in elevation following cessation of the LTVSMC operations in 2001 as the tailings drained, with water levels stabilizing since 2007. Following the cessation of the LTVSMC mine operations, the remaining surface water within Cell 2W was either drained into Cell 1E or infiltrated into the underlying tailings, such that no pond remains. Cells 1E and 2E still impound water, but at lower levels than during the active LTVSMC operations. Water levels measured in the Pond and the piezometer located within the cells indicate that these cells may have been approaching steady-state conditions prior to the seep pump-backs that are part of the Cliffs Erie Consent Decree.

Although water levels were monitored starting in 2001, assessment of the existing conditions and the project effects for this FEIS primarily rely on water-level data collected for 2007 through July 2013 (PolyMet 2015j). Monitoring data shows that the water table slopes to the west, northwest, and north, producing flow from the LTVSMC tailings toward the Embarrass River (see Figure 4.2.2-11 and Figure 4.2.2-17). The fluctuations at individual wells since 2007 have been small. The maximum range in the wells adjacent to the tailings has been 3.8 ft (both GW-005 and GW-008 had this range), and in the farther downgradient wells, the range in water levels at individual wells ranged from 0.33 to 4.67 ft (well GW-011; Figure 4.2.2-8).

Baseline groundwater elevations, depths to bedrock, and surface water drainage locations have been used to identify three flowpaths (West, Northwest, and North) that represent the most direct paths between Tailings Basin facilities and evaluation locations (i.e., property boundaries and surface waters of the state) (PolyMet 2015j). Groundwater flow at the East Embankment is toward the west (under the Tailing Basin), while flow to the east is negligible because of the presence of bedrock outcrops. Groundwater flow toward the south is also negligible because surficial deposits are present there only as thin and laterally discontinuous bodies; tailings water at the South Toe seeps out to ground surface and a portion of that is pumped back to the Tailings Basin.

Plant Site	Tailings Basin Toe Well
Transportation and Utility Corridor	Natural Background Well
Stream/River	Groundwater Monitoring Well
Existing Railroad	Tailings Basin Downgradient Well

MNDNR
US Army Corps of Engineers St. Paul District

N W E S

0 0.25 0.5 1 Miles

Figure 4.2.2-16
Monitoring Locations Near Existing Tailings Basin
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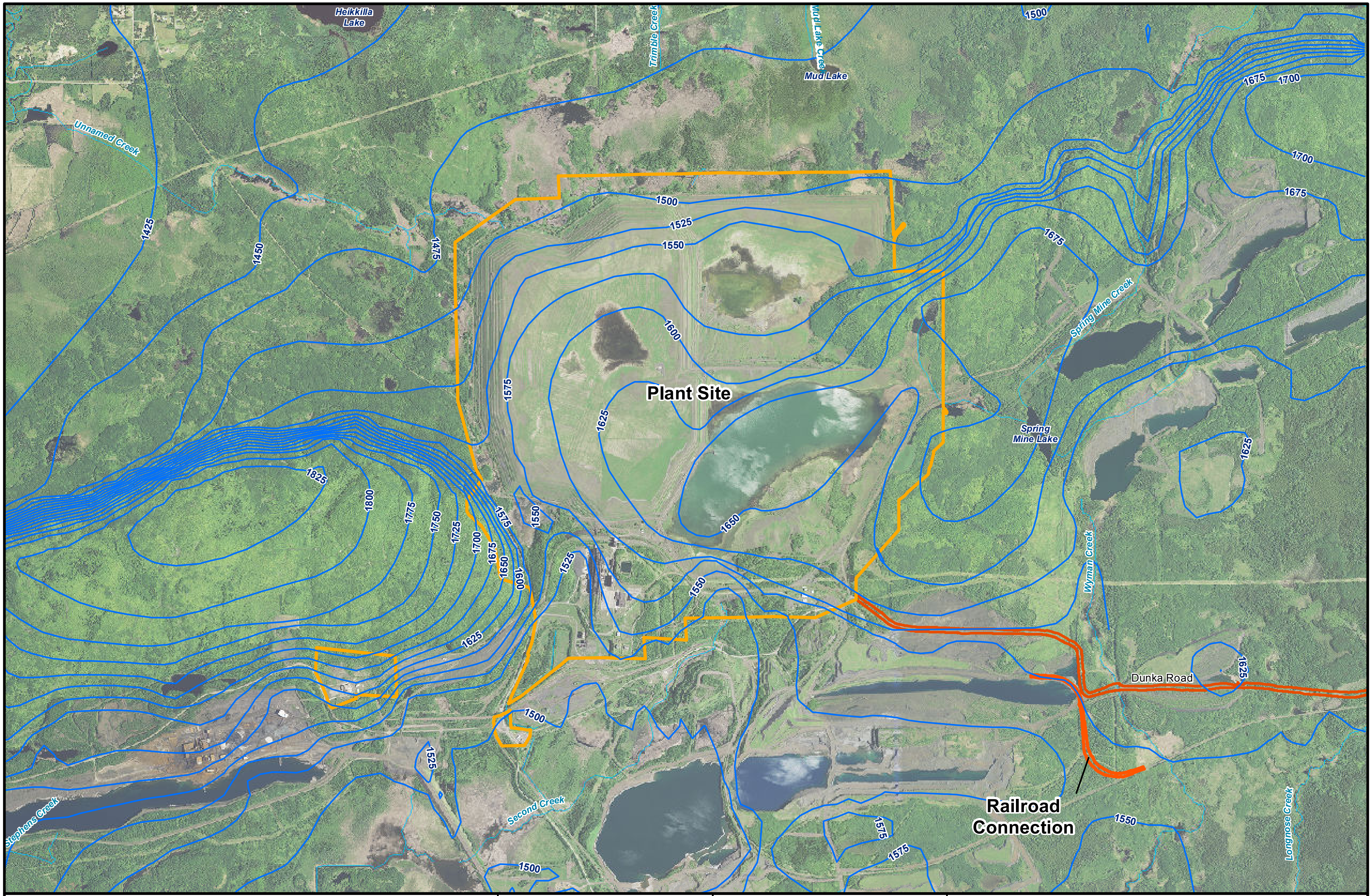

Plant Site

Transportation and Utility Corridor

* Water Table Elevation in Surficial Aquifer (Ft AMSL)

Stream/River

* Source: PolyMet 2015j

0 0.25 0.5 1 Miles

Figure 4.2.2-17

Estimated Existing Groundwater Contours in Surficial Deposits and Bedrock Outcrops - Plant Site

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Hydraulic characteristics of the surficial deposits and shallow bedrock in the Tailings Basin area are derived from the following sources:

- Eight single-well pumping tests conducted in monitoring wells in the surficial deposits (Barr 2009e).
- Multiple slug tests performed in standpipe piezometers located in the surficial deposits of Cell 2W (Pint and Dehler 2008).
- Slug tests performed in 10 standpipe piezometers installed in surficial deposits, typically right above bedrock, around the perimeter of Tailings Basin, as well as in four accessible wells that were installed in 2008 (PolyMet 2015l, Attachment F).
- Packer tests performed in five of the 12 bedrock borings completed along the northern, northwestern, and western perimeters of the Tailings Basin. In total, 10 tests were performed at one to three depth intervals of each tested boring. Drilling of those bedrock borings produced rock cores and RQD data (PolyMet 2015l, Attachment F).

Estimated hydraulic properties of the native units found near the Tailings Basin vary by several orders of magnitude (Barr 2008c). Estimated hydraulic conductivities range from approximately 0.0002 ft/day for the Giants Range bedrock to approximately 70 ft/day for the glacial till (Barr 2009f). Single well pumping tests conducted in eight of the monitoring wells located within the glacial till found an average permeability of 14 ft/day within a range of 0.4 to 65 ft/day (Barr 2009e), while slug tests performed in standpipe piezometers located in the glacial till downgradient of Cell 2W found an average permeability of only 1.5 ft/day within a range of 0.25 to 2.1 ft/day (Pint and Dehler 2008). The hydraulic conductivity of the LTVSMC tailings ranges from approximately 0.003 ft/day for the slimes to approximately 7 ft/day for the coarse tailings.

Slug tests performed in standpipe piezometers completed in glacial till in different parts of the Plant Site showed hydraulic conductivity ranging from 0.15 to 130 ft/day, with geometric mean of 4.41 ft/day. Those values for glacial till are considered to be the best representation of in situ conditions in glacial till (PolyMet 2015l, Attachment F).

Geometric mean of hydraulic conductivity values obtained from the packer tests performed in the bedrock borings is 0.14 ft/day. This value is judged to be the best estimate characterizing the top 20 ft of bedrock around the Plant Site; it is similar to a geometric mean of hydraulic conductivity values quoted in literature for the Giants Range Granite (Barr 2014b).

It was observed that a density of fractures often decreases with an increasing core depth, indicating hydraulic conductivity decreasing with depth.

Groundwater Quality

Characterization of groundwater quality at the Plant Site is based on the analyses of water collected from the following wells installed in surficial deposits:

- Eight groundwater monitoring wells (i.e., wells GW-001 through GW-008) monitored since at least 1999 (see Figure 4.2.2-16). GW-002 is considered a baseline well for the Tailings Basin, as it is located distant from the Tailings Basin groundwater flowpaths. Wells GW-003, GW-004, and GW-005 located within Cell 2W were intended to monitor the high sulfide Virginia Formation hornfels waste rock that was placed in this cell in 1993. The remaining wells—GW-001, GW-006, GW-007, and GW-008—are located at or very near the toe of the Tailings Basin embankment.

- Seven additional wells installed and monitored since 2009:
  - One at the toe of the Tailings Basin (GW-012);
  - Three downgradient of the Tailings Basin (GW-009, GW-010, and GW-011);
  - Three new wells installed in July 2010, after issuance of the 2009 DEIS (GW-013, GW-014, and GW-015) (PolyMet 2015j); and
- Fifteen residential wells near the Tailings Basin were sampled. Twenty-three non-sampled residential wells were identified between the Tailings Basin and Embarrass River (see Table 4.2.2-26). The 38 wells in total were completed in surficial deposits and in bedrock. The wells are located between 1 and 3.8 miles north of the Tailings Basin (see Figure 4.2.2-18).

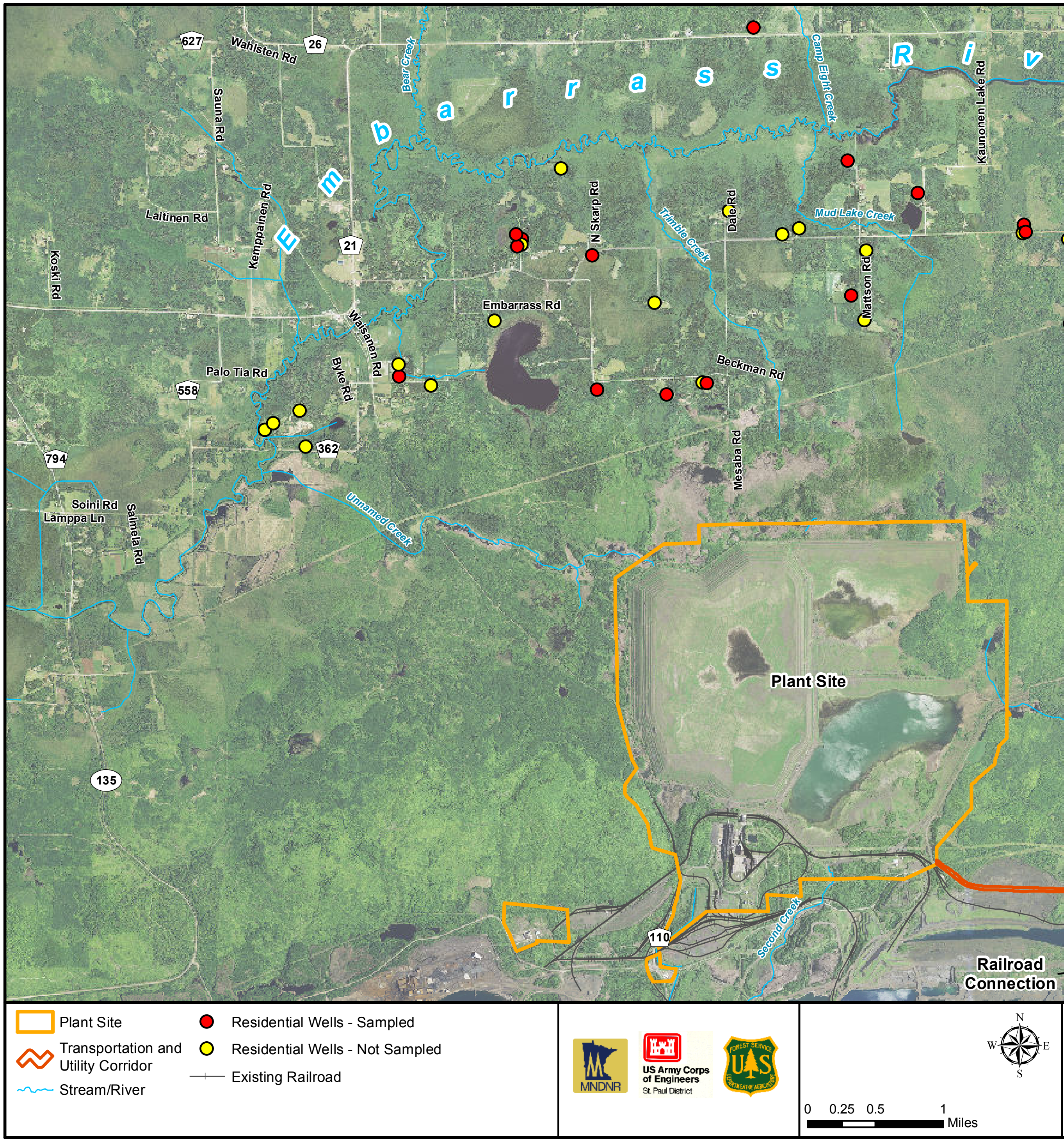

Figure 4.2.2-18
Residential Well Locations Between the Tailings Basin and the Embarrass River
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Minnesota

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The discussion of groundwater quality in the Plant Site area groups the available wells into three categories:

- Natural background wells (GW-002, GW-011, GW-013, and GW-015). These best approximate groundwater quality unaffected by the LTVSMC tailings. Low chloride concentrations measured in those wells indicate that groundwater around those wells have not been affected appreciably by Tailings Basin seepage. Table 4.2.2-22 presents solute concentrations measured in the background wells. It also shows the concentrations reported in the studies of regional background water quality conducted by the MPCA and the USGS (MPCA 1999a; Siegel and Ericson 1980).
- Tailings Basin toe wells (GW-001, GW-006, GW-007, GW-008, and GW-012). These wells are located at the toe of the Tailings Basin. Analytical results from some of these wells have been used (in conjunction with a few surface seeps) to estimate the composition of LTVSMC Tailings Basin seepage. Table 4.2.2-23 presents the range for solute concentrations measured in these wells and the remaining Cell 2E Pond.
- Downgradient wells. This group consists of two types of wells:
  - Tailings Basin downgradient wells (GW-009, GW-010, GW-014, and GW-016). These wells are located downgradient of and to the north and northwest of the Tailings Basin, beyond its toe. Table 4.2.2-24 presents ranges for solute concentrations in these wells.
  - Residential wells. Figure 4.2.2-18 shows the location of: 1) 23 non-sampled residential wells identified between the Tailings Basin and the Embarrass River and 2) 15 sampled wells.

Natural Background Wells

In the period since release of the 2009 DEIS, an updated review of available groundwater quality data allowed a conclusion that natural water quality in the Tailings Basin area was reflected by wells GW-002, GW-011, GW-013, and GW-015. These four wells were selected as unaffected natural background baseline wells primarily because of their low chloride concentrations (ranging from below detection up to 4.8 mg/L), which are consistent with regional values for background chloride concentrations, and clearly distinct from chloride concentrations in discharge from the existing LTVSMC tailings (approximately 30 mg/L; PolyMet 2015j). Also, concentrations of ammonia (as nitrogen), calcium, fluoride, magnesium, sodium, potassium, sulfate, as well as TDS (total dissolved solids) and hardness are lower in these wells than in the Tailings Basin toe wells and downgradient wells discussed below.

Baseline concentrations of some constituents in groundwater of the Tailings Basin area exceed the groundwater evaluation criteria (see Table 4.2.2-22). For example, at well GW-002, groundwater within the surficial aquifer has elevated concentrations (i.e., at or higher than the groundwater evaluation criteria) of aluminum, iron, and manganese. The manganese levels were within the range of baseline concentrations found by MPCA in northeastern Minnesota (MPCA 1999a) and in the Regional Copper-Nickel Study (Siegel and Ericson 1980), but the aluminum and iron values were above the range of concentrations found in these two studies. In addition, beryllium did not meet the groundwater evaluation criteria. However, interpretation of the beryllium concentrations is complicated because the detection limits exceeded the evaluation criteria. Beryllium was detected in some groundwater samples at concentrations above the evaluation criteria.

Aluminum, iron, and manganese concentrations are heavily influenced by natural processes, particularly chemically reducing conditions and the presence of dissolved organic acids, both of which can arise in aquifer zones enriched in natural organic matter. Further, the analyses of "total" groundwater concentrations included an unknown amount of fine particulates that were then digested in sample preparation and contributed to the reported concentrations. Reported total concentrations could thus be influenced by the high values for elements common in clays and other fine particulates, including aluminum, iron, and manganese. Consequently, the dissolved concentrations are generally considered more representative of groundwater quality than total concentrations. Very few dissolved concentrations measured in the collected samples are exceeding the evaluation criteria. All other parameters met the groundwater evaluation criteria.

Table 4.2.2-22 Summary of Natural Background Groundwater Quality Monitoring Data for the Tailings Basin Area and Two Larger Regional Areas

Parameters	Units	Groundwater Evaluation Criteria	Baseline Quality in Surficial Aquifer (GW-002, GW-011, GW-013, and GW-015)				Northeast MN Baseline	Copper-Nickel Study Baseline
General			**Detection**	**Mean[1]**	**Range**	**# Exceed**	**Range**	**Range**
Alkalinity	mg/L	--	49 of 50	51.2	<10–133	NA	--	--
Ammonia as Nitrogen	mg/L	--	10 of 50	0.07	<0.025–0.49	NA	--	--
Calcium	mg/L	--	50 of 50	14.8	3.1–41.4	NA	--	--
Carbon, total organic	mg/L	--	48 of 50	2.8	<0.5–7.4	NA	--	--
Chloride	mg/L	250	30 of 50	0.80	<0.25–4.8	0	--	0.4–35
Fluoride	mg/L	2	14 of 50	0.10	<0.05–0.56	0	0.2–0.57	--
Hardness	mg/L	--	50 of 50	64.6	13.3–236	NA	--	--
Magnesium	mg/L	--	50 of 50	6.7	1.3–32.2	NA	--	--
pH	s.u.[3]	6.5–8.5	50 of 50	7.0	5.5–8.3	**13**	6.0–8.4	5.7–8.0
Potassium	mg/L	--	50 of 50	1.4	0.25–6.1	NA	--	--
Sodium	mg/L	--	44 of 50	3.4	<1–9.8	NA	--	--
Sulfate	mg/L	250	50 of 50	7.5	2.6–38.6	0	<0.3–14.2	1.8–450
TDS	mg/L	--	49 of 50	51.2	<10–133	NA	--	--
Metals – Total								
Aluminum	µg/L	200	49 of 50	4,772	<10–63,500	34	<0.1–30	0–200
Antimony	µg/L	6	0 of 50	0.25	<0.25	0	<0.01–0.04	--
Arsenic	µg/L	10	24 of 50	1.3	<0.25–18.0	1	<0.1–9.1	--
Barium	µg/L	2,000	50 of 50	102	10.9–703	0	1.6–191	--
Beryllium	µg/L	0.08	6 of 50	**0.20**	<0.1–2.7	BDL[2]	<0.01–0.41	--
Boron	µg/L	1,000	0 of 50	29.0	<25–<100	0	<13–41	--
Cadmium	µg/L	4	9 of 50	0.18	<0.1–1.7	0	<0.02–0.2	0–8.4
Chromium	µg/L	100	36 of 50	14.4	<0.5–258	**1**	0.09–4.7	0–5.5
Cobalt	µg/L	--	40 of 50	4.2	<0.1–87.1	NA	0.05–0.63	0.3–28.0
Copper	µg/L	1,000	49 of 50	15.8	<0.25–300	0	<5.5–22	0.6–190
Iron	µg/L	300	50 of 50	**5,862**	53.4–82,600	**34**	7–7,816	0–3,100
Lead	µg/L	--	29 of 50	2.6	<0.25–56.2	NA	<0.03–2.0	0.1–6.4

Parameters	Units	Groundwater Evaluation Criteria	Baseline Quality in Surficial Aquifer (GW-002, GW-011, GW-013, and GW-015)				Northeast MN Baseline	Copper-Nickel Study Baseline
General			Detection	Mean[1]	Range	# Exceed	Range	Range
Manganese	µg/L	50	50 of 50	**271**	1.0–2,140	**30**	0.9–1,248	10–7,190
Mercury	ng/L	2,000	44 of 48	4.1	<0.25–43.1	0	--	--
Methylmercury	ng/L	--	5 of 45	0.041	<0.015–0.10	NA	--	--
Molybdenum	µg/L	--	34 of 50	1.7	<0.1–17.1	NA	<4.2–12	--
Nickel	µg/L	100	46 of 50	15.7	<0.25–316	**1**	<6.0–16	--
Selenium	µg/L	30	1 of 50	0.55	<0.1–1.6	0	<1.0–4.7	--
Silver	µg/L	30	1 of 50	0.11	<0.1–0.46	0	<0.01–0.05	--
Thallium	µg/L	0.6	4 of 50	0.14	<0.0085–0.81	**1**	<0.005–0.01	--
Zinc	µg/L	2,000	25 of 50	19.9	<3–366	0	<2.7–138	3.9–170
Dissolved/Filtered Metals								
Aluminum	µg/L	200	29 of 50	48.5	<10–352	**1**	--	--
Antimony		6	0 of 1	0.25	<0.25	0	--	--
Arsenic	µg/L	10	9 of 44	0.46	<0.25–1.1	0	--	--
Barium		2,000	30 of 31	60.3	<5–236	0	--	--
Beryllium		0.08	0 of 1	1.0	<1–<1	BDL[2]		
Boron	µg/L	1,000	0 of 31	27.4	<25–<100	0	--	--
Cadmium	µg/L	4	4 of 50	0.13	<0.015–1.3	0	--	--
Chromium	µg/L	100	22 of 50	0.90	<0.5–2.4	0	--	--
Cobalt		--	1 of 31	0.14	<0.1–1.3	NA	--	--
Copper	µg/L	1,000	41 of 50	2.0	<0.25–6.5	0	--	--
Iron		300	19 of 43	60.3	<25–288	0	--	--
Lead		--	0 of 31	0.25	<0.25–<0.3	NA	--	--
Manganese	µg/L	50	43 of 45	**152**	<5–744	**12**	--	--
Molybdenum		--	28 of 50	1.4	<0.1–16.6	NA		
Nickel	µg/L	100	43 of 50	1.5	<0.25–5.6	0	--	--
Selenium	µg/L	30	0 of 50	0.49	<0.1–<0.5	0	--	--
Silver	µg/L	30	0 of 50	0.10	<0.1	0	--	--
Thallium		0.6	0 of 1	0.20	<0.2	0	--	--
Zinc	µg/L	2,000	16 of 50	5.4	<3–17.8	0	--	--

Sources: Barr 2014d; NTS 2009; MPCA 1999a; Siegel and Ericson 1980.

Notes:
Groundwater evaluation criteria: The maximum allowed concentrations (or for some less toxic substances, the maximum recommended concentrations) of various constituents in groundwater. The specific thresholds are either the USEPA primary Maximum Contaminant Levels (MCLs), the MDH Health Risk Limits (HRLs), or the USEPA sMCLs (sMCLs are used to set thresholds for aluminum, iron, and manganese). These thresholds are considered when determining whether alternatives considered in this FEIS are expected to have a significant environmental effect.
Bold (e.g., **0.014**) indicates exceeds evaluation criteria.
< less than indicated reporting limit.

1 Where non-detects occur, the mean was calculated using half the detection limit.
2 Below detection limit. Detection limit is greater than water quality standard.

Tailings Basin Toe Wells

Ponds remain atop the existing LTVSMC Tailings Basin within Cells 1E and 2E. No pond is present in Cell 2W. Table 4.2.2-23 summarizes the results of surface water quality monitoring of the Cell 2E pond (mean values for data collected from 2001 to 2004) and groundwater quality monitoring at monitoring wells located along the northern, northwestern, and western toes of the Tailings Basin (GW-001, GW-006, GW-007, GW-008, and GW-012). The existing LTVSMC Tailings Basin is a disposal facility and is not a natural surface waterbody or a point of compliance pursuant to Cliffs Erie's NPDES/SDS permit. Therefore, comparison of these data with surface or groundwater evaluation criteria is not appropriate; however, these criteria are listed for informational purposes.

Table 4.2.2-23 Existing Pond Water and Groundwater Quality at the Toe of the Tailings Basin

Parameters	Units	Pond Water Quality (Cell 2E)	Groundwater Evaluation Criteria	Toe of Tailings Basin (GW-001, GW-006, GW-007, GW-008, GW-012, Surficial Aquifer)		
General		**Mean**		**Detection**	**Mean[1]**	**Range**
Alkalinity	mg/L	--	--	83 of 83	421	17.6–852
Calcium	mg/L	30	--	83 of 83	84.0	4.3–211
Chloride	mg/L	23	250	82 of 82	18.2	0.56–30.4
Fluoride	mg/L	5.2	2	64 of 82	0.90	<0.05–2.6
Hardness	mg/L	--	--	80 of 80	591	19.0–1,360
Magnesium	mg/L	--	--	83 of 83	95.0	2.0–262
pH	s.u.	8.4	6.5–8.5	91 of 91	7.3	4.1–8.7
Potassium	mg/L	--	--	83 of 83	5.9	0.58–16.0
Sodium	mg/L	--	--	82 of 83	55.5	<1–131
Sulfate	mg/L	109	250	82 of 82	234	4.1–659
TDS	mg/L	381	500	63 of 63	**799**	85–1,610
Metals – Total						
Aluminum	µg/L	--	200	57 of 83	**1,522**	<10–29,000
Antimony	µg/L	--	6	0 of 80	0.25	<0.25
Arsenic	µg/L	5	10	38 of 80	1.8	<0.25–7.1
Barium	µg/L	--	2,000	82 of 83	133	<5–452
Beryllium	µg/L	--	0.08	4 of 80	**0.19**	<0.1–1.0
Boron	µg/L	278	1,000	66 of 83	319	<25–554
Cadmium	µg/L	--	4	10 of 80	0.17	<0.1–2.0
Chromium	µg/L	--	100	33 of 80	4.3	<0.5–68.2
Cobalt	µg/L	1	--	72 of 80	1.9	<0.1–17.9
Copper	µg/L	2	1,000	79 of 80	7.8	<0.35–205
Iron	µg/L	--	300	69 of 83	**4,709**	<25–31,000
Lead	µg/L	--	--	18 of 80	0.87	<0.25–8.5
Manganese	µg/L	100	50	83 of 83	**1,299**	10.0–4,130
Mercury	ng/L	1.4	2,000	55 of 72	4.9	<0.25–153
Methylmercury	ng/L	--	--	9 of 71	0.048	<0.015–0.28
Molybdenum	µg/L	113	--	74 of 80	20.1	<0.1–47.0
Nickel	µg/L	2.1	100	70 of 80	7.3	<0.25–90.6
Selenium	µg/L	--	30	3 of 80	0.58	<0.5–<5
Silver	µg/L	--	30	2 of 80	0.10	<0.1–0.23
Thallium	µg/L	--	0.6	5 of 80	0.14	<0.0085–0.53

Parameters	Units	Pond Water Quality (Cell 2E)	Groundwater Evaluation Criteria	Toe of Tailings Basin (GW-001, GW-006, GW-007, GW-008, GW-012, Surficial Aquifer)		
General		**Mean**		**Detection**	**Mean[1]**	**Range**
Zinc	µg/L	--	2,000	17 of 80	9.3	<3–94.9
Metals – Dissolved/Filtered						
Aluminum	µg/L	--	200	15 of 80	14.2	<5–93.2
Antimony	µg/L	--	6	0 of 4	0.25	<0.25
Arsenic	µg/L	--	10	26 of 63	1.0	<0.25–6.5
Barium	µg/L	--	2,000	42 of 42	115	1.2–277
Beryllium	µg/L		0.08	0 of 4	1.0	<1
Boron	µg/L	--	1,000	37 of 47	308	<25–531
Cadmium	µg/L	--	4	4 of 80	0.12	<0.1–1.1
Chromium	µg/L	--	100	15 of 80	0.72	<0.5–2.9
Cobalt	µg/L	--	--	32 of 42	0.89	<0.1–3.5
Copper	µg/L	--	1,000	74 of 80	2.0	<0.25–11.0
Iron	µg/L	--	300	34 of 62	**2,265**	<25–11,000
Lead	µg/L	--	--	0 of 42	0.25	<0.25–<0.3
Manganese	µg/L	--	50	64 of 64	**1,158**	5.4–3,710
Molybdenum	µg/L		--	76 of 80	20.0	<0.1–45.0
Nickel	µg/L	--	100	63 of 80	3.3	<0.25–12.2
Selenium	µg/L	--	30	0 of 80	0.50	<0.5
Silver	µg/L	--	30	0 of 80	0.10	<0.1
Thallium	µg/L	--	0.6	0 of 4	0.20	<0.2
Zinc	µg/L	--	2,000	27 of 80	6.9	<3–50.8

Sources: Barr 2014d; Barr 2006f.

Notes:
< less than indicated reporting limit.
Bold (e.g., **0.014**) indicates exceeds evaluation criteria.
1 Where non-detects occur, the mean was calculated using half the detection limit.

Comparing the existing Cell 2E pond water quality with water quality at the toe of the Tailings Basin can define the effect that passage through the existing LTVSMC tailings has on seepage water quality. Such comparison shows that passage through the LTVSMC tailings apparently reduces the average concentrations of arsenic, fluoride, and molybdenum, although it is difficult to determine to what extent these reductions are simply attributable to the effects of dilution. The concentrations of several other parameters, such as calcium, manganese, nickel, and TDS, increase as they seep from the tailings pond to the toe of the Tailings Basin.

The limited amount of pond water quality data generally show fluoride concentrations that are elevated relative to the groundwater evaluation criteria. This could be attributable to the historic use of wet scrubbers for emission control at the former LTVSMC furnaces. These scrubbers removed highly soluble hydrogen fluoride gas (Jiang et al. n.d.) resulting in elevated fluoride concentrations in the scrubber water, which was disposed of in the Tailings Basin.

Groundwater quality monitoring at several wells completed in the surficial aquifer at or near the toe of the Tailings Basin found the pH tending neutral or toward slightly basic (mean of 7.3), and elevated concentrations of several parameters (see Table 4.2.2-23). As with the baseline wells, these wells exhibited elevated aluminum, iron, and manganese concentrations, but also exhibited elevated sulfate, fluoride, molybdenum, and TDS concentrations that are higher than in the baseline wells (see Table 4.2.2-22). Considering these results, NTS (2009) concluded that groundwater has been impacted by the Tailings Basin. NTS noted, however, that there does not appear to be an overall trend, either increasing or decreasing, in the concentration of the monitored constituents.

Tailings Basin Downgradient Wells and Residential Wells

PolyMet conducted between 2 and 15 rounds of groundwater sampling during the 2009 through 2013 period at three monitoring wells (GW-009, GW-010, and GW-014) located approximately 1 mile north of the Tailings Basin (see Figure 4.2.2-16), and a single round of sampling at 15 residential wells located between 1.6 miles and 3.8 miles north of the Tailings Basin (see Figure 4.2.2-18). Water quality in the three affected downgradient monitoring wells and the 15 residential wells is summarized in Tables 4.2.2-24 and 4.2.2-25, respectively (Barr 2014d). As with the baseline wells, the three downgradient monitoring wells also exhibited elevated aluminum and iron concentrations that are higher than those found at the toe of the Tailings Basin.

Samples collected from the residential wells (located farther from the Tailings Basin) showed manganese concentrations that exceeded the groundwater evaluation criteria (i.e., sMCL). High manganese concentrations can naturally occur at some locations under a range of conditions. The measured concentrations are within the range found in the Regional Copper-Nickel Study. One well had aluminum concentrations slightly above the evaluation criterion and four wells had pH concentrations below the minimum of the criterion's range (pH below 6.5), but again, these values are within the neutral range found in the Regional Copper-Nickel Study.

The samples from the residential wells (Barr 2009d) and the downgradient wells sampled for the NorthMet Project Proposed Action (compared in Table 4.2.2-24) include analyses for total (unfiltered) and dissolved (filtered) concentrations for manganese and aluminum, so the maximum reported concentrations of these constituents probably includes the effect of sediment included in the samples. Residential wells have had more time and pumping to flush out sediment and, therefore, samples from them would be expected to have little if any sediment and lower unfiltered analytical results than samples from a monitoring well at the same location.

Comparisons of the groundwater quality data between different groups of wells indicate a general pattern of decreasing concentrations of ammonia, calcium, chloride, fluoride, magnesium, sodium, potassium, sulfate, hardness, pH, and TDS from the Tailings Basin wells (the highest), to downgradient wells, to residential and natural background wells (the lowest). Concentrations of those general parameters are similar between the residential and background wells.

Concentrations of metals (both total and dissolved) do not show any clear pattern of increasing or decreasing concentrations between the well groups. Two exceptions are boron and molybdenum showing, again, a trend of decreasing concentrations from the Tailings Basin wells to downgradient wells, to residential and background wells.

The MPCA conducted a review of the residential well and monitoring well results (which, in part, included the consideration of chemical tracers) (Barr 2009d). This review concluded that it is not clear whether elevated concentrations in some of the residential wells were caused by the Tailings Basin or reflect natural or localized background concentrations. However, the results for residential wells are similar to the results for natural background wells. That similarity suggests that the residential wells may not be impacted by the Tailings Basin.

Table 4.2.2-24 Summary of Existing Groundwater Quality Monitoring Data Downgradient from the Existing LTVSMC Tailings Basin

Parameters	Units	Groundwater Evaluation Criteria	Downgradient Wells (GW-009, GW-010, GW-014, GW-016) Surficial Aquifer			
General			**Detection**	**Mean[1]**	**Range**	**# Exceed**
Alkalinity	mg/L	--	42 of 42	286	32.9–507	NA
Ammonia as Nitrogen	mg/L	--	24 of 42	0.12	<0.025–0.36	NA
Calcium	mg/L	--	42 of 42	65.8	6.9–252	NA
Carbon, total organic	mg/L	--	42 of 42	13.5	5.4–25.5	NA
Chloride	mg/L	250	42 of 42	12.2	1.4–20.4	0
Fluoride	mg/L	2	35 of 42	0.22	<0.05–0.86	0
Hardness	mg/L	--	42 of 42	326	32.3–1,220	NA
Magnesium	mg/L	--	42 of 42	39.3	3.7–144	NA
pH	s.u.	6.5–8.5	43 of 43	7.1	6.6–7.8	**0**
Potassium	mg/L	--	42 of 42	3.9	0.99–17.2	NA
Sodium	mg/L	--	42 of 42	47.7	3.7–79.4	NA
Sulfate	mg/L	250	42 of 42	62.7	1.6–235	0
TDS	mg/L	500	38 of 38	422	97–653	**11**
Metals – Total						
Aluminum	µg/L	200	37 of 42	**11,356**	<10–134,000	**28**
Antimony	µg/L	6	3 of 42	0.37	<0.25–<2.5	0
Arsenic	µg/L	10	34 of 42	3.0	<0.25–26.6	**1**
Barium	µg/L	2,000	42 of 42	621	15.1–1930	0
Beryllium	µg/L	0.08	10 of 42	**0.45**	<0.1–5.43	BDL[2]
Boron	µg/L	1,000	36 of 42	139	<25–278	0
Cadmium	µg/L	4	10 of 42	0.35	<0.1–4.57	**1**
Chromium	µg/L	100	34 of 42	54.8	<0.5–1,000	**5**
Cobalt	µg/L	--	42 of 42	13.7	1.1–215	NA
Copper	µg/L	1,000	42 of 42	37.0	1.2–545	0
Iron	µg/L	300	42 of 42	**24,834**	729–228,000	**42**
Lead	µg/L	--	22 of 42	5.5	<0.25–78.4	NA
Manganese	µg/L	50	42 of 42	**2,044**	217–6,720	**42**
Mercury	ng/L	2,000	41 of 41	12.7	0.81–102	0
Methylmercury	ng/L	--	16 of 39	0.09	<0.015–0.51	NA
Molybdenum	µg/L	--	42 of 42	12.5	0.22–130	NA
Nickel	µg/L	100	39 of 42	39.1	<0.25–620	**3**
Selenium	µg/L	30	4 of 42	0.8	<0.5–6.49	0
Silver	µg/L	30	4 of 42	0.16	<0.1–1.05	0
Thallium	µg/L	0.6	7 of 42	0.19	<0.0085–1.15	**3**
Zinc	µg/L	2,000	19 of 42	42.8	<3–610	0
Metals – Dissolved/Filtered						
Aluminum	µg/L	200	16 of 42	29.1	<10–232	**1**
Antimony	µg/L	6	0 of 0	--	--	NA
Arsenic	µg/L	10	25 of 38	1.6	<0.25–6.2	0
Barium	µg/L	2,000	22 of 22	515	9.1–1,920	0
Beryllium	µg/L	0.08	0 of 0	--	--	NA
Boron	µg/L	1,000	23 of 26	143	<25–267	0
Cadmium	µg/L	4	3 of 42	0.12	<0.1–1.1	0
Chromium	µg/L	100	16 of 42	1.0	<0.5–2.86	0
Cobalt	µg/L	--	22 of 22	2.4	0.58–5.4	NA

Parameters	Units	Groundwater Evaluation Criteria	Downgradient Wells (GW-009, GW-010, GW-014, GW-016) Surficial Aquifer			
Copper	µg/L	1,000	42 of 42	2.9	0.52–20.7	0
Iron	µg/L	300	35 of 36	**7,132**	<25–14,800	**33**
Lead	µg/L	--	0 of 22	0.25	<0.25–<0.25	NA
Manganese	µg/L	50	38 of 38	1,624	17.3–3,910	37
Molybdenum	µg/L	--	42 of 42	9.2	0.24–59	NA
Nickel	µg/L	100	40 of 42	3.3	<0.25–11.2	0
Selenium	µg/L	30	1 of 42	0.5	<0.5–<0.5	0
Silver	µg/L	30	0 of 42	0.1	<0.1–<0.1	0
Thallium	µg/L	0.6	0 of 0	--	--	NA
Zinc	µg/L	2,000	15 of 42	6.3	<3–37.2	0

Source: Barr 2014d; Barr 2009d.

Notes:
< less than indicated reporting limit.
Bold (e.g., **0.014**) indicates exceeds evaluation criteria.
1 Where non-detects occur, the mean was calculated using half the detection limit.
2 Below detection limit. Detection limit is greater than water quality standard.

Table 4.2.2-25 Summary of Groundwater Quality of Residential Wells Downgradient from the Existing LTVSMC Tailings Basin

Parameters	Units	Groundwater Evaluation Criteria	Downgradient Residential Wells Bedrock and Surficial Aquifers			
General			**Detection**	**Mean[1]**	**Range**	**# Exceed**
Alkalinity	mg/L	--	--	--	--	NA
Ammonia as Nitrogen	mg/L	--	--	--	--	NA
Calcium	mg/L	--	15 of 15	25	11.7–51.4	NA
Carbon, total organic	mg/L	--	--	--	--	NA
Chloride	mg/L	250	14 of 15	4.2	<0.5–12.5	0
Fluoride	mg/L	2	11 of 15	0.2	<0.1–0.6	0
Hardness	mg/L	--	--	--	--	NA
Magnesium	mg/L	--	--	--	--	NA
pH	s.u.	6.5–8.5	15 of 15	6.9	5.7–7.9	**4**
Potassium	mg/L	--	--	--	--	NA
Sodium	mg/L	--	--	--	--	NA
Sulfate	mg/L	250	11 of 15	6.1	<1–20.9	0
TDS	mg/L	500	15 of 15	125	83–243	0
Metals – Total						
Aluminum	µg/L	200	2 of 15	30.2	<25–83	**1**
Antimony	µg/L	6	0 of 15	<0.5	<0.5	0
Arsenic	µg/L	10	3 of 15	2.8	<2–7.5	0
Barium	µg/L	2,000	--	--	--	--
Beryllium	µg/L	0.08	--	--	--	--
Boron	µg/L	1,000	3 of 15	79	<50–459	0
Cadmium	µg/L	4	--	--	--	--
Chromium	µg/L	100	--	--	--	--
Cobalt	µg/L	--	--	--	--	--
Copper	µg/L	1,000	13 of 14	38	<0.7–155	0
Iron	µg/L	300	--	--	--	--

Parameters	Units	Groundwater Evaluation Criteria	Downgradient Residential Wells Bedrock and Surficial Aquifers			
Lead	µg/L	--	--	--	--	--
Manganese	µg/L	50	15 of 15	**579**	0.66–4,710	**7**
Mercury	ng/L	2,000	--	--	--	--
Methylmercury	ng/L	--	--	--	--	--
Molybdenum	µg/L	--	12 of 15	0.6	0.2–2.8	--
Nickel	µg/L	100	14 of 15	1.9	<0.6–5.5	0
Selenium	µg/L	30	--	--	--	--
Silver	µg/L	30	--	--	--	--
Thallium	µg/L	0.6	--	--	--	--
Zinc	µg/L	2,000	--	--	--	--
Metals – Dissolved/Filtered						
Aluminum	µg/L	200	2 of 15	28	<25–71	1
Arsenic	µg/L	10	3 of 15	2.7	<2–7.5	0
Barium	µg/L	2,000	--	--	--	--
Boron	µg/L	1,000	3 of 15	80	<50–461	0
Cadmium	µg/L	4	--	--	--	--
Chromium	µg/L	100	--	--	--	--
Cobalt	µg/L	--	--	--	--	--
Copper	µg/L	1,000	14 of 15	19.3	<0.7–64.5	0
Iron	µg/L	300	--	--	--	--
Lead	µg/L	--	--	--	--	--
Manganese	µg/L	50	15 of 15	579	0.63–4,850	7
Molybdenum	µg/L	--	--	--	--	--
Nickel	µg/L	100	12 of 15	1.6	<0.6–5	0
Selenium	µg/L	30	--	--	--	--
Silver	µg/L	30	--	--	--	--
Zinc	µg/L	2,000	--	--	--	--

Source: Barr 2009d.

Notes:
< less than indicated reporting limit.
Bold (e.g., **0.014**) indicates exceeds evaluation criteria.
[1] Where non-detects occur, the mean was calculated using half the detection limit.

Legacy Groundwater Quality Issues

In 2002, Cliffs Erie commissioned a Phase I ESA of the former LTVSMC property and improvements (NTS 2002). This study identified 62 potential AOCs. Designation as an AOC does not necessarily mean that contamination occurred in the past or is currently present, but simply that these are areas requiring further investigation. The AOCs are discussed further in Section 4.2.1.

In May 2009, Cliffs Erie conducted a detailed assessment of both surface and groundwater quality at the existing LTVSMC Tailings Basin that included testing for VOCs, SVOCs, PCBs, and other parameters to determine if there was any organic contamination that could be transported off-site via stormwater runoff or groundwater seepage. The laboratory analyses showed no evidence of organic contamination leaving the site (Cliffs Erie 2009). The investigations conducted to date and the results of laboratory analyses (which include sampling at seven monitoring wells, 14 surface discharges, 12 internal waste streams, and six downstream surface water monitoring stations, and visual observation and limited field analyses at 33 seeps at or near the existing LTVSMC Tailings Basin) indicate that these pollutants, if present on site, have not migrated off site.

As noted above, groundwater quality monitoring at several wells completed in the surficial deposits at or near the toe of the Tailings Basin found elevated aluminum, iron, and manganese concentrations, similar to the baseline wells (see Table 4.2.2-23), but also exhibited elevated sulfate, fluoride, molybdenum, and TDS concentrations relative to the baseline wells (see Table 4.2.2-22). Considering these results, NTS (2009) concluded that groundwater had been impacted by the Tailings Basin. NTS noted, however, that there did not appear to be an overall trend, either increasing or decreasing, in the concentration of the monitored constituents.

Baseline Groundwater Quality in the Bedrock

No bedrock groundwater samples have been collected from the Plant Site/Tailings Basin area. Although some of the residential wells are drilled into bedrock, the well completion records indicate that these wells were not constructed as monitoring wells to separate the bedrock groundwater from the surficial aquifer. Siegel and Ericson (1980) report that iron and manganese concentrations of up to 500 µg/L are common in the Giants Range batholith.

Groundwater Use

There are 38 known residential wells between the Tailings Basin and the Embarrass River (see Table 4.2.2-26), with the closest located approximately 1 miles from the toe of Cell 2E (see Figure 4.2.2-18). Characteristics of the wells are presented in Table 4.2.2-25. Table 4.2.2-26 and Figure 4.2.2-18 shows the locations of all the identified wells and which of those wells were sampled. Analytical results for groundwater samples collected from these 15 residential wells are summarized in Table 4.2.2-25.

Table 4.2.2-26 Existing Residential Wells Located Between the NorthMet Project Proposed Action Tailings Area and the Embarrass River

Unique Well No.	Direction From Site	Surface Elev. (ft)	Depth (ft)	Depth Cased (ft)	GWL (ft bgs)	Casing Diameter (in)	Aquifer
174550	NE	1,445	60	50	8	7	Bedrock
683838	NE	1,440	202	202	--	6	Bedrock
771087	NE	1,487	45	22	10	6	Bedrock
555048(1)	NNE	1,459	45	29	--	6	Bedrock
555023	NNE	1,459	100	19	--	6	Bedrock
620123	NNE	1,458	65	18	8.2	6	Bedrock
779752	NE	1,473	203	28	--	6	Bedrock
716183	NNE	1,473	325	29	20.5	6	Bedrock
563293(1)	N	1,459	325	18	--	6	Bedrock
658445(2)	N	1,432	83	81	2	6	Bedrock
144818	N	1,467	45	28	--	6	Bedrock
735554(1)	N	1,476	205	31	14	6	Bedrock
584595	N	1,468	30	30	8.3	6	Alluvium
701452	N	1,447	125	40	8	6	Bedrock

Unique Well No.	Direction From Site	Surface Elev. (ft)	Depth (ft)	Depth Cased (ft)	GWL (ft bgs)	Casing Diameter (in)	Aquifer
668955	N	1,460	50	50	15.3	6	Alluvium
447031	N	1,451	86	86	15	6	Alluvium
773694	N	1,462	43	22	9	6	Bedrock
762811	NW	1,451	85	72	19	6	Bedrock
576439[(1)]	NNW	1,447	80	80	7.7	6	Alluvium
718806	NW	1,456	44	44	--	6	Alluvium
529149	NNW	1,463	42	42	22	6	Alluvium
620143[(1)]	NNW	1,465	61	61	34.4	6	Alluvium
187853[(1)]	NNW	1,465	90	90	--	6	Alluvium
477836	NNW	1,450	81	80.5	17	6	Alluvium
189325	NW	1,427	97	97	7	6	Alluvium
151880[(1)]	NW	1,433	103	96	--	6	Bedrock
476480	NW	1,441	63	63	8	6	Alluvium
169958	NW	1,446	223	33	23	6	Bedrock
519773	NW	1,417	42	42	5	6	Alluvium
411142	NW	1,445	229	34	35	6	Bedrock
409338	NW	1,429	43	43	25	6	Alluvium
572971[(1,2)]	N	1,450	325	20	9	6	Bedrock
--[1,3]	--	--	--	--	--	--	Alluvium
--[1,3]	--	--	28	--	--	--	Alluvium
--[1,3]	--	--	16	--	--	--	Alluvium
--[1,3]	--	--	93	--	--	--	Alluvium
--[1,3]	--	--	200	--	--	--	Bedrock
--[1,3]	--	--	--	--	--	--	Alluvium

Sources: MDH 2015; Barr 2009d; Barr 2015a.

Note:
GWL = groundwater level

[1] Sampled by PolyMet in Barr 2009d, Table 2.
[3] Residential well north of Embarrass River
[3] There is no existing unique well number for this sampled well.

4.2.2.4.2 Surface Water Resources

This section describes the existing surface water resources in the Embarrass River Watershed that could be affected by the NorthMet Project Proposed Action. These resources include the Embarrass River, several small streams draining the Tailings Basin that are tributaries of the Embarrass River (i.e., Mud Lake Creek, Trimble Creek, and Unnamed Creek—see Figure 4.2.2-4), and the Embarrass River chain of lakes. Note that Mud Lake Creek is an unofficial name given the Unnamed Creek that flows north from the northeast corner of the Tailings Basin. It was given this name for the EIS because of Mud Lake near the headwaters of the stream, and to distinguish it from the other Unnamed Creek that flows northwest from the northwest corner of the Tailing Basin. It is referred to as Mud Lake Creek throughout the FEIS.

Since publication of the DEIS, additional surface water quality data has been collected at many locations within the Embarrass River Watershed. These new data have been summarized below to better describe existing conditions. The surface water hydrology of the Embarrass River and its tributaries was not evaluated using the XP-SWMM model. Rather, it was estimated using a spreadsheet model that extrapolates flows from a USGS gaging station on a catchment area basis.

Embarrass River

This section describes the baseline surface water hydrology and water quality of the mainstem of the Upper Embarrass River, several streams that receive drainage from the Tailings Basin and are tributaries of the Embarrass River, and the Lower Embarrass River as it flows through an area referred to as the chain of lakes.

Embarrass River Hydrology

The Embarrass River originates just south of the City of Babbitt and flows southwest approximately 23 miles to its confluence with the St. Louis River, draining 171 square miles as measured at McKinley, near the confluence with the St. Louis River. The Embarrass River Watershed is dominated by upland forests (44 percent), lowland forest and aquatic environments (23 percent), crop/grassland (8 percent), and scrub/shrub (21 percent), with little development (4 percent). Most of the Tailings Basin seepage drains to the Embarrass River via three tributary streams.

There were two USGS gaging stations located within the Embarrass River Watershed (#04017000 located about three miles northwest of the Tailings Basin and #04018000 located about 7 miles southwest of the Tailings Basin). Table 4.2.2-27 provides flow data for the nearest gaging station at the Embarrass River Watershed (Station #04017000; see Figure 4.2.2-19 for location).

Table 4.2.2-27 Monthly Statistical Flow Data for USGS Embarrass Gaging Stations

Station:	04017000 Embarrass River at Embarrass		
Period of Record:	1942–1964		
Drainage Area:	88.3 mi^2		
Month	**Monthly Average (cfs)**	**Daily Minimum (cfs)**	**Daily Maximum (cfs)**
October	46	2.6	453
November	33	4.9	166
December	14	3.4	50
January	6.7	0.90	22
February	5.0	0.90	14
March	22	1.4	774
April	190	2.6	1,490
May	194	21	1,720
June	114	5.2	1,090
July	63	3.6	790
August	31	1.8	284
September	50	2.2	789

Source: Siegel and Ericson 2008.

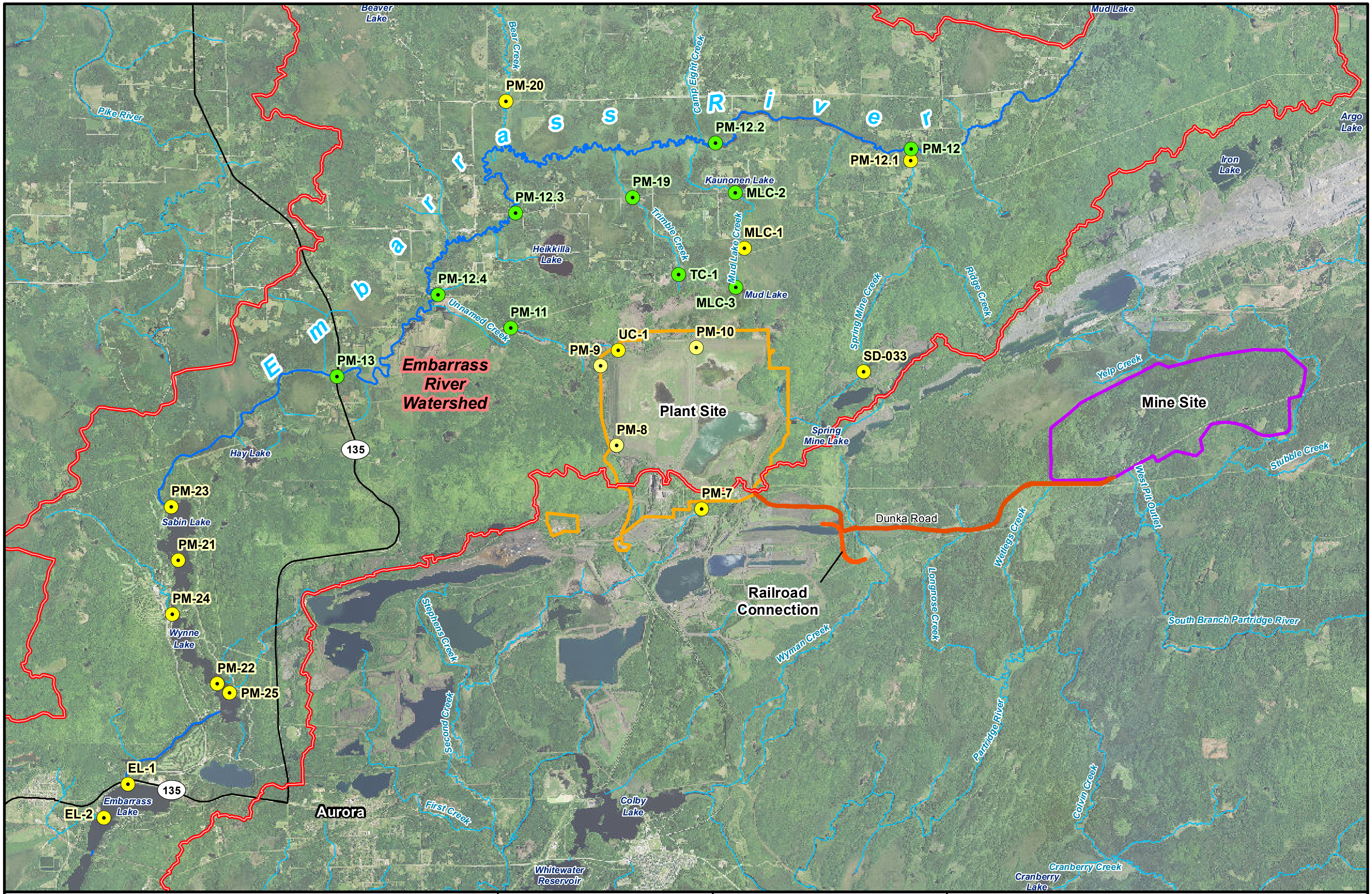
Flow characteristics for different reaches of the Embarrass River and selected tributaries were estimated by extrapolating flows from USGS gaging station 04017000 (located just downstream of PM-12.3) on a catchment area basis. A summary of the flow results for different stations on Embarrass River, Mud Lake Creek, Trimble Creek, and Unnamed Creek is provided in Table 4.2.2-28. Flow contributed by the Tailings Basin seepage is separated from the flows derived using the unit-area basis in the table to provide greater clarity of water origins. Tailings Basin flows presented in the last column of Table 4.2.2-28 can be added to the annual flow characteristics presented in the table to determine the appropriate flow volume.

Table 4.2.2-28 Plant Site Surface Water Flows for Existing Conditions Based on Embarrass River Stream Gaging Results Applied to Contributing Watersheds and Additional Flow Tailings Basin Seepage and Flowpath Discharge

Stream	Embarrass River or Tributary Surface Water Station	Existing Watershed Area Excluding Tailings Basin Footprint (mi^2)	Estimated Groundwater Baseflow (cfs)	Annual 7-Day Minimum Flow with 10-year Return Period[1] (cfs)	Annual 1-Day Minimum Flow[1,2] (cfs)	Annual Daily Mean Flow[1,2] (cfs)	Annual 1-day Maximum Flow[1,2] (cfs)	Annual 1-day Maximum Flow with 10-year Return Period[1] (cfs)	Additional Flow to Station from Tailings Basin Seepage (cfs)
Embarrass River	PM-12	19.0	0.86	0.4	0.74	13.8	145	259	0.00
	PM-12.2	34.2	1.55	0.7	1.34	24.9	261	467	0.00
	PM-12.3	83.0	3.76	1.79	3.24	60.5	633	1,135	4.41
	PM-12.4	94.4	4.27	2.07	3.69	68.8	720	1,290	4.43
	PM-13[(3)]	107	4.83	2.33	4.17	77.8	814	1,457	5.77[4]
Mud Lake Creek	MLC-3	1.40	0.06	0.07	0.05	1.02	10.7	19.2	0.83
	MLC-2	3.57	0.16	0.07	0.14	2.60	27.2	49.1	0.93
Trimble Creek	TC-1	2.18	0.10	0.04	0.09	1.59	16.6	29.6	3.36
	PM-19	3.94	0.18	0.12	0.15	2.87	30.1	53.5	3.48
Unnamed Creek	UC-1a	2.29	0.10	0.09	0.09	1.67	17.5	30.9	1.11
	PM-11	3.37	0.15	0.09	0.13	2.46	25.7	45.9	1.11

Source: Barr 2015i.

Notes:
1 Based on USGS record applied to watershed area, flow from the tailings basin (last column) is in addition to the flow values presented.
2 Long-term average.
3 Values differ from those in Table 4-5 of the Plant Site Water Modeling Data Package (PolyMet 2015j), which were based on the historical drainage area of 88.3 mi^2.
4 5.77 cfs (2,590 gpm) is the estimated total seepage from the Tailings Basin.



Mine Site
Plant Site
Transportation and Utility Corridor
Embarrass River
Surface Water Monitoring/Modeling Location
Surface Water Monitoring Location
Embarrass River Watershed
Extisting Road

MNDNR
US Army Corps of Engineers St. Paul District

N W E S
0 0.5 1 2 3 Miles

Figure 4.2.2-19
Surface Water Monitoring and Modeling Locations within the Embarrass River Watershed
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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Overflow and seepage from several former mining facilities, including the Area 5 NW Pit upstream of the Tailings Basin, contribute to the flow farther downstream in the Embarrass River, as shown in Table 4.2.2-29 and Figure 4.2.2-11. Based on measurements between 2012 and 2014, an average of approximately 1.2 cfs overflows from Pit 5NW to Spring Mine Creek where it flows north about 5 miles before joining the Embarrass River just downstream of monitoring station PM-12 (see Figure 4.2.2-1).

Table 4.2.2-29 NPDES/SDS Discharges to the Embarrass River Watershed

NPDES/SDS Permit Number	Permit Number	Outfalls ID	Outfall Description	Receiving Waters	Flow (cfs)	
					Avg.[1]	**Max.**
Mesabi Mining LLC	MN0069078	SD-022	Pit 9 Dewatering Pipe	Wynne Lake	0 0	0.0
Cliffs Erie LLC	MN0042536	SD-033	Pit 5NW overflow	Spring Mine Creek	1.2	--
Mesabi Mining LLC	MN0069078	SD-004	Pit 1 dewatering discharge	Wynne Lake	0.0	0.0
Cliffs Erie LLC	MN0054089	SD-001	NW seepage collection ditch	Unnamed creek	--	--
		SD-002	NE seepage collection ditch	Trimble Creek	--	--
		SD-004	Tailings Basin Cell 2W Seep A	Unnamed creek	0.28	3.00
		SD-005	Tailings Basin Cell 2W Seep B	Kaunonen Creek	--	0.46
		SD-006	Power line access road culvert	Unnamed creek	5.0	6.2

Sources: MPCA 2012a; 2012j; 2012l; 2013a; 2013h; 2013j; 2013k; 2014d; 2014e; 2014f.

Note:
[1] Average flow when discharging. Many of these discharges only occur intermittently and may be currently inactive.

There are no large surface water withdrawals or water appropriation permits issued for the Embarrass River in the NorthMet Project area. The headwaters of the Embarrass River Watershed include a portion of the City of Babbitt, but are otherwise relatively undeveloped and unaffected by any mining. The City of Babbitt WWTP has an annual average discharge of approximately 0.33 cfs to the headwaters (PolyMet 2015j).

Embarrass River Water Quality

As indicated in Table 4.2.2-30, PolyMet collected water quality data from five locations that can be used to establish baseline water quality along the Embarrass River. Samples from two primary locations, PM-12 and PM-13, were subject to evaluation for all water quality parameters, while samples from locations PM-12.2, PM-12.3, and PM-12.4 were analyzed for a more limited set of parameters. The locations of the monitoring stations are shown in Figure 4.2.2-19. Table 4.2.2-32 summarizes the water quality data for the five Embarrass River sites sampled by PolyMet between 2004 and 2013. Average parameter concentrations above evaluation criteria were observed for aluminum at PM-12.3 and PM-13, for sulfate at PM-13 (where the 10 mg/L wild rice sulfate standard is applicable), and for mercury at PM-12 and PM-13.

Table 4.2.2-30 Available Surface Water Quality Monitoring Data in the Embarrass River Main Branch (see Figure 4.2.2-1)

Sample Location	Source	Sampling Period
Mainstem Embarrass River		
PM-12[1]	PolyMet / C-N Study / Cliffs Erie	1976, 2001–2013
CN120	USGS/C-N Study	1955–1963, 1976–1977
PM-12.2	PolyMet	2010–2013
PM-12.3	PolyMet	2010–2013
PM-12.4	PolyMet	2010–2013
PM-13	PolyMet / Cliffs Erie	2001–2013

Sources: Barr 2007h; Barr 2014d.

Notes:
C-N Study – Regional Copper-Nickel Study (Siegel and Ericson 1980)
[1] Monitoring station formally designated as CN121.

The Regional Copper-Nickel Study (Siegel and Ericson 1980) considered monitoring station PM-12 (formally designated as CN121) as representative of “undisturbed” conditions. Under current assumed conditions, this monitoring station receives stormwater runoff and WWTP discharges (0.33 cfs of predominantly domestic wastewater) from the City of Babbitt, but is otherwise unaffected by mining or other significant development (PolyMet 2015j). Table 4.2.2-31 compares 1976 data from the Regional Copper-Nickel Study with recent data from PolyMet for monitoring station PM-12. These data show that mean water quality at this monitoring station currently meets surface water quality standards for the parameters monitored. Most of the measured parameters exhibit relatively little changes over the 30-year period, although concentrations of several constituents (notably iron, manganese, and zinc) have increased, while concentrations of aluminum and cobalt appear to be decreasing slightly.

Table 4.2.2-31 Comparison of Historic and Recent Mean Water Quality Data for Selected Parameters at PM-12 on the Embarrass River

General Parameter	Units	Evaluation Criteria	1976	2004–2013[1]
Hardness	mg/L	500	50[4]	60.4
pH	s.u.	6.5–8.5	6.9	6.9
Sulfate	mg/L	--[2]	6.1	7.2
Metals – Total				
Aluminum	µg/L	125	**127**	99.8
Arsenic	µg/L	53	0.9	1.6
Cobalt	µg/L	5	2.3[4]	1.0
Copper	µg/L	5.2[3]	0.9[4]	1.1
Iron	µg/L	--	1,121	4,151
Lead	µg/L	1.3[3]	0.2	0.26
Manganese	µg/L	--	234	429
Nickel	µg/L	29[3]	1.0[4]	1.4
Zinc	µg/L	67[3]	1.1[4]	9.5

Sources: Siegel and Ericson 1980; Barr 2007i for 1976 data; Barr 2014d for 2004–2013 data.

Notes:
1 Includes non-detects at half the detection limit.
2 Sulfate standard of 10 mg/L applies to designated waters supporting the production of wild rice.
3 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 50 mg/L.
4 Based on fewer than five samples.

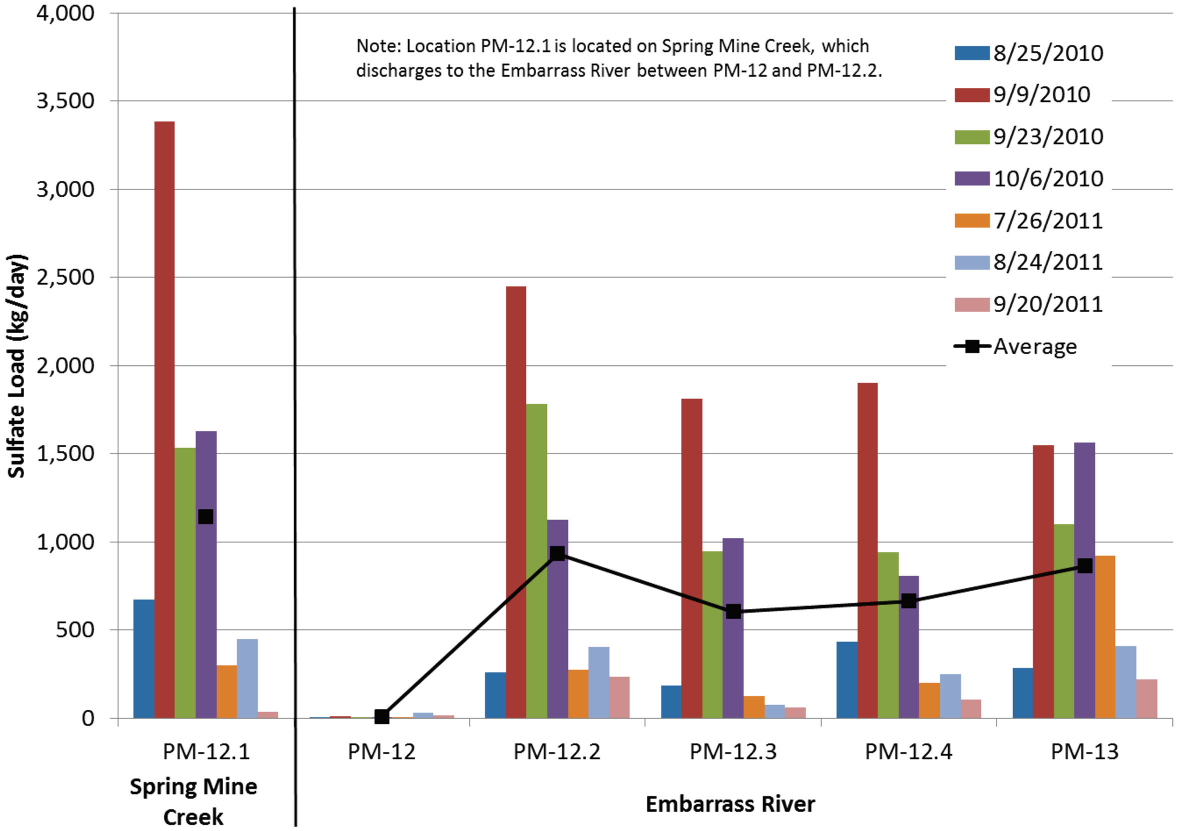
Samples of limited water quality data collected at PM-12.2, PM-12.3, and PM-12.4 between 2010 and 2013 allow the identification of progressive trends for major anions and some metals between PM-12 and PM-13 along the mainstem of the Embarrass River. Chloride appeared relatively constant with location, varying from an average of 4.7 mg/L at PM-12 to 5.0 mg/L at PM-12.4 and 5.8 mg/L at PM-13. pH also appeared relatively constant, from an average of 6.9 at PM-12 to 7.3 at PM-12.4 and 7.4 at PM-13. Sulfate, however, varied substantially, increasing from an average of 7.2 mg/L at PM-12 to 131 mg/L at PM-12.2, and then decreasing to an average of 39.4 mg/L at PM-13, indicating introduction of a significant source of sulfate followed by either dilution or a process that sequesters sulfate in the Embarrass River and the surrounding wetlands.

The increase in sulfate concentrations between PM-12 and PM-12.2 can be attributed to sulfate loading from Spring Mine Creek, which flows into the Embarrass River immediately downstream from PM-12. Limited water quality data were collected at PM-12.1 on Spring Mine Creek, which receives drainage from former LTVSMC Pit 5NW (see Figure 4.2.2-1). These data are summarized in Table 4.2.2-32 alongside the Embarrass River mainstem sites. Pit 5NW is completely flooded and has been overflowing since before 2001, with an annual average flow of about 1.5 cfs to Spring Mine Creek, which discharges into the Embarrass River. This discharge has sulfate concentrations that average 1,060 mg/L (PolyMet 2015j), as measured at the Pit 5NW outflow. Sulfate concentrations at PM-12.1 averaged 388 mg/L and ranged as high as 944 mg/L, indicating that the Pit 5NW outflow via Spring Mine Creek provides a significant source of sulfate loading to Embarrass River, which accounts for the increase in sulfate concentrations between PM-12 and PM-12.2. As noted in Table 4.2.2-2, Spring Mine Creek from Ridge Creek to Embarrass River was listed by the MPCA as impaired for aquatic macroinvertebrates and fish while the Embarrass River Watershed from the headwaters to Embarrass Lake was listed as impaired for fish.

Sulfate and chloride loading data were collected concurrently with water quality data in Spring Mine Creek and the Embarrass River in 2010 and 2011, and were consistent with the observations discussed above (see Figures 4.2.2-20 and 4.2.2-21). Sulfate loading increased from an average of 10.2 kg/day at PM-12 to an average of 932 kg/day at PM-12.2, due to sulfate loading contributed from Pit 5NW via Spring Mine Creek (average sulfate load of 1142 kg/day measured at PM-12.1). Between PM-12.2 and PM-13, the average sulfate load decreased by approximately 70 kg/day, even though there is approximately 3,120 kg/day currently leaving the Tailings Basin towards the Embarrass River (the sum of loads leaving the northern, northwestern, and western toes of the Tailings Basin; PolyMet 2015j). Meanwhile, the calculated load of chloride (Figure 4.2.2-21), a parameter which serves as a tracer for Tailings Basin seepage, increased in the downstream direction along the Embarrass River, indicating that the Tailings Basin seepage is reaching the Embarrass River. Consequently, the decrease in sulfate loading between PM-12 and PM-12.2, and between the Tailings Basin and the Embarrass River, is attributable to some natural process such as biological sulfate reduction that can be sequestering sulfate in the wetlands and tributaries between the Tailings Basin and the Embarrass River.

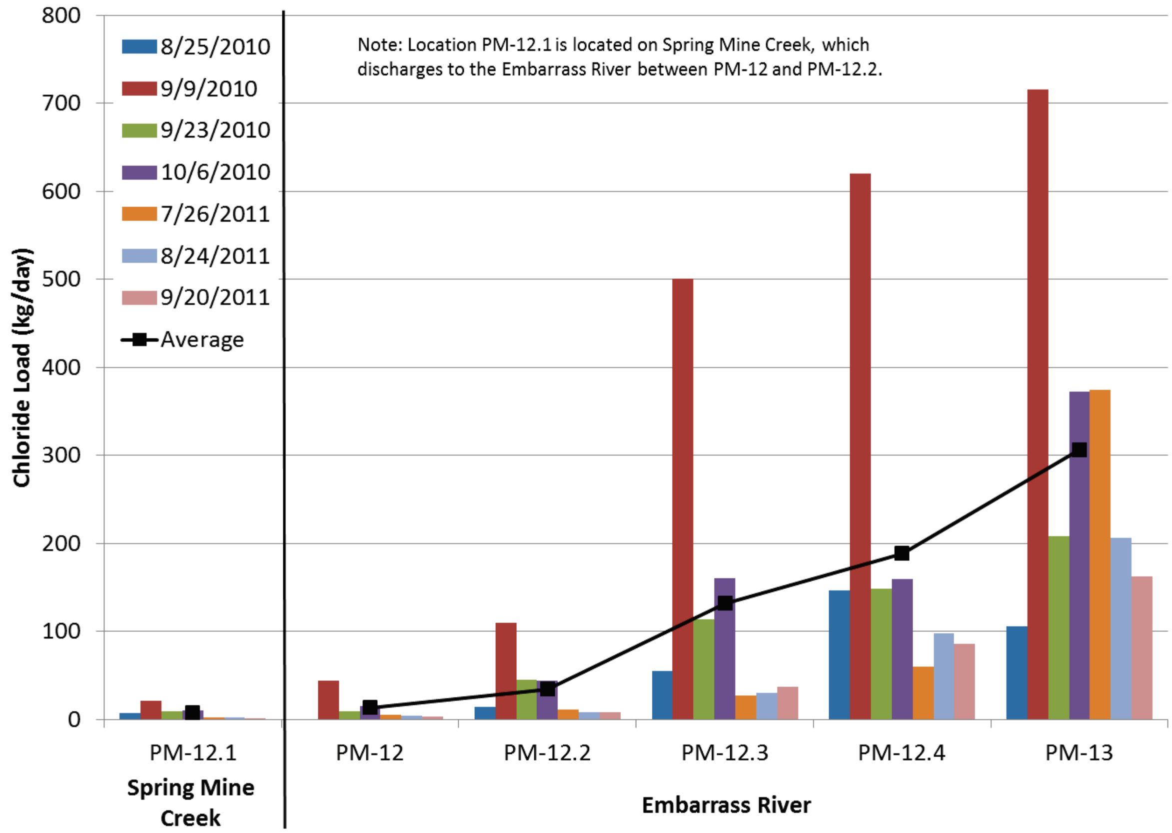
Flows from groundwater and surface seepage from the existing LTVSMC Tailings Basin reach the Embarrass River via several small tributaries including Mud Lake Creek and Trimble Creek, which enter upstream of station PM-12.3, and Unnamed Creek, which enters upstream of station PM-13 (see Figure 4.2.2-1). These tributaries are described in more detail below. There are also extensive wetlands on the northern, northwestern, and western sides of the LTVSMC Tailings Basin. While much of the wetlands water likely flows into the tributaries, other flows may diffusely reach the Embarrass River by means of the system of wetlands.

The effects of Pit 5NW, the existing LTVSMC Tailings Basin, and groundwater seepage and surface runoff from elsewhere within the watershed are reflected in the water quality at station PM-13, which is located downstream of these and all NorthMet Project area sources of pollution within the Embarrass River Watershed (see Table 4.2.2-29). Since PM-13 is downstream of all Tailings Basin seepage, it was used to evaluate NorthMet Project Proposed Action effects on flow and water quality in the Embarrass River in Section 5.2.2.



Source: Adapted from PolyMet 2015j.

Figure 4.2.2-20 Sulfate Load Calculated in Spring Mine Creek and the Embarrass River (2010-2011)



Source: Adapted from PolyMet 2015j.

Figure 4.2.2-21 Chloride Load Calculated in Spring Mine Creek and the Embarrass River (2010-2011)

Table 4.2.2-32 Average Existing Water Quality in the Embarrass River, 2004-2013[1]

Parameter	Units	Evaluation Criteria	Spring Mine Creek			Embarrass River															
			PM-12.1			PM-12			PM-12.2			PM-12.3			PM-12.4			PM-13		
			Detection	Mean	Range	Detection	Mean	Range	Detection	Mean	Range	Detection	Mean	Range	Detection	Mean	Range	Detection	Mean	Range
General																				
Alkalinity	mg/L	--	2 of 2	140	120–159	33 of 33	50.2	15.2–152	--	--	--	--	--	--	--	--	--	31 of 31	90.5	26.0–197
Calcium	mg/L	--	2 of 2	36.3	33.0–39.6	46 of 46	13.8	4.1–29.3	--	--	--	--	--	--	--	--	--	44 of 44	21.7	7.0–44.7
Chloride	mg/L	230	29 of 29	2.5	0.62–4.9	61 of 61	4.7	1.3–22.3	27 of 27	3.4	1.3–10.3	27 of 27	4.7	1.5–11.2	27 of 27	5.0	1.6–13.0	59 of 59	5.8[2]	2.0–94.8
Fluoride	mg/L	--	0 of 0	--	--	11 of 21	0.10	<0.05–0.20	--	--	--	--	--	--	--	--	--	18 of 21	0.37	<0.05–2.3
Hardness	mg/L	500	2 of 2	380	330–429	46 of 46	60.4	17.8–171	--	--	--	--	--	--	--	--	--	44 of 44	129	35.6–337
Magnesium	mg/L	--	2 of 2	70.2	60.2–80.1	46 of 46	6.4	1.9–27.3	--	--	--	--	--	--	--	--	--	44 of 44	18.3	6.1–54.7
pH	s.u.	6.5-8.5	28 of 28	7.5	6.7–**8.6**	61 of 61	6.9	**5.8**–7.9	25 of 25	7.0	**6.1**–8.1	26 of 26	7.2	**6.3–**7.9	26 of 26	7.3	**6.4**–8.2	59 of 59	7.4	**6.3–8.6**
Potassium	mg/L	--	2 of 2	15.3	12.7–17.8	13 of 15	1.1	<0.25–4.0	1 of 1	7.4	7.4–7.4	--	--	--	--	--	--	13 of 13	2.8	1.5–7.4
Sodium	mg/L	--	2 of 2	27.7	23.0–32.4	17 of 17	3.6	2.2–9.0	--	--	--	--	--	--	--	--	--	15 of 15	13.0	5.2–29.8
Sulfate	mg/L	10[4]	29 of 29	388	81.6–944	48 of 65	7.2	<0.5–116	27 of 27	131	30.4–490	27 of 27	50.2	5.6–221	27 of 27	42.8	5.7–181	64 of 64	**39.4**[3]	7.6–**688**[6]
TDS	mg/L	700	2 of 2	521	490–551	46 of 46	130	46.0–258	--	--	--	--	--	--	--	--	--	44 of 44	210	48.0–494
Metals																				
Aluminum	µg/L	125	20 of 23	57.4	<10–**210**	40 of 40	99.8	44.3–**210**	22 of 23	80.2	<10–**174**	23 of 23	**130**	26.8–**433**	22 of 23	122	<12.5–**349**	40 of 40	**188**	43.9–**505**
Antimony	µg/L	31	0 of 1	0.25	<0.25–<0.25	0 of 19	0.51	<0.25–<1.5	--	--	--	--	--	--	--	--	--	0 of 18	0.53	<0.25–<1.5
Arsenic	µg/L	53	0 of 2	0.38	<0.25–<0.5	19 of 25	1.6	<0.25–<5	--	--	--	--	--	--	--	--	--	17 of 23	1.2	<0.25–2.5
Barium	µg/L	--	2 of 2	19.5	18.5–20.4	11 of 15	19.0	<5–55.9	--	--	--	--	--	--	--	--	--	13 of 13	34.7	14.3–57.5
Beryllium	µg/L	--	0 of 2	0.10	<0.1–<0.1	0 of 12	0.10	<0.1–<0.1	--	--	--	--	--	--	--	--	--	0 of 10	0.10	<0.1–<0.1
Boron	µg/L	500	1 of 2	37.7	<25–50.4	0 of 13	24.0	<17.5–<50	--	--	--	--	--	--	--	--	--	3 of 10	32.7	<17.5–68.9
Cadmium	µg/L	2.5[5]	0 of 2	0.055	<0.01–<0.1	1 of 15	0.094	<0.01–<0.1	--	--	--	--	--	--	--	--	--	1 of 13	0.10	<0.1–<0.1
Cobalt	µg/L	5	0 of 2	0.10	<0.1–<0.1	23 of 44	1.0	<0.1–4.1	--	--	--	--	--	--	--	--	--	21 of 42	0.46	<0.1–0.89
Copper	µg/L	9.3[5]	1 of 2	0.61	<0.35–0.86	39 of 46	1.1	<0.25–2.8	--	--	--	--	--	--	--	--	--	40 of 44	1.4	<0.35–<2.5
Iron	µg/L	--	21 of 21	308	172–749	28 of 28	4,151	1.7–11,200	19 of 19	2,183	642–4,450	19 of 19	2,522	999–6,620	19 of 19	2,253	1,020–5,790	26 of 26	2,109	2.1–5,610
Lead	µg/L	3.2[5]	1 of 2	0.15	<0.25–<0.25	4 of 33	0.26	<0.15–<0.5	--	--	--	--	--	--	--	--	--	3 of 31	0.28	<0.15–0.63
Manganese	µg/L	--	21 of 21	225	76.9–669	31 of 31	429	15.0–1,490	19 of 19	627	78.9–1,440	19 of 19	569	43.3–1,660	19 of 19	406	53.7–1,050	28 of 29	279	<0.25–757
Mercury	ng/L	1.3	24 of 30	--**4.8**	**--**<1.0 to 9.	28 of 34	**5.1**	<1 to <10										23 of 35	**4.3**	**<1 to 12.4**
Methylmercury	ng/L	--	0 of 0	--	**--**	13 of 13	0.53	0.12–1.3	--	--	--	--	--	--	--	--	--	13 of 13	0.38	0.074–1.1
Nickel	µg/L	52[5]	2 of 2	1.2	0.88–1.4	41 of 46	1.4	<0.25–2.8	--	--	--	--	--	--	--	--	--	37 of 44	1.5	<0.25–2.7
Selenium	µg/L	5	1 of 1	0.10	0.096–0.096	1 of 29	0.87	<0.5–<5	--	--	--	--	--	--	--	--	--	0 of 28	0.76	<0.5–<1.8
Silver	µg/L	1.0[5]	0 of 2	0.10	<0.1–<0.1	0 of 17	0.20	<0.1–<0.5	--	--	--	--	--	--	--	--	--	0 of 15	0.21	<0.1–<0.5
Thallium	µg/L	0.56	0 of 2	0.10	<0.1–<0.1	7 of 28	0.19	<0.0002–<1	--	--	--	--	--	--	--	--	--	6 of 26	0.20	<0.0002–<1
Vanadium	µg/L	--	0 of 0	--	--	0 of 6	1.5	<1.5–<1.5	--	--	--	--	--	--	--	--	--	0 of 6	1.5	<1.5–<1.5
Zinc	µg/L	120[5]	0 of 2	3.0	<3–<3	11 of 46	9.5	<3–104	--	--	--	--	--	--	--	--	--	7 of 44	7.9	<3–51.2

Source: Barr 2014d.

Notes:
Values in bold indicates an exceedance of surface water quality standards.
1 2010 data not collected for all parameters. Includes non-detects at half the detection limit.
2 Excludes 94.8 mg/L value from November 8, 2006.
3 Excludes 688 mg/L value from November 8, 2006.
4 The MPCA staff have previously recommended the waters within and downstream from Embarrass Lake, the northernmost tip of Wynne Lake, and the segment of the Embarrass River from Sabin Lake to the Highway 135 bridge as waters used for the production of wild rice, so the 10 mg/L sulfate standard is only applicable to that portion of the Embarrass River (PM-13).
5 Water quality standard for this metal is hardness-dependent. Listed value assumes a concentration of 100 mg/L.
6 Omitting one anomalously high (688 mg/L) value, the concentration range is 7.6 to 173 mg/L.

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Embarrass River Tributary Streams

There are several tributaries to the Embarrass River that also serve as receiving waters for seepage from the existing LTVSMC Tailings Basin, including Mud Lake Creek, Trimble Creek, and Unnamed Creek. This Tailing Basin seepage occurs from both observable surface water seeps and diffuse surface water and groundwater seepage.

The existing LTVSMC Tailings Basin, proposed for tailings deposition by PolyMet, was operated from 1953 until it was shut down in January 2001. The Tailings Basin is unlined and the perimeter embankments do not have a clay core or cutoff, which allows for both surface seepage through the embankment and groundwater seepage under the embankment.

Most of the uncontrolled groundwater and surface water seepage from the existing LTVSMC Tailings Basin ultimately reaches the Embarrass River between monitoring stations PM-12 and PM-13. Table 4.2.2-33 identifies the observable Tailings Basin seeps and the flow range for the period from 2005 to 2014 for the 33 LTVSMC seeps shown in Figure 4.2.2-13 (Barr 2007f), but most of the existing Tailings Basin seepage is diffuse and not associated with these observed seeps.

As the flow monitoring shows, flow at most of these identified surface seeps has declined or stopped since tailings disposal was discontinued in 2001. Only Seep 30, which drains to wetlands north of the Tailings Basin in the Embarrass River Watershed, and Seeps 32/33, which drain to Second Creek in the Partridge River Watershed, still have flow greater than 10 gpm (Table 4.2.2-33). A portion of seeps 32/33 (outfall SD-026) and all seepage from the vicinity of outfalls SD-006 and SD-004 are presently being pumped back into the Tailings Basin under the Consent Decree agreement between the MPCA and Cliffs Erie. In addition to surface Seep 32/33, seepage bypasses the collection system at outfall SD-026 and discharges to Second Creek.

PolyMet estimates that the current combined groundwater seepage from the Tailings Basin to the Embarrass River is 2,590 gpm (PolyMet 2015j). PolyMet has collected water quality data at four locations along the toe of the tailings embankment (PM-8, PM-9, PM-10, and UC-1) and along the three receiving streams, including three locations along Trimble Creek (PM-19, TC-1, and TC-1A), one location along Unnamed Creek (PM-11), and three locations along Mud Lake Creek (MLC-1, MLC-2, and MLC-3A). Table 4.2.2-34 lists the sampling periods for each location and Figure 4.2.2-19 shows the monitoring locations. Tables 4.2.2-35 through 4.2.2-38 contain summaries of the data from these locations.

Table 4.2.2-33 Summary of Existing LTVSMC Tailings Basin Surface Seeps (see Figure 4.2.2-13)

Seep ID	Average Seepage Flow (gpm) 2005-2014	Notes
Seep 1	0	
Seep 2	0	
Seep 3	0	
Seep 4	0	
Culvert (WS-011)	1	Includes combined flow of Seeps 1–4; may include both Tailings Basin seepage and watershed runoff
Seep 5	0	
Seep 6	0	
Seep 7	0	
Seep 8	0	
Seep 9	0	
Weir (WS-012)	2	Includes combined flow of Seeps 4–9; may include both Tailings Basin seepage and watershed runoff
Emergency Basin Outflow	681	Includes watershed runoff
Seeps 10–17	0	
Weir (West Side Seep)	0	Includes combined flow of area including Seeps 11–17
Culvert/Pipe	1	Culvert beneath road; may include both Tailings Basin seepage and watershed runoff
SD-006	515	No discharge since 2011; Tailings Basin pump-back system installed and operating; may include both Tailings Basin seepage and watershed runoff
Seep 18	6	
Seep 19	0	
Seep 20	2	Flow from pipe
Seep 21	0	
Seep 22 (SD-004)	3	No discharge since 2011; Tailings Basin pump-back system installed and operating
Seep 23	0	
Seep 24 (North Side Seep)	10	Flow from pipe
Seep 25	7	Flow from pipe
Seep 26	0	Flow from pipe
Seep 27	0	Flow from pipe
Seep 28	0	Flow from pipe
Seep 29	0	Flow from pipe
Seep 30	134	Flow dispersed over length of Cell 2E north dam
Seep 31	0	
Seeps 32–33	579	Tailings Basin pump-back system installed and operating

Sources: Barr 2014e; PolyMet 2015i.

Table 4.2.2-34 Water Quality Monitoring Locations for Embarrass River Tributary Streams and Tailings Basin Receiving Streams (see Figure 4.2.2-19)

Sample Location	Source	Sampling Period
Tailings Basin		
PM-8	PolyMet	2001–2006
PM-9	PolyMet	2001–2006
PM-10	PolyMet	2001–2007
UC-1	PolyMet	2012-2013
PM-11	PolyMet	2004, 2006, 2008–2013
PM-19	PolyMet	2009–2013
MLC-1	PolyMet	2011–2013
MLC-2	PolyMet	2011–2013
MLC-3/MLC-3A[1]	PolyMet	2012
TC-1	PolyMet	2012
TC-1A	PolyMet	2012–2013

Sources: Barr 2007h; Barr 2014d.

Note:
[1] The sample location was originally identified as MLC-3, but was inaccessible. The actual sample location, which was approximately 50 yards from the intended sample location, was identified as MLC-3A at the time. However, because of the close proximity of the intended and actual sample locations, and the fact that samples have only been taken at one location at the headwaters of Mud Lake Creek, these samples have been re-labelled as MLC-3.

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Table 4.2.2-35 Summary of Surface Water Quality Monitoring Data for the Tailings Basin Surface Seeps (see Figure 4.2.2-13)

Parameter	Units	Surface Water Evaluation Criteria	PM-8[6]				PM-9[6]				PM-10[6]				UC-1			
General			**Detection**	**Mean[5]**	**Range**	**# Exceed**	**Detection**	**Mean[5]**	**Range**	**# Exceed**	**Detection**	**Mean[5]**	**Range**	**# Exceed**	**Detection**	**Mean[5]**	**Range**	**# Exceed**
Alkalinity	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	3 of 3	437	399–471	NA
Ammonia as Nitrogen	mg/L	--	0 of 4	0.1	<0.1	NA	0 of 4	0.1	<0.1	NA	0 of 4	0.1	<0.1	NA	2 of 3	0.13	<0.05–0.24	NA
Calcium	mg/L	--	47 of 47	42.4	9.2–73.9	NA	124 of 124	53.9	33.0–98.9	NA	132 of 132	66.4	17.5–92.4	NA	11 of 11	61.8	35.9–91.7	NA
Carbon, total organic	mg/L	--	8 of 8	5.4	2.6–6.9	NA	8 of 8	8.4	1.7–18.5	NA	15 of 15	7.5	5.2–9.4	NA	11 of 11	11.4	7.1–18.0	NA
Chloride	mg/L	230	19 of 19	20.3	3.1–30	0	122 of 122	28.1	12.6–66.5	0	130 of 130	27.7	7.2–33.6	0	11 of 11	26.0	11.0–43.9	0
Fluoride	mg/L	--	42 of 42	2.9	1.0–5.8	NA	128 of 128	2.4	0.6–5.8	NA	136 of 136	2.3	0.5–4.8	NA	--	--	--	--
Magnesium	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	11 of 11	94.2	54.2–149	NA
Hardness	mg/L	500	36 of 36	431	230–721	**9**	41 of 41	452	268–818	**11**	48 of 48	438	327–649	**7**	11 of 11	**542**	313–844	**6**
Nitrate + Nitrite as Nitrogen	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	0 of 3	0.050	<0.05–<0.05	NA
pH	s.u.	6.5–8.5	81 of 81	7.9	6.8–8.7	**1**	130 of 130	7.8	6.4–8.8	**7**	136–136	6.7	6.4–8.9	**5**	11 of 11	7.4	7.0–7.8	0
Potassium	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	3 of 3	5.0	4.1–6.3	NA
Sodium	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	3 of 3	47.6	44.7–52.3	NA
Sulfate	mg/L	--[2]	61 of 61	161	27.1–312	NA	125 of 125	159	56.8–344	NA	133 of 133	182	8.1–473	NA	11 of 11	185	67.5–380	NA
TDS	mg/L	700	--	--	--	--	--	--	--	--	--	--	--	--	11 of 11	666	410–1,030	**3**
Metals – Total																		
Aluminum	µg/L	125	3 of 5	25.7	<10–40.7	0	4 of 5	29.9	<25–48.4	0	4 of 12	39.6	<10–230	**1[4]**	7 of 11	26.9	<10–47.3	0
Antimony	µg/L	31	0 of 5	3	<3	0	0 of 5	3	<3	0	0 of 5	3	<3	0	0 of 11	0.25	<0.25–<0.25	0
Arsenic	µg/L	53	5 of 12	3	<2–7.2	0	1 of 12	2.1	<2–2.7	0	2 of 12	2.1	<2–2.7	0	6 of 11	0.78	<0.25–1.6	0
Barium	µg/L	--	15 of 15	25.6	11–76.4	NA	15 of 15	41.6	18.3–140	NA	22 of 22	86.7	39.5–148	NA	3 of 3	53.0	45.3–59.5	NA
Beryllium	µg/L	--	0 of 5	1.64	<0.2–<2	NA	0 of 5	1.64	<0.2–<2	NA	0 of 5	1.64	<0.2–<2	NA	0 of 3	0.10	<0.1–<0.1	NA
Boron	µg/L	500	37 of 37	351	164–483	0	127 of 127	337	115–452	0	135 of 135	379	85–517	**3**	3 of 3	277	228–333	0
Cadmium	µg/L	2.5[3]	0 of 5	1.6	<0.2–<2	0	0 of 5	1.6	<0.2–<2	0	0 of 5	1.6	<0.2–<2	0	0 of 3	0.10	<0.1–<0.1	0
Cobalt	µg/L	5	4 of 43	1.2	<1–<2.5	0	3 of 81	1.1	<1–4.9	0	7 of 82	1.3	<1–16.8	**1**	6 of 11	0.20	<0.1–0.34	0
Copper	µg/L	9.3[3]	5 of 32	2.1	<0.7–5.4	0	19 of 84	2.5	<0.7–12	**1**	16 of 92	2.3	<1–24.2	**1**	9 of 11	1.4	<0.25–3.8	0
Iron	µg/L	--	23 of 23	410	<30–4,500	NA	18 of 19	673	<30–5,100	NA	23 of 25	501	<30–4,020	NA	11 of 11	496	188–1,590	NA
Lead	µg/L	3.2[3]	9 of 10	0.7	<0.3–<1	0	9 of 10	0.7	<0.3–<1	0	10 of 10	1.3	<0.3–7.1	**1**	0 of 11	0.25	<0.25–<0.25	0
Manganese	µg/L	--	40 of 40	3,039	70–110,000	NA	95 of 98	631	<10–50,000	NA	93 of 93	100,192	20–2,950,000	NA	11 of 11	369	78.2–1,520	NA
Mercury	ng/L	1.3	13 of 17	1.7	0.5–4.6	**7[1]**	12 of 65	1.8	0.7–4.1	**6[1]**	14 of 66	1.4	0.6–2.3	**7[1]**	3 of 3	1.1	1.0–1.4	**1**
Methylmercury	ng/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Molybdenum	µg/L	--	12 of 12	50.5	13.9–81.6	NA	110 of 112	43.2	<5–96.8	NA	119 of 121	21.5	<5–47.6	NA	3 of 3	5.7	4.4–7.6	NA
Nickel	µg/L	52[3]	3 of 27	2.5	<2–<5	0	3 of 64	2.3	<2–<5	0	11 of 72	2.3	<2–5.9	0	4 of 11	0.51	<0.25–1.4	0
Selenium	µg/L	5	0 of 10	2.5	<1.0–<3.6	0	0 of 10	2.5	<1.0–<3.6	0	0 of 10	2.5	<1.0–<3.6	0	0 of 11	0.50	<0.5–<0.5	0
Silver	µg/L	1.0[3]	0 of 10	0.6	<0.2–<1	0	0 of 10	0.6	<0.2–<1	0	0 of 10	0.6	<0.2–<1	0	0 of 3	0.10	<0.1–<0.1	0
Thallium	µg/L	0.56	0 of 10	1.2	<0.4–<2	0[1]	0 of 10	1.2	<0.4–<2	0[1]	0 of 10	2.7	<0.4–<2	**1**	2 of 10	0.0013	<0.0002–0.0060	0
Vanadium	µg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	0 of 3	1.5	<1.5–<1.5	NA
Zinc	µg/L	120[3]	2 of 27	13.6	<10–<25	0	2 of 12	10.3	<10–12.7	0	3 of 19	16.2	<10–32.5	0	3 of 11	7.8	<3–30.3	0

Sources: Barr 2007h; Barr 2006f; Barr 2014d.

Notes:
Values in bold indicates an exceedance of surface water quality standards.
1 Some detection limits exceed evaluation criteria; Barr 2006f. Data reported as less than such a detection limit is not included in the number of exceedances.
2 Sulfate standard of 10 mg/L applies to waters used for production of wild rice.
3 Water Quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
4 Predicted values represent total aluminum concentrations, while the water quality standard is for dissolved aluminum. Since aluminum has a very low solubility in water under relatively neutral pH conditions, it is expected that the predicted aluminum concentration would meet the surface water standard (see discussion in Section 4.1.2.2).
5 Includes non-detects at half the detection limit.
6 Seepage at PM-8 is presently being pumped back into the Tailings Basin in accordance with the Consent Decree between the MPCA and Cliffs Erie. Seepage at PM-9 and PM-10 are discharging to tributaries of the Embarrass River.

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Table 4.2.2-36 Summary of Surface Water Quality Monitoring Data for Unnamed Creek

Parameter	Units	Surface Water Evaluation Criteria	PM-11 Unnamed Creek			
General Parameters			**Detection**	**Mean[3]**	**Range**	**# Exceed**
Alkalinity	mg/L	--	29 of 29	295	108–492	NA
Ammonia as Nitrogen	mg/L	--	4 of 18	11.2	<0.05–<50	NA
Calcium	mg/L	--	42 of 42	44.6	18.2–78.0	NA
Carbon, total organic	mg/L	--	44 of 44	12.2	6.5–23.3	NA
Chloride	mg/L	230	55 of 55	17.5	3.1–34.1	0
Fluoride	mg/L	--	11 of 11	1.5	0.84–2.2	NA
Hardness	mg/L	500	42 of 42	371	109–660	**9**
Magnesium	mg/L	--	42 of 42	63.4	19.8–113	NA
Nitrate + Nitrite as Nitrogen	mg/L	--	1 of 24	17.1	<0.05–110	NA
pH	s.u.	6.5–8.5	51 of 51	7.5	6.6–8.3	0
Potassium	mg/L	--	24 of 24	5.3	1.6–8.4	NA
Sodium	mg/L	--	26 of 26	43.5	13.4–59.4	NA
Sulfate	mg/L	--(1)	59 of 59	122	13.5–233	NA
TDS	mg/L	700	42 of 42	491	186–831	**7**
Metals – Total						
Aluminum	µg/L	125	25 of 40	28.6	<10–92.1	0
Antimony	µg/L	31	0 of 27	0.44	<0.25–<1.5	0
Arsenic	µg/L	53	21 of 34	0.87	<0.25–2.3	0
Barium	µg/L	--	18 of 18	32.3	13.4–67.9	NA
Beryllium	µg/L	--	0 of 15	0.1	<0.1–<0.1	NA
Boron	µg/L	500	15 of 15	225	129–307	0
Cadmium	µg/L	2.5(2)	4 of 18	0.077	<0.015–<0.1	0
Cobalt	µg/L	5	13 of 40	0.22	<0.1–<0.5	0
Copper	µg/L	9.3(2)	36 of 42	0.99	<0.33–<2.5	0
Iron	µg/L	--	37 of 37	527	0.21–1,270	NA
Lead	µg/L	3.2(2)	6 of 36	0.24	<0.15–<0.5	0
Manganese	µg/L	--	40 of 40	260	19.3–1,270	NA
Mercury	ng/L	1.3	24 of 30	**2.5**	<0.25–<10	**19(4)**
Methylmercury	ng/L	--	9 of 9	0.26	0.15–0.46	NA
Molybdenum	µg/L	--	27 of 27	12.1	3.7–29.3	NA
Nickel	µg/L	52(2)	17 of 42	0.77	<0.25–<2.5	0
Selenium	µg/L	5	3 of 32	0.72	<0.5–<1.8	0
Silver	µg/L	1.0(2)	0 of 20	0.18	<0.1–<0.5	0
Thallium	µg/L	0.56	5 of 36	0.15	<0.0002–<1	**4**
Vanadium	µg/L	--	0 of 8	2.4	<1.5–<5	NA
Zinc	µg/L	120(2)	5 of 42	4.5	<3–41.2	0

Source: Barr 2014d.

Notes:
Values in bold indicates an exceedance of surface water quality standards.
1 Sulfate standard of 10 mg/L applies to waters used for production of wild rice.
2 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
3 Mean includes non-detects at half the detection limit.
4 Minimum detection limit exceeds evaluation criteria; Barr 2006f. Data reported as less than such a detection limit is not included in the number of exceedances.

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Table 4.2.2-37 Summary of Surface Water Quality Monitoring Data for Trimble Creek

Parameter	Units	Surface Water Evaluation Criteria	PM-19 Trimble Creek				TC-1 Trimble Creek				TC-1A Trimble Creek			
General Parameters			**Detection**	**Mean[3]**	**Range**	**# Exceed**	**Detection**	**Mean[3]**	**Range**	**# Exceed**	**Detection**	**Mean[3]**	**Range**	**# Exceed**
Alkalinity	mg/L	--	37 of 37	351	190–514	NA	1 of 1	335	335–335	NA	4 of 4	305	243–355	NA
Ammonia as Nitrogen	mg/L	--	10 of 25	0.11	<0.05–5,830	NA	0 of 1	0.05	<0.05–<0.05	NA	2 of 4	0.14	<0.05–0.31	NA
Calcium	mg/L	--	68 of 68	48.1	18.5–99.3	NA	4 of 4	43.6	38.2–49.8	NA	14 of 14	49.5	22.1–77.6	NA
Carbon, total organic	mg/L	--	63 of 63	17.8	10.9–33.7	NA	4 of 4	23	14.8–31.8	NA	14 of 14	13.8	10.6–23.2	NA
Chloride	mg/L	230	89 of 89	16.5	6.8–55.1	0	4 of 4	11.7	7.5–17.2	0	14 of 14	19.7	7.4–33.5	0
Fluoride	mg/L	--	2 of 2	0.91	0.87–0.95	NA	--	--	--	--	--	--	--	--
Hardness	mg/L	500	68 of 68	311	123–1,350	**2**	4 of 4	273	231–299	0	14 of 14	332	147–532	**2**
Magnesium	mg/L	--	68 of 68	46.3	18.6–270	NA	4 of 4	39.9	33.0–42.3	NA	14 of 14	50.5	22.3–82.1	NA
Nitrate + Nitrite as Nitrogen	mg/L	--	8 of 32	0.050	<0.05–0.41	NA	0 of 1	0.05	<0.05–<0.05	NA	0 of 4	0.050	<0.05–<0.05	NA
pH	s.u.	6.5–8.5	79 of 79	7.2	6.1–8.2	**2**	4 of 4	7.5	7.4–7.7	0	14 of 14	7.3	6.9–7.8	0
Potassium	mg/L	--	32 of 32	3.0	1.4–58.2	NA	1 of 1	2.3	2.3–2.3	NA	4 of 4	3.3	2.4–4.7	NA
Sodium	mg/L	--	32 of 32	51.7	26.9–100	NA	1 of 1	47.0	47–47	NA	4 of 4	55.6	36.3–70.0	NA
Sulfate	mg/L	--[(1)]	86 of 89	32.7	<0.5–1,170	NA	4 of 4	12.4	1.3–36.6	NA	14 of 14	56.4	1.0–119	NA
TDS	mg/L	700	68 of 68	453	195–1,920	**2**	4 of 4	400	366–416	0	14 of 14	481	231–722	**2**
Metals – Total														
Aluminum	µg/L	125	32 of 57	33.7	<10–184	**1**	3 of 4	44.9	<20.0–82.5	0	9 of 14	23.7	<10–37.4	0
Antimony	µg/L	31	0 of 44	0.25	<0.25–<0.25	0	0 of 4	0.25	<0.25–<0.25	0	0 of 9	0.25	<0.25–<0.25	0
Arsenic	µg/L	53	37 of 59	1.1	<0.25–3.9	0	4 of 4	2.6	0.98–5.2	0	7 of 14	0.78	<0.25–2.7	0
Barium	µg/L	--	22 of 22	80.9	52.0–137	NA	1 of 1	95.2	95.2–95.2	NA	4 of 4	107	83.2–137	NA
Beryllium	µg/L	--	0 of 22	0.10	<0.1–<0.1	NA	0 of 1	0.1	<0.10–<0.10	NA	0 of 4	0.10	<0.1–<0.1	NA
Boron	µg/L	500	22 of 22	136	111–333	0	1 of 1	137	137–137	0	4 of 4	155	142–173	0
Cadmium	µg/L	2.5[(2)]	0 of 22	0.076	<0.01–<0.1	0	0 of 1	0.1	<0.10–<0.10	0	0 of 4	0.10	<0.1–<0.1	0
Cobalt	µg/L	5	37 of 59	0.29	<0.1–0.98	0	4 of 4	0.62	0.25–1.4	0	7 of 14	0.26	<0.1–0.66	0
Copper	µg/L	9.3[(2)]	47 of 59	0.65	<0.25–3.8	0	1 of 4	0.32	<0.25–<0.25	0	9 of 14	0.50	<0.25–0.85	0
Iron	µg/L	--	61 of 63	1,284	226–5,830	NA	4 of 4	3,233	941–8,330	NA	14 of 14	871	232–4,040	NA
Lead	µg/L	3.2[(2)]	2 of 53	0.22	<0.01–<0.25	0	0 of 4	0.25	<0.25–<0.25	0	0 of 14	0.25	<0.25–<0.25	0
Manganese	µg/L	--	59 of 59	830	24.2–3,990	NA	4 of 4	1,305	202–3,670	NA	14 of 14	640	43.9–1,660	NA
Mercury	ng/L	1.3	26 of 26	**1.5**	0.50–5.1	**7**	1 of 1	1.1	1.1–1.1	0	4 of 4	**2.5**	0.90–5.1	**2**
Methylmercury	ng/L	--	1 of 2	0.11	<0.05–0.16	NA	--	--	--	--	--	--	--	--
Molybdenum	µg/L	--	28 of 28	1.3	0.39–7.6	NA	1 of 1	0.89	0.89–0.89	NA	4 of 4	1.1	0.63–1.5	NA
Nickel	µg/L	52[(2)]	21 of 59	0.50	<0.25–5.1	0	2 of 4	0.52	<0.25–<0.25	0	3 of 14	0.36	<0.25–1.2	0
Selenium	µg/L	5	5 of 51	0.50	<0.5–1.1	0	0 of 4	0.5	<0.50–<0.50	0	0 of 14	0.50	<0.5–<0.5	0
Silver	µg/L	1.0[(2)]	0 of 24	0.10	<0.1–<0.1	0	0 of 1	0.1	<0.10–<0.10	0	0 of 4	0.10	<0.1–<0.1	0
Thallium	µg/L	0.56	5 of 54	0.017	<0.0002–<0.1	0	0 of 4	0.001	<0.0002–0.003	0	0 of 13	0.0013	<0.0002–<0.0025	0
Vanadium	µg/L	--	0 of 15	2.4	<1.5–<5	NA	0 of 1	1.5	<1.5–<1.5	NA	0 of 4	1.5	<1.5–<1.5	NA
Zinc	µg/L	120[(2)]	6 of 59	3.9	<3–31.2	0	1 of 4	4.5	<3.0–8.9	0	2 of 14	3.9	<3–11.5	0

Source: Barr 2014d.

Notes:
Values in bold indicates an exceedance of surface water quality standards.
1 Sulfate standard of 10 mg/L applies to waters used for production of wild rice.
2 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
3 Mean includes non-detects at half the detection limit.

Table 4.2.2-38 Summary of Surface Water Quality Monitoring Data for Mud Lake Creek

Parameter	Units	Surface Water Evaluation Criteria	MLC-1 Mud Lake Creek				MLC-2 Mud Lake Creek				MLC-3/MLC-3A[4] Mud Lake Creek			
General Parameters			**Detection**	**Mean[3]**	**Range**	**# Exceed**	**Detection**	**Mean[3]**	**Range**	**# Exceed**	**Detection**	**Mean[3]**	**Range**	**# Exceed**
Alkalinity	mg/L	--	7 of 7	218	97.7–394	NA	14 of 14	122	76.5–201	NA	1 of 1	448	448–448	NA
Ammonia as Nitrogen	mg/L	--	3 of 7	0.31	<0.05–1.7	NA	4 of 14	0.35	<0.05–2.1	NA	0 of 1	0.05	<0.05–<0.05	NA
Calcium	mg/L	--	18 of 18	31.1	14.5–58.6	NA	27 of 27	19.5	9.1–32.7	NA	2 of 2	47.2	34.5–59.8	NA
Carbon, total organic	mg/L	--	18 of 18	21.9	10.7–43.8	NA	27 of 27	24.7	12.9–48.0	NA	2 of 2	14.7	14.3–15	NA
Chloride	mg/L	230	18 of 18	8.4	2.5–21.6	0	28 of 28	6.0	1.7–12.7	0	2 of 2	18.0	13.2–22.8	0
Fluoride	mg/L	--	2 of 2	0.23	0.15–0.31	NA	4 of 4	0.25	0.20–0.33	NA	--	--	--	--
Hardness	mg/L	500	18 of 18	196	92.6–383	0	27 of 27	113	59.9–194	0	2 of 2	315	236–394	0
Magnesium	mg/L	--	18 of 18	28.6	13.7–60.2	NA	27 of 27	15.7	9.0–27.2	NA	2 of 2	47.9	36.4–59.4	NA
Nitrate + Nitrite as Nitrogen	mg/L	--	0 of 7	0.050	<0.05–<0.05	NA	2 of 14	0.059	<0.05–0.12	NA	0 of 1	0.05	<0.05–<0.05	NA
pH	s.u.	6.5–8.5	16 of 16	7.1	6.7–7.6	0	29 of 29	7.0	6.4–7.7	**2**	2 of 2	7.3	7.1–7.6	0
Potassium	mg/L	--	7 of 7	2.0	1.3–3.2	NA	14 of 14	1.1	0.33–1.9	NA	1 of 1	3	3–3	NA
Sodium	mg/L	--	7 of 7	28.9	15.4–57.5	NA	14 of 14	14.9	9.5–20.7	NA	1 of 1	63.9	63.9–63.9	NA
Sulfate	mg/L	--(1)	14 of 18	11.5	<0.5–82.3	NA	21 of 28	3.1	<0.5–12.3	NA	2 of 2	35.3	17.3–53.2	NA
TDS	mg/L	700	18 of 18	302	141–553	0	27 of 27	200	117–292	0	2 of 2	491	369–613	0
Metals – Total														
Aluminum	µg/L	125	14 of 18	31.8	<10–58.3	0	24 of 28	48.7	<10–149	**1**	0 of 2	10	<10–<10	0
Antimony	µg/L	31	0 of 12	0.25	<0.25–<0.25	0	0 of 22	0.25	<0.25–<0.25	0	0 of 2	0.25	<0.25–<0.25	0
Arsenic	µg/L	53	16 of 17	2.6	<0.25–7.0	0	23 of 27	1.3	<0.25–3.1	0	1 of 2	0.42	<0.25–0.59	0
Barium	µg/L	--	7 of 7	36.1	11.0–93.8	NA	10 of 10	28.2	10.5–61.6	NA	1 of 1	37.3	37.3–37.3	NA
Beryllium	µg/L	--	0 of 7	0.10	<0.1–<0.1	NA	0 of 10	0.10	<0.1–<0.1	NA	0 of 1	0.1	<0.1–<0.1	NA
Boron	µg/L	500	5 of 7	57.2	<25–85.3	0	0 of 10	25.0	<25–<25	0	1 of 1	160	160–160	0
Cadmium	µg/L	2.5(2)	0 of 7	0.076	<0.015–<0.1	0	1 of 10	0.069	<0.015–<0.1	0	0 of 1	0.1	<0.1–<0.1	0
Cobalt	µg/L	5	11 of 18	0.41	<0.1–1.1	0	17 of 27	0.43	<0.1–1.2	0	1 of 2	0.15	<0.1–0.2	0
Copper	µg/L	9.3(2)	5 of 18	0.38	<0.25–1.1	0	15 of 27	0.48	<0.25–1.3	0	2 of 2	0.56	0.53–0.59	0
Iron	µg/L	--	18 of 18	9,098	373–37,600	NA	27 of 27	5,322	266–27,100	NA	2 of 2	280	275–284	NA
Lead	µg/L	3.2(2)	1 of 18	0.23	<0.01–<0.25	0	4 of 23	0.23	<0.25–<0.25	0	0 of 2	0.25	<0.25–<0.25	0
Manganese	µg/L	--	18 of 18	413	14.8–1,040	NA	27 of 27	353	8.4–1,310	NA	2 of 2	211	19.1–402	NA
Mercury	ng/L	1.3	7 of 7	**2.2**	1.1–4.0	**6**	14 of 14	**3.1**	0.90–6.5	**12**	1 of 1	0.99	0.99–0.99	0
Methylmercury	ng/L	--	--	--	--	--	3 of 4	1.3	<0.05–3.7	NA	--	--	--	--
Molybdenum	µg/L	--	6 of 7	0.63	<0.15–1.1	NA	13 of 14	0.48	<0.15–0.92	NA	1 of 1	1.7	1.7–1.7	NA
Nickel	µg/L	52(2)	4 of 18	0.36	<0.25–0.92	0	9 of 27	0.46	<0.25–1.7	0	1 of 2	0.42	<0.25–0.59	0
Selenium	µg/L	5	1 of 18	0.48	<0.1–0.53	0	3 of 23	0.45	<0.1–<0.5	0	0 of 2	0.5	<0.5–<0.5	0
Silver	µg/L	1.0(2)	0 of 7	0.10	<0.1–<0.1	0	0 of 10	0.10	<0.1–<0.1	0	0 of 1	0.1	<0.1–<0.1	0
Thallium	µg/L	0.56	3 of 16	0.0027	<0.0002–0.014	0	7 of 24	0.0059	<0.0002–0.030	0	0 of 2	0.00135	<0.0002–<0.0025	0
Vanadium	µg/L	--	1 of 5	1.9	<1.5–3.7	NA	0 of 10	2.9	<1.5–<5	NA	0 of 1	1.5	<1.5–<1.5	NA
Zinc	µg/L	120(2)	4 of 18	4.0	<3–9.0	0	4 of 27	5.4	<3–42.4	0	0 of 2	3	<3–<3	0

Source: Barr 2014d.

Notes:
Values in bold indicates an exceedance of surface water quality standards.
1 Sulfate standard of 10 mg/L applies to waters used for production of wild rice.
2 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
3 Mean includes non-detects at half the detection limit.
4 The sample location was originally identified as MLC-3, but was inaccessible. The actual sample location, which was approximately 50 yards from the intended sample location, was identified as MLC-3A at the time. However, because of the close proximity of the intended and actual sample locations, and the fact samples have only been taken at one location at the headwaters of Mud Lake Creek, these samples have been re-labelled as MLC-3.

Lower Embarrass River

Approximately 4 miles downstream from monitoring station PM-13, the Embarrass River flows through a chain of lakes: Sabin, Wynne, Embarrass, and Esquagama lakes. In addition to the previously discussed Embarrass River monitoring, PolyMet also conducted limited water quality monitoring for sulfate and chloride in Sabin Lake (PM-21 and PM-23), Wynne Lake (PM-22 and PM-24), and Embarrass Lake (EL-1 and EL-2) in 2010 and 2011 (see Figure 4.2.2-1). Samples were taken at the inlet to each lake and near the center of each lake at multiple depths: surface, middle, and near-bottom. Additional monitoring was performed at PM-21 for total and dissolved aluminum (PolyMet 2015j).

The average surface sulfate concentration in Sabin Lake was 11.7 mg/L (average surface concentration at PM-21 and PM-23 for 2010 to 2011) with concentrations increasing with depth. The northernmost tip of Wynne Lake is subject to the 10 mg/L sulfate standard for waters used for production of wild rice. The monitoring shows that the lake exceeds this standard (average surface concentration 16.0 mg/L at PM-22 and PM-24) and that concentrations increase with depth. Embarrass Lake is also subject to the 10 mg/L sulfate standard for waters used for production of wild rice. The monitoring shows that the lake exceeds this standard (average surface concentration 19.3 mg/L at EL-1 and EL-2). The data generally shows little fluctuation through the sampling period for all three lakes, although surface sulfate concentrations were typically higher in all three lakes in 2010 than in 2011. The increasing sulfate concentrations through the chain of lakes suggest that there is additional sulfate coming from other sources; however, monitoring did not identify specific sources (PolyMet 2015j). Section 4.2.2.1.3 discusses additional sulfate monitoring conducted as part of wild rice and water quality monitoring surveys.

Several lakes downstream of the NorthMet Project area within the chain of lakes are on the 303(d) list for “mercury in fish tissue” impairment, including Sabin, Wynne, Embarrass, and Esquagama lakes (see Figure 4.2.2-1). Further downstream, most of the St. Louis River is also listed for “mercury in fish tissue” impairment. These lakes and the St. Louis River are not covered by the Statewide Mercury TMDL, but are impaired waters that are still in need of a TMDL pollution reduction study. These waters are not included in Minnesota’s regional mercury TMDL because the mercury concentrations in the fish are considered too high to be returned to Minnesota’s mercury water quality standard using solely the state-wide TMDL approach. Similar to other lakes in Minnesota, the main source of the mercury is atmospheric mercury deposition.

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4.2.3 Wetlands

Wetlands in Minnesota are protected under federal and state laws, including Section 404 of the federal Clean Water Act (CWA), the State of Minnesota's Wetland Conservation Act (WCA), the MDNR's Public Waters Work Permit Program, and the MPCA's Wetland Standards and Mitigation Rules (*Minnesota Rules*, part 7050.0186). In addition, a DA permit pursuant to Section 404 of the CWA is not valid until the state has either certified under Section 401 of the CWA that the discharges comply with state water quality standards or waived the 401 certification requirements. For metallic mineral mining, WCA requirements are addressed under the MDNR Permit to Mine. WCA rules (including those parts applicable to mining projects under *Minnesota Rules*, part 8420.0930) include a special consideration for wetlands that are rare natural communities (*Minnesota Rules,* part 8420.0515, subpart 3). See FEIS Section 4.2.4.2.1 for additional information about these communities. The Permit to Mine would address special consideration of wetlands that include rare natural communities. Additional information on rare natural communities would be included in the wetland permit application as part of the Permit to Mine process for further refinement of site-specific conditions.

The majority of wetlands in Minnesota are subject to regulation under both state and federal programs that regulate activities in wetlands. However, there are some differences with respect to the types of wetland resources and activities subject to regulation under these state and federal programs. For example, under the state WCA, "incidental" wetlands are not jurisdictional, but those wetlands may be subject to the permitting requirements of Section 404 of the CWA at the federal level. Although there are wetlands within the NorthMet Project area that may be regulated exclusively under state law, or conversely, exclusively under federal law, all of the wetlands in the NorthMet Project area would be regulated under either the CWA or the WCA, with the proposed exception of two wetland areas that would not be regulated by either program as a result of being located within an actively permitted waste storage facility. These two wetland areas are discussed under Section 4.2.3.2 below.

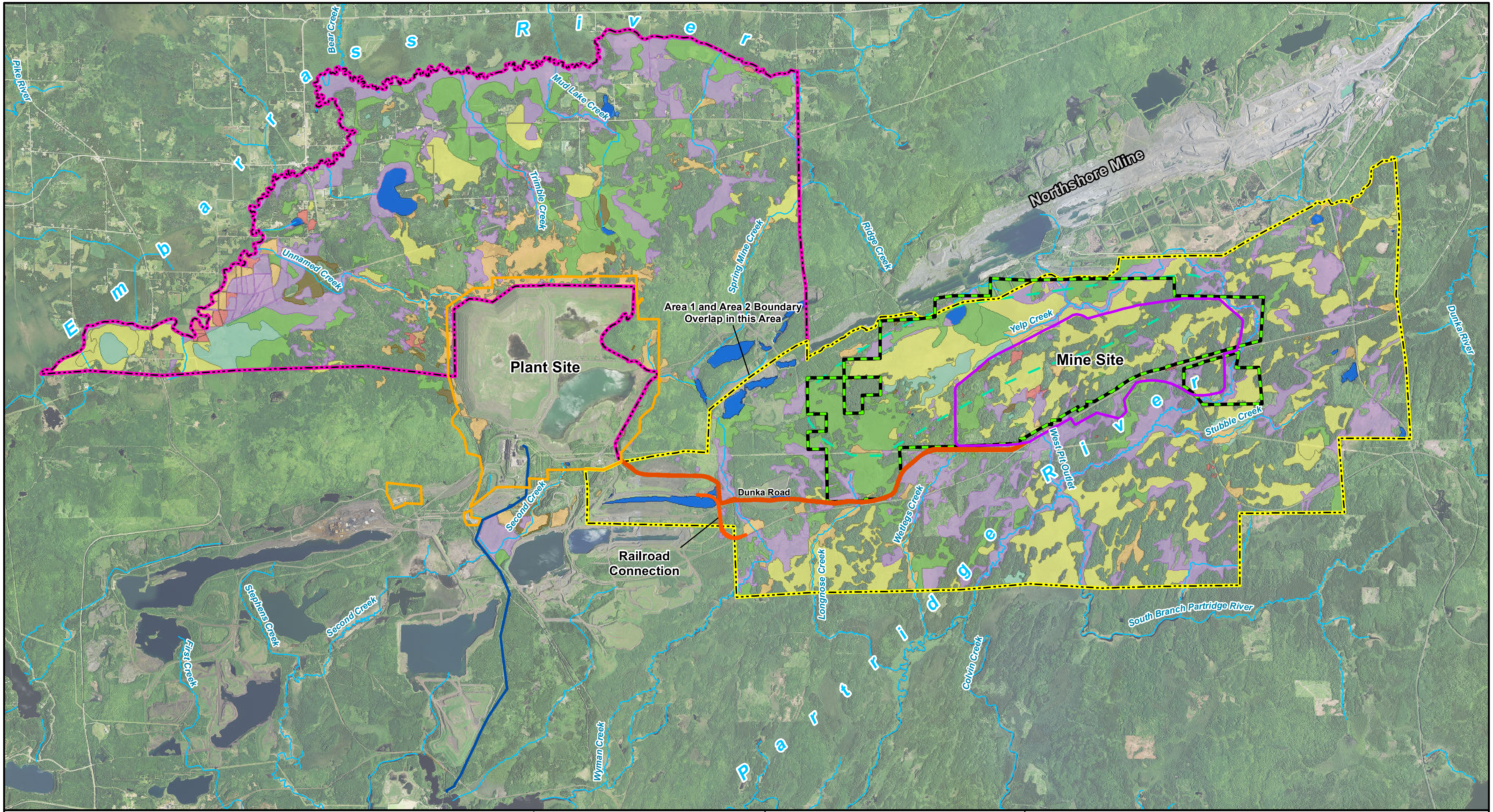
The required public notice to fulfill requirements for Section 404 permitting and Section 401 certification was originally issued by the USACE in May of 2005. The MPCA did not exercise its right to review the NorthMet Project Proposed Action under Section 401 of the CWA at that time; therefore, certification of the original NorthMet Project Proposed Action was waived by default. However, due to the revised NorthMet Project Proposed Action, PolyMet submitted a revised permit application in August 2013, and the public notice for the Section 404 application was reissued on December 13, 2013. The MPCA will need to re-issue the Section 401 public notice for the NorthMet Project Proposed Action. Under the provisions of the CWA, the MPCA has one year from the public notice (December 3, 2014) to act upon an application for Section 401 Certification. However, the MEPA (*Minnesota Statutes*, chapter 116.04, subdivision 2b) and rules regarding environmental review (*Minnesota Rules*, part 4410.3100) prohibit final agency decisions, such as the Section 401 Certification, until all environmental review steps are complete. The environmental review process being undertaken by the Co-lead Agencies would not be completed within the 1-year timeframe for issuance of the Section 401 Certification. Therefore, PolyMet has made a procedural decision to withdraw the Section 401 application before the MPCA and resubmit it in the near future to allow for processing of the application.

The wetland section for the NorthMet Project Proposed Action includes a discussion of the Mine Site and Plant Site, as well as Area 1 and Area 2. Area 1 and Area 2 represent the wetland boundaries that were developed and evaluated in 2010 and 2011 for the potential indirect effects on wetlands and are exclusive to this environmental resource section. The USACE determined that there was a need to evaluate wetland types in the areas surrounding the Mine Site (Area 1) and the Plant Site (Area 2) for their potential to experience indirect hydrologic wetland effects, and then to classify the wetland types by the likelihood of experiencing these effects (Barr 2011d). The Area 1 boundary extends beyond the Mine Site boundary and includes 23,927.4 acres. Area 1 encompasses the Mine Site, the federal lands, and the majority of the Transportation and Utility Corridor, as well as adjacent lands. Area 2 encompasses a 19,396.7-acre area just north and northwest of the Plant Site.

Detailed wetland field delineation/mapping was performed in 2004, and supplemented in 2005, 2006, 2007, 2008, and 2010 (Barr 2006d; Barr 2007b; Barr 2008k; Barr 2011d; PolyMet 2015b). These investigations delineated and mapped the portion of each wetland located within the Mine Site, Area 1, Area 2, Plant Site, and the adjoining federal lands (see Section 4.3.3.1.1 for the federal lands discussion).

The NorthMet Project area includes 166 wetlands covering 1,579.6 acres (see Figure 4.2.3-1). The percentage of wetland types identified in the NorthMet Project area include: coniferous bog (55 percent); shrub swamp (12 percent), which includes alder thicket and shrub-carr; shallow marsh (11 percent); coniferous swamp (9 percent); deep marsh (7 percent); sedge/wet meadow (3 percent); open bog (1 percent); hardwood swamp (1 percent); and open water (less than 1 percent) (PolyMet 2015b). Within the NorthMet Project area, 105 of the 166 wetlands (63 percent) are rated as high-quality, 11 wetlands (7 percent) are rated as moderate-quality, and 50 wetlands (30 percent) are rated as low-quality. The low-quality wetlands are located at the Hydrometallurgical Residue Facility and the existing LTVSMC Tailings Basin. The moderate-quality wetlands are located at the Mine Site and the existing LTVSMC Tailings Basin. Wetlands at the Mine Site and Transportation and Utility Corridor are ranked as high-quality.

In addition to the NorthMet Project area, the Colby Lake Water Pipeline Corridor and Second Creek areas were evaluated. The area of analysis for Second Creek includes the origin of the creek at the south end of Tailings Basin and ends at the east edge of the Colby Lake Water Pipeline Corridor (see Figure 4.2.3-1). These two areas include 44 wetlands covering 305.9 acres (see Figure 4.2.3-1). The percentage of wetland types identified in the two areas include: shrub swamp (44 percent), which includes alder thicket and shrub-carr; shallow marsh (36 percent); deep marsh (7 percent); hardwood swamp (7 percent); coniferous swamp (5 percent); and sedge/wet meadow (1 percent) (PolyMet 2015b). The majority of the wetlands within the Colby Lake Water Pipeline Corridor have been rated low quality (93 percent), with the remaining wetlands related as moderate quality (7 percent).



Mine Site
Plant Site
Transportation and Utility Corridor
Colby Lake Water Pipeline Corridor
Federal Lands
Area 1
Area 2
Stream/River
One Hundred Mile Swamp (Approximate Boundary)

Eggers & Reed Wetland Types

Coniferous Bog
Coniferous Swamp
Deep Marsh & Shallow Marsh
Hardwood Swamp
Open Bog
Sedge Meadow & Wet Meadow
Shrub Swamps (Alder Thicket & Shrub-Carr)
Shallow, Open Water & Lake

MNDNR
US Army Corps of Engineers
St. Paul District

N
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0 0.5 1 2 Miles

Figure 4.2.3-1
Wetland Community Types
Overview
NorthMet Mining Project and Land Exchange FEIS
Minnesota
November 2015

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4.2.3.1 Mine Site and Transportation and Utility Corridor

The Mine Site is 3,014.5 acres (see Figures 4.2.3-1, 4.2.3-2, and 4.2.3-3) and is located in the Partridge River Watershed, about 3 miles south of the Laurentian Divide. The Partridge River is located in the East St. Louis River Watershed, which discharges into Lake Superior. The Transportation and Utility Corridor (120.1 acres), which includes the Railroad Connection Corridor, is discussed below (see Figures 4.2.3-1 and 4.2.3-4). The following sections provide baseline information on the Mine Site, Transportation and Utility Corridor, and Area 1.

4.2.3.1.1 Wetland Delineation and Classification

Wetland characterization, mapping, and surveys for the Mine Site, Transportation and Utility Corridor, and Area 1 were conducted between 2004 and 2010 (Barr 2006d; Barr 2007b; Barr 2008k; Barr 2011d; PolyMet 2015b). Wetland acreages were determined using USGS topographic and USFWS National Wetlands Inventory (NWI) maps, aerial photographs, soil survey data, and field investigations.

Wetlands on the Mine Site were initially mapped in June 2004 based on a general survey of the area for wetland and upland habitats potentially used by various species of fish and wildlife. Wetland and upland plant communities were mapped on 1997 infrared aerial photographs of the site. Wetland delineations of the Mine Site and lands surrounding the Mine Site were subsequently conducted in August 2004, June 2005, and July 2006. This wetland delineation consisted of applying a combination of on-site and off-site procedures in accordance with the 1987 USACE Wetland Delineation Manual (Manual; USACE 1987). Wetland boundaries were field-mapped using Global Positioning System (GPS), aerial photographic interpretation, topography, and soils information.

Along Dunka Road and other possible transportation routes, field studies were conducted to determine wetland boundaries, vegetation cover types, and plant species composition of identified wetlands. For areas outside of Dunka Road and possible transportation routes, wetlands were mapped primarily based on the presence of photographic signatures with limited field-truthing and GPS locating.

Subsequent to publication of the SDEIS, baseline wetland types were re-evaluated. Additional field visits were conducted from April to October 2010, in addition to further mapping efforts. A Wetland Impact Assessment Planning (IAP) Workgroup was formed and facilitated the refinement of the wetland resource mapping efforts. In addition to the ground surveys, wetlands were evaluated during a helicopter reconnaissance in October 2010. Photographs were taken during the aerial reconnaissance using a GPS-equipped digital camera from a distance of 20 to 100 ft above the ground.

In 2010 and 2011, a baseline wetland evaluation was conducted using information from studies and surveys undertaken between 2004 and 2010. Wetlands were evaluated and classified in the areas around the Mine Site and the existing LTVSMC Tailings Basin to determine the potential for indirect hydrologic wetland effects using the Eggers and Reed (1997) community classification system, as determined by the Wetlands IAP Workgroup (MDNR et al. 2011). This system classifies the wetlands into 15 unique plant communities (see Table 4.2.3-1).

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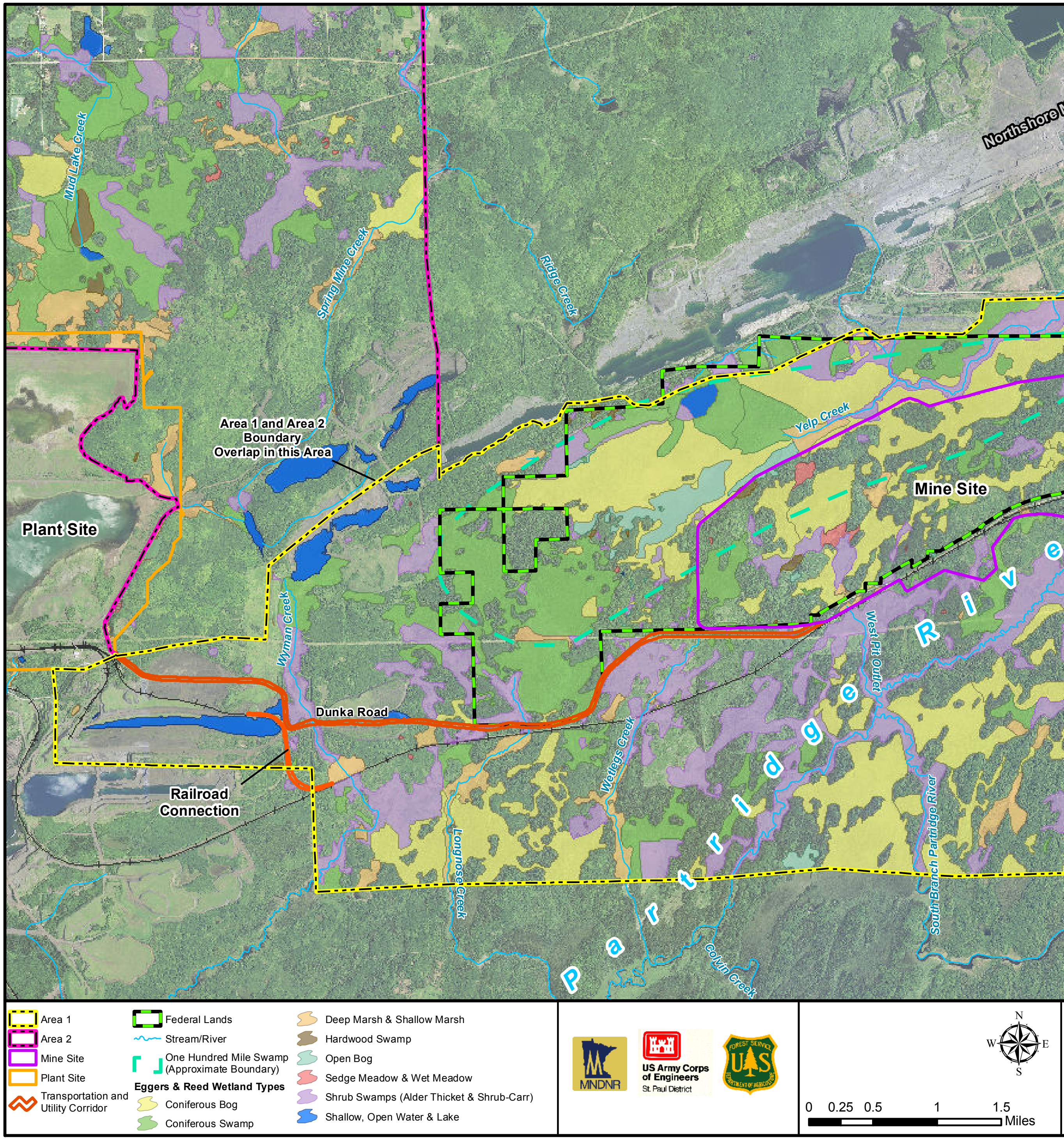

Figure 4.2.3-2
Wetland Community Types
Mine Site, Federal Lands, and Area 1
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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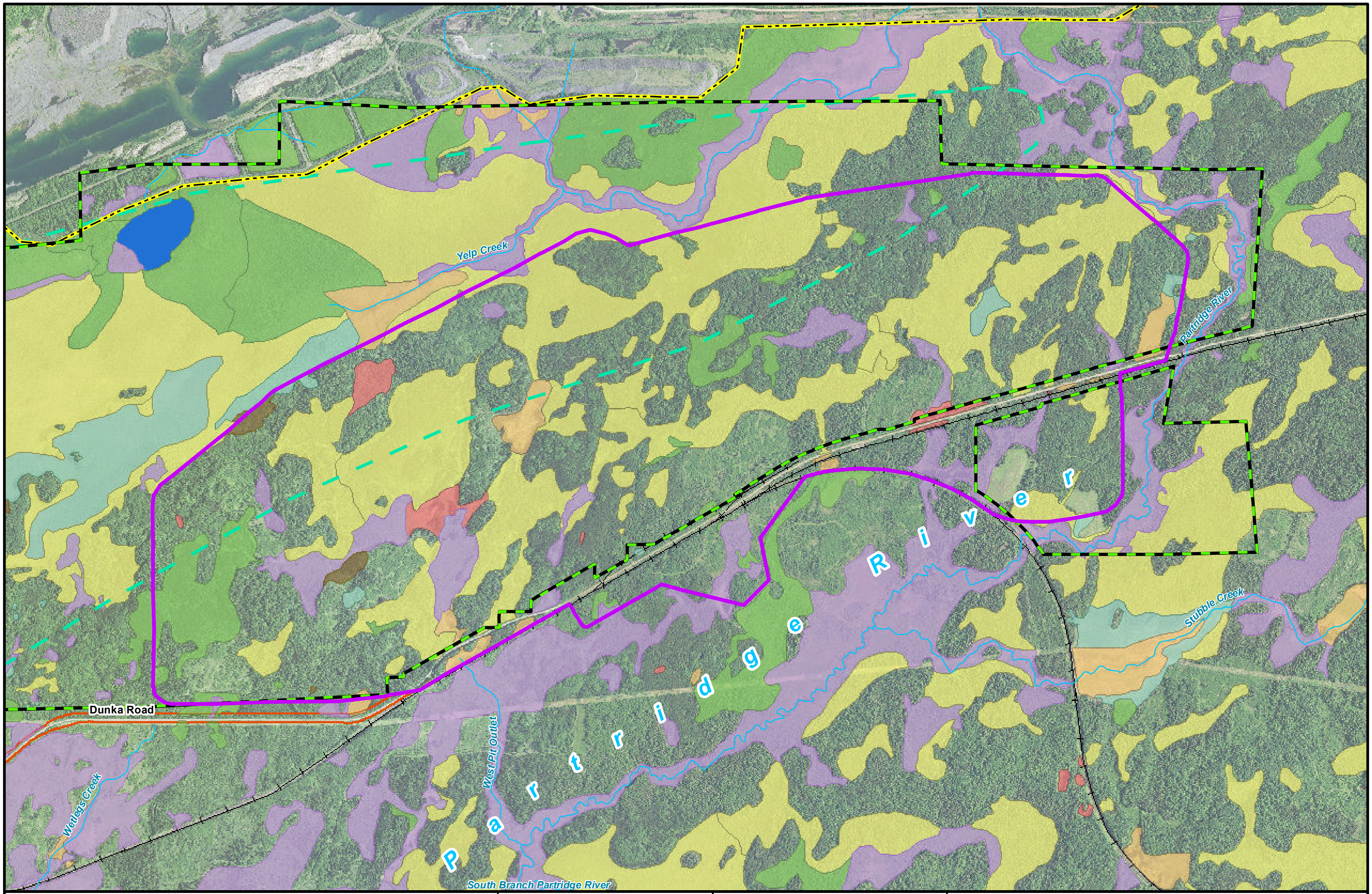

Mine Site
Area 1
Federal Lands
Transportation and Utility Corridor
One Hundred Mile Swamp (Approximate Boundary)
Stream/River

Eggers & Reed Wetland Types

Coniferous Bog
Coniferous Swamp
Hardwood Swamp
Deep Marsh & Shallow Marsh
Open Bog
Shrub Swamps (Alder Thicket & Shrub-Carr)
Sedge Meadow & Wet Meadow
Shallow, Open Water & Lake

MNDNR
US Army Corps of Engineers
St. Paul District

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Figure 4.2.3-3
Wetland Community Types - Mine Site
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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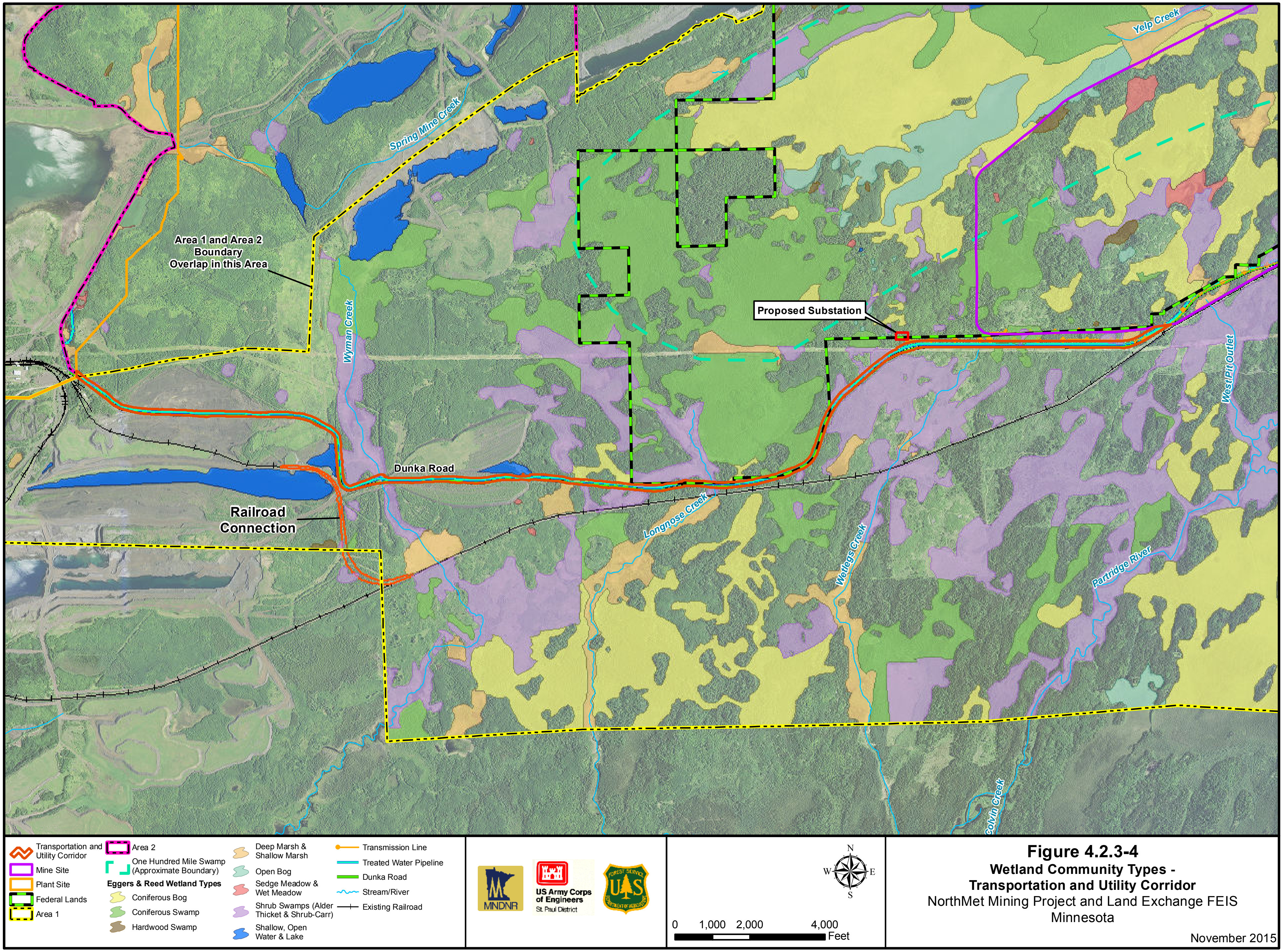

Figure 4.2.3-4
Wetland Community Types - Transportation and Utility Corridor
NorthMet Mining Project and Land Exchange FEIS
Minnesota

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Table 4.2.3-1 Wetland Classification System Descriptors

Wetland Plant Community Types[1]	Water Depth	Soils	Common Vegetation
Shallow, open water	6.6’ deep; permanently inundated	Lacustrine deposits and sediments	Pondweed, duckweed, coontail, water milfoil, water lily
Deep marsh	6” to > 3’ deep; permanently to semi-permanently inundated	Lacustrine deposits	Cattail, reed, bulrush, pickerelweed, giant bur-reed, Phragmites, spikerush, wild rice, pondweed, naiad, coontail, water milfoil, waterweed, duckweed, water lily, spatterdock
Shallow marsh	Saturated soils to < 6” deep	Organic or mineral	Manna grass, spikerush, cattail, arrowhead, lake sedge, pickerelweed, smartweed
Sedge meadow	Saturated soils	Organic	Sedges-dominant; spike rush, bulrush, nut grass, Canada blue-joint grass, true rush, forbs
Fresh (wet) meadow	Saturated soils	Mineral or organic	Grass and forbs-dominant; redtop, reed canary grass, manna grass, prairie cordgrass, mint
Wet to wet-mesic prairie	High groundwater table < 12” during portion of growing season	Mineral	Native grasses and forbs-dominant; prairie cordgrass, big bluestem, aster, culver’s root, sunflower
Calcareous fen	Upwelling, calcareous, groundwater discharge	Organic alkaline	Calciphiles-dominant; shrubby cinquefoil, sterile sedge, wild timothy, beaked spike rush, Riddell’s goldenrod, common valerian, lesser fringed gentian
Open bog	Saturated	Organic acid	Continuous sphagnum moss mat present; scattered immature (dbh < 6 in) black spruce or tamarack, ericaceous shrubs, sedges and forbs, such as pitcher plants
Coniferous bog	Saturated	Organic acid	Continuous sphagnum moss mat present; mature (dbh > 6 in) black spruce or tamarack, ericaceous shrubs, sedges and forbs such as pitcher plants
Shrub-carr	Saturated to seasonally flooded	Organic or mineral	Woody vegetation < 20 ft high and dbh < 6 in dominated by willows and/or dogwoods with various sedges, grasses and forbs
Alder thicket	Saturated to seasonally flooded	Organic or alluvial	Woody vegetation < 20 ft high and dbh < 6 in dominated by speckled alder with various sedges, grasses and forbs
Hardwood swamp	Saturated to < 12” deep during most of growing season	Organic alkaline	Continuous sphagnum moss mat absent; black ash, red maple, yellow birch, silver maple, aspen, American elm, dogwood, alder and various sedges, grasses and forbs
Coniferous swamp	Saturated to < 12” deep during most of growing season	Organic ranging from acid to alkaline	Continuous sphagnum moss mat absent; northern white cedar, tamarack, balsam fir, birch, black ash, alder and various sedges, grasses and forbs

Wetland Plant Community Types[1]	Water Depth	Soils	Common Vegetation
Floodplain forest	Inundated during flood events; somewhat well-drained during growing season	Alluvial	Silver maple, green ash, river birch, plains cottonwood, American elm, black willow, jewelweed, nettle
Seasonally flooded basin	Poorly drained; inundated for a few weeks during the growing season	Mineral	Smartweed, beggartick, nut-grass, wild millet and other annual species

Source: Eggers and Reed 1997, 2014; Barr 2011d.

dbh = Diameter at breast height

[1] All wetland classification systems have some limitations; however, wetlands identified as open bogs or coniferous bogs under the Eggers and Reed (1997, 2014) classification system were further subcategorized as either ombrotrophic (hydrology and mineral inputs entirely from direct precipitation) or somewhat minerotrophic (some degree of mineral inputs from groundwater and/or surface water runoff) (Eggers 2011a, 2015; PolyMet 2015b). See Section 4.2.3.1.2 and Section 5.2.3 for more information.

Wetlands were evaluated within Area 1 and Area 2 (see Figures 4.2.3-1). The boundaries for each evaluation area generally follow the St. Louis County section lines and large streams, including portions of the Partridge and Embarrass rivers. The baseline wetland type evaluation was deemed final by the USACE at the wetland workgroup meeting on March 30, 2011 (Barr 2011d). Updates to previous wetland delineations were made between April 2011 and the fall of 2012 as a result of additional site visits and aerial photograph review. Wetland boundaries and types were further refined (PolyMet 2015b).

Prior to conducting the various field delineations, numerous sources of existing information were gathered and reviewed to assist in developing a strategy for evaluating wetlands within the NorthMet Project area. Wetlands within Area 1 and Area 2 that were not delineated between 2004 and 2010 were also identified and classified using the following sources:

- Farm Service Administration true color aerial photographs between 2003 and 2010;
- Farm Service Administration color infrared aerial photographs (2003 and 2008);
- USFWS NWI maps;
- Superior National Forest USFS stand data GIS shapefile (Area 1 only);
- USFS Ecological Land Type (ELT) soils data (where available);
- Natural Resources Conservation Service (NRCS) soils data for St. Louis County (where available);
- USGS topographic maps and digital elevation models; and
- MDNR 2005 color infrared photography stereo pairs with 60 percent overlap (Barr 2011d).

During the field surveys, data were collected for the functions and values of the wetlands within the Mine Site. Wetland functions and values were rated using the guidelines in the Minnesota Routine Assessment Method (MnRAM) for Evaluating Wetland Functions, Versions 3.0 to 3.2. Final wetland locations and wetland functional assessment areas are shown on Figure 4.2.3-2.

4.2.3.1.2 Hydrology, Wetland Vegetation, and Community Types

The NorthMet Project area is located near the headwaters of the Partridge River and Embarrass River watersheds. The Partridge River is a tributary to the St. Louis River, which is located within the Lake Superior Basin. The Mine Site and Transportation and Utility Corridor are located within the Upper Partridge River Watershed. See Section 4.2.2 for more information on water resources.

Currently, runoff from the northernmost area of the Mine Site generally drains north into the One Hundred Mile Swamp and associated wetlands along the Partridge River. These wetlands form the headwaters of the Partridge River, which meanders around the east end of the Mine Site before turning southwest. Runoff from the majority of the Mine Site naturally drains to the south through culverts under Dunka Road and the adjacent rail line, into the Partridge River downstream of the Dunka Road crossing. The Partridge River hydrology is affected by the periodic and variable dewatering of the Northshore Mine pits near the headwaters of the Partridge River, upstream of the proposed Mine Site.

The hydrology of the wetlands at the Mine Site has been stable over time (Barr 2008h). Factors contributing to this stability include: 1) the general lack of continuity between the bedrock and surficial aquifers within the perched wetlands, 2) slow water movement through heterogeneous soils, 3) a slow lateral groundwater flow component that helps sustain downgradient wetlands with a continual supply of groundwater over time, 4) recharge from surrounding uplands slowly providing local groundwater discharge to wetlands over time, 5) relatively flat topography across most of the site, and 6) the high water-holding capacity of the soils (Barr 2008h). However, monitoring would detect connectivity trends and reveal potential drawdown issues. Refer to Section 5.2.3 for more details on monitoring.

The hydrogeologic setting of the Partridge River watershed consists of a thin veneer of heterogeneous unconsolidated deposits (glacial till) underlain by fractured bedrock (Duluth Complex in most of the Mine Site and Virginia Formation in the northern portion of the Mine Site). In the Mine Site, saturated conditions exist within the unconsolidated deposits and bedrock and the depth to groundwater is typically less than 10 ft. The water table is generally a subdued replica of the land surface, with groundwater divides in the Mine Site expected to roughly coincide with surface water divides. Wetlands cover approximately 43 percent of the Mine Site.

Because of the general lack of interaction between the surficial and bedrock aquifers, the hydrology of many wetlands at the Mine Site is primarily supported by direct precipitation with some variable surficial groundwater components from the uplands. Organic and mineral soils at the Mine Site are typically perched over the dense till or a local sandy textured surficial aquifer, resulting in perched wetlands. The primary method for water to move across the landscape towards the Partridge River is by lateral flow that is either on the surface or within the subsurface soil. Surface flow laterally across the wetland complexes is negligible because of the flat slopes and surface roughness. The wetlands on the site receive minimal surficial runoff from the upland areas because the soil texture allows rapid infiltration (Barr 2008h). The bedrock has low primary permeability, so groundwater flow within the bedrock is through fractures or other secondary porosity features. Because of the low permeability of the bedrock, the interaction between the surficial deposits and the bedrock aquifers is assumed to be insignificant.

Lateral flow within the soils is typically very slow. Fibric peat at the surface allows infiltration of surficial water; however, the more highly decomposed sapric peat has greatly reduced lateral and vertical hydraulic conductivity compared to the fibric peat. Therefore, water tends to stay perched and stored within the large peat complexes, which typically exhibit only subtle variations in the water tables over time. The silty sand or clay that typically underlies the organic soil has low hydraulic conductivity and, therefore, is a contributing factor that helps maintain the hydrology of the wetlands. The silty sands are sands mixed with clay and silt that are not permeable enough to be used as drainage sands (Barr 2008h).

The soils and hydrology at the Mine Site support stable wetland systems comprised in large part by open and coniferous bogs, as well as shrub carr/alder thickets dominated by alder and willow species, and forested wetland communities comprised of hardwood swamps and coniferous swamps. Most of the wetland vegetation present at the Mine Site (69 percent) is indicative of acid peatland systems (i.e., open and coniferous bogs) that are dependent on precipitation rather than groundwater for hydrologic inputs (i.e., ombrotrophic) and reflect a perched water table. However, it should be noted that although the hydrology of ombrotrophic bogs is solely precipitation-driven, these wetlands can have flowpath connections to groundwater (Eggers 2015). Potential effects are discussed in Section 5.2.3.

The soils at the Mine Site have been mapped by the USFS using the Superior National Forest Ecological Classification System (ECS). This system utilizes Ecological Land Types (ELTs). ELTs present at the Mine Site include Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), and Upland Shallow Loamy Dry (ELT 16). With the exception of the Wahlsten-Eaglenest-Rock outcrop complex (ELT 16), all the soils associated with these ELTs are listed as hydric soils (USDA 2012). These ELTs have been cross-correlated by the University of Minnesota with the NRCS classification as follows:

- ELT 1 – Babbitt-Bugcreek complex 0 to 2 percent slope;
- ELT 2 – Bugcreek stony loam;
- ELT 6 – Rifle-Greenwood; and
- ELT 16 – Wahlsten-Eaglesnest-Rock outcrop complex, 2 to 8 percent slopes and Eveleth-Conic Rock complex.

Pre-NorthMet Project Proposed Action wetland hydrology monitoring reports, to meet reporting requirements, have been compiled and document 5 years of pre-project planning and monitoring at the Mine Site (2005 to 2009). PolyMet has continued to conduct wetland hydrology monitoring at the Mine Site since 2009. Future wetland hydrology monitoring reports would be submitted in accordance with any permit issued. The degree of hydraulic connection between the wetland areas and adjacent unconsolidated deposits and bedrock at the Mine Site is expected to be variable, depending on the characteristics of the wetlands and the localized hydraulic conductivity and degree of bedrock fracturing. The hydraulic conductivity 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 and ranges over several orders of magnitude. Data collected during a 30-day pumping test at the Mine Site showed a small amount of drawdown in the deep wetland piezometer nearest to the pumping well, but there was no detectable drawdown at other water table or deep wetland piezometers, indicating that the connection between the bedrock, unconsolidated deposits, and wetlands may be relatively weak. Virtually all water movement in peat wetlands occurs horizontally in the upper layers of peat. The deeper, more decomposed peat soils limit vertical seepage because of the low hydraulic conductivities (approximately 0.0028 ft/day) and the wetland hydrology is generally perched on the relatively impermeable peat layer; however, groundwater flowpaths may still occur. Vertical seepage losses from wetlands without peat soils would 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 (Barr 2010d; Barr 2011j). There is a surface drainage divide oriented generally from southwest to northeast near the northern border of the Mine Site. The majority of the Mine Site, approximately 80 percent, drains south to the Partridge River through extensive wetland complexes. The remaining 20 percent of the Mine Site drains north to the One Hundred Mile Swamp and the Partridge River or northeast to the Partridge River. The 2005 to 2009 wetland hydrology monitoring has determined the following (Barr 2010d):

- The four full years of wetland monitoring well data indicated that the large fluctuations in water levels exhibited within the majority of the wetlands are indicative of wetlands supported primarily by precipitation and local surface runoff. The hydrology of these wetlands tends to fluctuate in a pattern that closely mirrors weather patterns. The shrub swamp wetlands located near the downstream portion of the project generally show more stable water levels due to larger watershed areas and some apparent groundwater inflow. The groundwater flowpaths are generally short with recharge areas (uplands) located close to the discharge areas (wetlands). Surface water runoff and local groundwater contributions from uplands can cause increased mineral content within the water in adjacent wetlands. Wetlands that are solely dependent on precipitation for their hydrology are classified as ombrotrophic. Although the hydrology of ombrotrophic wetlands is solely driven by precipitation, they can have flowpath connections with groundwater. As such, they may be susceptible to effects from groundwater drawdown associated with mining operations; however, that susceptibility is estimated to be low (Eggers 2011a, 2015). Potential effects are discussed in Section 5.2.3.
- There is a general lack of connectivity between the shallow water table in the wetlands and the deeper bedrock aquifer. The depth of soil and till overlying the bedrock ranges up to 33 ft, with bedrock outcrops present that alter local groundwater flowpaths. A pumping and isotope test conducted in 2006 indicated that the groundwater pumped during a 30-day pump test was derived from aquifer recharge rather than seepage from surface water features such as the Northshore Mine Pit or wetlands. The variability of the bedrock and soil surface, along with the location of the surface water divide, creates localized, short, surficial groundwater flowpaths within the watersheds on the Mine Site.
- From 2005 to 2009, the maximum water level fluctuation was less than 12 inches in two wetlands (58 and 114) and between 12 and 18 inches in all other wetlands. Wells located in the southwest and south-central areas of the Mine Site show the greatest range of water table fluctuations, while wells in the northwest area of the Mine Site show the least fluctuation. The wetlands on the Mine Site exhibit stable year-to-year water levels and elevations. Water levels in all wells fluctuated in direct response to precipitation events, with the exception of one well in 2008 and 2009 and one well in 2009. These two wells showed stability indicative of contributing discharge from the larger upstream watersheds.
- The hydrographs in the monitored black spruce and tamarack dominated wetlands (i.e., coniferous bogs) exhibited a stable water table with some fluctuations indicative of

saturated, precipitation-driven hydrology (i.e., rapid response to precipitation with mid-summer drawdown). However, Eggers (2015) noted that these coniferous bogs could have flowpath connections to groundwater, albeit limited.

Wetlands were found to consist predominantly of coniferous bog, shrub swamp, and coniferous swamp. Other wetlands include shallow marsh, sedge/wet meadow, open bog, and hardwood swamps. The largest wetland complex near the Mine Site is the One Hundred Mile Swamp (see Figure 4.2.3-2). The swamp is drained by Yelp Creek, which flows east into the Partridge River. The Partridge River flows to the north of the Mine Site and then through the eastern and southeastern portions of the adjoining federal lands. In addition, several impounded wetlands associated with past mine workings and detention ponds were found during the field work along the northern boundary of the adjoining federal lands. These wetlands are best classified as precipitation-driven wetlands on low-permeability soils. Several wetlands have been enlarged due to damming of streams by beaver dams, and other obstructions along the Partridge River have helped to raise water levels that resulted in stands of dead and dying spruce along portions of the river (AECOM 2011a).

The coniferous bog communities have a tree canopy of black spruce and tamarack with occasional balsam fir, while stunted forms of these species may exist in open bog communities. White cedar and deciduous swamp birch are also occasionally found in this community. Shrubs are usually ericaceous (belonging to the heath family) species such as leatherleaf, bog-Labrador tea, and cranberry. Sphagnum moss comprises an almost continuous mat with interspersed, non-dominant forbs such as bunchberry and blue bead lily along with sedges and grasses. Hydrologically, this complex is characterized by a relatively stable year-to-year water table (Barr 2006e; Barr 2010d). All but one of the coniferous bogs identified at the Mine Site are rated as high-quality in accordance with the MnRAM for Evaluating Wetland Functions. This wetland has some fill and therefore was rated as moderate quality.

Wetland hydrology can be driven by precipitation, or by groundwater, or a combination or both. Wetlands identified as open bogs or coniferous bogs under the Eggers and Reed (1997, 2014) classification system can be further subcategorized as either ombrotrophic (i.e., hydrology and mineral inputs entirely from direct precipitation) or somewhat minerotrophic (i.e., some degree of mineral inputs from groundwater and/or surface water runoff). This is important because ombrotrophic bogs would likely not be affected by groundwater drawdowns associated with proposed mining operations, whereas more minerotrophic bogs would have a higher likelihood of being affected (Eggers 2011a). Eggers (2015) noted that although the hydrology of ombrotrophic bogs is solely precipitation-driven, they can have flowpath connections to groundwater. As such, these wetlands types could be affected by groundwater drawdowns, although the degree of that effect is estimated to be low (Eggers 2015). Please refer to Section 5.2.3 for detailed discussion on effects to these wetland types from drawdown.

An assessment of wetland types within the NorthMet Project area was conducted to distinguish between open and coniferous bogs that are principally precipitation driven (i.e., ombrotrophic peatlands) versus those with some degree of mineral inputs from groundwater and/or surface water runoff (i.e., minerotrophic peatlands). In order to help differentiate ombrotrophic bog communities from bog communities that are somewhat minerotrophic, the *Field Guide to the Native Plant Communities of Minnesota – The Laurentian Mixed Forest Province* (MDNR 2003b) was used, which characterizes plant communities to a finer level of detail than Eggers and Reed (1997, 2014). Ombrotrophic peatlands develop from minerotrophic peatlands when conditions allow *Sphagnum* peat to accumulate to levels above the groundwater table. Once the peat is above the water table, surface water flows away from or around the elevated peat surface, which reduces inputs of minerals and nutrients (Eggers 2011a; MDNR 2003b). Of the 149 coniferous and open bogs within the Mine Site/Area 1 boundaries, 144 are ombrotrophic and five are minerotrophic (PolyMet 2015b).

The shrub communities generally have a sparse tree canopy and are mostly alder thickets, with some willow and raspberry. Occasionally, balsam fir and paper birch were observed along the perimeter of the wetlands. Grasses, sedges, rushes, and some ferns comprise most of the herb stratum with some areas of sphagnum moss. Hydrologically, this community can be characterized by prolonged periods of shallow inundation with the water table dropping 6 to 12 inches below the ground surface during dry periods (Barr 2006e). Soils are typically fibric (i.e., the least decomposed of the peats and containing un-decomposed fibers) and hemic peat (i.e., peat that is somewhat decomposed) at the surface underlain by bedrock or mineral soils. All of these wetlands are rated as high-quality.

The forested swamp communities (coniferous swamps and hardwood swamps) are dominated by a mix of coniferous (conifers) and deciduous (hardwood) forest complexes. Common trees include black spruce, tamarack, and balsam fir, with some white cedar, black ash, paper birch, and aspen present. The shrub canopy is comprised of speckled alder, willows, and raspberry. Grasses and sedges comprise a majority of the ground story stratum with occasional sphagnum moss. Soils include organic and mineral soils. Some hydrologic observations indicate a greater level of hydrologic fluctuation in the forested swamp community than in the larger bog wetlands, with saturation near the surface early in the growing season and a lower water table in late summer (Barr 2006e). All of these wetlands are rated as high-quality.

Sedges, grasses, and bulrushes dominate wet meadow and sedge meadow communities. Soils are organic at the surface and underlain with mineral soils. These plant communities typically have saturated or inundated water levels for prolonged periods during the growing season (Barr 2006e). Two of these communities, situated between Dunka Road and the railroad, are rated moderate-quality, while the others are rated as high-quality.

Approximately one-half of the shallow marsh communities at the Mine Site have resulted from artificial impoundments by roads, railroads, and beavers. These wetlands are dominated by cattails, bulrushes, sedges, and grasses. Soils are usually organic at the surface underlain by mineral soils. Inundation with 1 to 4 inches of water is common throughout most of the growing season except during dry periods. Eight of these shallow marshes are rated as high-quality and four as moderate-quality. Hydrologic disturbance in these four wetlands is primarily responsible for the moderate-quality rating.

The wetland delineation identified 87 wetlands covering 1,297.8 acres (43 percent) within the 3,014.5-acre Mine Site (see Figure 4.2.3-3) (PolyMet 2015b). Table 4.2.3-2, below, summarizes the wetland areas within the Mine Site represented by each Eggers and Reed (1997, 2014) wetland community type. A large portion of the wetlands to the west of the Mine Site on the federal lands are located in the floodplains of Yelp Creek and the Partridge River or one of their associated tributaries. The most common wetland types within the Mine Site are coniferous bogs (approximately 67 percent); shrub swamps (approximately 14 percent), which includes alder thicket and shrub-carr; and coniferous swamps (10 percent). A total of seven wetlands, each over 50 acres in size within the Mine Site, comprise 773.7 acres of wetlands within the Mine Site.

There are an additional five wetlands, each over 20 acres in size within the Mine Site that comprise 164.5 acres of wetlands. Together, these 12 wetlands make up 72 percent of the wetland areas within the Mine Site (PolyMet 2015b). A total of 79 percent of the wetlands in the Mine Site are coniferous swamp, coniferous bog, and open bog communities.

Other wetland community types present at the Mine Site include shallow marshes, sedge/wet meadows, open bogs, hardwood swamps, and deep marshes. The sedge/wet meadows may receive some portion of their hydrology from groundwater while the shallow marsh community generally results from artificial impoundment by beaver dams, roads, and railroads and is primarily dependent on surface waters for hydrology.

Table 4.2.3-2 Wetland Acreage by Wetland Community Type for Mine Site, Transportation and Utility Corridor, and Area 1

Eggers and Reed Class[1]	Mine Site: Mine Site Federally Managed		Mine Site: Mine Site Private Lands		Mine Site: Mine Site Total		Transportation and Utility Corridor		Area 1[2]	
	acres	%	acres	%	acres	%	acres	%	acres	%
Coniferous bog	869.2	71	4.2	6	873.4	67	0.9	12	4,581.2	41
Coniferous swamp	122.0	10	6.6	10	128.6	10	1.6	22	2,071.9	18
Deep marsh	0.0	0	5.0	7	5.0	<1	0.0	0	220.5	2
Hardwood swamp	12.8	1	0.0	0	12.8	1	0.0	0	26.8	<1
Open bog	17.8	1	0.5	<1	18.3	1	0.0	0	283.1	3
Open Water (includes shallow, open water, and lakes)	0.0	0	0.0	0	0.0	0	0.0	0	245.0	2
Sedge/wet meadow	34.9	3	4.6	7	39.5	3	0.0	0	46.0	<1
Shallow marsh	36.5	3	7.5	11	44.0	3	0.6	8	358.7	3
Shrub swamp (includes alder thicket and shrub-carr)	136.0	11	40.0	58	176.0	14	4.1	57	3,368.0	30
Total	1,229.2	100	68.4	100	1,297.8	100	7.2	100	11,201.2	100

Source: PolyMet 2015b.

1 Eggers and Reed 1997, 2014.
2 Area 1 acreage is inclusive of the other project area components (e.g., Mine Site, federal lands).

A total of 25 wetlands, encompassing 7.2 acres, have been identified within the Transportation and Utility Corridor (see Figure 4.2.3-4 and Table 4.2.3-2). The wetlands in the corridor include shrub swamps (57 percent), coniferous swamps (22 percent), coniferous bogs (12 percent), and shallow marshes (8 percent). Some of the wetlands adjacent to Dunka Road have been previously logged. Wetlands in the western half of the Dunka Road and Transportation and Utility Corridor are located within areas previously disturbed by mining activities of the former LTVSMC operations (PolyMet 2015b).

Overall, Area 1 encompasses 465 wetlands covering 11,201.2 acres (see Figure 4.2.3-2), and these 465 wetlands represent approximately 47 percent of the overall area. The total number of wetlands and the amount of wetlands within Area 1 is inclusive of the other project area components (e.g., Mine Site, federal lands wetlands). Table 4.2.3-2, above, summarizes the wetland areas represented by each Eggers and Reed (1997, 2014) wetland community type for Area 1 (PolyMet 2015b).

Coniferous bogs are the dominant wetland type present within Area 1, comprising approximately 41 percent of the overall wetland area, while open bogs represent only a small component (approximately 3 percent). Coniferous bogs generally have a tree cover greater than 50 percent, which is typically made up of black spruce and/or tamarack. Forested wetlands that are acid peatlands dominated by dense cover of black spruce and/or tamarack with a more or less continuous carpet of Sphagnum mosses have been classified as coniferous bogs in the Eggers and Reed (1997, 2014) classification system. Occasionally, there are areas with balsam fir, jack pine, and northern white cedar present within the large coniferous bog complexes. The open bogs do not support a dense tree cover and it was observed that typically only a scattering of immature black spruce and/or tamarack are present (Barr 2011d). Additionally, Eggers (2015) and MDNR (2003b) state that ombrotrophic bogs exhibit four specific characteristics: 1) the landform type is a raised bog that is always higher than the peatland margin; 2) there is an absence of minerotrophic (i.e., fen) indicator species; 3) the surface water chemistry has a pH of less than 4.2 and calcium concentrations of less than 2 mg/L; and 4) the hydrology and source of minerals is entirely sourced from precipitation.

The shrub layer and ground layer of coniferous bogs and open bogs have similar composition. The shrub layer is typically dominated by ericaceous shrubs such as leatherleaf, bog-Labrador tea, and cranberry. The ground layer herb stratum commonly includes a continuous sphagnum moss mat with various sedges and other herbaceous vegetation also observed. Northern pitcher plants are abundant in the large bog areas that surrounded Mud Lake. Soils in the coniferous bogs and open bogs generally consist of fibric peat that is usually saturated to the surface throughout much of the growing season (Barr 2011d).

Shrub swamps, which include both alder thicket and shrub-carr community types, represent the second most dominant wetland type within Area 1, comprising approximately 30 percent of the overall wetland area. These shrub swamps are dominated by either alder or willow species, with some dogwoods also present. The ground layer was made up of Canada bluejoint grass and various sedge species, with woolgrass, rushes, and ferns also present. Sphagnum mosses may be present but do not typically form a continuous mat within these shrub swamps. Soils in the shrub swamps are usually fibric and hemic peat at the surface underlain by bedrock or mineral soil (Barr 2011d).

Coniferous swamps represent the third-most dominant wetland type within Area 1, comprising approximately 18 percent of the overall wetland area. These swamps are dominated by black spruce and/or tamarack, with balsam fir and northern white cedar. Deciduous tree species, such as aspen, birch and, on a few occasions, black ash, are also observed in some areas. The shrub layer is observed to be typically dominated by alder and willows. The ground layer commonly includes Canada bluejoint grass, sedges, bunchberry, wild sarsaparilla, and starflower. Sphagnum mosses are also present in the ground layer; however, a continuous sphagnum mat is usually absent. Soils in the coniferous swamps are generally organic and are usually saturated to the surface throughout much of the growing season (Barr 2011d).

Although shallow and deep marshes are present within Area 1, they represent a relatively small percentage of the overall wetland area. These wetlands are dominated by cattails, with sedges and Canada bluejoint grass also present. Soils in the shallow and deep marshes are typically organic at the surface and underlain by mineral soils. The shallow marshes are typically inundated with up to 6 inches of water throughout the entire growing season, while the deep marshes are inundated with over 6 inches of water throughout the entire growing season. These wetlands are often associated with disturbances, such as beaver activity (Barr 2011d).

Hardwood swamps are present but not abundant in Area 1. The hardwood swamps that are present are dominated by black ash, aspen, and birch. Coniferous trees, such as balsam fir, black spruce, and northern white cedar are occasionally present in these hardwood swamps. The shrub layer is generally dominated by alder and young trees while the ground layer species present includes Canada bluejoint grass, sedges, and ferns. Sphagnum mosses were also observed; however, they typically did not form a continuous mat. Soils in the hardwood swamps vary between organic or mineral and are usually saturated throughout much of the growing season (Barr 2011d).

Sedge meadow and wet meadow communities are present within Area 1 but represent a very small portion of the total wetland area. These wetlands are dominated by sedges, Canada bluejoint grass, woolgrass, manna grass, and bulrushes. Soils in the sedge meadow and wet meadow communities are typically organic at the surface underlain by mineral soils. These wetlands are generally saturated close to the ground surface or have shallow inundation for prolonged periods during the growing season (Barr 2011d).

4.2.3.1.3 Wetlands Functional Assessment

Wetlands can serve many functions, including groundwater recharge/discharge, flood storage and alteration/attenuation, nutrient and sediment removal/transformation, toxicant retention, fish and wildlife habitat, wildlife diversity/abundance for breeding migration and wintering, shoreline stabilization, production export, aquatic diversity/abundance, vegetative diversity/integrity, and support of recreational activities. Both the USACE and MDNR use MnRAM for rating wetland functions in Minnesota.

MnRAM is an assessment tool designed to assess functions and values of Minnesota wetlands. MnRAM versions 3.0, 3.1, and 3.2 were used to assess wetland functions and values on the Mine Site (Barr 2006d) and the federal lands (AECOM 2011d; AECOM 2011a). Information on the overall functions and values of the wetland and vegetative quality of each wetland community at the Mine Site was obtained during wetland surveys in 2005 and 2006 and included: 1) plant cover and types, 2) plant community diversity and interspersion, 3) outlet characteristics, 4) watershed and adjacent upland land uses and condition, 5) soil condition, 6) erosion and sedimentation, and 7) past and present human disturbance (Barr 2006d).

Landscape characteristics are also important for evaluating wetland functions within the NorthMet Project area. Key landscape wetland characteristics considered in rating functional quality in the MnRAM assessment are provided in Table 4.2.3-3.

Table 4.2.3-3 Key Landscape Factors Influencing Wetland Functional Scores in MnRAM 3.0

MnRAM 3.0 Factor	Role in Wetland Function and Quality
Wetland or Lake Outlet Characteristics	Outlets influence flood attenuation, downstream water quality, and other hydrologic processes
Watershed and Adjacent Land Uses and Condition	Adjacent land uses influence wetland hydrology, sediment and nutrient loading to wetlands, connectivity for wildlife habitat, and other factors
Soil Condition	Soil condition influences plant community type, vegetative diversity, overall wetland quality and productivity (trophic state)
Erosion and Sedimentation	Influences downstream water quality, trophic state of wetlands, vegetative diversity, and overall wetland quality
Wetland Vegetative Cover and Vegetation Types	Influences vegetative diversity and wildlife habitat as well as hydrologic characteristics (e.g., evapotranspiration or resistance to flow in floodplain wetlands)
Wetland Community Diversity and Interspersion	Influences the vegetative diversity and overall wetland quality as well as value for wildlife habitat
Human Disturbance (both past and present)	Mining, logging, road-building, stream channelization, and other alterations to the landscape

Source: MnRAM 3.0.

These broader landscape factors were applied and evaluated on a larger scale than a single wetland because there are soil and vegetation similarities within the sub-watersheds that are characteristic of large groups of similar wetland types. Human disturbance factors were also similar across broad areas, notably that the majority of the Mine Site is relatively undisturbed by humans and the limited disturbance that does exist is due to logging. Other local factors were considered for each wetland or small groups of wetlands.

Approximately 92 percent of the wetlands in the Mine Site are of high overall wetland quality, and 8 percent of wetlands are of moderate overall wetland 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 USFS roads, the Dunka Road corridor, or the railroad corridor (PolyMet 2015b). Summaries of the 87 wetlands evaluated for vegetative diversity/integrity and overall functional quality rating (low, moderate, or high) for wetlands at the Mine Site are presented in Table 4.2.3-4. The overall wetland quality rating was based on professional judgment and considered several wetland functions and the overall degree of human disturbance (Barr 2006d). The plant community diversity/integrity ratings incorporate two principal components, integrity and diversity (MnRAM). Diversity refers to species richness (i.e., number of plant species). The more floristically diverse a community is, the higher the rating. Integrity refers to the condition of the plant community in comparison to the reference standard for that community. The degree and type of disturbance typically play an important role in the diversity/integrity rating.

Table 4.2.3-4 Wetland Functions and Value Assessment for the Mine Site from 2004 and 2006

Wetland Functions and Values Rating	Vegetative Diversity/Integrity (%)	Overall Wetland Quality (%)	Existing Disturbance Level (%)
High	75	92	8
Moderate	8	8	5
Low	0	0	70
Not Available	17	0	17
Total	100	100	100

Source: Barr 2006d.

The wetlands along the Transportation and Utility Corridor have all been rated as high-quality. While the wetlands along the Railroad Connection Corridor are moderately affected by either a haul road or an existing railroad, they have a high vegetative diversity/integrity (PolyMet 2015b).

4.2.3.2 Plant Site

4.2.3.2.1 Wetland Delineation and Classification

The Plant Site and Area 2 were delineated and classified using the same methodology as discussed in Section 4.2.3.1.1 above. The Plant Site encompasses 4,515.4 acres, which includes the former LTVSMC processing plant, the existing LTVSMC Tailings Basin, Area 1 Shops, the Hydrometallurgical Residue Facility, and the administration buildings. Area 2 encompasses about a 19,396.7-acre area just north and northwest of the existing LTVSMC Tailings Basin (see Figures 4.2.3-1, 4.2.3-5, and 4.2.3-6).

In addition to the NorthMet Project area, two non-project areas (i.e., the Colby Lake Water Pipeline Corridor (50.6 acres) and Second Creek) are included within this discussion (see Figures 4.2.3-6 and 4.2.3-7). These two non-project areas are included to assess if direct or potential indirect wetland effects could occur as a result of the NorthMet Project Proposed Action.

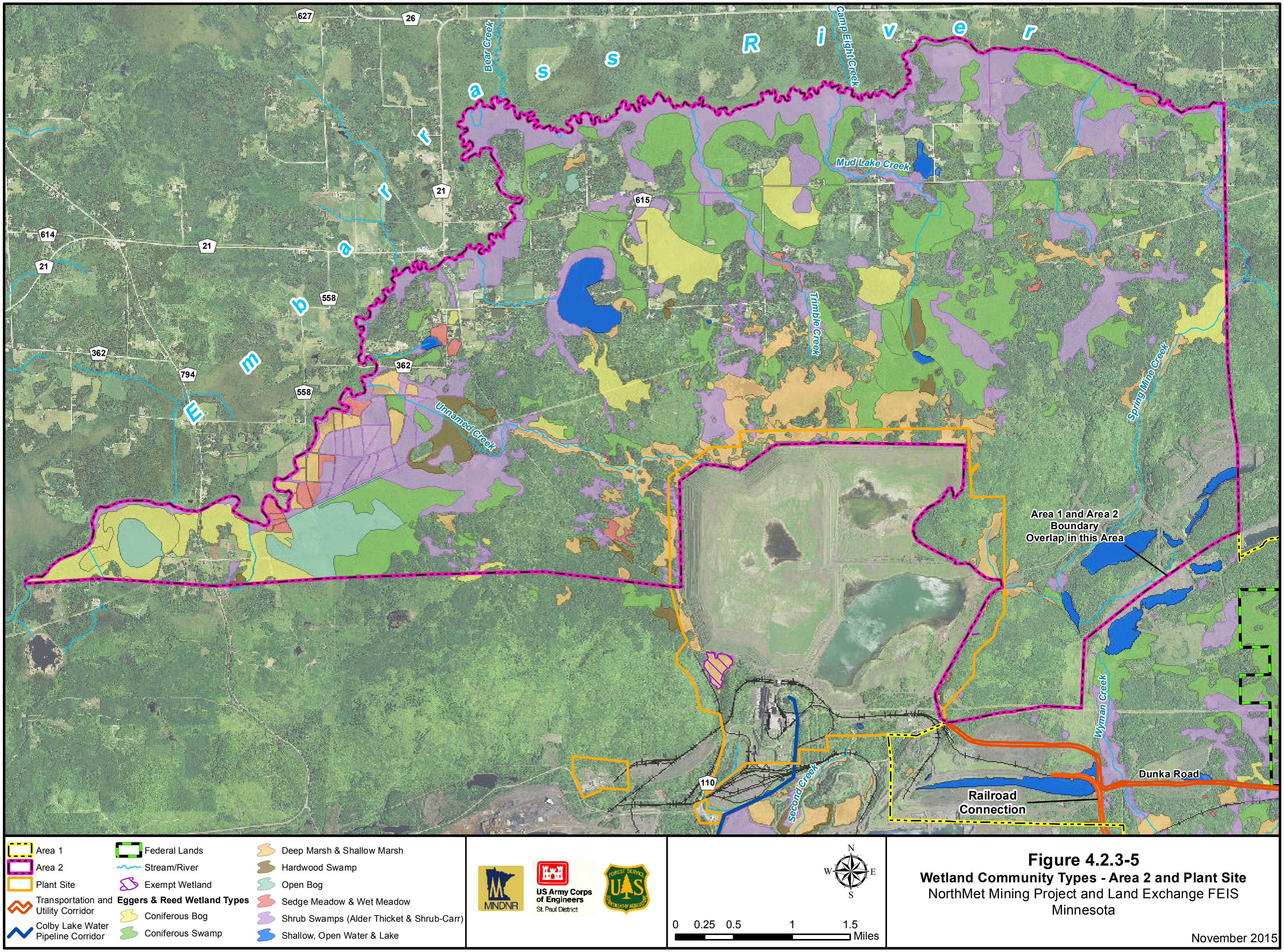

Figure 4.2.3-5
Wetland Community Types - Area 2 and Plant Site
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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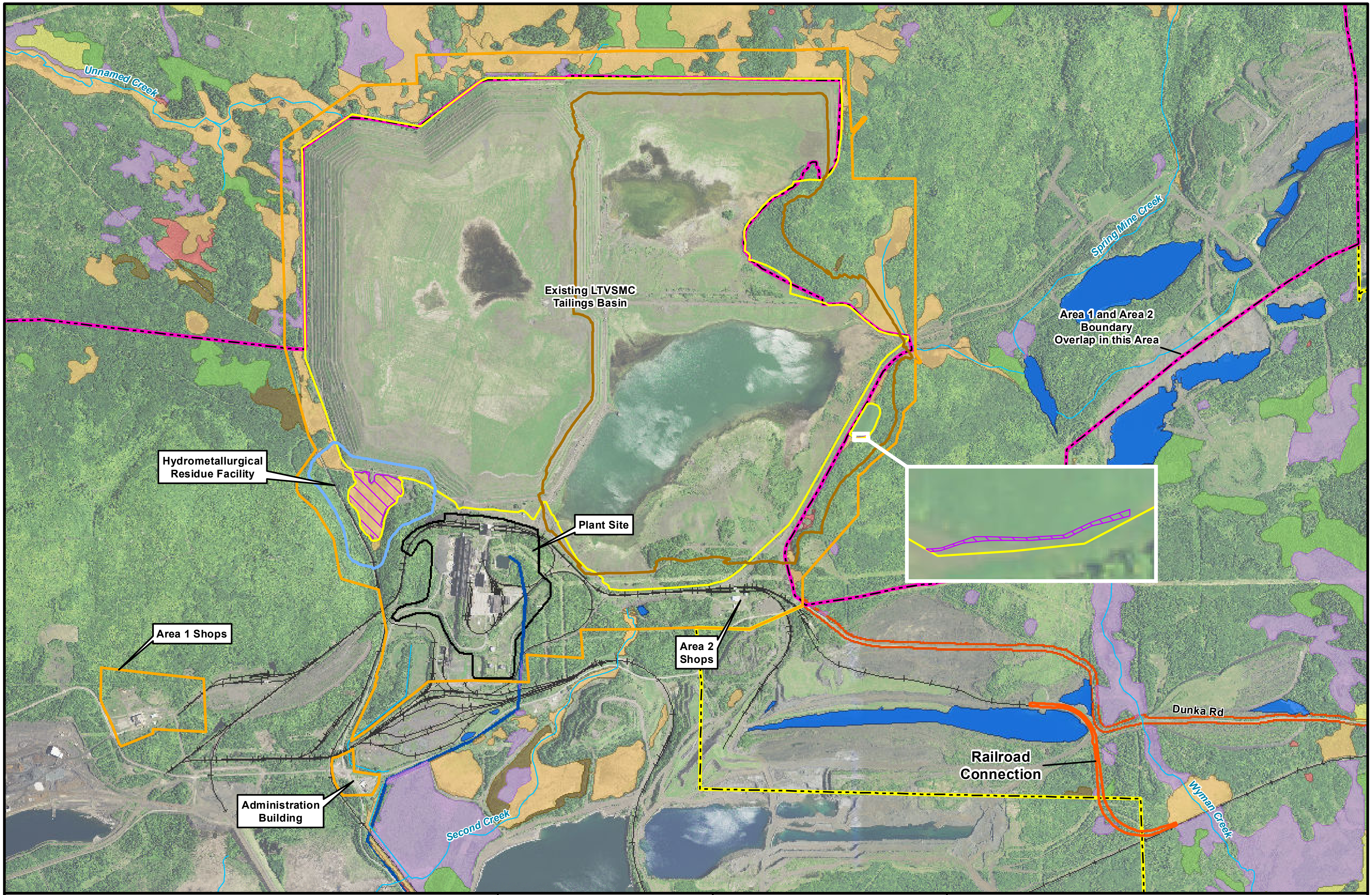

Plant Site
Tailings Basin
Hydrometallurgical Residue Facility
Colby Lake Water Pipeline Corridor
Transportation and Utility Corridor
Cliffs Erie, LLC Permit to Mine Ultimate Tailings Basin Limit
Exempt Wetland

Eggers & Reed Wetland Types

Coniferous Bog
Coniferous Swamp
Hardwood Swamp
Deep Marsh & Shallow Marsh
Open Bog
Sedge Meadow & Wet Meadow
Shrub Swamps (Alder Thicket & Shrub-Carr)
Shallow, Open Water & Lake
Area 1
Area 2
Existing Railroad
Stream/River

MNDNR
US Army Corps of Engineers
St. Paul District

N W E S

0 1,000 2,000 4,000
Feet

Figure 4.2.3-6

Wetland Community Types - Plant Site

NorthMet Mining Project and Land Exchange FEIS

Minnesota

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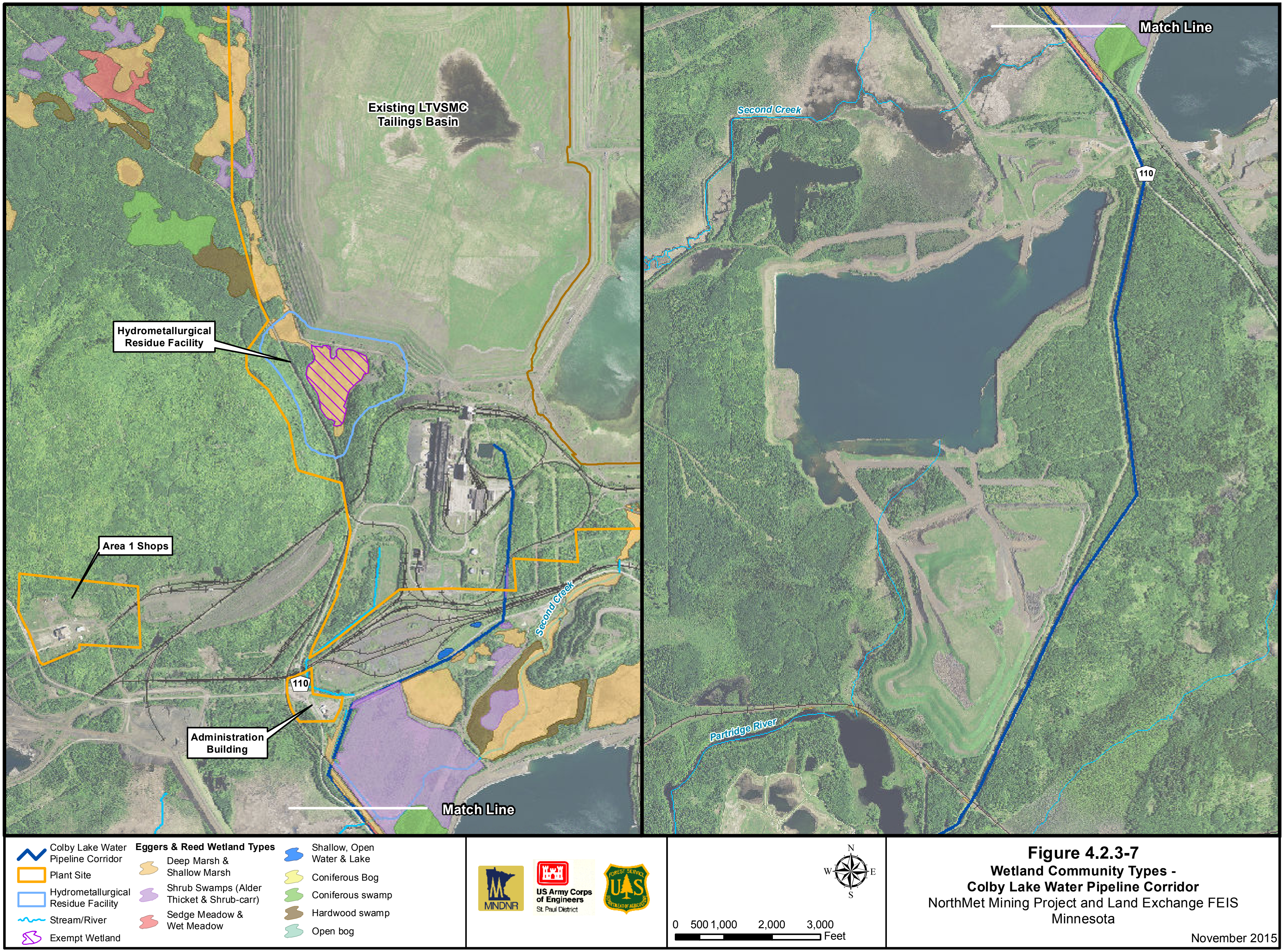

Figure 4.2.3-7
Wetland Community Types -
Colby Lake Water Pipeline Corridor
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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4.2.3.2.2 Hydrology, Wetland Vegetation, and Community Types

The NorthMet Project area is located near the headwaters of the Partridge River and Embarrass River watersheds. The Partridge River and the Embarrass Rivers are both tributary to the St. Louis River, which is located within the Lake Superior Basin. A portion of the Plant Site and the Colby Lake Water Pipeline Corridor are located within the Upper Partridge River Watershed, while the majority of the Plant Site and the remaining portion of the Colby Lake Water Pipeline Corridor are located in the Embarrass River watershed. See Section 4.2.2 for more information on water resources.

Currently, groundwater and surface water seepage from the Tailings Basin drain towards Mud Lake Creek to the north, Trimble Creek to the northwest, and Unnamed Creek to the west. Runoff from the outer slopes of the Tailings Basin is tributary to the surrounding creeks and precipitation falling within the Tailings Basin is contained in the basin.

The hydrogeologic setting of the Embarrass River watershed is generally similar to the Partridge River watershed, although the unconsolidated deposits are generally thicker and more continuous north of the Plant Site area along the Embarrass River valley. The Plant Site is located south of the Laurentian Divide and the area is underlain by granitic rocks of the Giants Range batholith. Although these rocks may be fractured to some extent, they are expected to have significantly lower hydraulic conductivity than the bedrock units at the Mine Site. There are some wetlands located within the Plant Site and saturated conditions generally exist less than 10 ft below the ground surface, like the Mine Site. Similar to the Mine Site, the degree of hydraulic connection between the wetland areas and adjacent unconsolidated deposits and bedrock at the Plant Site is expected to be variable, depending on the characteristics of the wetlands and the localized hydraulic conductivity and degree of bedrock fracturing. Given the very low hydraulic conductivity of the underlying bedrock, there is minimal potential for hydraulic connection between bedrock and wetlands.

The southwest corner of the Plant Site, the former LTVSMC processing plant, has almost entirely been disturbed by past mining activities. Although there is a plant reservoir located east of the concentrator, the plant reservoir is not anticipated to be regulated as a wetland during permitting as it was created during past mining activities (see Figure 4.2.3-6) (PolyMet 2015b) The incidental status will be determined during wetland permitting. Wetland hydrology at the Plant Site has been affected by the operation of the existing LTVSMC Tailings Basin. Evidence suggests that hydrologic changes from seepage originating from the Tailings Basin, along with beaver dams, have resulted in inundation of wetland areas immediately north of the Tailings Basin (Barr 2008b). Wetlands within the Plant Site are presented in Table 4.2.3-5 and Figure 4.2.3-6.

The existing wetlands differ from the wetlands that occupied the area prior to the construction of the existing LTVSMC Tailings Basin. Historical aerial photographs (1940 and 1948) indicate the presence of large wetland complexes that were a mixture of forested and shrub swamp wetlands, which were primarily saturated to the surface with relatively few open water areas. Past disturbances that have affected the hydrology and vegetative characteristics of the wetlands in the vicinity of the existing LTVSMC Tailings Basin include seepage from the basin along with beaver dams, culverts, road construction, parking areas, railroad embankments, and diversion of flowages (Barr 2008k).

The Plant Site, the Colby Lake Water Pipeline Corridor, and the Second Creek area contain wetland resources (see Table 4.2.3-5). Portions of the existing LTVSMC Tailings Basin and the Hydrometallurgical Residue Facility 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 (28.6 acres) located within the Cliffs Erie (formerly LTVSMC) Permit to Mine Ultimate Tailings Basin Limit Boundary are not anticipated to be regulated during permitting as they are an actively permitted waste storage facility (see Figure 4.2.3-6) (PolyMet 2015b). The incidental status will be determined during wetland permitting.

The regulated wetlands within the Plant Site include a total of 52 wetlands covering 246.1 acres. Wetlands located within the Plant Site are presented in Table 4.2.3-5 and Figure 4.2.3-6. A 0.03-acre area of sedge/wet meadow within the Tailings Basin and a 28.6 acre area of shallow marsh within the Hydrometallurgical Residue Facility are anticipated to be regulated during permitting as they are both located within the Cliffs Erie Permit to Mine Ultimate Tailings Basin Limit Boundary. The incidental status will be determined during wetland permitting. Existing wetland resources within the Plant Site consist largely of deep marshes and shallow marshes with dead black spruce trees scattered throughout (Barr 2008l; PolyMet 2015b). Other smaller wetland areas are coniferous swamps, hardwood swamps, sedge/wet meadows, and shrub swamps.

There would be no construction within the Colby Lake Water Pipeline Corridor as the existing pipeline would be used to provide water for the NorthMet Project Proposed Action. A total of 14 wetlands covering 7.0 acres were identified within the Colby Lake Water Pipeline Corridor (see Figure 4.2.3-7 and Table 4.2.3-5). The wetlands in the corridor include shallow marshes (37 percent), shrub swamps (29 percent), sedge/wet meadows (19 percent), and deep marshes (14 percent). The wetlands are adjacent to an unpaved, gravel road and within a previously disturbed corridor (PolyMet 2015b).

There would be no construction within the Second Creek area, which is located south of the Plant Site. A total of 30 wetlands covering 298.9 acres were identified within the Second Creek area of analysis (see Figure 4.2.3-6 and Table 4.2.3-5). The wetlands in the Second Creek area of analysis included shrub swamps (44 percent), shallow marshes (35 percent), deep marshes (7 percent), hardwood swamps (7 percent), coniferous swamp (6 percent), sedge/wet meadows (less than 1 percent), and open water (less than 1 percent) (PolyMet 2015b).

Overall, Area 2 contains 373 wetlands covering 8,621.9 acres of the 19,396.7-acre area, or approximately 44 percent of Area 2. The wetlands are shown on Figure 4.2.3-5. Table 4.2.3-5, below, summarizes the wetland areas represented by each Eggers and Reed (1997, 2014) wetland community type classification system (Barr 2011d; PolyMet 2015b).

Shrub swamps, which include both alder thicket and shrub-carr wetland types, represent the most abundant wetland type within Area 2 comprising approximately 34 percent of the overall wetland area. These shrub swamps are dominated by either alder or willow species, with some dogwoods also present. The ground layer is dominated by Canada bluejoint grass and sedges, woolgrass, rushes, and ferns are also present. Sphagnum mosses may also be present but do not typically form a continuous mat within these shrub swamps. Soils in shrub swamps are usually fibric and hemic peat at the surface underlain by bedrock or mineral soil (Barr 2011d; PolyMet 2015b).

Coniferous swamps within Area 2 are the second most abundant wetland type, comprising approximately 29 percent of the overall wetland area. These swamps are made up of black spruce and/or tamarack, with balsam fir and northern white cedar present in some areas. Deciduous tree species, such as aspen, birch and, to a minor extent, black ash, are also present in some locations. The shrub layer is observed to be typically dominated by alder and willow species. The ground layer commonly includes Canada bluejoint grass, sedges, bunchberry, wild sarsaparilla, and starflower. Sphagnum mosses are also present in the ground layer; however, a continuous sphagnum mat is usually absent. Soils in the coniferous swamps are generally organic and are usually saturated to the surface throughout much of the growing season (Barr 2011d; PolyMet 2015b).

Coniferous bogs are the third-most abundant wetland type within Area 2, representing approximately 12 percent of the overall wetland area, while open bogs represent only a small component of wetlands in Area 2 (approximately 4 percent). Coniferous bogs generally have a tree cover greater than 50 percent, which is typically dominated by black spruce and/or tamarack. Forested wetlands that are acid peatlands dominated by dense cover of black spruce and/or tamarack with a more or less continuous carpet of Sphagnum mosses have been classified as coniferous bogs in the Eggers and Reed (1997, 2014) classification system. Occasionally, there are areas with balsam fir, jack pine, and northern white cedar present within the large coniferous bog wetland complexes. The open bogs do not support a dense tree cover and it was observed that typically only a scattering of immature black spruce and/or tamarack are present (Barr 2011d; PolyMet 2015b).

The shrub layer and ground layer of coniferous bogs and open bogs have similar composition. The shrub layer is typically dominated by ericaceous shrubs such as leatherleaf, bog Labrador-tea, and cranberry. The ground layer commonly includes a continuous sphagnum moss mat with various sedges and herbaceous vegetation also observed. Northern pitcher plants are abundant in the large bog areas that surround Mud Lake. Soils in the coniferous bogs and open bogs generally consist of fibric peat that is usually saturated to the surface throughout much of the growing season (Barr 2011d; PolyMet 2015b).

Shallow and deep marshes are present within Area 2, and together represent about 14 percent of the wetland area. These wetlands are dominated by cattails, with sedges and Canada bluejoint grass also present. Soils in the shallow and deep marshes are typically organic at the surface and underlain by mineral soils. The shallow marshes present are typically inundated with up to 6 inches of water throughout the entire growing season, while the deep marshes are inundated with over 6 inches of water throughout the entire growing season. These wetlands are often associated with disturbances, such as beaver activity (Barr 2011d; PolyMet 2015b).

Hardwood swamps are present but not abundant in Area 2. The hardwood swamps that are present are dominated by black ash, aspen, and birch. Coniferous trees, such as balsam fir, black spruce, and northern white cedar are occasionally present in these hardwood swamps. The shrub layer is generally dominated by alder and young saplings while the ground layer species present include Canada bluejoint grass, sedges, and ferns. Sphagnum mosses are also observed; however, they do not typically form a continuous mat. Soils in the hardwood swamps are either organic or mineral and are usually saturated throughout much of the growing season (Barr 2011d; PolyMet 2015b).

Sedge meadow and wet meadow communities are present within Area 2 but represent only a small proportion of the total wetland area. These wetlands are populated by sedges, Canada bluejoint grass, woolgrass, manna grass, and bulrushes. Soils in the sedge meadows and wet meadow communities are typically organic at the surface and underlain by mineral soils. These wetlands are generally saturated close to the ground surface or have shallow inundation for prolonged periods during the growing season (Barr 2011d; PolyMet 2015b).

Table 4.2.3-5 Total Wetland Acreage by Wetland Type for Plant Site, Colby Lake Water Pipeline Corridor, Second Creek Area, and Area 2

	Plant Site[2]		Colby Lake Water Pipeline Corridor		Second Creek Area[5]		Area 2	
Eggers and Reed Class[1]	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Coniferous bog	0.0	0	0.0	0	0.0	0	1017.9	12
Coniferous swamp	14.4	5	0.0	0	16.8	6	2,536.9	29
Deep marsh	106.6	39	1.0	14	19.6	7	513.0	6
Hardwood swamp	1.0	<1	0.0	0	21.1	7	161.2	2
Open bog	0.0	0	0.0	0	0.0	0	353.6	4
Open water (includes shallow, open water, and lakes)	0.9	<1	0.0	0	1.3	<1	285.4	3
Sedge/wet meadow	1.5[(3)]	<1	1.4	19	1.3	<1	137.52	2
Shallow marsh	135.9[(4)]	50	2.6	37	106.0	35	654.0	8
Shrub swamp (includes alder thicket and shrub-carr)	14.4	5	2.1	29	132.9	44	2,961.6	34
Total[6]	274.7	100	7.0	99	298.9	100	8,621.9	100

Source: PolyMet 2015b.

1 Eggers and Reed 1997, 2014.
2 There are 52 unique wetland areas at the Plant Site, which includes the Tailings Basin and Hydrometallurgical Residue Facility footprint. Two wetlands (ID 1155 and 1159) have been split between the Tailings Basin and Hydrometallurgical Residue Facility footprint in the Wetland Data Package for a total of 54 wetlands resource areas in Wetland Data Package report.
3 A 0.03-acre area of this wetland type is classified as exempt and is not anticipated to be regulated during permitting. The incidental status will be determined during wetland permitting.
4 A 28.56-acre area of this wetland type is classified as exempt and is not anticipated to be regulated during permitting. The incidental status will be determined during wetland permitting.
5 A total of 30 wetlands are associated with the Second Creek area of analysis; however, only 22 are unique to the Second Creek area of analysis as one wetland is associated with the Plant Site and 7 wetlands are located within the Colby Lake Water Pipeline Corridor. To avoid double counting during the analysis of impacts, these 8 wetlands (6.2 acres) would be excluded from the Second Creek area of analysis.
6 Percent totals are greater than 100 percent due to rounding.

4.2.3.2.3 Wetlands Functional Assessment

Wetlands within the Tailings Basin have been previously affected by the LTVSMC tailings deposition, roads, and impoundment. The majority (92 percent) of the wetlands within this area are currently rated as low-quality with low vegetative diversity/integrity. Eight percent of the wetlands within the Tailings Basin are rated as moderate quality. The wetlands within the Hydrometallurgical Residue Facility are located on the south side of an unpaved, gravel road with small buildings and associated facilities used in the former LTVSMC operations. These wetlands are currently rated as low-quality (PolyMet 2015b).

The majority of wetlands within the Colby Lake Water Pipeline Corridor, which are located adjacent to an unpaved, gravel road and within a previously disturbed corridor, are rated as low-quality (93 percent), with the remaining wetlands rated as moderate-quality (7 percent) (PolyMet 2015b).

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4.2.4 Vegetation

This section describes the existing cover type categories, plant communities, and individual plant species in the NorthMet Project area. Cover type categories and plant communities are defined for each parcel, and their geographic locations are presented on the corresponding figures. Minnesota Biological Survey (MBS) Sites of Biodiversity Significance, Scientific and Natural Areas (SNAs), and culturally important plant species are also discussed for each parcel. Species are grouped into two partially overlapping categories: state-listed Endangered, Threatened, or Special Concern (ETSC) species; and the USFS's Regional Foresters Sensitive Species (RFSS). There are no federally listed plant species within the NorthMet Project area.

Additional information beyond what the MDNR Natural Heritage Information System (NHIS) contained, such as species conservation ranking, distribution, and habitat, were obtained from NatureServe, an online public database that utilizes sources such as scientific literature, web sites, expert knowledge, and information from local data centers. The Bell Museum of Natural History, which maintains an herbarium vascular plant collection database, was also consulted.

Several vegetation surveys have been conducted on the federal lands (including part of the Mine Site) and the non-federal lands. These studies gathered information on dominant plant species within various habitats, as well as the presence or absence of ETSC species.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list. A Biological Evaluation (BE) has been prepared that contains further information about RFSS. The BE is included in Appendix D.

4.2.4.1 Regional Setting

The Mine Site, Transportation and Utility Corridor, and Plant Site are located in the MDNR-designated Nashwauk Uplands and Laurentian Uplands subsections of the Northern Superior Uplands section of the Laurentian Mixed Forest Province ecoregion, corresponding roughly to the Arrowhead region of northeastern Minnesota (MDNR 2006a; MDNR 2011e). Most of the vegetative cover types in these subsections grow in acidic to neutral glacial materials over Precambrian bedrock (MDNR 2011f; MDNR 2011i). Soils vary from medium to coarse texture, and they support forest communities of aspen-birch, jack pine (*Pinus banksiana*), balsam fir (*Abies balsamea*), white spruce (*Picea glauca*), red pine (*Pinus resinosa*), and white pine (*Pinus strobus*) on the uplands and conifer bogs and swamps on the lowlands.

4.2.4.2 Mine Site

The Mine Site includes a single contiguous 3,014.5-acre tract of land. It is located on both private lands (295.2 acres) and federal lands (2,719.3 acres) within the Superior National Forest.

4.2.4.2.1 Cover Types

Cover types are of several classifications, including MDNR Gap Analysis Program (GAP) land cover types, specific plant communities identified through surveys, MBS Sites of Biodiversity Significance, native plant communities, and SNAs.

Habitat Types

The MDNR uses a hierarchical land classification system called the GAP land cover system, which organizes vegetation communities into 1-acre blocks. The primary GAP land cover types at the Mine Site are upland conifer forest (40 percent) and lowland conifer forest (26 percent), in addition to upland deciduous forest (see Table 4.2.4-1 and Figure 4.2.4-1). Some of the least represented cover types on the Mine Site include cropland/grassland or upland conifer-deciduous mixed forest types. The MDNR GAP land cover types below do not fully represent the extent of mixed forest types, since the cover type level below is fairly specific. As detailed below in ENSR (2005) surveys, there is much more mixed forest types than indicated.

Table 4.2.4-1 NorthMet Mine Site Cover Types

Cover Types	Total Acres	Percent of Area
Upland coniferous forest[1]	1,195.5	40
Lowland coniferous forest[2]	781.2	26
Upland deciduous forest[3]	648.0	21
Shrubland	241.7	8
Disturbed	128.0	4
Aquatic environments	12.7	<1
Cropland/Grassland	4.9	<1
Upland conifer-deciduous mixed forest[4]	2.4	<1
Lowland deciduous forest[5]	0.1	<1
Total	**3,014.5**	**100**

Source: MDNR 2006b.

Notes:
1 Includes pine and spruce/fir forest cover types.
2 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
3 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
4 Includes all mixed coniferous-deciduous forest cover types.
5 Includes black ash forest cover types.

Plant Community Surveys

The primary cover types at the Mine Site are mixed pine-hardwood forests on the uplands and black spruce (*Picea mariana*) swamp/bog in the wetlands (ENSR 2005). USFS stand data and field verification indicate that northern white cedar also occurs at the Mine Site in lowland conifer forests (Barr 2011d). The remaining forest on the Mine Site is made up of aspen (*Populus* spp.), aspen-birch, jack pine, and mixed hardwood swamp. The relatively small amount of grass/brushland habitat that is present is land recovering from past logging through natural succession. There are also small areas of open water and disturbed ground that were previously cleared for logging roads and log landings. Of the wetlands that are located on the Mine Site, the majority (92 percent) is rated as having a high overall wetland quality and 8 percent are of moderate overall wetland quality. Vegetation diversity and integrity are rated moderate to high for all wetlands because recent human contact and alteration are minimal and the wetlands have a relatively constant supply of water. Section 4.2.3 provides a more detailed discussion on wetlands.

Many of the upland forest areas on the Mine Site have been harvested in the last 20 to 60 years. The oldest forest at the Mine Site includes approximately 297 acres of 40- to 80-year-old trees within the mixed pine-hardwood forest in the southwest portion of the Mine Site (ENSR 2005).

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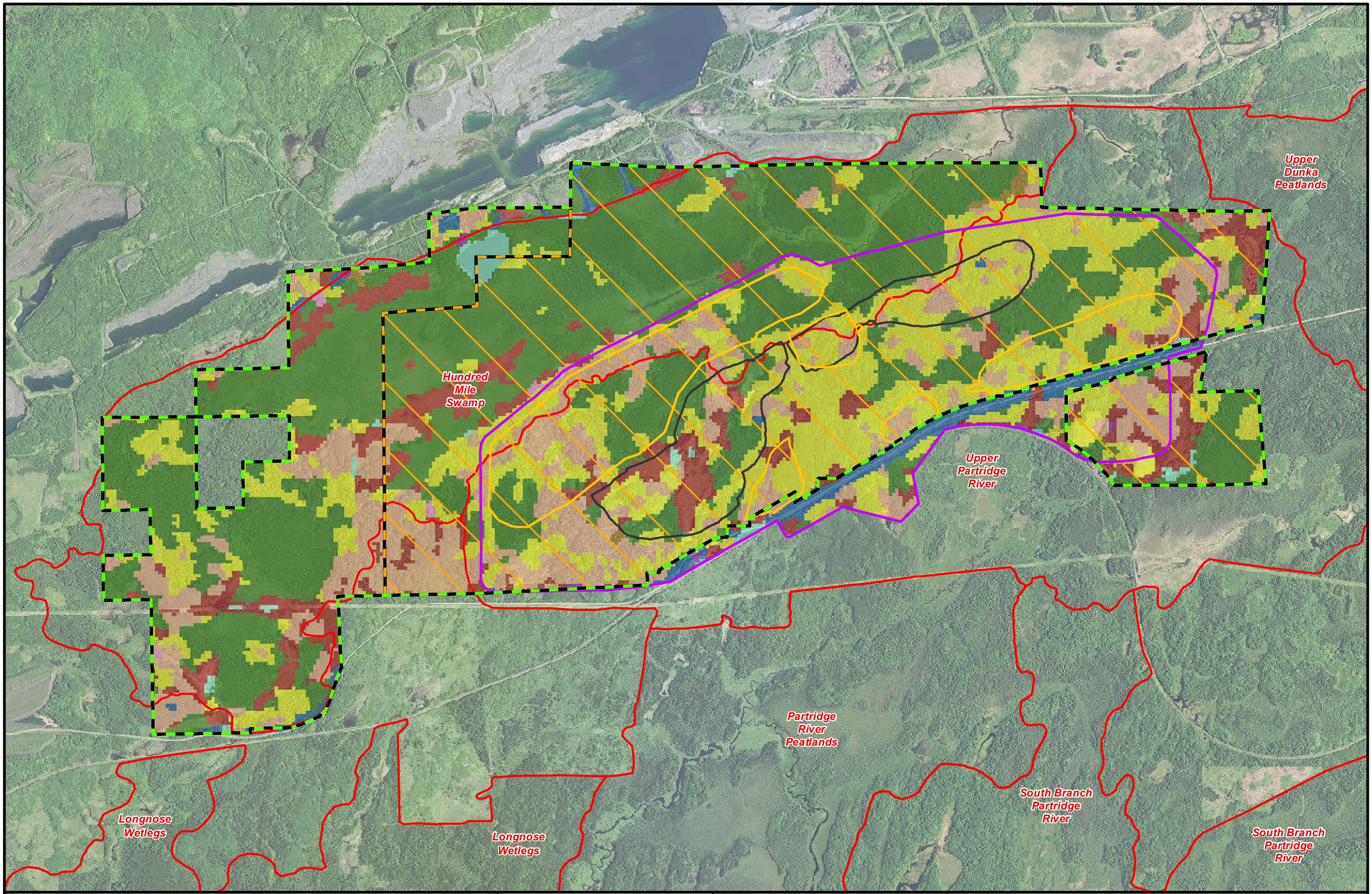

Federal Lands
Alternative B: Smaller Federal Parcel
Mine Site
Stockpile
Mine Pit

MBS Site of Biodiversity Significance

Land Cover Classes
Aquatic Environments
Cropland/Grassland
Lowland Conifer Forest
Lowland Deciduous Forest
Disturbed
Shrubland
Upland Conifer Forest
Upland Conifer-Deciduous mix
Upland Deciduous Forest

MNDNR
US Army Corps of Engineers St. Paul District

N W E S
0 0.25 0.5 1 Miles

Figure 4.2.4-1
Land Cover/Habitat Types - Federal Lands and Mine Site
NorthMet Mining Project and Land Exchange FEIS
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Minnesota Biological Survey

The MDNR operates the MBS program, which includes spatial information from survey reports on native plant communities and rare species. Sites of Biodiversity Significance are designated and ranked by the MDNR based on the environmental conditions present, including native plant communities, rare species, and unique habitat. The MBS utilizes a four-tiered ranking system: Outstanding, High, Moderate, and Below (from highest to lowest). Sites of High Biodiversity Significance contain very good-quality occurrences of the rarest species, high-quality examples of rare native plant communities, and/or important functional landscapes (MDNR 2008a). The entire 3,014.5-acre Mine Site has been characterized by the MBS as various Sites of High Biodiversity Significance due to the presence of the One Hundred Mile Swamp site, which covers 15 percent of the Mine Site, and the Upper Partridge River site, which is 85 percent of the Mine Site (see Figure 4.2.4-2) (MDNR 2008a).

Native plant communities are also ranked by the MDNR by their quality and abundance in a given area. “Imperiled” or “vulnerable” designations indicate that the communities have high ecological value, are rare in a given area, and/or could face danger of extirpation. Those with “apparently secure” designations are uncommon in a given area, but are not rare. Those with “widespread and secure” designations are fairly common and in no immediate risk of extirpation. Native plant communities are identified by their name and a unique code assigned to them by the MDNR (e.g., FDn32c). Two native plant communities, black spruce-jack pine woodlands (FDn32c; 34 percent of Mine Site) and rich black spruce swamp (FPn62a; 7 percent of Mine Site), have been characterized by the MBS as “imperiled/vulnerable” and “vulnerable,” respectively (MDNR 2008b). Poor tamarack-black spruce swamps (APn81b) and black spruce bogs (APn80a1) are ranked as “apparently secure” based on abundance, distribution, trends, and threats (MDNR 2008b). Aspen-birch forests: balsam fir subtype (FDn43b1), alder (*Alnus* spp.) swamps (FPn73a), poor black spruce swamps (APn81a), and low shrub poor fens (APn91a) are all considered “widespread and secure.”

Scientific and Natural Areas

The MDNR SNA program designates and preserves areas that have outstanding rare resources or features. There are no lands designated or nominated for designation as SNAs on the Mine Site (MDNR 2006c; MDNR, Pers. Comm., February 14, 2012).

Culturally Important Plants

Wild rice is an important plant species to the Bands, as well as an important wildlife food source. The MPCA staff have provided draft recommendations regarding three segments within the Partridge River watershed as waters used for the production of wild rice; the closest segment is about 2 miles from the Mine Site and includes the lower portion of the Upper Partridge River just upstream of the railroad bridge near Allen Junction to where it enters Colby Lake (see Figure 5.2.2-1) (MPCA 2012b). There were no observations of wild rice in Colby Lake itself or the tributary stream Wyman Creek (Barr 2011a; Barr 2012a; MPCA 2012b). The MPCA’s draft staff recommendation identifies the portion of the Partridge River from Colby Lake to its confluence with the St. Louis River as a water source used for production of wild rice. Small populations of wild rice have been observed in Second Creek from First Creek to its confluence with the Partridge River (Barr 2011a). Natural resources culturally important to the Bands are discussed in Section 4.2.9.3.3.

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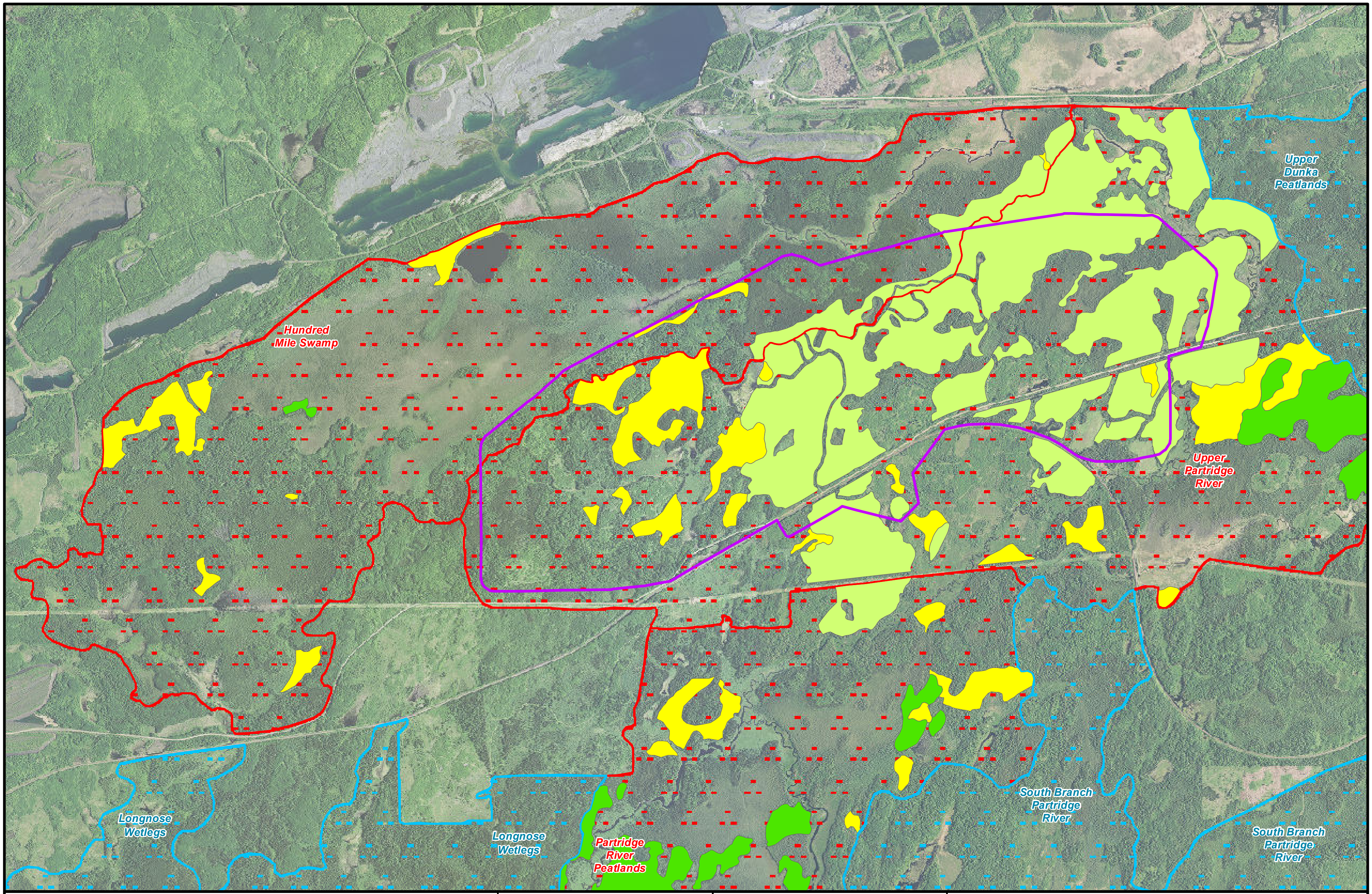

Mine Site

MBS Site of Biodiversity Significance - High

MBS Site of Biodiversity Significance - Moderate

Native Plant Community (S-Rank)

S2 - imperiled

S2-S3 - imperiled/vulnerable

S3 - vulnerable

MNDNR

US Army Corps of Engineers St. Paul District

0 0.25 0.5 1 Miles

Figure 4.2.4-2

Minnesota Biological Survey - Federal Lands and Mine Site

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National Hierarchical Framework of Ecological Units

The National Hierarchical Framework of Ecological Units (NHFEU) is a land classification system that uses a nested hierarchy of eight levels of ecological units (Cleland et al. 1997). Units are differentiated using a combination of physical and biological factors, such as geology, topography, soils, and vegetation. The Landscape scale contains the Land Type Association (LTA) level, which is defined using several factors, including bedrock types, lake and stream distributions, wetland patterns, and pre-European settlement vegetation (MDNR 2011g). The Land Unit scale contains the ELT level, which is a subtype of the LTA level. The MDNR and USFS also have an ECS that identifies and classifies lands in a similar fashion according to provinces, sections, subsections, and LTAs (MDNR 2011g).

The portion of the One Hundred Mile Swamp that is on the federal lands, including part of the Mine Site, has been identified as a Site of High Biodiversity Significance and was aerially surveyed by Chel Anderson in 1997 (MDNR 1997). The One Hundred Mile Swamp comprises approximately 3,028 acres located within LTA 8A – Big Rice Outwash (MDNR 1997), which has since been reclassified as LTA 212Le11 – Big Lake-Bird Lake End Moraines. Two other sites besides the One Hundred Mile Swamp site were surveyed on the ground and by air in LTA 212Le11. These sites provide a good representation of most of the LTA's biological and physical attributes at the ELT level, as mentioned above. The One Hundred Mile Swamp and the two other sites surveyed provide a complete representation of the prominent ELTs present within LTA 212Le11.

4.2.4.2.2 Invasive Non-native Plants

Invasive non-native plants are a concern because they can quickly form self-sustaining monocultures that out-compete native plants or reduce the quality of wildlife habitat, particularly in disturbed areas. "Non-native" species are those that have been introduced, or moved, by human activities to a location where they do not naturally occur (MDNR 2011b). "Invasive" species are non-native species that cause ecological or economic problems (e.g., out-competing indigenous species or altering the existing ecological community through rapid development of monocultures). In general, few invasive non-native plants have been observed on the federal lands because wetland disturbance has been minimal, upland disturbance has been restricted to timber harvests, and human access has been limited, thereby reducing the spread of these plants (AECOM 2011a; ENSR 2005). No known occurrences of invasive species on the federal lands are listed in the Superior National Forest invasive plant geodatabase, but no inventories have been performed in the NorthMet Project area (USFS 2010a). The majority of representative wetland locations surveyed on the federal lands yielded 100 percent native plants with no occurrences of non-native species at those sites according to MnRAM 3.2 worksheets (AECOM 2011d). Field surveys indicate that disturbed upland areas on the federal lands contain occurrences of yellow sweetclover and bladder campion, both of which are invasive non-native species. Yellow sweetclover invades grasslands and early successional habitats by overtopping and shading out native species (MDNR 2011b). Bladder campion is a prolific seed-producer and can spread vegetatively, as well.

A vegetation survey of mines on the Mesabi Iron Range (Apfelbaum et al. 1995) identified a large number of invasive non-native plant species that could invade the Mine Site, and some species are estimated to be currently present on the Mine Site (see Table 4.2.4-2). Some of these species are grasses and legumes that were planted on mines and other sites to reduce erosion and to fix nitrogen into the soil as part of a reclamation effort (e.g., redtop, smooth brome, birdsfoot trefoil, yellow sweetclover, white sweetclover, alfalfa, timothy, Kentucky bluegrass, Canada bluegrass, and white clover). In addition, a road weed survey by the Superior National Forest (USFS 2011k) documented several invasive species (species tracked by the USFS and Minnesota Class 2 invasive species) within 3 miles of the Mine Site, primarily along roadways (see Table 4.2.4-3). Species with a high percentage of occurrences in the surveys (e.g., common tansy) are more likely to occur on the Mine Site.

Table 4.2.4-2 Invasive Non-native Plant Species Found on Mine Sites in the Mesabi Iron Range

Scientific Name	Common Name	Percent Occurrence[1]	Wetland/ Upland	Estimated Abundance at NorthMet Mine Site
Bromus inermis	Smooth brome	60	U	Uncommon
Tanacetum vulgare	Common tansy	60	U	Uncommon
Taraxacum officinale	Dandelion	60	U	Common
Cirsium arvense	Canada thistle	40	U	Uncommon
Phleum pratense	Timothy	40	U	Common
Poa pratensis	Kentucky bluegrass	40	U	Common
Leucanthemum vulgare	Oxeye daisy	30	U	Common
Lotus corniculatus	Birdsfoot trefoil	30	U	Common
Hieracium pratense	Yellow hawkweed	20	U	Uncommon
Lychnis alba	Bladder campion	20	U	Uncommon
Melilotus officinalis	Yellow sweetclover	20	U	Uncommon
Agrostis alba	Redtop	10	W/U	Uncommon
Cirsium vulgare	Bull thistle	10	U	Uncommon
Hieracium aurantiacum	Devil's hawkweed	10	U	Common
Medicago lupulina	Black medic	10	U	Common
Trifolium repens	White clover	10	U	Common

Source: Apfelbaum et al. 1995.

Note:
1 Percent occurrence is the percentage of mine areas in the Mesabi Iron Range with reported observations based on 3-minute surveys at 10 mine areas. Three-minute surveys report the most abundant plant species observed during a 3-minute time period and provide a rough estimate of species abundance.

Table 4.2.4-3 Invasive Non-native Plant Species Found Within 3 Miles of the Mine Site and Plant Site by the USFS Road Weed Survey

Scientific Name	Common Name	Percent Occurrence Near Plant and Mine Sites[1]	Wetland/ Upland
Tanacetum vulgare[3]	Common tansy	35	U
Hypericum perforatum[2]	St. John's wort	29	U
Cirsium arvense[3]	Canada thistle	24	U
Cirsium vulgare	Bull thistle	6	U
Centaurea stoebe (*C. maculosa*)[3]	Spotted knapweed	5	U

Source: USFS 2011k.

Notes:
1 Percent occurrence is the observed number of populations of the species divided by the 96 total plant populations identified within 3 miles of the Mine and Plant Sites.
2 Tracked by USFS.
3 Minnesota Class 2 - Controlled noxious weed as identified by the 2012 Minnesota Noxious Weed Law.

4.2.4.2.3 Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

No federally listed threatened and endangered plant species are known to occur on the federal lands, including the Mine Site. However, ten state-listed ETSC plant species are known to occur in the vicinity of the Mine Site. Based on a review of the MDNR NHIS and field investigations (AECOM 2009b; Barr 2007i; Johnson-Groh 2004; Pomroy and Barnes 2004; Walton 2004), one state endangered species, and nine state species of special concern have been identified on the Mine Site (see Table 4.2.4-4 and Figure 4.2.4-3). No other state-listed species are known to occur and no appropriate habitat for other species occurs on the Mine Site. Minnesota's endangered species law (*Minnesota Statute,* § 84.0895) and associated rules (*Minnesota Rules,* part 6212.1800 to 6212.2300 and 6212.6134) impose a variety of restrictions, permits, and exemptions pertaining to ETSC species. Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Population numbers correspond to the MDNR Element Occurrence within the NHIS database (MDNR, Pers. Comm., February 13, 2012). According to the 2011 MDNR NHIS training notes, Element Occurrences may have multiple observations in a given area, but are considered one population if they are "within close enough proximity to one another to allow for gene flow and there are no known barriers to movement." These clusters of observations are described here as colonies for given populations. An individual is defined as a single plant of a species. A colony is a group of individual plants of one species in a distinct geographic location. A population is a group of individuals or colonies of one species that may be separated geographically, but are close enough to interbreed and persist over time.

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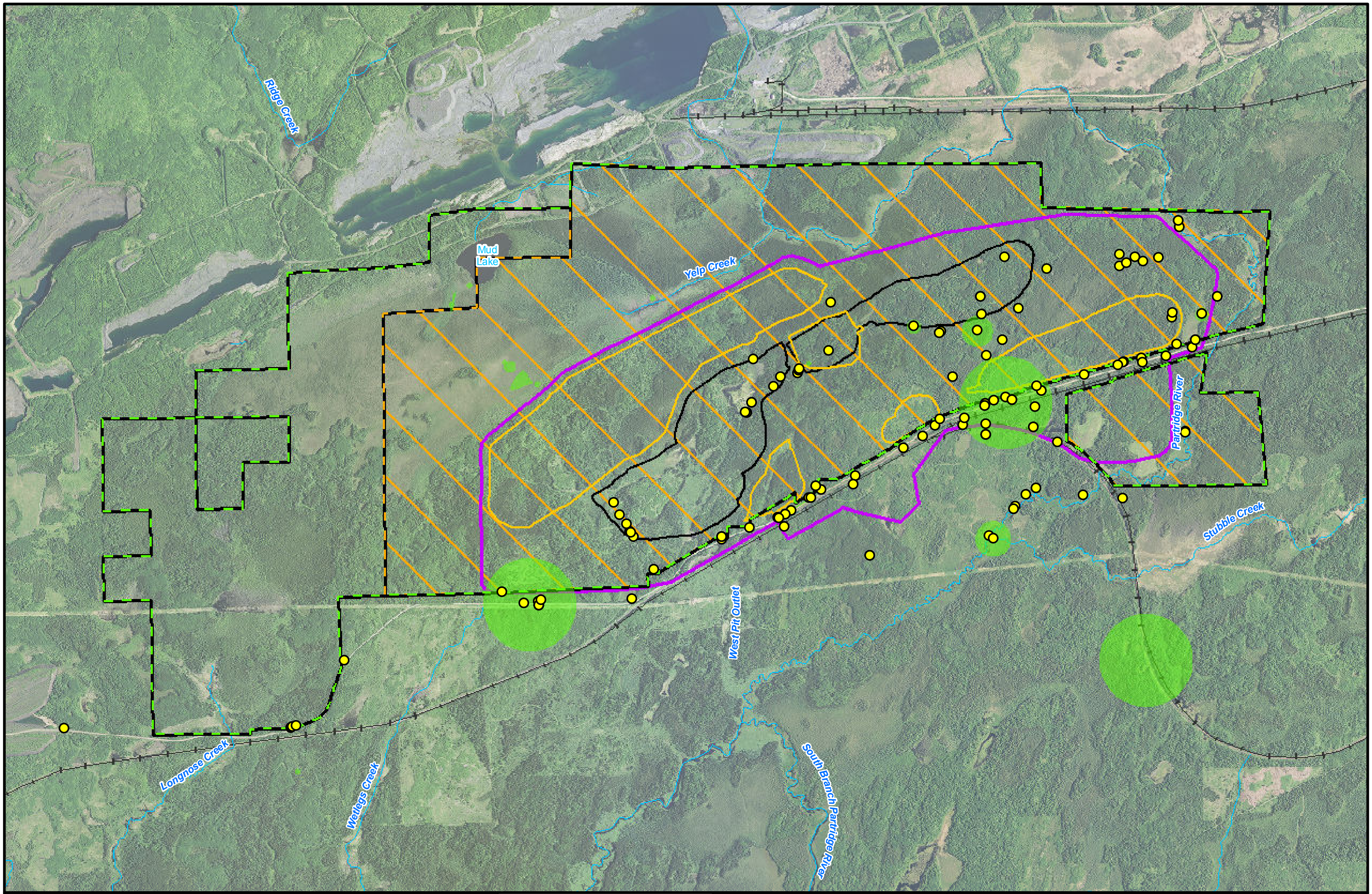

Federal Lands
Alternative B: Smaller Federal Parcel
Mine Site
Rare Species - Pomroy, Johnson - Groh, Barr Reports
Vicinity of Endangered, Threatened, and Special Concern Vegetation Species
Stockpile
Mine Pit
Stream / River
Existing Railroad

MNDNR
US Army Corps of Engineers St. Paul District

N W E S

0 0.25 0.5 1 Miles

Figure 4.2.4-3

ETSC Vegetation - NorthMet Project Area

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Table 4.2.4-4 Endangered, Threatened, and Special Concern Plant Species Identified on the Mine Site [5]

Scientific Name	Common Name	State Status[1]	No. of Populations[2]	No. of Individuals[2,3]	Habitat and Location
Botrychium campestre	Prairie moonwort	SC	1	Unknown	Dry soils along the Dunka Road.
Botrychium pallidum	Pale moonwort[4]	SC	1	21	Full to shady exposure, edge of alder thicket, along Dunka Road.
Botrychium rugulosum (*ternatum*)	Ternate or St. Lawrence grapefern[4]	SC	1	4	Early successional habitats, fields, open woods, forests, and along Dunka Road.
Botrychium simplex	Least grapefern[4]	SC	3	~1,580	Full to shady exposure, edge of alder thicket, forest roads, along Dunka Road.
Caltha natans	Floating marsh marigold[4]	E	1	56	Shallow water in ditches and streams, alder swamps, shallow marshes, beaver ponds, and Partridge River mudflat.
Eleocharis nitida	Neat spikerush[4]	SC	1	~1,562 ft^2	Full exposure, moist ditches along Dunka Road, wet area between railroad grades, and railroad ditch.
Juncus stygius var. *americanus*	Bog rush[4]	SC	1	Unknown	Open-patterned peatlands, rich and poor fens, northern spruce bog within the One Hundred Mile swamp.
Platanthera clavellata	Club-spur orchid	SC	1	Unknown	Black spruce and/or tamarack swamps, northern spruce bog within the One Hundred Mile swamp.
Ranunculus lapponicus	Lapland buttercup	SC	1	~919 ft^2	On and adjacent to Sphagnum hummocks in black spruce stands, up to 60 percent shaded with alder also dominant.
Torreyochloa pallida	Torrey's manna-grass	SC	1	~25 ft^2	In muddy soil along shore and in water within shallow channels, beaver ponds, shallow marshes, along Partridge River.

Sources: AECOM 2009b; Barr 2007i; Johnson-Groh 2004; MDNR 2005; MDNR 2011k; MDNR 2014d; Pomroy and Barnes 2004; Walton 2004.

Notes:
1 E = Endangered, T = Threatened, SC = Species of Special Concern.
2 Note that the number of populations may differ from those given in the NHIS data because of populations found during other surveys.
3 Where the number of individuals could not be determined without damaging the population, patch size (square feet) was used as a representative abundance measure.
4 These species are also RFSS as tracked by the USFS.
5 Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of August 5, 2014. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

Species Life Histories

The following summary provides descriptions of the life histories, statewide distributions, and sensitivity to disturbance for each of the 10 ETSC species found on the Mine Site.

Prairie moonwort (*Botrychium campestre*) is listed as a species of special concern in Minnesota; it is not listed as an RFSS in the Superior National Forest. It occurs primarily in prairies, dunes, grassy railroad sidings, and fields over limestone bedrock. *B. campestre* is a perennial fern that emerges in early spring and matures in late spring to early summer (eFlora 2011). This species is among the smallest moonworts and is difficult to observe when occurring among prairie vegetation; therefore, it is likely more widespread and abundant within its range than is typically apparent. It is now known to occur in several counties throughout Minnesota and even across the continent (MDNR 2011k). *B. campestre* is less frequently associated with disturbance than many moonwort species. On the Mesabi Iron Range of Minnesota, however, *B. campestre* has been found growing abundantly on sparsely vegetated mineral soil developed from sediments of iron mine tailings ponds.

Pale moonwort (*Botrychium pallidum*) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. *B. pallidum* was only first identified in Minnesota in 1992 and new populations are documented each year in a variety of habitats across northern Minnesota (MDNR 2011k). It occurs in open early successional habitats, log landings, roadsides, sandy gravel pits, and mine tailings within the Mesabi Iron Range of northeastern Minnesota. This diminutive perennial fern emerges in the late spring, produces spores, and matures within 3 to 4 weeks. Like many of the moonworts, *B. pallidum* may be sensitive to changes in soil mycorrhizae, herbivory from introduced earthworms, vegetative cover (i.e., increased vegetative competition and shading), soil moisture, or other environmental factors affecting suitable microhabitats. Disturbances such as vegetation clearing, mining, soil scarification, reduction of vegetative competition, decreased canopy cover, or fire likely play an important role in the preservation and proliferation of this species.

St. Lawrence grapefern (*Botrychium rugulosum*) (Synonym: *B. ternatum*, ternate grapefern) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. The name "rugulosum" refers to the tendency of the segments to become wrinkled and convex. Relatively little is known about the overall distribution, genetics, and life history requirements of *B. rugulosum,* and some taxonomists question whether *B. rugulosum* is a distinct species. It is a perennial semi-evergreen fern that occurs in the northern and south-central portions of Minnesota (MDNR 2011k). In northern Minnesota, *B. rugulosum* prefers partially shaded mine tailings, sandy conifer forests and plantations, and shaded vernal pool margins in rich deciduous hardwood forests. It also occurs in wetland areas within habitats subject to past clearing or cultivation (NatureServe 2014b). *B. rugulosum* is similar morphologically and in its life history requirements to *B. multifidum* (leathery grapefern), and these two species are often confused in the field. *B. rugulosum* is most easily distinguished from similar species in the late summer and early autumn when the trophophore (i.e., photosynthetic branch) has matured. Like *B. pallidum, B. rugulosum* may be associated with soil mycorrhizae and may be sensitive to increased competition, earthworms, changes in soil moisture, and other environmental factors affecting microhabitats. *B. rugulosum* is often found in small stands of 5 to 10 individuals, though larger populations can also occur (eFlora 2011). Disturbance also likely plays an important long-term role in the proliferation of this species.

Least grapefern (*Botrychium simplex*) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. Least grapefern occurs throughout northern and central Minnesota, with no occurrences documented in southern Minnesota (Bell Museum of Natural History 2011). Least grapefern was first described as a species in 1823 (eFlora 2011) and has been extensively surveyed and studied for over a century. *B. simplex* is a perennial fern that produces a single leaf each year and occurs in a variety of natural and disturbed habitats, including brushy fields (often with other species of *Botrychium*), moist or dry woods, edges of forested vernal pools and swamps, mine tailings, and edges of sand/gravel/exposed forest roads. The morphology of the species is quite variable, and the many environmental forms and juvenile stages of *B. simplex* have resulted in the naming of numerous intraspecific taxa (eFlora 2011). Like the other *Botrychium* species, disturbance likely plays an important role in the proliferation of this species.

Floating marsh marigold (*Caltha natans*) is listed as an endangered species in Minnesota and as an RFSS in the Superior National Forest. *C. natans* was first collected in Minnesota in 1889 from Vermilion Lake in St. Louis County (Coffin and Pfannmuller 1988). All subsequent collections have been from St. Louis County (Bell Museum of Natural History 2011) and all known occurrences in the NHIS database occur in St. Louis County. Very few populations are known in Minnesota. Habitat loss is largely the reason behind recent local extirpations of this species in Minnesota (MDNR 2011k). Floating marsh marigold is a perennial aquatic forb and occurs within shallow open water or on moist mud within northern ponds, lakes, slow-moving rivers, streams, ditches, and wet meadows. The species flowers in late spring-summer (i.e., June to August). *C. natans* is found in relatively stable aquatic systems and may be sensitive to disturbances, including alteration of hydrology or hydro-period, water quality, water chemistry, and non-native species invasion, although a few populations are found in disturbed habitats.

Neat spike-rush (*Eleocharis nitida*) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. Neat spike-rush's distribution in Minnesota is limited to the northeastern counties of the Arrowhead region and west to Itasca County. *E. nitida* was first collected in Minnesota in 1946 from various wetland habitats in Cook and St. Louis counties. Despite the long collection record for this species in Minnesota, relatively few populations have been documented and little is known about the overall distribution of the species throughout the state. *E. nitida* occurs within various wetland habitats of northern Minnesota, including acid bog pools, small streams, areas of seasonal water drawdown (mucky/peaty flats), disturbed wetland edges, and along roads and trails (MDNR 2011k). *E. nitida* is a perennial plant that flowers in late spring and develops fruit in early to mid-summer. Mature achenes (i.e., seed-containing fruit) are often necessary to positively identify *E. nitida* to species (both in the field and herbarium). This rooted perennial species may be intolerant of hydrologic fluctuations and alterations to water quality and chemistry associated with landscape and wetland alteration and development. However, roadside distributions suggest the species may be semi-tolerant to disturbance and at least mild alterations in water quality in the short term.

Bog rush (*Juncus stygius* var. *americanus*) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. Within Minnesota, bog rush is distributed across the northern and northeastern Arrowhead counties in large patterned peatlands and calcareous fens. It was first documented in St. Louis County in 1886 (Bell Museum of Natural History 2011). It is generally not a dominant species; even in ideal, large-patterned peatland settings, it occurs in isolated colonies with scattered individuals (MDNR 2011k). Bog rush is a perennial graminoid species that occurs in full sun, and, generally, it is restricted to narrow wet zones of bogs and fens where it can exploit small gaps in surrounding vegetation. Since it often grows in calcareous fens, it is influenced in some way by mineralized groundwater. It flowers and bears fruit in mid to late summer (eFlora 2011). Threats to *J. stygius* var. *americanus* include climate warming, water diversion (since it cannot compete well without vegetation gaps caused by inundation), and invasion of non-native species.

Club-spur orchid (*Platanthera clavellata*) (synonyms: *Habenaria clavellata*, *Gymnadeniopsis clavellata*) is listed as a species of special concern in Minnesota; it is not listed as an RFSS in the Superior National Forest. Club-spur orchid was first recorded in Ramsey County in 1886 and has since been documented in several counties across the northeast Arrowhead region and south to Ramsey and Hennepin counties (Bell Museum of Natural History 2011). It generally occurs in swamp forests with a canopy of black spruce and tamarack, and in non-forested fens with hummocks of *Sphagnum* moss species (MDNR 2011k). *P. clavellata* is a perennial orchid with a root/tuber system that is usually confined to growing within the living moss layer rather than the peat below it. The species flowers in mid-summer (from early to late July), and is insect-pollinated. Germination of the wind-borne seeds requires the presence of certain habitat-specific mycorrhizal fungi. Club-spur orchid may be sensitive to habitat alterations and changes in hydrology. It is suggested that activities several miles from a site could disrupt the hydrological processes (through groundwater and surface water) that are needed to sustain habitat for *P. clavellata* (MDNR 2011k).

Lapland buttercup (*Ranunculus lapponicus*) is listed as a species of special concern in Minnesota; it is not listed as an RFSS in the Superior National Forest. Lapland buttercup occurs throughout much of northern Minnesota, with the exception of extreme northwestern Minnesota. This species was first documented in 1928 in Minnesota from a *Sphagnum* bog in Aitkin County (Bell Museum of Natural History 2011). *R. lapponicus* is a perennial forb species that occurs amongst *Sphagnum* moss hummocks and pools in rich forested swamps in Minnesota, usually under a canopy of northern white cedar (MDNR 2011k). No populations have been found on disturbed sites. Lapland buttercup is sensitive to changes in conifer forest canopy, wetland hydrology/hydro-period, water chemistry, and other environmental factors affecting optimal conifer forest pools and hummock micro-sites.

Torrey's manna grass (*Torreyochloa pallida*) (synonym: *Puccinellia pallida*) is listed as a species of special concern in Minnesota; it is not listed as an RFSS in the Superior National Forest. Torrey's manna grass was first collected in 1886 from Vermilion Lake in St. Louis County (Bell Museum of Natural History 2011). Within Minnesota, *T. pallida* occurs throughout the Arrowhead Region south to Chisago County (along the St. Croix River drainage). Torrey's manna grass is a perennial graminoid species that occurs in various wetland habitats in northern Minnesota. Habitats include shallow muck-bottomed pond and stream shores, bogs, and beaver meadows. Some populations occur within roadside ditches, suggesting the species may be somewhat tolerant of disturbance; however, this rooted perennial wetland species is sensitive to alterations in wetland hydro-period, water level fluctuations, sedimentation, changes in water chemistry associated with landscape alteration, and development and competition from introduced invasive wetland species (e.g., *Typha angustifolia*, *Typha* x *glauca*, *Lythrum salicaria*, *Phragmites australis*, *Phalaris arundinacea*).

Regional Foresters Sensitive Species

The Mine Site is located within the current boundaries of the Superior National Forest; however, following the Land Exchange Proposed Action, the federal lands including a portion of the Mine Site would no longer be National Forest System land. The USFS currently manages 58 vascular and non-vascular plant species that are listed as RFSS in the Superior National Forest (see Table 4.2.4-5). The list of these species was updated in early 2012 (USFS 2012f). The assessment of effects to RFSS would be detailed in the Biological Evaluation; this section provides a summary based on RFSS plants that could exist on the NorthMet Project area lands. The Biological Evaluation is an assessment of the likely effects on species with viability concerns and their suitable habitat as a result of the NorthMet Project Proposed Action.

Eight of the RFSS are state-listed ETSC species relevant to the NorthMet Project Proposed Action (*Botrychium pallidum*, *Botrychium rugulosum*, *Botrychium simplex*, *Caltha natans*, *Eleocharis nitida*, *Juncus stygius*, *Pyrola minor*, and *Saxifraga paniculata*) and are discussed above or in Section 4.3.4. All of these species, except *Pyrola minor* and *Saxifraga paniculata*, occur at the Mine Site. The RFSS plant species in Table 4.2.4-5 are grouped according to predominant habitat types/natural communities in which they occur, specifically Management Indicator Habitat (MIH) types if available. Additionally, more specific suitable habitat descriptions within each MIH type are provided for each species, and whether that habitat is potentially present on or near the federal lands, including portions of the Mine Site.

Table 4.2.4-5 USFS RFSS Plant Species within Superior National Forest

Species Name	Common Name	Habitat Description	Potential Habitat on/near Federal Lands
Upland Forest - MIH 1			
Adoxa moschatellina	Muskroot	Shaded damp cliffs and slopes in upland mature northern hardwood forest on North Shore	No
Botrychium lanceolatum	Triangle grapefern	Mature northern hardwood forests	Yes
Botrychium lanceolatum var. *angustisegmentum*	Lanceleaf grapefern	Northern hardwood forest, old fields, old logging roads, trails	Yes
Botrychium lunaria	Common moonwort	Open habitats such as old log landings, sawmill sites, old building sites	Yes
Botrychium michiganense (hesperium) [3]	Michigan moonwort	Open habitats such as old log landings, old dirt roads, gravel pits, power line corridors, borrow pits, old fields, trails, and dredge spoil dumps	Yes
Botrychium mormo	Little goblin moonwort	Mesic northern hardwood forest with thick leaf litter layer	No
Botrychium pallidum [1,2]	Pale moonwort	Open disturbed habitats, log landings, roadsides, dunes, sandy gravel pits	Yes
Botrychium rugulosum [1,2]	Ternate or St. Lawrence grapefern	Generally open habitats, such as old log landings and edges of trails	Yes
Botrychium simplex [1,2]	Least grapefern	Generally open habitats, such as old log landings, roadside ditch, trails, open fields, base of cliff, railroad rights-of-way	Yes

Species Name	Common Name	Habitat Description	Potential Habitat on/near Federal Lands
Carex novae-angliae	New England sedge	Moist woods with sugar maple, also with birch, aspen, tall shrubs; yellow birch and white spruce-dominated forest	Yes
Crataegus douglasii	Douglas' hawthorn	North Shore rocky, gravelly streambeds/ banks and open areas, rocky borders of woods	No
Osmorhiza berteroi	Chilean sweet-cicely	Northern hardwood forest dominated by sugar maple on North Shore	No
Piptatherum (=Oryzopsis) canadense	Canada mountain ricegrass	Sandy/gravelly soil, red pine/jack pine plantations, borders/edges, trail sides, openings	Yes
Polystichum braunii	Braun's holly fern	Cool, shady cliffs and slopes in northern hardwoods in North Shore Highlands subsection	No
Prosartes trachycarpa (syn=*Disporum trachycarpum)*	Roughfruit fairybells	Semi-open jack pine forest with aspen, birch, shallow rocky soils, in east Border Lakes subsection	No
Taxus canadensis	Canada yew	Wide variety of uplands and lowlands, including cedar/ash swamps, talus and cliffs, northern hardwoods, aspen/birch forest	Yes
Waldsteinia fragarioides	Barren strawberry	Upland coniferous and deciduous forests, in recently harvested areas, established plantations	Yes
Lowland Black Spruce-tamarack Forest - MIH 9			
Caloplaca parvula	Lichen spp.	Smooth bark of young black ash in moist, humid old-growth black ash stand	No
Calypso bulbosa	Fairy slipper	Hummocks in northern white cedar swamps, moist to wet lowland conifer swamps, and to lesser extent in upland coniferous forests	Yes
Cetraria (=Ahtiana) aurescens	Lichen spp.	Conifer bark in lowland conifer swamps (old cedar/black spruce)	Yes
Cypripedium arietinum	Ram's-head lady's-slipper	White cedar swamps, forests dominated by jack pine, red pine, or white pine	Yes
Drosera linearis	Slenderleaf sundew	Minerotrophic water tracks in patterned peatlands	Yes
Frullania selwyniana	Selwyn's scalewort	Lowland cedar swamps on bark of white cedar	Yes
Menegazzia terebrata	Honey-combed lichen	Cedar swamps, especially old growth, base of cedar trees	Yes
Polemonium occidentale ssp. *lacustre*	Western Jacob's-ladder	White cedar swamps, also mixed conifer swamps, thrives in openings	Yes

Species Name	Common Name	Habitat Description	Potential Habitat on/near Federal Lands
Pyrola minor [2]	Snowline wintergreen/small shinleaf	Black spruce swamps, and ecotone between uplands and lowland alder/conifer swamp, prefers closed canopy	Yes
Ramalina thrausta	Cartilage lichen	Cedar swamps, especially old growth	Yes
Rubus chamaemorus	Cloudberry	Black spruce/sphagnum forest, acidic; Superior National Forest at southern edge of species range	Yes
Sticta fuliginosa	Spotted felt lichen	On hardwood trees in humid, old growth cedar or ash bogs	Yes
Usnea longissima	Beard lichen	On old conifer trees in moist situations, often in or near a conifer or hardwood swamp	Yes
Aquatic Habitats – MIH 14			
Astragalus alpinus	Alpine milkvetch	Sandy, gravelly fluctuating shorelines with sparse vegetation	No
Caltha natans [1,2]	Floating marsh marigold	Shallow water of pools, ditches, sheltered lake margins, slow-moving creeks, sloughs/oxbows, pools in shrub swamps	Yes
Juncus subtilis	Creeping rush	Sandy lakeshore – only known occurrence in BWCAW	No
Listera auriculata	Auricled twayblade	On alluvial- or lake-deposited sands or gravels, with occasional seasonal flooding, associated with riparian alder or spruce/fir forest	Yes
Littorella uniflora (=L. americana)	American shoregrass	Shallow margins of nutrient-poor lakes, seepage lakes, sandy substrate, may have fine gravel/organic soil	Yes
Nymphaea leibergii	Dwarf water-lily	Slow-moving streams, rivers, beaver impoundments 1 to 2 meters deep	Yes
Potamogeton oakesianus	Oakes' pondweed	Quiet, acidic waters of bogs, ponds, and lakes	No
Subularia aquatica	Awlwort	Beach zone of sandy nutrient-poor lakes, shallow lake margins, 15- to 45-centimeter-deep water	Yes
Other - Emergent wetland habitats			
Bidens discoidea	Swamp beggarticks	Silty shores, hummocks in floating mats and swamps, partly submerged logs	Yes
Eleocharis nitida [1,2]	Neat spikerush	Mineral soil of wetlands, often with open canopy and disturbance, such as logging roads/ditches through wetlands	Yes
Juncus stygius [1,2]	Moor rush/bog rush	Shallow pools in non-forested peatlands, often in a sedge-dominated community	Yes
Muhlenbergia uniflora	Bog muhly	Wet sandy beaches, floating peat mats	Yes
Viola lanceolata	Bog white violet	Sandy to peaty lakeshores, borders of marshes and bogs, damp sand ditches	Yes
Other - Cliff, Talus Slopes, and Exposed Rock Habitat			
Arctoparmelia centrifuga	*Arctoparmelia* lichen	Sunny rocks and open talus slopes	No

Species Name	Common Name	Habitat Description	Potential Habitat on/near Federal Lands
Arctoparmelia subcentrifuga	*Arctoparmelia* lichen	Sunny rocks and open talus slopes	No
Arnica lonchophylla	Northern arnica	Cool and moist cliffs and ledges on North Shore	No
Asplenium trichomanes	Maidenhair spleenwort	In crevices of moist, mostly east-facing cliffs, ledges, and talus, Rove formation	No
Carex rossii	Short sedge	Rocky summits, dry exposed cliff faces, rocky slopes, in east Border Lakes subsection	No
Cladonia wainioi	Wain's cup lichen	On rock outcrops and thin soil, exposed sites with lots of light	No
Huperzia appalachiana	Appalachian clubmoss	Shelves and crevices on cliff/talus/rock outcrops, and shrub dominated talus piles	No
Moehringia macrophylla	Largeleaf sandwort	Cliffs/rock outcrops, talus, conifer sites on shallow soils, pine plantation with rocky outcrops, usually semi-open shrub or tree canopy	No
Oxytropis borealis var. *viscida*	Viscid locoweed	Slate cliffs and talus slopes in east Border Lakes subsection	No
Saxifraga cernua	Nodding saxifrage	Cliffs, ledges, diabase cliff (calcium-based feldspars)	No
Saxifraga paniculata [2]	White mountain saxifrage/encrusted saxifrage	Cliffs, sheltered crevices, and ledges of north-facing cliffs	No
Tofieldia pusilla	Scotch false asphodel	Sedge mats at edges of shoreline rock pools along Lake Superior	No
Woodsia glabella	Smooth woodsia	Moist, north-facing cliffs along Lake Superior	No
None Specified			
Pseudocyphellaria crocata	*Pseudocyphellaria* moss	Mossy rocks, trees in partially shaded, moist, frequently foggy habitats	Yes
Peltigera venosa	Felt lichen	Soil and moist cliffs, exposed root wads	Yes

Sources: NatureServe 2011; NatureServe 2014b; USFS 2004a; USFS 2010d; USFS 2012f.

Notes:
[1] Listed as a state ETSC species and located at the Mine Site.
[2] Listed as a state ETSC species and located on the federal or non-federal lands.
[3] Known to occur on the federal lands.

Six state-listed ETSC plant species (*Botrychium pallidum*, *Botrychium rugulosum*, *Botrychium simplex*, *Caltha natans*, *Eleocharis nitida*, and *Juncus stygius*) are also RFSS plants and are located on the Mine Site, as discussed in Section 4.2.4.2.3. *Botrychium michiganense* is also located on the Mine Site, according to MDNR NHIS data, and is an RFSS plant (see Table 4.2.4-5). The USFS designates and maintains data about MIH types on federal lands; MIH types are categories of forest types, including dominant species, stand age class, and stand condition. A smaller subset of all MIH types was used for this RFSS discussion, including upland forest (MIH 1), upland conifer forest (MIH 5), lowland black spruce-tamarack forest (MIH 9), and aquatic habitats (MIH 14). Upland forest (MIH 1) and lowland black spruce-tamarack forest (MIH 9) are most prevalent in the federal lands portion of the Mine Site (see Table 4.3.4-3 and Figure 4.2.4-

4), indicating that the 17 RFSS associated with MIH 1 and the 13 RFSS associated with MIH 9 have the highest probability of occurring on the federal lands, including the Mine Site. Upland conifer forest (MIH 5) occurs in smaller acreage; however, there are no RFSS associated with MIH 5. Since this category overlaps MIH 1, the 17 RFSS associated with MIH 1 may also occur within this category. The lowland emergent habitat type occurs on the federal lands portion of the Mine Site, as well, and the five associated RFSS may be present.

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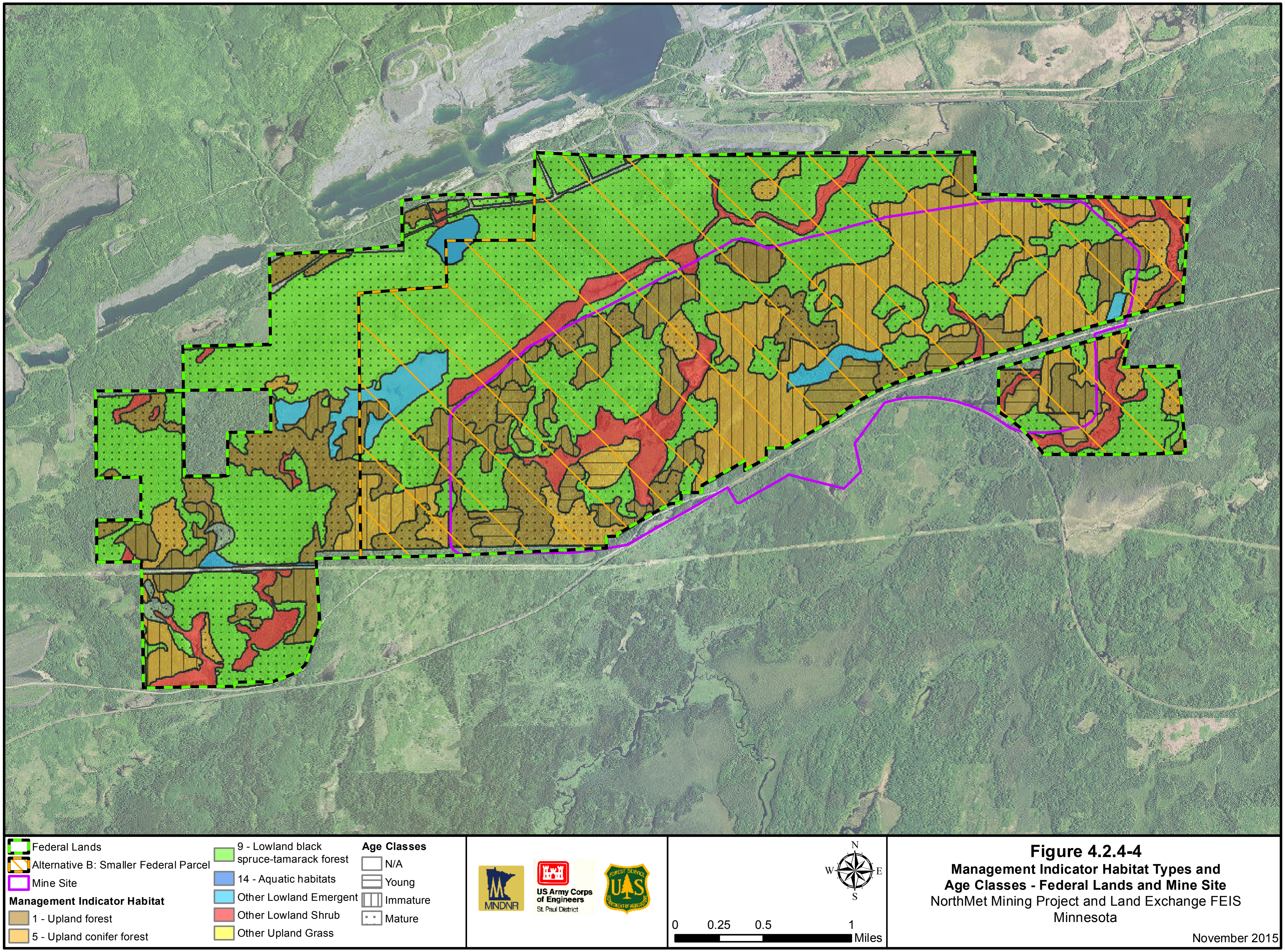

Figure 4.2.4-4
Management Indicator Habitat Types and Age Classes - Federal Lands and Mine Site
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4.2.4.3 Transportation and Utility Corridor

The Transportation and Utility Corridor includes the existing private Dunka Road, an existing private PolyMet railroad grade, a Minnesota Power Company 138-kV electric transmission line, a proposed Treated Water Pipeline, a proposed 13.8-kV electric distribution line, and a proposed railroad connection between the Cliffs Erie railroad track and existing PolyMet track.

4.2.4.3.1 Cover Types

Habitat Types

Because of prior use during the former LTVSMC taconite mining operation, the Transportation and Utility Corridor is now defined as having a "disturbed" cover type (see Table 4.2.4-6). The remaining MDNR GAP land cover types that are not disturbed include cropland/grassland (8 percent of the Corridor), shrubland (6 percent of the Corridor), and smaller acreages of the remaining types. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.2.4-6 NorthMet Transportation and Utility Corridor Cover Types

Cover Types	Total Acres	Percent of Area
Disturbed	94.4	79
Cropland/Grassland	9.8	8
Shrubland	7.7	6
Aquatic environments	2.7	2
Upland deciduous forest[4]	2.7	2
Upland coniferous forest[3]	2.6	2
Lowland coniferous forest[1]	0.2	<1
Lowland deciduous forest[2]	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**120.2[(6)]**	**100**

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.

Minnesota Biological Survey

There are two MBS Sites of High Biodiversity Significance (18.8 acres) located within the Transportation and Utility Corridor, including the One Hundred Mile Swamp (2 percent of the Corridor) and the Upper Partridge River (13 percent of the Corridor) (MDNR 2008a).

There are several native plant communities occupying the Transportation and Utility Corridor, most of which have no assigned conservation status rank. The aspen-birch forest: balsam fir subtype (FDn43b1) native plant community (1 percent of the Corridor) is ranked as "widespread and secure" (MDNR 2008b).

Scientific and Natural Areas

There are no SNAs located within the Transportation and Utility Corridor.

Culturally Important Plants

As with the Mine Site discussion, Section 4.2.9.3.3 provides a discussion of natural resources culturally important to the Bands.

4.2.4.3.2 Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species within the Transportation and Utility Corridor, but no invasive species inventories have been performed in the NorthMet Project area (USFS 2010a). USFS roadside surveys indicate that several invasive non-native species (e.g., common tansy, spotted knapweed, etc.) could be located within the Corridor (see Table 4.2.4-3). A qualitative vegetation field survey conducted by Barr (2012n) indicated that hawkweeds, red and white clover, oxeye daisy, smooth brome, bluegrass, and timothy were observed along the Transportation and Utility Corridor.

4.2.4.3.3 Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS and field investigations, no federally listed plant species occur on the Transportation and Utility Corridor. However, two state-listed ETSC plant species (*Botrychium pallidum*, *B. simplex*) have been identified within the Transportation and Utility Corridor area (see Figure 4.2.4-3). These two species' populations that occur along Dunka Road immediately adjacent to or overlapping the Mine Site were discussed previously in the review of the Mine Site to avoid repetition. The species (*B. pallidum*) populations that occur along Dunka Road, farther away from and not overlapping the Mine Site are discussed separately below (see Table 4.2.4-7).

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Table 4.2.4-7 Endangered, Threatened, and Special Concern Plant Species Identified within the Transportation and Utility Corridor

Scientific Name	Common Name	State Status[1]	No. of Populations	No. of Individuals	Habitat and Location
Botrychium pallidum	Pale moonwort[2]	SC	3	16	Full to shady exposure, edge of forests along Dunka Road

Source: Barr 2012n.

Notes:
[1] SC = Species of Special Concern
[2] These species are also RFSS as tracked by the USFS.

Species Life History

Section 4.2.4.2.3 discusses the life history of *Botrychium pallidum*.

4.2.4.4 Plant Site

The Plant Site includes the Beneficiation Plant, Area 1 Shops, Area 2 Shops, Hydrometallurgical Residue Facility and Plant, and the Tailings Basin (PolyMet 2015a). The Plant Site itself comprises 4,515.4 acres, but including the surrounding buffer lands that PolyMet owns or has leased surface rights to, the Plant Site consists of approximately 15,000 acres, one-third of which is estimated to have been disturbed by previous LTVSMC operations. The Colby Lake Water Pipeline Corridor is also included in this section. The pipeline connects the Plant Site to Colby Lake, which is south of the Plant Site.

4.2.4.4.1 Cover Types

Plant Site

Habitat Types

Because of use during the former LTVSMC taconite mining operation, the majority of the Plant Site is now defined as having a “disturbed” cover type (see Table 4.2.4-8 and Figure 4.2.4-5). The remaining MDNR GAP land cover types include approximately equal areas of aquatic environments (14 percent of the Plant Site) and upland deciduous forests (14 percent of the Plant Site), and smaller areas of shrubland, upland conifer forest, and lowland conifer forest. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

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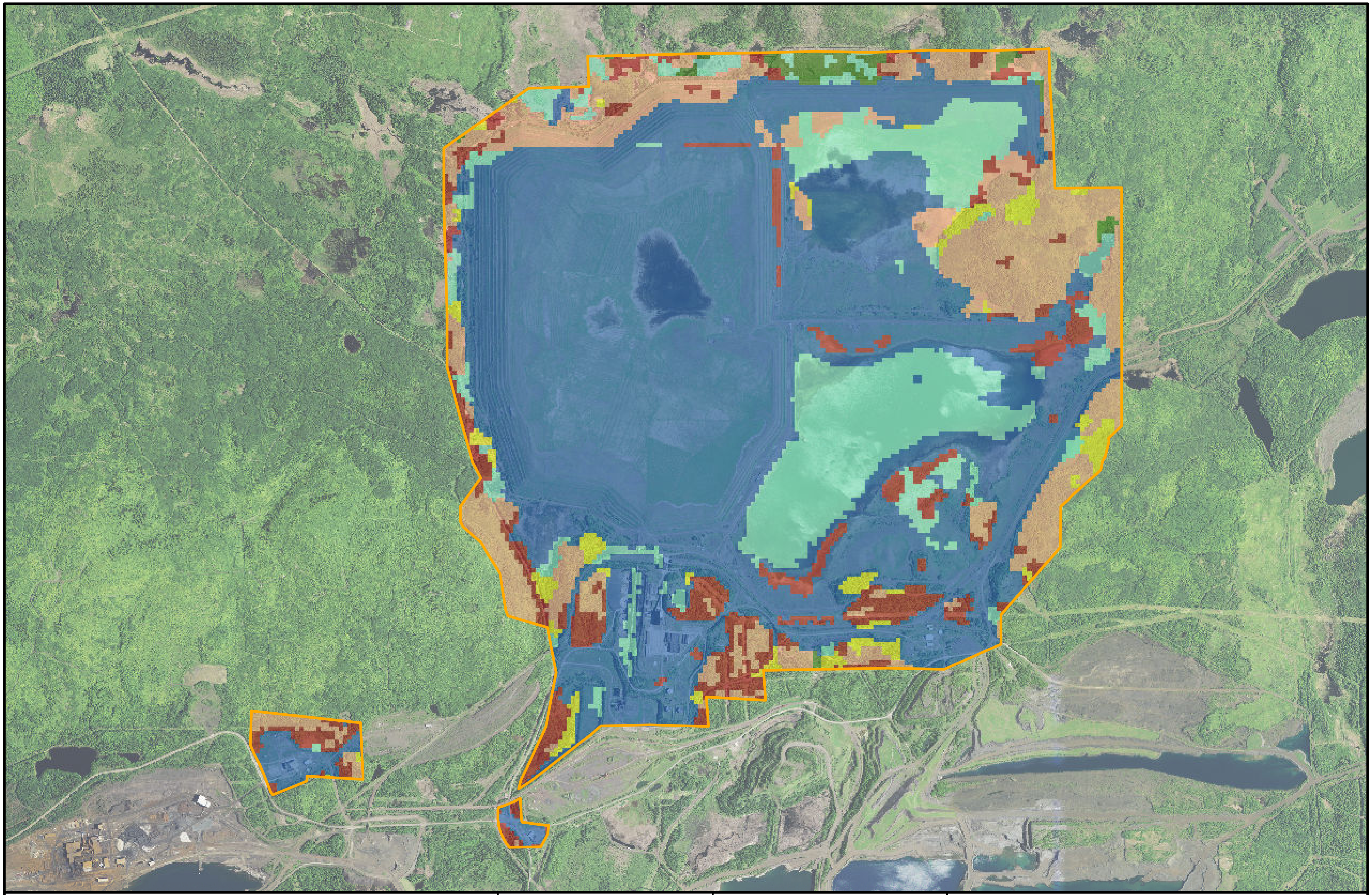

Plant Site
MBS Site of Biodiversity Significance
Land Cover Classes
Aquatic Environments
Lowland Conifer Forest
Disturbed
Shrubland
Upland Conifer Forest
Upland Deciduous Forest

MNDNR
US Army Corps of Engineers St. Paul District

Figure 4.2.4-5
Land Cover/Habitat Types - Plant Site
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Table 4.2.4-8 NorthMet Plant Site Cover Types

Cover Types	Total Acres	Percent of Area
Disturbed	2,755.5	61
Upland deciduous forest[4]	647.6	14
Aquatic environments	636.8	14
Shrubland	333.8	7
Upland coniferous forest[3]	99.8	2
Lowland coniferous forest[1]	41.9	1
Cropland/Grassland	0.0	0
Lowland deciduous forest[2]	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**4,515.4**	**99[(6)]**

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Percent totals are less than 100 percent due to rounding.

Minnesota Biological Survey

There are no MBS Sites of Biodiversity Significance located on the Plant Site (see Figure 4.2.4-5) (MDNR 2008a). Native plant community rankings are not available for the Plant Site.

Scientific and Natural Areas

There are no SNAs located on or near the Plant Site.

Culturally Important Plants

The most upstream portion of the Embarrass River Watershed, subject to a draft MPCA staff recommendation as a water source used for production of wild rice, is from the MN-135 highway bridge to the inlet of Sabin Lake (MPCA 2012b). The former Wild Rice Valley Farms is located adjacent to the Embarrass River, but no wild rice was observed within this area or the adjacent portion of the Embarrass River during field surveys, and it is not recommended as a water source used for production of wild rice (MPCA 2012b). Hay Lake, located along the upper stretch of the Embarrass River, is subject to a draft MPCA staff recommendation as a water source used for production of wild rice, but Sabin and Wynne lakes are not draft recommended as waters used for production of wild rice except for the northern-most tip of Wynne Lake (MPCA 2012b). Embarrass Lake is subject to a draft MPCA staff recommendation as a water used for production of wild rice (MPCA 2012b). Though low-density beds of wild rice were observed on Embarrass Lake in 2009 and 2010, no rice was observed in 2011 (Barr 2012a). No wild rice was observed in Spring Mine Creek, Trimble Creek, or Unnamed Creek near the Plant Site and they are not recommended as waters used for production of wild rice (Barr 2011a; Barr 2012a; MPCA 2012b). Section 4.2.2 provides a discussion on wild rice survey results and water quality standards (see Figure 4.2.2-3).

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Colby Lake Water Pipeline Corridor

Habitat Types

Extending south from the Plant Site is the Colby Lake Water Pipeline Corridor. There would be no construction within this pipeline corridor, as an existing pipeline would be used for the NorthMet Project Proposed Action. The corridor consists of 50.6 acres (see Table 4.2.4-9), and the MDNR GAP land cover types are dominated by disturbed areas (42 percent) and cropland/grassland (23 percent).

Table 4.2.4-9 NorthMet Colby Lake Water Pipeline Corridor Cover Types

Cover Types	Total Acres	Percent of Area
Disturbed	21.4	42
Cropland/Grassland	11.5	23
Shrubland	8.4	17
Upland deciduous forest[4]	6.5	13
Aquatic environments	1.4	3
Lowland deciduous forest[2]	0.6	1
Upland coniferous forest[3]	0.5	1
Lowland coniferous forest[1]	0.2	<1
Upland conifer-deciduous mixed forest[5]	0	0
Total	**50.5[(6)]**	**100**

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.

4.2.4.4.2 Invasive Non-native Plants

The Tailings Basin at the Plant Site is severely disturbed and already contains invasive non-native plants such as smooth brome grass, reed canary-grass, and yellow sweet clover. These species are tolerant of a wide variety of conditions, and can spread vegetatively or reproductively (MDNR 2011b). They often grow on disturbed lands, roadsides, and ditches. According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on the Plant Site, but no inventories have been performed in the NorthMet Project area (USFS 2010a). Similar to the Mine Site, the Plant Site could also have the species listed in Table 4.2.4-3, including common tansy, spotted knapweed, or thistle species.

4.2.4.4.3 Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS, no federally listed or state-listed ETSC plant species are known to occur on the Plant Site or within Colby Lake Water Pipeline Corridor. A detailed ETSC plant species survey was not conducted at the Plant Site because suitable habitat for these species is not present at this predominantly disturbed and developed site. ETSC species that are disturbance-adapted may exist along the rail line or roads. Consequently, the federal lands (including the Mine Site), Transportation and Utility Corridor, and non-federal lands are the focus of this FEIS vegetation analysis.

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4.2.5 Wildlife

This section describes the existing wildlife species and habitat which are or may be present in the NorthMet Project area. These species or their sign, such as tracks or droppings, have been observed during surveys, were identified as historically present, and/or typically use habitat present in the NorthMet Project area. Species are grouped in four partially overlapping categories: federally and state-listed ETSC (16 species); SGCN (95 species); the USFS's RFSS (18 species, excluding aquatic species); and other wildlife species, including wildlife species important to the Bands.

Several federally and state-listed ETSC wildlife species that were identified in scoping as potentially present in the NorthMet Project area are described in Section 4.2.5.1.1. Others were added to this section upon updating of the NHIS records and new state ETSC list. Federally listed species records are maintained by the USFWS and the state-listed species records are maintained in the Minnesota NHIS. The NHIS is the most complete source of data on Minnesota's rare or otherwise significant wildlife species, but it is not a comprehensive statewide inventory. It is based on historical museum records, published information, and field work, and is continually updated as new information becomes available. Therefore, the lack of a species occurrence in the NHIS database does not necessarily confirm the absence of a particular species in that area (MDNR 2014d). A county-by-county survey of rare natural features is being conducted by the MDNR as part of the Minnesota Biological Survey.

Additional information—such as species conservation ranking, distribution, and habitat—was obtained from NatureServe, an online public database that utilizes sources such as scientific literature, web sites, experts, and information from local data centers.

Several wildlife surveys have been conducted on the federal lands (including the Mine Site), Plant Site, Transportation and Utility Corridor, and non-federal lands. These studies gathered information on general wildlife utilization of the area, presence or absence of species of concern, and identification of habitat used by wildlife.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list. A Biological Assessment (BA) that provides further information on federally listed species, and a BE that contains further information about RFSS have been prepared. The BA and BE are included in Appendix D. The Co-lead Agencies met with the USFWS several times during informal consultation. The USACE, USFS, and USFWS initiated informal consultation on February 26, 2010, when the agencies met to discuss the NorthMet Project. The USACE subsequently met with the USFWS on May 3, 2011, September 1, 2011, and February 28, 2013 to discuss it further. The USACE, USFS, and USFWS met on July 9, 2014 to identify tasks to be accomplished in the development of the BA. Specifically, the northern long-eared bat and habitat were discussed, which led to further USFS bat survey work being proposed. The USACE, USFS, and USFWS met on October 29, 2014, February 5, 2015, and March 23, 2015, to discuss comments received on the draft BA and potential mitigation measures. The Co-lead Agencies signed the cover letter to the BA to initiate formal consultation with USFWS on August 21, 2015.

4.2.5.1 Mine Site

4.2.5.1.1 Federally and State-listed Species and Species of Special Concern

Canada Lynx

Canada lynx (*Lynx canadensis)* populations in the continental United States are protected under the ESA as a federally listed threatened species. The species is also listed as a species of special concern in Minnesota, but is considered globally secure by NatureServe (NatureServe 2014a). Lynx population cycles are related to snowshoe hare populations, and therefore, lynx are predominantly found in boreal forests, specifically spruce and fir. This habitat type corresponds to USFS MIH types 5, 6, and/or 9. Lynx mortality due to starvation and declining reproduction rates have been documented during periods of hare scarcity (Poole 1994; Slough and Mowat 1996). Hunger-related stress, which induces dispersal, may increase exposure of lynx to other forms of mortality such as trapping and vehicle collisions (Brand and Keith 1979; Ward and Krebs 1985; Bailey et al. 1986). Between 2001 and 2013, the USFWS has documented two lynx killed by trains and seven lynx killed by road traffic in Minnesota (USFWS 2013). Lynx may also be subject to competition and predation from species such as bobcat and cougar (Buskirk et al. 2000).

Lynx have been described as generally tolerant of humans (Sunde et al. 1998). Reports suggest that lynx are not displaced by human activity, including moderate levels of snowmobile traffic (Mowat et al. 2000) and ski resort activities (ENSR 2006). In an area with sparse roads in north-central Washington State, logging roads did not appear to affect habitat use by lynx (McKelvey et al. 2000). By contrast, lynx in the southern Canadian Rocky Mountains, where road density is higher, crossed highways within their home ranges less than would be expected (Apps 2000).

Over three-quarters of lynx records in Minnesota are from the northeastern portion of the state (McKelvey et al. 2000). Research in Minnesota confirmed a resident breeding population of lynx. Of the 426 sightings reported to the MDNR Division of Ecological Resources between 2000 and 2006, 76 percent were in St. Louis, Lake, and Cook counties. Approximately 113 lynx were sighted in St. Louis County between 2000 and 2006 and 8 percent of these lynx showed evidence of reproductive activity (MDNR 2012d).

Current conditions for this species in the NorthMet Project area were determined through review of existing data sources, including various lynx sighting databases (Moen et al. 2006; MDNR 2012d; USFS 2013), project-specific studies during the summer season (ENSR 2005), and a winter tracking survey (ENSR 2006). The winter tracking survey also included interviews with experts, private conservation groups, and the public, who are familiar with lynx use of the survey area.

On February 25, 2009, the USFWS published the *Final Rule for Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx* (50 CFR 17). Portions of the Mine Site lie within the revised boundaries of federally designated lynx critical habitat, which includes most of northeastern Minnesota. A recovery plan has not yet been issued for the Canada lynx.

The USFS designates Lynx Analysis Units (LAUs) within the Superior National Forest that include landscape-scale analysis areas for lynx management. These LAUs were developed in consultation with the USFWS. The federal lands, including the Mine Site, are located within

LAU 12, a 70,980-acre area in the southwest portion of the Superior National Forest. According to the USFS (USFS 2013), approximately 69,131 acres, or 96 percent, of LAU 12 currently provide suitable lynx habitat.

Lynx sign has been observed at the Mine Site. Moen et al. (2006) found that at least 20 different individual lynx sightings have occurred within 18 miles of the NorthMet Project area, including several radio-collared and reproductive individuals. During this study, the nearest reported sighting was approximately 6 miles from the Mine Site (Moen et al. 2006). The majority of sightings are clustered along roads and other places frequented by people.

An ENSR 2006 lynx winter tracking survey covered a 250-square-mile area centered on the NorthMet Project area. The survey did not find any sign of lynx within the Mine Site or federal land boundaries, but tracks and DNA analysis of scat indicated four unrelated female lynx had been present at some time within the 250-square-mile survey area approximately five miles south and east of the Mine Site (ENSR 2006). Track surveys suggest that two individuals made most of the trails found. Although preferred cover types for the snowshoe hare exist on the Mine Site (i.e., jack pine, fir-aspen-birch, aspen-birch), the forest may be too old for there to be appreciable hare densities, as snowshoe hare generally favor sapling or young pole stands (ENSR 2006). The USFS observed lynx tracks at the Mine Site in 2010, and multiple observations of lynx sign within 5 miles of the federal lands are noted in the USFS lynx tracking database (USFS 2013). Lynx density may increase as the snowshoe hare population cycles from a low point. Areas of blow down or logging slash where there is both vertical and horizontal cover may be used by lynx for denning sites (Moen 2009). Some logging slash is located on the west end of the Mine Site.

Northern Long-Eared Bat

The northern long-eared bat (*Myotis septentrionalis*), also known as the northern myotis, is federally listed as threatened, state-listed as a species of special concern in Minnesota, and is also a Superior National Forest RFSS. It is considered imperiled globally or vulnerable in Minnesota by NatureServe (NatureServe 2014a). Several bat species were added to the Minnesota ETSC list due to the emergence of white-nose syndrome, a fungal disease that could threaten Minnesota bat populations as it has in eastern bat populations. On October 2, 2013, the USFWS published a proposal to federally list the northern long-eared bat throughout its range. There was a 6-month extension and re-opening of the public comment period on the proposed rule listing on June 30, 2014. The final listing and interim 4(d) rule were published on April 2, 2015, and went into effect on May 4, 2015 (50 CFR Part 17, April 2, 2015).

The northern long-eared bat occurs throughout Canada and in much of the eastern United States, west to North and South Dakota. Its preferred summer habitat includes upland forests and riparian areas where they forage for insects in forest clearings, under tree canopies, and over water (MDNR 2014b; NatureServe 2014a). Generally, summer day roost sites include those under loose tree bark or within buildings, while night roosts include areas in caves, mines, and tunnels. It seems to be opportunistic in the selection of roost sites (USFWS 2013b). The northern long-eared bat enters its winter hibernacula (which may include caves, mines, overhangs, crevices, drill holes, and similar sites) in late August to September. Typically, winter hibernacula require constant temperatures, high humidity, and no air currents (USFWS 2013b). It generally hibernates in small colonies (fewer than 100 individuals) (MDNR 2014b; NatureServe 2014a), but the Soudan Underground Mine in northern Minnesota has supported a winter hibernating colony of up to 2,000 individuals. However, there is uncertainty in the high end of this estimate, as much of the mine may not be available for surveys (MDNR 2006e). Both summer and winter habitat types may be found on or near the Mine Site.

Baseline acoustic surveys for bats, which include the northern long-eared bat, the eastern pipistrelle, and the little brown bat, have been completed in the Superior National Forest east of the NorthMet Project area (Abel 2011). Bats were observed at the Mine Site and surrounding federal lands during echolocation surveys, but they were not identified to species (AECOM 2011a). The USFS conducted various bat surveys at the NorthMet Project area during summer of 2014 (USFS 2014b). Passive bat detectors were deployed on exploration trails within the Mine Site to detect bat calls. The northern long-eared bat was responsible for 13.6 percent of all calls detected at the Mine Site during this survey. The USFS also conducted additional bat surveys at sites in Lake and St. Louis counties in spring 2014 (USFS 2014c). Of the 130 bats captured during mist-netting surveys, 28 were northern long-eared bats. A USFS survey in the Kawishiwi District in the summer of 2013 found that of 34 bats captured by mist-netting efforts, 13 were northern long-eared bat (Grandmaison et al. 2013).

Gray Wolf

On July 1, 2009, the U.S. District Court issued a settlement agreement to remand an April 2009 USFWS decision to delist the western Great Lakes population of gray wolves. As a result, the gray wolf (*Canis lupus*) was again a federally listed threatened species. On May 4, 2011, the USFWS once again proposed to reinstate the 2009 decision to delist the gray wolf population in the western Great Lakes. This decision was finalized on December 26, 2011 and was made effective on January 27, 2012. Effective on December 19, 2014, however, the U.S. District Court again reinstated federal protection of the gray wolf, classifying it as a threatened species. The gray wolf was removed from the Minnesota ETSC species list in 2013, but it is still listed as a Superior National Forest RFSS. With the 2014 federal re-listing of the wolf, Minnesota is again divided into the five federal wolf management zones and critical habitat has been reinstated. According to NatureServe, it is globally ranked as apparently secure, but vulnerable in Minnesota (NatureServe 2014a).

Populations of gray wolves have been re-established in several western states from their low point in the mid-1970s when only northeast Minnesota, among the lower 48 states, had a reproducing population. Gray wolf populations in the western Great Lakes Region (i.e., Minnesota, Wisconsin, and Michigan) are expanding and have exceeded recovery goals for several years (Erb and Benson 2004). A 2007 to 2008 winter survey by the MDNR (Erb 2008) estimated that 2,921 gray wolves lived in Minnesota, which is second only to Alaska in wolf populations across the United States. The MDNR considers the gray wolf population fully recovered, as it has surpassed the federal delisting goal of 1,251 to 1,400 wolves (MDNR 2012e). Surveys conducted in the winter of 2013 to 2014 estimate the Minnesota wolf population to be approximately 2,423 animals, 212 more than estimated in 2013 (Erb et al. 2014). In the fall of 2013, the MDNR established a designated wolf hunt with an overall quota of 220 wolves. A total of 238 wolves were harvested during the hunt. The MDNR set a 2014 statewide target harvest of 250 wolves.

In northern Minnesota, the principal prey of the gray wolf includes white-tailed deer, moose, beaver, snowshoe hare, and muskrat, with occasional other small mammals, birds, and large invertebrates. Most wolves live in 2- to 11-member family packs and defend territories of 8 to

184 square miles. In Minnesota, the average pack size during winter 2013-2014 was estimated to be 4.4 individuals (Erb et al. 2014). The forest and brush habitats at the federal lands and Mine Site are typical wolf habitat (MIHs 1 to 14).

Radio-collared wolves have been observed in the vicinity of the federal lands and the Mine Site. Additionally, tracks and scat have been observed along Dunka Road and the roads within the Mine Site. The surrounding area is likely to support a pack of at least three individuals (ENSR 2005).

Moose

The moose (*Alces americanus*) is not federally listed, but was added to the Minnesota ETSC species list as a species of special concern in 2013. It is considered globally secure by NatureServe (NatureServe 2014a). Moose, which have been observed in the NorthMet Project area (ENSR 2005), are a species of importance to the Bands. Moose typically utilize a mosaic of habitat types, including early successional (young) forests, mixed conifer-hardwood forests, wetlands, and lakes (NatureServe 2014a). Waterbodies are often used in summer for foraging aquatic plants, cooling down, or escaping insects, while early successional forests (created by logging, forest fires, or windstorms) are browsed year-round. Dense conifer stands are used for thermal cover in the heat of summer, or used in winter to avoid deep snow. Moose are adapted very well for cold conditions, but are fairly intolerant of heat, making thermal cover or access to water important to reduce heat stress. However, Lenarz et al. (2011) suggest that moose in northeastern Minnesota may display higher preferences for early successional habitat in summer and winter than either aquatic environments or conifer forests. Some research suggests that climate change and warming temperatures may be related to mortality along the southern edge of the moose range (Lenarz et al. 2011). Higher mortality rates could be due to several causes, including heat stress or increased parasites. Several parasites and diseases can negatively affect moose mortality rates; these include winter ticks, brainworm, and liver flukes, among several others (NRRI 2014).

The overall moose population in Minnesota declined approximately 35 percent from 2012 to 2013 (MDNR 2013d). The 2014 winter aerial moose survey estimated the population at 4,350 animals, up from the 2013 estimate of 2,760 (DelGiudice 2014). However, this is likely due to variability in the survey conditions from year to year and uncertainty inherent in the survey itself. The MDNR is currently partnering with several other agencies, including the Bands, to conduct multiple research projects to identify the causes of the increase in moose mortalities.

Due to decreased population levels in the state of Minnesota and its new state listing as a species of special concern, the moose hunting season was closed in 2013 and not reopened. In previous years, when moose hunting was open, the NorthMet Project area would have been outside of the hunting zone, though moose zone 30 has been located to the south of the Transportation and Utility Corridor in previous hunting seasons. In 2012, two bull moose were harvested in zone 30 (DelGiudice 2012).

Little Brown Bat

The little brown bat (*Myotis lucifugus*), also known as the little brown myotis, is not federally listed, but is state-listed as a species of special concern in Minnesota. It is listed as a Superior National Forest RFSS. It is considered globally vulnerable by NatureServe, but ranges across North America (NatureServe 2014a). Several bat species were added to the Minnesota ETSC list due to the emergence of white-nose syndrome, a fungal disease that could threaten Minnesota populations as it has in eastern populations. A habitat generalist, its preferred habitat includes boreal forests, bogs and fens, open fields, shrublands, and urban areas. It forages primarily in woodlands near water sources. The little brown bat generally enters its hibernacula in September to October, and utilizes caves, tunnels, and abandoned mines with a relatively stable temperature (NatureServe 2014a). The Soudan Underground Mine in northern Minnesota has served as a hibernaculum for an estimated 10,000 bats, the majority of which are little brown bat (MDNR 2006e). Its summer day roost and maternity sites include hollow trees, caves, and human-made structures. This tree roost habitat may potentially be found at the Mine Site. Bats were observed at the Mine Site and surrounding federal lands during echolocation surveys, but they were not identified to species (AECOM 2011a).

The USFS conducted various bat surveys at the NorthMet Project area during the summer of 2014 (USFS 2014b). Passive bat detectors were deployed on exploration trails within the Mine Site to detect bat calls. The little brown bat was responsible for 77.8 percent of all calls detected at the Mine Site during this survey. The USFS also conducted additional bat surveys at sites in Lake and St. Louis counties in spring 2014 (USFS 2014c). Of the 130 bats captured during mist-netting surveys, 59 were little brown bats. A USFS survey in the Kawishiwi District in the summer of 2013 found that of 34 bats captured by mist-netting efforts, 21 were little brown bat (Grandmaison et al. 2013).

Eastern Pipistrelle

The eastern pipistrelle (*Perimyotis subflavus*), also known as the tri-colored bat, is not federally listed, but is state-listed as a species of special concern in Minnesota. It is also listed as a Superior National Forest RFSS. It is considered vulnerable globally and in Minnesota by NatureServe (NatureServe 2014a). Several bat species were added to the Minnesota ETSC list due to the emergence of white-nose syndrome, a fungal disease that could threaten Minnesota populations as it has in eastern populations. Minnesota is located at the western edge of the species’ range. Its preferred habitat includes partially open areas with large trees and woodland edges, but it avoids open fields and deep woods (MDNR 2014b; NatureServe 2014a). It primarily forages over open water areas. It generally enters its hibernacula beginning in October, and occupies the deeper portions of caves and mines where temperatures and humidity levels are higher. Typically, they are semi-solitary hibernators, hanging singly and separated from other bats (Nordquist and Birney 1985). The eastern pipistrelle has occasionally been observed hibernating in the Soudan Underground Mine in northern Minnesota (MDNR 2006e). During summer, its day roost sites include trees and human-made structures, while night roosts may include caves. Tree roost habitat can potentially be found at the Mine Site, though the species is more common in the southern half of Minnesota. Bats were observed at the Mine Site and surrounding federal lands during echolocation surveys, but they were not identified to species (AECOM 2011a). The USFS conducted various bat surveys at the NorthMet Project area during summer of 2014 (USFS 2014b). The USFS also conducted additional bat surveys at sites in Lake and St. Louis counties in spring 2014 (USFS 2014c) and on the Kawishiwi District in summer 2013 (Grandmaison et al. 2013). The eastern pipistrelle was not detected during any of the USFS surveys.

Northern Goshawk

The northern goshawk (*Accipiter gentilis*) is not federally listed and is considered globally secure by NatureServe (NatureServe 2014a). It is state-listed as a species of special concern in the state of Minnesota, and the Minnesota NHIS records indicate it does occur on the Mine Site. It is also listed as a Superior National Forest RFSS. Its preferred habitat includes older forests, particularly aspen. This habitat is found in the NorthMet Project area. Calling surveys did not identify northern goshawk at the Mine Site (ENSR 2005; AECOM 2009a); however, a northern goshawk nest was identified at the Mine Site. Two northern goshawk territories have been identified at or near the Mine Site, as northern goshawk have nested on the Mine Site and adjacent federal lands in 2000, 2009, 2011, and 2013 (USFS 2013). The One Hundred Mile Swamp northern goshawk territory, which is within the Mine Site, is no longer considered active. The Wetlegs Creek northern goshawk territory, located on the federal lands adjacent to the Mine Site, is still considered active and is currently being monitored. In addition, the northern goshawk is federally protected by the Migratory Bird Treaty Act (MBTA) of 1918.

Boreal Owl

The boreal owl (*Aegolius funereus*) is not federally listed and is considered globally secure by NatureServe (NatureServe 2014a). It is state-listed in Minnesota as a species of special concern, and is also listed as a Superior National Forest RFSS. Its preferred habitat includes dense coniferous and mixed forests containing spruce, pine, aspen, and alder trees. This habitat is found on and near the NorthMet Project area. A boreal owl was heard on Dunka Road during surveys in 1988 to 1989 near the Mine Site and federal lands (ENSR 2005); however, Minnesota is at the southern edge of its range in North America. The Minnesota NHIS does not contain any boreal owl records within 10 miles of the NorthMet Project area, and it was not observed during subsequent surveys (ENSR 2000; ENSR 2005; AECOM 2009; AECOM 2011a). The boreal owl nests in tree holes and natural cavities in far northeastern Minnesota, but is rarely seen due to its nocturnal hunting habit (MDNR 2014e). In addition, the boreal owl is federally protected by the MBTA.

Wood Turtle

The wood turtle (*Glyptemys insculpta*) is listed as a threatened animal species by the state of Minnesota and as an RFSS by the USFS. The wood turtle is not federally listed, but is considered globally vulnerable (imperiled in Minnesota) by NatureServe (NatureServe 2014a). The species' range extends from Virginia to Nova Scotia and westward to Minnesota and northeast Iowa. The NorthMet Project area is located at the western edge of its range in Minnesota. Significant wood turtle populations, however, are unlikely to be found at the Mine Site because it prefers a habitat of sandy-gravelly streams and bars, used for hibernating, mating, and nesting (Compton et al. 2002), which are not present at the Mine Site.

The Minnesota NHIS records indicate the northernmost population in the state was observed immediately south of the Mine Site. Given this proximity, it is possible that wood turtles may potentially occur along the southern fringes of the Mine Site.

Eastern Heather Vole

The eastern heather vole (*Phenacomys ungava*) is listed as a species of special concern by the state of Minnesota and as an RFSS by the USFS. It is not federally listed, and is globally secure but vulnerable in Minnesota according to NatureServe (NatureServe 2014a). The eastern heather vole is a habitat generalist, but typically inhabits the coniferous zones in upland forests and brushlands and meadows with low shrub species, usually near water. Habitats of this type may occur on the federal lands or at the Mine Site; however, the Minnesota NHIS does not contain any eastern heather vole records within 10 miles of the NorthMet Project area. It was also not found in nearby surveys of small mammals on the Chippewa National Forest (Christian 1993) and in Cook County (Jannett 1998). The NorthMet Project area is at the southern edge of the eastern heather vole's home range in far northern Minnesota and only a few collections of the species occur within Minnesota. The USFS MIH 8, which is primarily jack pine forest, is considered indicative of eastern heather vole habitat. No significant stands of MIH 8 were observed on the federal lands or the proposed Mine Site.

Yellow Rail

The yellow rail (*Coturnicops noveboracensis*) is a state-listed species of special concern. It is not federally listed, and its global rank is considered apparently secure, although vulnerable in Minnesota (NatureServe 2014a). Habitat for yellow rail includes lowland sedge meadows. Several small patches (totaling 39.5 acres) of wet meadow/sedge meadow occur at the Mine Site. The Minnesota NHIS has no records of the yellow rail occurring within 10 miles of the NorthMet Project area and field surveys did not identify any yellow rail (ENSR 2005). In addition, the yellow rail is federally protected by the MBTA.

Laurentian Tiger Beetle

The Laurentian tiger beetle (*Cicindela denikei*) is listed as a species of special concern by the state of Minnesota. It is not federally listed, and its global rank is considered vulnerable (imperiled in Minnesota) (NatureServe 2014a). Although it was not searched for during field surveys, the NHIS has no records of Laurentian tiger beetle occurring within 10 miles of the NorthMet Project area. This species inhabits openings in northern coniferous forests, specifically abandoned gravel and sand pits, undisturbed corners of active gravel and sand pits, sand and gravel roads, and sparsely vegetated rock outcrops (MDNR 2012g). Conifer forests occur on the Mine Site, but field surveys did not detect sandy or rocky openings in the forest (ENSR 2005). Rock exposures are evident in areas disturbed by past mining, but conifer forests do not surround these areas.

Taiga Alpine

The taiga alpine (*Erebia mancinus*) butterfly is listed as a species of special concern by the State of Minnesota. It is not federally listed, and it is considered globally secure by NatureServe (NatureServe 2014a). It is listed as a Superior National Forest RFSS. Minnesota is at the southern limit of the species' range. Although it was not searched for during field surveys, the NHIS has no records of taiga alpine occurring within 10 miles of the NorthMet Project area. This species inhabits black spruce bogs and swamps that include Labrador tea shrub layers, and sphagnum moss carpets (MDNR 2014b). These habitat types occur on the Mine Site and federal lands.

Freija's Grizzled Skipper

The Freija's grizzled skipper (*Pyrgus centaureae freija*) butterfly is listed as a species of special concern by the State of Minnesota. It is not federally listed, and it is considered globally apparently secure by NatureServe (NatureServe 2014a). It is listed as a Superior National Forest RFSS. Minnesota is at the southern limit of the species' range, and it is known to occur in Minnesota from only a single locality in Lake County (MDNR 2014b). Although it was not searched for during field surveys, the NHIS has no records of Freija's grizzled skipper occurring within 10 miles of the NorthMet Project area. This species inhabits primarily forest edges and openings; the Lake County location included grassy and sandy openings with willow, alder, and blueberries, bordered by black spruce and tamarack swamps (MDNR 2014b). These habitat types occur on the Mine Site and federal lands.

Nabokov's Blue

The Nabokov's blue (*Lycaeides idas nabokovi*) butterfly is listed as a species of special concern by the State of Minnesota. It is not federally listed, and it is globally unrankable by NatureServe (NatureServe 2014a). It is listed as a Superior National Forest RFSS. This subspecies ranges from the Great Lakes states up into Ontario and southeastern Manitoba (MDNR 2014b). Although it was not searched for during field surveys, the NHIS has no records of Nabokov's blue occurring within 10 miles of the NorthMet Project area. This species' preferred habitat includes open woodlands and upland openings where the larval host plant, dwarf bilberry (*Vaccinium cespitosum*), is abundant (MDNR 2014b). In Minnesota, all known colonies of this butterfly subspecies occur at sandy sites. These habitat types may occur on the Mine Site and federal lands, but the larval host plant was not observed.

Quebec Emerald

The Quebec emerald dragonfly (*Somatochlora brevicincta*) is listed as a species of special concern in the state of Minnesota. It is not federally listed, and is considered globally apparently secure by NatureServe (NatureServe 2015). It is listed as a Superior National Forest RFSS. Field surveys for this species were not completed, but the NHIS has no records of Nabokov's blue occurring within 10 miles of the NorthMet Project area. The Minnesota Odonata Survey Project, however, found an individual in northern Lake County approximately 30 miles north of the NorthMet Project area in 2006. This species' habitat requirements are not well-understood in Minnesota. Reports suggest that it inhabits poor fens found in the NorthMet Project area and wet meadow/sedge meadow habitat such as at the Mine Site. The likelihood of observing Quebec emerald individuals or populations in the vicinity of the federal lands and Mine Site is low.

4.2.5.1.2 Species of Greatest Conservation Need

The Minnesota Comprehensive Wildlife Conservation Strategy (MCWCS), an ecoregion-based wildlife management strategy (MDNR 2006d) identifies SGCN by ecoregion subsections based on a statewide approach. The MCWCS was created with input from multiple stakeholders and expert panels to cover issues of regional, as well as statewide, concern. The Mine Site and Plant Site are located within the Nashwauk and Laurentian Uplands subsections and include five key habitat types. The SGCN species associated with these habitat types at the Mine Site are identified below in Table 4.2.5-1.

Mature upland and lowland forest is the most common habitat type at the NorthMet Project area (primarily at the Mine Site). Section 4.2.4 provides a more detailed discussion of vegetation cover and habitat types (see Figure 4.2.4-1). Northern goshawk, spruce grouse, black-backed woodpecker, and boreal owl were observed in these forests (ENSR 2005). These species represent a group that generally requires large forested blocks and/or minimal human intrusion.

Brush/grassland and very early successional forest are uncommon at the Mine Site (ENSR 2005) and, where present, are typically small patches resulting from recent logging. The USFS has indicated that American woodcock has been observed at the Mine Site and the least weasel may occur as well. Most of the other SGCN species in Table 4.2.5-1 are generally associated with large patches of grassland and savanna habitats that are not present at the Mine Site.

Table 4.2.5-1 Key Habitat, Cover Types, and Associated Species in the Nashwauk and Laurentian Uplands Subsections at the NorthMet Project Area

Key Habitat Type, Cover Types, and Management Indicator Habitats	**Associated Wildlife Species[1]**	**Mine Site (Acres)**	**Transportation and Utility Corridor (Acres)**	**Plant Site (Acres)**
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIH 1-13)	Veery, whip-poor-will, eastern wood-pewee, yellow-bellied sapsucker, ovenbird, Canada warbler, Cape May warbler, **spruce grouse**, winter wren, boreal chickadee, wood thrush, **black-backed woodpecker**, *bald eagle[2]*, **boreal owl (MIH 4, 5, and 9)**, *bay-breasted warbler, black-throated blue warbler*	2,627.2	5.5	789.3
2.Open Ground, Bare Soils: disturbed/ developed (no MIH)	None	128.0	94.4	2,755.5
3.Grassland and Brushland, Early Successional Forest (no MIH)	Eastern meadowlark, Franklin's ground squirrel, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, *American woodcock*, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, red-headed woodpecker, tawny crescent, *least weasel*	246.6	17.5	333.8
4. Aquatic Environments: Tailings Basin, Partridge River, Embarrass River, former LTVSMC mine pits, wetlands (MIH 14)	Common loon, red-necked grebe, common snapping turtle, northern rough-winged swallow, American white pelican, common tern, Wilson's phalarope, black tern, trumpeter swan, black duck, American bittern, swamp sparrow, eastern red-backed salamander, bog copper, taiga alpine, *marbled godwit*	12.7	2.7	636.8

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Mine Site (Acres)	Transportation and Utility Corridor (Acres)	Plant Site (Acres)
5. Multiple Habitats (MIH 1-14)	**Gray wolf**[2] (1-4[(3)]), ***Canada lynx***[2] (1-4), rose-breasted grosbeak (1, 3), Macoun's arctic (1, 3), **least flycatcher** (1, 3), *Connecticut warbler* (1, 3), *olive-sided flycatcher (1, 4)*, grizzled skipper (2, 3), Nabokov's blue (2, 4), wood turtle[2] (1, 3, 4)			
Total		3,014.5	120.1	4,515.4

Source: MDNR 2006d.

Notes:

1 Bold text indicates SGCN species observed at Mine Site and/or Plant Site (ENSR 2005); italicized text indicates SGCN species targeted by ENSR (2005) that were not found; plain text indicates SGCN species identified as likely to be present at the Mine Site or Plant Site but not targeted in surveys.

2 Canada lynx, gray wolf, bald eagle, and wood turtle are or have recently been listed as ETSC species, as discussed in detail in the ETSC species section.

3 Numbers refer to the Key Habitat Types (1-5) where those species may occur or are known to occur.

The Mine Site and adjacent federal lands contain a large expanse of wetland habitat consisting primarily of coniferous bogs and coniferous swamps. No wetland SGCN species have been observed in this area. Marbled godwit was not found likely because its preferred habitat of graminoid wetlands and shallow marshes near extensive upland grassland are not present at the Mine Site. Currently, there are no bodies of open water at the Mine Site.

Multiple habitats are not mapped as such, but are made up of combinations of other key habitat types. This category is used for SGCN species that are known to use multiple habitats during a season. The gray wolf, Canada lynx, least flycatcher, and wood turtle were observed in the general vicinity of the Mine Site and are known to utilize multiple key habitat types, including mature and early-successional upland forest and wetlands. The Connecticut warbler, which also uses mature and early-successional upland forest and wetlands, was searched for, but not found. Similarly, the olive-sided flycatcher was surveyed for in both lowland forest and wetlands, but was not found, most likely because it prefers more open and mature conifer and mixed conifer-deciduous stands. The butterfly species grizzled skipper and Nabokov's blue are not found within 12 miles of the Mine Site or Plant Site.

4.2.5.1.3 Regional Forester Sensitive Species

RFSS are not protected but their needs are taken into consideration by the USFS when planning natural resource management on USFS lands. The majority of the Mine Site (and adjacent federal lands) is located in the Superior National Forest. Currently, 18 terrestrial wildlife RFSS are included on the Superior National Forest RFSS list, which was updated on February 20, 2012 (USFS 2012f).

Twelve of the RFSS are federally or state-listed ETSC species (i.e., gray wolf, northern long-eared bat, little brown bat, eastern pipistrelle, eastern heather vole, northern goshawk, boreal owl, wood turtle, taiga alpine, Freija's grizzled skipper, Nabokov's blue, and Quebec emerald) and are discussed above in Section 4.2.5.1.1. Three other RFSS (the olive-sided flycatcher, bay-breasted warbler, Connecticut warbler) are on the SGCN list and are discussed by habitat type in Table 4.2.5-1 above. Three other RFSS species are discussed briefly below.

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) was removed from the federal threatened species list on June 28, 2007. After a period of decline due to hunting and widespread use of dichlorodiphenyltrichloroethane (DDT), bald eagle populations in the lower 48 states rose dramatically beginning in 1972. The bald eagle was removed from the Minnesota ETSC species list in 2013, but continues to be listed as an RFSS by the USFS. According to NatureServe, it is globally secure, but vulnerable in Minnesota (NatureServe 2014a). In addition, the bald eagle is federally protected by the Bald and Golden Eagle Protection Act and the MBTA.

The Minnesota NHIS (MDNR 2014d) contains records of 18 nesting areas, some with multiple nests, within 12 miles of the federal lands and Plant Site. Some of these areas contained nests in close proximity to each other and were assumed to be used by a single pair of bald eagles (Guinn 2004). No nests were recorded at the Mine Site and field surveys found no evidence of any nests (ENSR 2005). The five closest bald eagle nesting territories were 2.4 to 7.3 miles from the Mine Site or Plant Site (averaging 5.7 miles apart). Bald eagles are typically associated with large lakes surrounded by mature forest where large trees provide suitable nest sites and a perch while searching for fish and other prey. No large lakes are located at the Mine Site and it is unlikely that bald eagles would heavily use these areas.

The NorthMet Project area was also reviewed to evaluate whether it may provide wintering habitat for bald eagles. Eagles generally winter where there is available food at or near open water, and where carrion is available. Animal-vehicle collisions on Dunka Road and/or natural deer mortality are not likely to produce sufficient carrion to sustain bald eagles at the Mine Site (ENSR 2005). While bald eagles have been observed utilizing dead trees on other tailings basins in the Mesabi Iron Range for nesting and perching, no nests have been observed in the NorthMet Project area. Bald eagles may use standing dead trees near the existing LTVSMC Tailings Basin for perching.

MIH 7, which is primarily red and white pine forest, is considered indicative of bald eagle habitat by the USFS. No stands of MIH 7 were specifically observed on the federal lands or proposed Mine Site; however, MIH 7 is a subset of the broader MIH 5, which was observed at the Mine Site (see Figure 4.2.4-4).

Great Gray Owl

The great gray owl (*Strix nebulosa*) is not listed federally or in Minnesota, nor is it tracked in the Minnesota NHIS. It is considered globally secure by NatureServe (NatureServe 2014). Its preferred habitat includes coniferous and mixed forests and boreal bogs, which include MIHs 4, 5, and 9. These habitats are found in the NorthMet Project area. Calling surveys did not identify great gray owls at the Mine Site (ENSR 2000 and 2005); however, 2009 surveys identified a great gray owl hunting along Dunka Road south of the Mine Site, and the USFS has records of a great gray owl nesting in the NorthMet Project area in 2006 (AECOM 2009a), 2010, and 2011 (USFS 2013). In addition, the great gray owl is federally protected by the MBTA.

Three-Toed Woodpecker

The three-toed woodpecker (*Picoides tridactylus*) is not listed federally or in Minnesota and is globally secure according to NatureServe (NatureServe 2014a). It is not tracked in the Minnesota NHIS. This species was identified during winter field surveys (ENSR 2000); however, it was not identified during summer field surveys (ENSR 2005). A limiting factor for this species is foraging habitat where sufficient insects can be found to feed its young during the breeding season. Three-toed woodpeckers prefer and are most abundant in large tracts of old growth coniferous forest near recent burns where they forage on dead and dying trees for bark beetles (Burdett and Niemi 2002). MIH 9 and MIH 12 are considered habitat for the three-toed woodpecker. No old growth coniferous habitat or recent burns are present at the Mine Site or adjacent federal lands. A three-toed woodpecker was observed at the Mine Site by USFS personnel in 2007; however, the birds are unlikely to be common due to a lack of suitable habitat. In addition, the three-toed woodpecker is federally protected by the MBTA.

Bat Species

The northern long-eared bat, eastern pipistrelle, and little brown bat species were added to the 2011 RFSS list due to the spread of white-nose syndrome, which is a fungal disease impacting bats. The disease carries a high mortality rate for all bat species; the Superior National Forest is closely watching the RFSS bat species to identify signs of white-nose syndrome, as discussed above in Section 4.2.5.1.1.

4.2.5.1.4 Other Wildlife Species

Other wildlife species common to the area may be present at the Mine Site and surrounding NorthMet Project area. Species of interest include the monarch butterfly, northern leopard frog, common loon, hooded merganser, osprey, red-tailed hawk, ruffed grouse, spruce grouse, American woodcock, killdeer, common tern, belted kingfisher, pileated woodpecker, black-backed woodpecker, brown creeper, golden-crowned kinglet, Swainson’s thrush, magnolia warbler, pine warbler, savannah sparrow, beaver, porcupine, black bear, and white-tailed deer.

Species observed, or their sign, on the Mine Site and surrounding federal lands include black bear, white-tailed deer, coyote, red fox, beaver, marten, snowshoe hare, red squirrel, ruffed grouse, spruce grouse, American woodcock, common snipe, mallard, lesser scaup, hooded merganser, red-tailed hawk, broad-winged hawk, barred owl, saw-whet owl, great-horned owl, great blue heron, pileated woodpecker, and several passerine bird species (ENSR 2005; AECOM 2009a; AECOM 2009b).

Game species such as white-tailed deer and black bear are found in and near the NorthMet Project area, and are of importance to the Bands. The NorthMet Project area is located within bear management unit 31. The 6-year harvest average is 319 animals within unit 31 (MDNR 2013b; MDNR 2014c). Similarly, the NorthMet Project area is within the hunting zone for deer area 176. The 5-year average is 2.3 deer harvested per square mile in this deer area (MDNR 2013c). Sections 4.2.9 and 5.2.9 discuss species of importance to the Bands.

4.2.5.2 Plant Site and Transportation and Utility Corridor

4.2.5.2.1 Federally and State-listed Species and Species of Special Concern

Canada Lynx

The Plant Site is not on USFS land, and therefore is not located within an LAU. The western edge of the Plant Site borders a critical lynx habitat zone but not an LAU. The lynx winter tracking survey (ENSR 2006) did not identify any sign of lynx at the Plant Site.

The eastern portion of the Transportation and Utility Corridor, located directly south of the federal lands, is included in LAU 12 and in a lynx critical habitat zone. The western portion of the Transportation and Utility Corridor is not located in an LAU or critical habitat zone. The Transportation and Utility Corridor is located along areas of potential for moderate and high quality wildlife travel corridors, including surveyed wildlife corridors (Emmons and Olivier 2006; Barr 2009a). Section 6.2.5.4.2 includes further discussion of wildlife travel corridors.

Northern Long-Eared Bat

The USFS conducted various bat surveys at the NorthMet Project area during summer of 2014 (USFS 2014b). Driving surveys were conducted along Dunka Road, the Tailings Basin, and the Plant Site, and the northern long-eared bat was responsible for 4.6 percent of all calls detected. Emergence surveys were also conducted around Plant Site buildings to identify potential roost sites. The largest number of emerging bats was observed at the coarse crusher building. Of the bats observed within and emerging from the buildings, the northern long-eared bat comprised 6.9 percent at the coarse crusher building, and 27.8 percent at the concentrator building.

Gray Wolf

As previously mentioned, collared gray wolves and gray wolf signs have been observed in the vicinity of the NorthMet Project area, including the Plant Site. Gray wolf tracks and scat have been observed along Dunka Road, and radio-collared individuals and call survey responses indicate that gray wolves may be present along the Transportation and Utility Corridor. As noted previously, the area near the federal lands and Mine Site, including the eastern end of the Transportation and Utility Corridor, may support a pack of three or more individual gray wolves.

Moose

The Minnesota NHIS does not contain any records of moose occurring within the Transportation and Utility Corridor or Plant Site, and no wildlife surveys specifically for moose were conducted in these areas. Moose have been observed at the Mine Site and federal lands (ENSR 2005; AECOM 2011a), which are both located in close proximity to the Transportation and Utility Corridor and Plant Site. Due to the area's primarily disturbed nature, it is possible that moose occur in these areas, but it is unlikely that they utilize them often.

Little Brown Bat

The USFS conducted various bat surveys at the NorthMet Project area during summer of 2014 (USFS 2014b). Driving surveys were conducted along Dunka Road, the Tailings Basin, and the Plant Site, and the little brown bat was responsible for 31.3 percent of all calls detected. Emergence surveys were also conducted around Plant Site buildings to identify potential roost sites. The largest number of emerging bats was observed at the coarse crusher building. Of the bats observed within and emerging from the buildings, the little brown bat comprised 93.1 percent at the coarse crusher building, 72.2 percent at the concentrator building, and 100 percent (8 to 10 bats) at the drive house.

Eastern Pipistrelle

The USFS conducted various bat surveys at the NorthMet Project area during summer of 2014 (USFS 2014b). The eastern pipistrelle was not detected during any of the USFS surveys along Dunka Road, the Tailings Basin, or the Plant Site buildings.

Northern Goshawk

The northern goshawk's preferred habitat includes older forests, particularly aspen. This habitat is found on and near the Plant Site and Transportation and Utility Corridor. The Minnesota NHIS does not contain any northern goshawk records within the Transportation and Utility Corridor or Plant Site. However, since a northern goshawk nest was identified at the Mine Site, and two northern goshawk territories have been identified at or near the Mine Site, it is possible that northern goshawks utilize the Plant Site and Transportation and Utility Corridor.

Boreal Owl

Given the lack of dense coniferous and mixed forests, which is the boreal owl's preferred habitat, it is unlikely that it would occur at the Plant Site. However, this habitat is found in proximity to the Plant Site and Transportation and Utility Corridor. A boreal owl was heard along Dunka Road during surveys in 1988 to 1989 near the Mine Site and federal lands (ENSR 2005); however, the Minnesota NHIS does not contain any boreal owl records within 10 miles of the NorthMet Project area, and it was not observed during subsequent surveys (ENSR 2000; ENSR 2005; AECOM 2009; AECOM 2011a).

Wood Turtle

No wood turtles were observed during wildlife surveys of the NorthMet Project area. Given the lack of sandy-gravelly streams and bars, which is the preferred habitat for the wood turtle, it is unlikely that the wood turtle would be found at the Plant Site. There are no NHIS records of wood turtles at the Plant Site (MDNR 2014d). The NHIS records indicate that the northernmost population of wood turtle in the state was observed immediately south of the Mine Site. Given the proximity of the Transportation and Utility Corridor, it is possible that wood turtles could be present along the eastern portion of the corridor and southern fringes of the Mine Site.

Eastern Heather Vole

The eastern heather vole is a habitat generalist, but typically inhabits the coniferous zones in upland forests and brushlands and meadows with low shrub species, usually near water. Habitats of this type occur at the Plant Site or along the Transportation and Utility Corridor; however, the Minnesota NHIS does not contain any eastern heather vole records within 10 miles of the NorthMet Project area. The NorthMet Project area is at the southern edge of the eastern heather vole's home range in far northern Minnesota and only a few collections of the species occur within Minnesota.

Yellow Rail

Yellow rail prefer sedge meadow, which is present in a very small amount (1.5 acres) at the Plant Site and in small patches adjacent to the Transportation and Utility Corridor. The Minnesota NHIS has no records of the yellow rail occurring within 10 miles of the NorthMet Project area and field surveys did not identify any yellow rail (ENSR 2005).

Laurentian Tiger Beetle

The Laurentian tiger beetle prefers rocky or sandy areas adjacent to conifer forests. This habitat is found at the Plant Site and along the Transportation and Utility Corridor, though there were no Minnesota NHIS records of occurrences of the species near the Plant Site or Transportation and Utility Corridor.

Taiga Alpine

The taiga alpine butterfly prefers black spruce bogs and swamps. This habitat is found at the Plant Site and along the Transportation and Utility Corridor in limited areas, though there are no Minnesota NHIS records of occurrences of the species near the Plant Site or Transportation and Utility Corridor.

Freija's Grizzled Skipper

The grizzled skipper butterfly prefers forest edges and openings. This habitat is found at the Plant Site and along the Transportation and Utility Corridor, though there are no Minnesota NHIS records of occurrences of the species near the Plant Site or Transportation and Utility Corridor.

Nabokov's Blue

The Nabokov's blue butterfly prefers open woodlands and upland openings where the larval host plant, dwarf bilberry, is abundant. This habitat is found at the Plant Site and along the Transportation and Utility Corridor in limited areas, though there are no Minnesota NHIS records of occurrences of the species near the Plant Site or Transportation and Utility Corridor.

Quebec Emerald

The Quebec emerald dragonfly prefers poor fens and wet meadow/sedge meadow habitat. This habitat is found at and near the Plant Site and along the Transportation and Utility Corridor in limited areas, though there are no Minnesota NHIS records of occurrences of the species near the Plant Site or Transportation and Utility Corridor.

4.2.5.2.2 Species of Greatest Conservation Need

As with the federal lands and Mine Site, the Plant Site is located along the border of the Nashwauk Uplands and Laurentian Uplands subsections. The habitat types and associated species are summarized in Table 4.2.5-1.

Areas of open ground and bare soils are rare at the Mine Site but are abundant at the Plant Site due to LTVSMC operations or deposition in the existing Tailings Basin. Both open ground and bare soils are considered non-natural habitats. No SGCN are associated with this habitat type.

Natural brush/grassland and very early successional forest are uncommon at the Plant Site (ENSR 2005). The existing Tailings Basin re-vegetation is counted as grassland, though it is disturbed habitat and is unlikely to be heavily used by wildlife species. Most of the SGCN species in Table 4.2.5-1 are generally associated with large patches of grassland and savanna habitats that are not present at the Plant Site.

Open water and aquatic communities are confined to the existing LTVSMC Tailings Basin at the Plant Site. The Tailings Basin attracts Canada geese, ducks, common loons, and other waterfowl, though the NorthMet Project area does not otherwise appear to provide good habitat for waterfowl or waterbirds. American white pelican, common tern, Wilson's phalarope, black tern, and trumpeter swan were surveyed for, but not found (ENSR 2000 and 2005).

As previously discussed, multiple habitats are made up of combinations of other key habitat types. Section 4.2.5.1 and Table 4.2.5-1 provide more discussion on species commonly found in multiple habitat types.

As with the federal lands (including the Mine Site) and the Plant Site, the Transportation and Utility Corridor is in the Laurentian Uplands and Nashwauk Uplands subsections. Section 4.2.5.1.2 and Table 4.2.5-1 provide more discussion of the habitat and species which may be present.

4.2.5.2.3 Regional Forester Sensitive Species

Section 4.2.5.1.3 provides additional discussion of the RFSS associated with the NorthMet Project area.

Bald Eagle

Typical bald eagle habitat is not present at the Plant Site, as there are no large nesting trees or waterbodies that are open year-round near the NorthMet Project area. Similarly, there is no bald eagle habitat located along the Transportation and Utility Corridor. As previously mentioned, animal-vehicle collisions on Dunka Road and/ or natural deer mortality are not likely to produce sufficient carrion to sustain bald eagles (ENSR 2005).

Great Gray Owl

The great gray owl preferred habitat includes coniferous and mixed forests and boreal bogs. These habitats are found in proximity to the Plant Site and Transportation and Utility Corridor. Calling surveys did not identify great gray owls at the Plant Site (ENSR 2000 and 2005); however, 2009 surveys identified a great gray owl hunting along Dunka Road south of the Mine Site, and the USFS has records of a great gray owl nesting in the NorthMet Project area in 2006 (AECOM 2009a), 2010, and 2011 (USFS 2013).

Three-Toed Woodpecker

The three-toed woodpecker prefers large tracts of old growth coniferous forest near recent burns where they forage on dead and dying trees for bark beetles (Burdett and Niemi 2002). No old growth coniferous habitat or recent burns are present at the Plant Site or Transportation and Utility Corridor. Though a three-toed woodpecker was observed at the Mine Site by USFS personnel in 2007, the birds are unlikely to be common at the Plant Site or Transportation and Utility Corridor due to a lack of suitable habitat.

4.2.5.2.4 Other Wildlife Species

Other wildlife species common to the region may be present on and around the Plant Site. Section 4.2.5.1.4 provides more discussion on these species.

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4.2.6 Aquatic Species

The NorthMet Project area encompasses several waterbodies that provide a variety of habitats for fish and aquatic macroinvertebrates. This section describes the known existing conditions of the fish and aquatic macroinvertebrate communities associated with waterbodies found in the Partridge River and Embarrass River watersheds and potentially affected by the NorthMet Project Proposed Action. For purposes of this FEIS, the Strahler Order (USEPA 2011a) is used to describe the hierarchical ordering of streams, where a first-order stream describes a headwater type stream with no branching. Where two first-order streams meet, they become larger, second-order streams, and where two second-order streams meet, they become third-order streams, etc.

The majority of the streams are low velocity; exhibit glide pool characteristics; meander through emergent, scrub-shrub, and forested wetlands; and have silty to boulder substrates.

The riparian edge along these streams is predominantly vegetated, which supports quality habitat for aquatic biota with little evidence of human disturbance. Baseline surveys are indicative of habitat supporting fish communities that are comparable to communities in similar waterbodies in the region. Macroinvertebrate habitat degradation from biological stressors is minimal and fair macroinvertebrate habitat exists. Habitat for several freshwater mussel species likely exists in the vicinity of the NorthMet Project area; however, only two species of mussels were observed in two years of baseline freshwater mussel surveys.

No federally or state-listed threatened or endangered, SGCN, or RFSS aquatic special status species or invasive species were found in the NorthMet Project area during surveys. According to available data, however, there are nine RFSS species, three SGCN species, and three state-listed special concern species known to occur in the general vicinity of the NorthMet Project site. Of these, suitable habitat likely exists for five special status species: headwaters chilostigman caddisfly, Quebec emerald, ebony boghaunter, creek heelsplitter, and northern brook lamprey. However, no occurrences of these species have been documented in baseline surveys in the NorthMet Project area.

Based on Minnesota's fish tissue mercury standard, the MDH has issued fish consumption advisories for the state. Waterbodies within the vicinity of the NorthMet Project area with fish consumption advisories include Colby Lake, Whitewater Reservoir, and the St. Louis River. No advisories have been issued for stream features within the NorthMet Project area. Fish sampling results from the Partridge River in 2014 indicated some species within the watershed exhibited elevated baseline levels of mercury found in the fish tissue. The streams located within the Partridge River Watershed are also tributaries of the St. Louis River, which does have fish consumption advisories.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). The FEIS considers any new listings, or changes in the previous listings, associated with the updated list. The FEIS also considers any federal listing changes. A Biological Evaluation has been prepared that contains further information about RFSS species. The BE is included in Appendix D.

4.2.6.1 Upper Partridge River Watershed

This section describes the aquatic resources found primarily within the Upper Partridge River Watershed portion of the NorthMet Project area generally described as the Partridge River headwaters, downstream to Colby Lake, as well as Second Creek, a tributary of the Lower Partridge River downstream of Colby Lake.

4.2.6.1.1 Surface Water Features and Habitat

The surface water features within the Upper Partridge River include Mud Lake, Partridge River, and several tributaries of the Partridge River (e.g., Yelp Creek, Longnose Creek, Wetlegs Creek, Wyman Creek). The limnological features include a range of aquatic biota habitats consisting of an undeveloped freshwater lake to a river system with several headwater tributaries each combining to form a fourth-order river.

The 30.5-acre Mud Lake is located in the One Hundred Mile Swamp northwest of the Mine Site but within the federal parcel (see Figure 4.2.6-1). It has a shoreline of 4,550.0 ft and a lake frontage index of 0.7 ft per acre (see Table 4.2.6-1). Review of aerial photography indicates the lake is entirely surrounded by a vegetated wetland riparian area with no apparent development, which should provide adequate undeveloped shoreline for quality fish and macroinvertebrate habitat. The lake also has extensive shallow, emergent vegetated areas throughout, which would also provide quality habitat. Mud Lake may be susceptible to winterkill, which would minimize fish habitat.

Yelp Creek is a first order, headwater stream that flows through the One Hundred Mile Swamp where it connects with the Partridge River, forming a second-order stream at the confluence of Yelp Creek and Partridge River (see Figure 4.2.6-1). Both streams combine to encompass 5.3 miles of river through the federal parcel with a frontage index of 8.6 ft per acre. No apparent development and a wide vegetated wetland riparian buffer are exhibited from aerial photograph review, which indicates that quality fish and macroinvertebrate habitat is likely present throughout the entire Yelp Creek and Partridge River wetted water course.

Wetlegs, Longnose, and Wyman creeks are each first-order, headwater streams that flow north to south with origins between the federal parcel and Plant Site and each form confluences with the Partridge River (see Figure 4.2.6-1). These streams exhibit approximately 13.8 miles of river, collectively, prior to their confluence with the fourth-order segments of the Partridge River.

Second Creek is a headwater stream located south of the Plant Site and is joined by several unnamed tributaries as it flows southwest, forming a second-order tributary prior to connecting with the Partridge River (see Figure 4.2.6-1). The riparian zone of Second Creek is characterized by reed canarygrass, grasses, willows and alder shrubs, birch, and other larger trees. Second Creek, upstream of CR 666, is characterized by open-water wetland and numerous beaver ponds, while the lower portion is characterized by riparian woods. Portions of Second Creek are channelized or otherwise altered due to mining activity, particularly between CR 666 and CR 110.

A total of seven habitat assessment surveys were conducted at six locations within the Partridge River Watershed in the vicinity of the NorthMet Project area that describe in-stream channel characteristics and habitat within select study reaches (see Figure 4.2.6-1; Table 4.2.6-2). Five locations (four sites on the Upper Partridge River and one site on Second Creek) were in the direct vicinity of the NorthMet Project area. The site located on the South Branch of the Partridge River is considered a reference site. These survey sites were established as baseline sampling sites for the DEIS in order to analyze habitat and aquatic biota within select study reaches. Data from these and other sampling sites from various MPCA programs are summarized below. Sites PR-B1 and PR-B2 scored near the upper range of the Qualitative Habitat Evaluation Index (QHEI) (Rankin 1989) scale, which indicates good fish habitat was present. The scores for PR-B3, PR-west, and PR-east sites scored lower in the QHEI range, which is likely a function of the dominant silt substrate found at these sites.

Tables 4.2.6-1 and 4.2.6-2 provide information regarding those waterbodies located within the federal parcel and those within the larger Partridge River Watershed, respectively. The USFS tracks MIHs, which are categories of habitat types. One of the MIH categories used by USFS includes MIH 14, which is defined as the wide variety of lakes, rivers, streams, ponds, marshes, or pools (permanent, intermittent, or seasonal) that provide habitat to wildlife (USFS 2004b). The MIH represented within the boundaries of the federal parcel includes 30.5 acres for Mud Lake and 55,968.0 linear ft for Partridge River and Yelp Creek (see Table 4.2.6-1). Based on the in-stream channel characteristics and habitat, these streams and headwater tributaries should support warm water game fish species such as northern pike, yellow perch, and bass, as they function as important spawning and rearing areas. Maintaining the seasonal variation in hydrological regime is important, especially during the spring when high flows cue spawning activity and provide access to traditional fish spawning and rearing habitat. The wetlands adjacent to all surface water features on the federal lands were not scored for fish habitat during the wetland functions and values assessment, since water levels were inadequate for most of the year to support fish habitat (AECOM 2011d).

Table 4.2.6-1 Federal Land Parcel Surface Water Characteristics

Surface Water	Size on Parcel	Approximate Shoreline Frontage (ft)	MIH Size	Frontage Index (ft/acre)
Mud Lake	30.5 acres	4,555.0	30.5 acres	0.7
Partridge River and Yelp Creek	5.3 miles	55,968.0	55,968.0 linear ft	8.6

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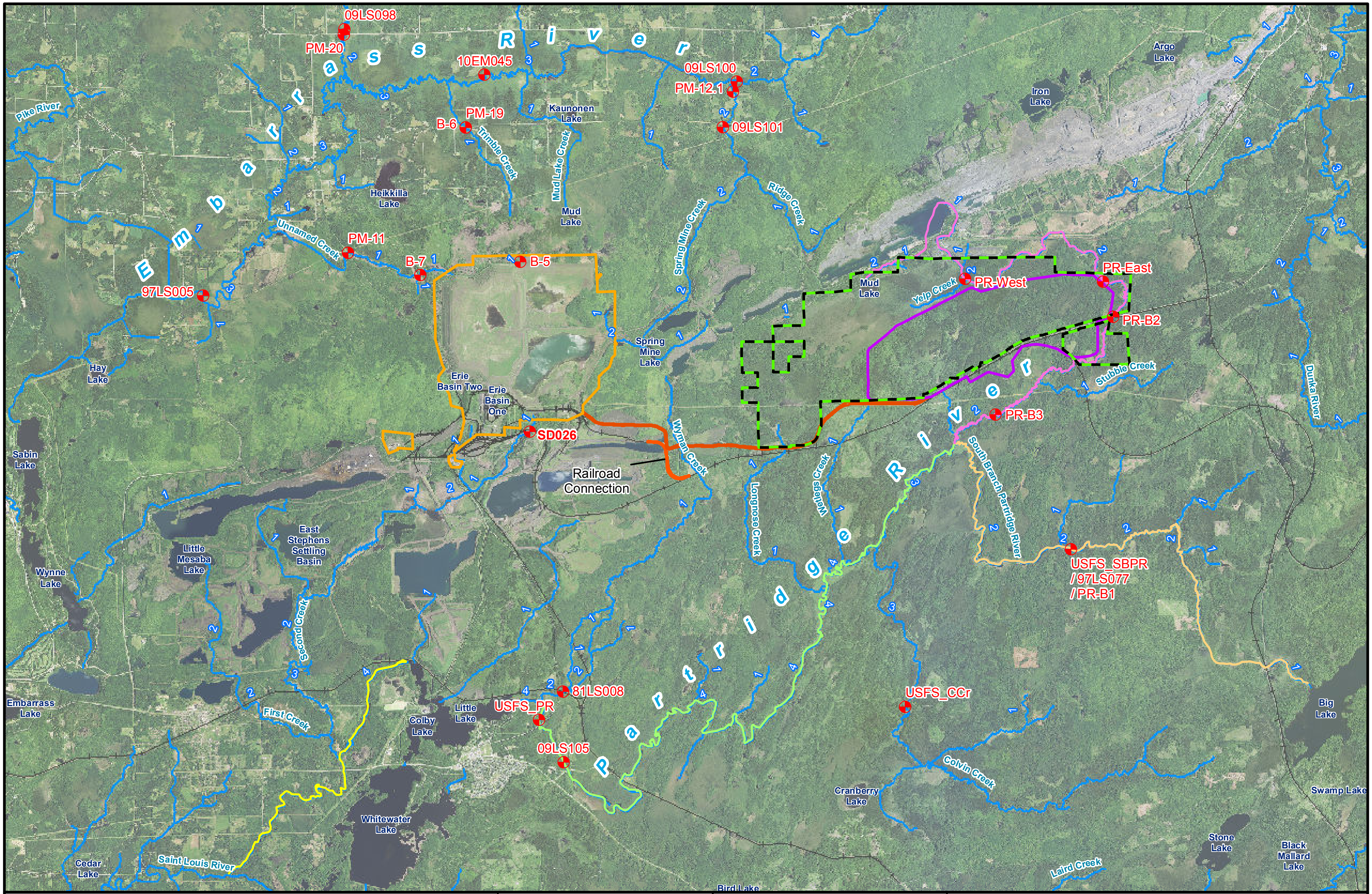

Federal Lands
Mine Site
Plant Site
Transporatioin and Utility Corridor

Sampling Reach
Reach 1
Reach 2
Reach 3
Reach 4

Monitoring Station
Existing Railroad
Stream / River
Stream Order Number

MNDNR
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

N W E S

0 0.5 1 2 Miles

Figure 4.2.6-1

Fish and Macroinvertebrate Sample Site Locations

NorthMet Mining Project and Land Exchange FEIS

Minnesota

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Table 4.2.6-2 Major Channel Characteristics at Biological Survey Stream Sites in the Partridge River Watershed

Water Body/ Reference	Channel Characteristics								
	Study Year	**Site Location**	**Stream Order[2]**	**Catchment (mi[1])**	**Dominant Substrate**	**Width (m)**	**Depth (cm)**	**Velocity (cm/s)**	**QHEI[2]**
Partridge River (Barr 2011b)	2009	PR-west site	2	na	Silt	4.9	79.25	na	40
Partridge River (Barr 2011b)	2009	PR-east site	2	na	Silt	4.0	88.39	na	41
South Branch Partridge River[3] (Breneman 2005)	2004	PR-B1	2	14.0	Boulder	7.5	26.74	6.90	70
South Branch Partridge River[3] (MPCA 2011c)	2009	MPCAB_97LS077	2	14.0	Boulder	7.0	21.1	na	na
Partridge River (Breneman 2005)	2004	PR-B2	2	15.2	Boulder	9.5	20.67	15.13	79
Partridge River (Breneman 2005)	2004	PR-B3	2	23.0	Silt	7.2	72.23	7.03	65
Second Creek (Barr 2011i)	2011	SD026	1	--	Boulder, gravel, silt, detritus	5.0	37	0.03	69

Source: Adapted from Breneman 2005, Barr 2011b, and MPCA 2011c.

Notes:
na = Not available
1 Referenced from Figure 4.2.6-1.
2 QHEI is designed to provide an integrated evaluation of physical habitat characteristics important to fish communities and ranges from 0 (low) to 100 (high).
3 South Branch Partridge River reference sites PR-B1 and 7LS077 are the same location.

Watershed Level Riparian Connectivity

Intact riparian areas are an important factor contributing to diverse and productive aquatic ecosystems. The streams present in any watershed are each part of an intricate web of perennial, defined as waterbodies with water present year-round, and non-perennial streams, lakes, and rivers. They are part of a larger watershed where the connections between these surface water features are affected by the vegetated, undisturbed riparian edges bordering these waterbodies. A Riparian Connectivity Index (RCI), developed by the MDNR, measures the percentage of undeveloped, vegetated land within the riparian zone and is typically derived using a GIS analysis of vegetative cover along riparian areas and takes into consideration agriculture and land development affected natural riparian vegetative cover (MDNR 2015a). The Partridge River is a tributary to the larger St. Louis Watershed where the score for the St. Louis Watershed was rated at 0 percent agriculture in the riparian zone, 5 percent development in the riparian zone, and a total RCI of 95. Localized GIS analysis of the Partridge River within the boundary of the federal lands indicates the score is also representative of this area.

Aquatic Connectivity

Dams, bridges, and culverts in streams, creeks, and rivers may reduce the hydrologic connectivity of watersheds if they become fish barriers and may affect the habitat available for aquatic organisms by influencing stream velocities, sediment deposition, substrate composition, erosion potential, and water quality.

The MDNR has developed an Aquatic Connectivity Index (ACI), which reflects the extent of dams, bridges, and culverts along stream segments. The number of structures that modify aquatic connectivity in Minnesota streams is very high. The vast majority of watersheds score 20 or below on a scale of 0 to 100, where 100 represented the fewest amount of structures per river mile, indicating a high density of bridges, culverts, and dams (MDNR 2015b).

The index exhibited for the St. Louis River Watershed indicated a score of 15 for bridges and culverts and 6 for dams. The overall ACI score for the St. Louis Watershed was 11, which indicates that dams, bridges, and culverts impair the aquatic connectivity of the watershed and limit the available physical habitat for aquatic organisms.

Localized analysis of dams, bridges, and culverts along the Partridge River are limited to one Dunka Road crossing within the vicinity of the Mine Site.

4.2.6.1.2 Existing Water Quality within the Vicinity of the Mine Site

Water quality can have significant effects on aquatic species. The existing water quality data collected within the Partridge River sampling locations provided the basis for the NorthMet Project Proposed Action and Continuation of Existing Conditions (CEC) Scenario models (Section 5.2.2.2.3). Existing condition mercury values were consistently in exceedance of Class 2B water quality standards while aluminum and thallium values were in exceedance of water quality standards at one or more sampling locations (see Figure 4.2.6-2; Table 4.2.6-3). No data were available to evaluate the Mud Lake and Yelp Creek water quality. Wyman Creek is included on the 2012 TMDL list for aquatic life based on Fishes Bioassessment. Additional existing water quality information is contained in Section 4.2.2.

Table 4.2.6-3 Average Existing Water Quality Concentrations in the Partridge River

Parameter	Units	Evaluation Criteria[1]	SW-001	SW-002	SW-003	SW-004	SW-004a	SW-004b	SW-005
General									
Chloride	µg/L	230	1.6	25.7	10.3	9.2	9.3	5.7	5.7
Specific Conductivity	umhos/cm	NA	230	363	217	208	209	148	142
TDS	mg/L	700	119	235	161	155	171	153	143
Temperature	ºC	-	13.7	10.7	10.8	11.2	12.5	11.7	11.8
Metals									
Aluminum	µg/L	125	18.0	31.3	51.8	**193**	119	**127**	**129**(3)
Antimony	µg/L	31	1.5	0.53	0.53	0.53	0.25	0.25	0.53
Arsenic	µg/L	53	6.5	0.48	0.90	1.1	0.95	0.96	1.0
Boron	µg/L	500	96.0	148	94.8	93.0	116	75.9	51.4
Cadmium	µg/L	2.5(2)	0.10	0.10	0.10	0.09	0.08	0.07	0.09
Cobalt	µg/L	5	0.45	0.30	0.33	0.57	0.42	0.43	1.16
Copper	µg/L	9.3(2)	1.6	0.8	1.0	1.5	1.5	1.5	1.6
Lead	µg/L	3.2(2)	0.30	0.29	0.27	0.32	0.22	0.26	0.41(4)
Mercury	ng/L	1.3	**2.3**	**2.7**	**2.8**	**3.3**	**4.1**	**5.4**	**4.3**
Nickel	µg/L	52(2)	1.4	0.71	1.1	1.5	1.2	1.6	1.7
Selenium	µg/L	5	1.7	0.90	0.90	0.73	0.44	0.64	0.77
Silver	µg/L	1	0.29	0.21	0.21	0.20	0.10	0.10	0.20

Parameter	Units	Evaluation Criteria[1]	SW-001	SW-002	SW-003	SW-004	SW-004a	SW-004b	SW-005
General									
Thallium	µg/L	0.56	**0.60**	0.19	0.19	0.16	0.01	0.01	0.15
Vanadium	µg/L	NA	--	1.5	1.5	1.5	1.5	1.5	1.5
Zinc	µg/L	120[(2)]	8.9	5.5	8.7	10.3	4.6	4.2	10.5

Source: Barr 2014d.

Notes:
Bold font indicates exceedance of the Class 2B water quality standards evaluation criteria.
1 Section 5.2.2 includes a detailed discussion of evaluation criteria.
2 Water quality standard for this metal is hardness-dependent. Listed value assumes a hardness concentration of 100 mg/L.
3 Excludes single outlier value of 1,550 µg/L from values included in Barr 2014d.
4 Excludes single outlier value of 12.3 µg/L from values included in Barr 2014d.

4.2.6.1.3 Aquatic Biota Studies

Several aquatic biota surveys are summarized below as referenced from Breneman (2005), Barr (2011b), MPCA (2011c), and USFS (2014). Breneman conducted biological surveys at two sites in the Upper Partridge River near the Mine Site (PR-B2 and PR-B3) and at a third site on the South Branch Partridge River (PR-B1) during August and September 2004, while Barr conducted surveys at two other sites in the upper Partridge River near the Mine Site (PR-east and PR-west) during September 2009 (see Figure 4.2.6-1). Two additional July 2009 surveys were reported by the MPCA (MPCA 2011c and MPCA 2013c) and were located at the South Branch Partridge River (same site as PR-B1) and at a site upstream of the Wyman Creek and Partridge River confluence (MPCA_09LS105). The main stem Partridge River sites have been previously affected by discharges from the Northshore Mine (Breneman 2005). The site on the South Branch Partridge River (PR-B1/MPCAB_97LS077), identified by Breneman (2005) to be a suitable reference site for the Partridge River, is approximately 4.3 river miles upstream of the South Branch Partridge River confluence with the Partridge River and is unaffected by any mining discharge (Breneman 2005).

The results of the fish and macroinvertebrate surveys are summarized in Table 4.2.6-4 and 4.2.6-5. The assemblages observed in the survey are typical of those sampled elsewhere in the northeast region of Minnesota (Barr 2011b). No listed SGCN, RFSS, state, federal, or invasive species were observed during these surveys.

Fish Communities

Abundance and diversity of taxa among the Upper Partridge River sampling sites were indicative of a warm water stream populated by typical warm water species, including gamefish such as northern pike, bluegill, northern rock bass, and yellow perch (see Table 4.2.6-4). The presence of one or more intolerant or intermediate species in each of these monitoring locations is, however, one indication that quality habitat is present at these sites and chemical and physical stream deterioration is likely negligible. A review of aerial photography reveals similar riparian vegetation cover for all Upper Partridge River sites.

Results of an extensive fish population assessment by MDNR conducted in 2014 indicated a healthy warm water fish population including walleye, largemouth bass, black crappie, and channel catfish in addition to other gamefish species (see Table 4.2.6-5). Reach 2, above Colby Lake had the highest diversity of fish species sampled and was the most popular stretch of the river used by anglers. Juvenile gamefish were found in all reaches, indicating good habitat for natural reproduction (MDNR 2015f).

The MPCA collected fish community data during a 2009 sampling event for Wyman Creek, a State of Minnesota-listed trout stream (see Figure 4.2.6-1). MDNR surveys were conducted on Wyman Creek in 1968, 1981, and 2003 (MDNR 1981; MDNR 2003). Based on the latest 2009 survey, a variety of taxa were collected; however, no trout species were collected, which likely contributed to an IBI score of only 33, four points below the minimum threshold for this stream classification (see Table 4.2.6-4). MDNR survey results reference elevated stream temperatures due to warm water surface runoff from Mine Pit lakes to the east and west of the headwaters, extensive logging in the watershed, and beaver dam and impoundments occurring along the entire length of Wyman Creek. It should be noted that Wyman Creek is not a comparable stream to others in the Upper Partridge River watershed for several reasons. Most notable, Wyman Creek is a designated cold water trout stream, it is affected by mining activity, and would not be in the direct drainage of the NorthMet Project Proposed Action. It is included in this FEIS because it contributes to watershed water quality.

No aquatic biota studies have been conducted in Longnose Creek, Wetlegs Creek, or Second Creek, and no fish or macroinvertebrate community or habitat characteristics could be documented, although, like Yelp Creek, all are first-order streams within the vicinity of the NorthMet Project area.

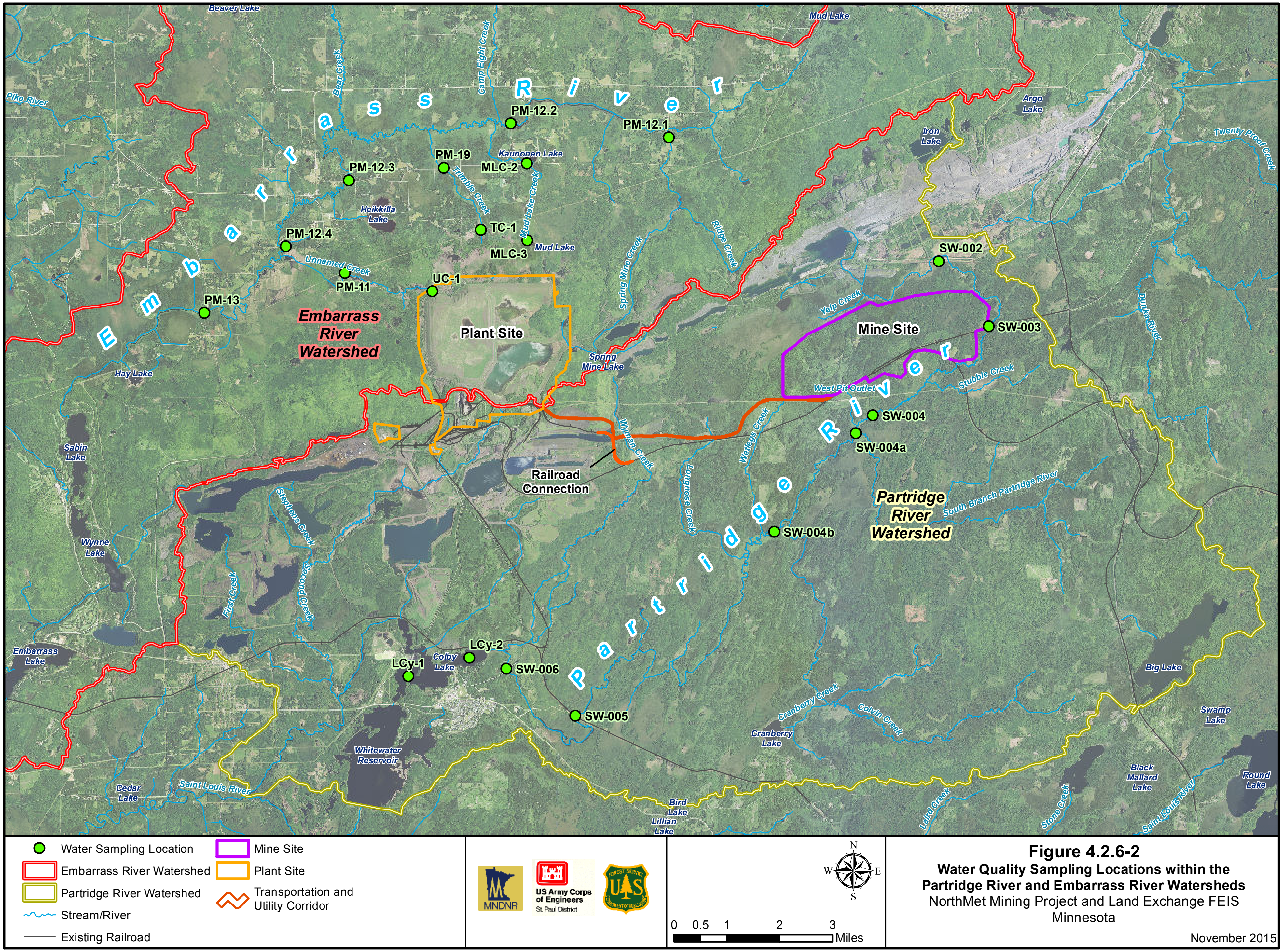

Figure 4.2.6-2
Water Quality Sampling Locations within the Partridge River and Embarrass River Watersheds
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Table 4.2.6-4 Fish Species Collected at Nine Sites in the NorthMet Project Area

			Site								
			Upper Partridge River Watershed								Wyman Creek Watershed
Scientific Name	**Common Name**	**Tolerance Designation[1]**	**PR-B2[2]**	**PR-B3**	**PR-east[2]**	**PR-west[2]**	**PR-B1[3]**	**97LS077[3]**	**09LS105**	**USFS_SBPR[5]**	**81LS008**
Ameiurus melas	Black bullhead	Intermediate							X		X
Catostomus commersonii	White sucker	Tolerant	X	X	X	X	X	X	X	X	X
Moxostoma macrolepidotum	Northern shorthead redhorse	Intermediate							X		
Rhinichthys cataractae	Longnose dace	Intolerant	X	X			X	X	X		X
Luxilus cornutus	Common shiner	Intermediate	X		X		X				X
Etheostoma nigrum	Johnny darter	Intermediate	X		X		X	X		X	X
Hybognathus hankinsoni	Brassy minnow	Intermediate	X		X		X				
Lota lota	Burbot	Intermediate					X	X	X	X	X
Percina caprodes	Northern logperch	Intermediate							X		
Percopsis omiscomaycus	Troutperch	Intermediate							X		
Ambloplites rupestris	Northern rock bass	Intermediate							X		
Esox lucius	Northern pike	Intermediate					X	X	X	X	
Lepomis macrochirus	Bluegill	Intermediate							X		
Perca flavens	Yellow perch	Intermediate							X		X
Pomoxis nigromaculatus	Black crappie	Intermediate							X		
Sander vitreus	Walleye	Intermediate							X		
Phoxinus eos	Northern redbelly dace	Tolerant	X		X	X					X
Culaea inconstans	Brook stickleback	Intermediate	X		X	X					
Rhinichthys atratulus	Blacknose dace	Intolerant	X		X						
Semotilus atromaculatus	Creek chub	Tolerant									X
Margariscus margarita	Pearl dace	Intermediate	X		X						X
Noturus gyrinus	Tadpole madtom	Intermediate		X							
Umbra limi	Central mudminnow	Tolerant		X						X	
Pimephales promelas	Fathead minnow	Tolerant			X						
Cottus bairdii	Mottled sculpin	Intolerant						X		X	X
Study Year			2004	2004	2009	2009	2004	2009	2009	2011/2012/2014	2009
Species Observed			9	4	9	3	7	6	13	6	11

Scientific Name	Common Name	Tolerance Designation[1]	Site: Upper Partridge River Watershed: PR-B2[2]	PR-B3	PR-east[2]	PR-west[2]	PR-B1[3]	97LS077[3]	09LS105	USFS_SBPR[5]	Wyman Creek Watershed: 81LS008
# intolerant species			2	1	1	0	1	2	1	1	1
Total Abundance			267	11	1,847	19	36	68	155	12	64
IBI[4]			na	na	na	na	na	61	87	na	33
Predominant Substrate			boulder	silt	silt	silt	boulder	boulder	na	na	na

Sources: Breneman 2005; Barr 2011b; MPCA 2011c; MPCA 2013c; MDNR 1981; MDNR 2003, and USFS 2014.

Notes:
[1] Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish - Second Edition EPA 841-B-99-002 (USEPA 2012b). Tolerance values indicate qualitative tolerances of physical and chemical disturbances.
[2] Federal parcel sites.
[3] South Branch Partridge River reference sites PR-B1 and 7LS077 are the same location.
[4] IBI is the sum of study specific metrics, where 0 represents the worst fish assemblage conditions and 100 represents the best fish assemblage conditions (USEPA 2011b).
[5] Results of one-pass electroshocking sampling in years 2011, 2012, and 2014. Summarized data is an average of three surveys combined.
-- = no designation assigned
na = Not available

Table 4.2.6-5 Fish Species Collected at Four Reaches within the Partridge River Watershed

Scientific Name	Common Name	Tolerance Designation[1]	Study Reach Fall 2014 MDNR Partridge River Watershed Fish Sampling			
			Reach 1	Reach 2	Reach 3	Reach 4
Ameiurus melas	Black bullhead	Intermediate	X	X	X	
Ameiurus natalis	Yellow bullhead	Intermediate	X	X		
Ictalurus punctatus	Channel catfish	Tolerant		X		
Catostomus commersonii	White sucker	Tolerant	X	X	X	X
Rhinichthys atratulus	Blacknose dace	Intolerant				X
Rhinichthys cataractae	Longnose dace	Intolerant	X	X	X	
Moxostoma macrolepidotum	Northern shorthead redhorse	Intermediate		X		
Luxilus cornutus	Common shiner	Intermediate		X		
Etheostoma nigrum	Johnny darter	Intermediate			X	X
Hybognathus hankinsoni	Brassy minnow	Intermediate				
Lota lota	Burbot	Intermediate	X	X	X	
Percina caprodes	Northern logperch	Intermediate	X	X		
Ambloplites rupestris	Northern rock bass	Intermediate	X	X		
Esox Lucius	Northern pike	Intermediate	X	X	X	
Lepomis macrochirus	Bluegill	Intermediate	X	X		
Micropterus salmoides	Largemouth bass	Intermediate		X		
Perca flavens	Yellow perch	Intermediate		X		
Pomoxis nigromaculatus	Black crappie	Intermediate	X	X		
Sander vitreus	Walleye	Intermediate	X	X	X	
Phoxinus eos	Northern redbelly dace	Tolerant				
Culaea inconstans	Brook stickleback	Intermediate				X
Rhinichthys atratulus	Blacknose dace	Intolerant				
Semotilus atromaculatus	Creek chub	Tolerant				X
Margariscus margarita	Pearl dace	Intermediate				X
Noturus gyrinus	Tadpole madtom	Intermediate		X		
Umbra limi	Central	Tolerant				

Scientific Name	Common Name	Tolerance Designation[1]	Study Reach Fall 2014 MDNR Partridge River Watershed Fish Sampling			
			Reach 1	Reach 2	Reach 3	Reach 4
	mudminnow					
Pimephales promelas	Fathead minnow	Tolerant				
Cottus bairdii	Mottled sculpin	Intolerant				
Cottus spp.	Sculpin species	Unknown	X	X	X	
Study Year			2014	2014	2014	2014
Species Observed			12	18	8	6
# intolerant species			1	1	1	1

Source: MDNR 2015f.

Note:
1 Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish - Second Edition EPA 841-B-99-002 (USEPA 2012b). Tolerance values indicate qualitative tolerances of physical and chemical disturbances.

Macroinvertebrate Communities

Aerial photography review and habitat descriptions found in the various studies indicate the reference site (PR-B1) and the USFS Colvin Creek and South Branch Partridge River sites should have no effects from previous mining and quality habitat should exist for macroinvertebrate assemblages. The results of the 2011 macroinvertebrate studies indicate habitats for macroinvertebrate assemblages are just as good or better at the PR-B2 and PR-B3 Partridge River study sites as the percent Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (%EPT) exhibited better results at the Partridge River sites and similar %Diptera results. The Hilsenhoff Biotic Index (HBI), which measures the pollution tolerance for various benthic macroinvertebrate families, exhibited a fair ranking for both sites, which indicates habitat degradations from biotic stressors are minimal and fair macroinvertebrate habitat exists. %EPT and %Diptera results are also similar to the 2004 results for sites PR-B2 and B3.

The results of the USFS studies indicate variable %EPT and %Diptera between three study years, but, in general, the results indicate %EPT scores on the high end. This indicates quality macroinvertebrate habitat likely exists at these sites. Comparing the generally high %EPT and low %Diptera results at the USFS sites with the 2011 studies indicates better habitat may be present at the USFS sites; however, the results may be indicative of differing sampling protocols or that the variability in sampling was absent for the one year effort in the 2011 studies.

Table 4.2.6-6 Composition of Macroinvertebrate Assemblages at Nine Sites in the Federal Parcel

Name	Study Year	Site	No. of Samples	Total Taxa	Mean Abundance	%EPT[1]	%Diptera[2]	HBI Scale of 0 - 10[3]	HBI Ranking[3]
South Branch Partridge River (Breneman 2005)	2004	PR-B1	7	90	627	6	58	na	na
South Branch Partridge River (USFS 2014)	2011/ 2012/ 2013	USFS-SBPR	1/ 1/ 1	43/ 55/ 62	300/ 300/ 319	11/ 34/ 54	75/ 32/ 33	na	na
Partridge River (Breneman 2005)	2004	PR-B2	6	89	1,261	15	65	na	na
Partridge River (Breneman 2005)	2004	PR-B3	4	82	1,278	16	52	na	na
Partridge River (Barr 2011b)	2009	PR-west	5	27	710	19	66	6.4	Fair
Partridge River (Barr 2011b)	2009	PR-east	5	26	912	22	50.2	6.0	Fair
Partridge River (USFS 2014)	2011/2012/ 2013	USFS-PR	1/ 1/ 1	52/ 61/ 44	329/ 301/ 308	67/ 44/ 58	16/ 17/ 32	na	na
Second Creek	2011	SD026	na	36	2,534	72	47	na	na
Colvin Creek (USFS 2014)	2011/2012/ 2013	USFS-CCk	1/ 1/ 1	50/ 51/ 28	330/ 325/ 134	60/ 31/ 10	28/ 34/ 27	na	na

Sources: Data and functional group assignments from Breneman 2005, Barr 2011b, Barr 2011i, and USFS 2014.

Notes:

[1] %EPT indicates the percent of mayflies, stoneflies, and caddisflies within the macroinvertebrate sample. High EPT percentages of the population typically indicates degraded habitat conditions are not present.

[2] %Diptera indicates the percent of true flies and bloodworms present within the macroinvertebrate sample. High percentages of the population typically indicates low habitat diversity and predominant silty habitats often present within slow-moving, headwater streams.

[3] HBI is the measure of macroinvertebrate assemblages tolerance toward organic (nutrient) enrichment. Not calculated in Breneman 2005.

na = Not available

Freshwater Mussel Communities and Habitats at Survey Sites

Unionid mussels (*Unionidae*) constitute one of the most imperiled major taxa in the United States (Master et al. 2000), and the MCWCS identifies 26 unionid species within Minnesota as species of special concern. Two of these species, creek heelsplitter (*Lasmigona compressa*) and black sandshell (*Ligumia recta*), are known to exist in the St. Louis River Watershed (see Table 4.2.6-6), but were not identified in areas near the Mine Site. Heath (2011) sampled mussels at M1 and M2 in 2004 and at PR-upstream and PR-downstream in 2009 (see Figure 4.2.6-3). Only one mussel species was collected in the Partridge River Watershed, the giant floater (*Pyganodon grandis*) (see Table 4.2.6-7), which is a widely distributed feeding generalist, tolerant of silt-dominated substrate, and often found in lakes, ponds, or slow-moving water pools of small to medium-sized creeks and rivers (Cummings and Mayer 1992; Heath 2011).

Some of the unionid species known to exist in the St. Louis River Watershed were not collected by Heath (2011), including the creeper (*Strophitus undulatus*), plain pocketbook (*Lampsilis cardium*), white heelsplitter (*Lasmigona complanata*), and the black sandshell (see Table 4.2.6-7). The creeper, plain pocketbook, and white heelsplitter are typically found in larger streams (Cummings and Mayer 1992) and may only exist farther downstream in the drainage system. It is unlikely that the SGCN-designated black sandshell occurs in the NorthMet Project area given its absence from the sample sites. Habitat for this species (riffles or raceways in gravel or firm sand; Cummings and Mayer 1992) likely only exists in small reaches within the NorthMet Project area.

Other species known to exist in the St. Louis River Watershed, but also not collected by Heath (2011) at all stations included cylindrical papershell (*Anodontoides ferussacianus*) and creek heelsplitter. The SGCN-designated creek heelsplitter is found in sand and fine gravel substrates (Cummings and Mayer 1992). Sand and gravel were minor substrate type at the sites sampled and is therefore unlikely to exist in the Partridge River Watershed (see Table 4.2.6-8).

Table 4.2.6-7 Mussel Species Identified in the Lake Superior Basin, St. Louis River Watershed, Partridge River, and Embarrass River

		Location			
		Sietman (2003)		Heath (2004 and 2009)	
Scientific Name	Common Name	Lake Superior Basin	St. Louis River Watershed	Partridge River[2]	Embarrass River[3]
Elliptio complanata	Eastern elliptio	X	X		
Anodontoides ferussacianus	Cylindrical papershell	X	X		
Lasmigona complanata	White heelsplitter	X	X		
L. compressa[1]	Creek heelsplitter	X	X		
Pyganodon grandis	Giant floater	X	X	X	X
Strophitus undulatus	Creeper	X	X		
Utterbackia imbecillis	Paper pondshell	X			
Lampsilis cardium	Plain pocketbook	X	X		
L. siliquoidea	Fat mucket	X	X		X
Ligumia recta[1]	Black sandshell	X	X		

Source: Adapted from Heath 2011.

Notes:
1 Minnesota Species of Special Concern.
2 Partridge River sampling sites include M-1, M-2, PR-upstream, and PR-downstream; only one species was found between four sites.
3 Embarrass River only sampled by Heath as summarized in the Heath 2011 report.

Table 4.2.6-8 Location and Physical Characteristics of Mussel Sample Sites

Name	Site	River Mile[1]	Mean Depth (cm)	Substrate Composition
Partridge River	PR-upstream	25.0	250	100% detritus (peat)
Partridge River	PR-downstream	21.6	150	20% clay 80% detritus (peat)
Partridge River	M1	20.5	80	95% silt 5% boulder
Partridge River	M2	16.7	60	40% silt 30% boulder 15% coarse sand 15% fine sand
Trimble Creek	M3	na	20	50% gravel 50% coarse sand
Embarrass River	M4	na	60	20% boulder 20% rubble 20% coarse sand 20% fine sand 20% clay

Source: Modified from Heath 2011.

Notes:
1 River mile indicated is measured from the sample site to the Colby Lake inlet.
na = Not available

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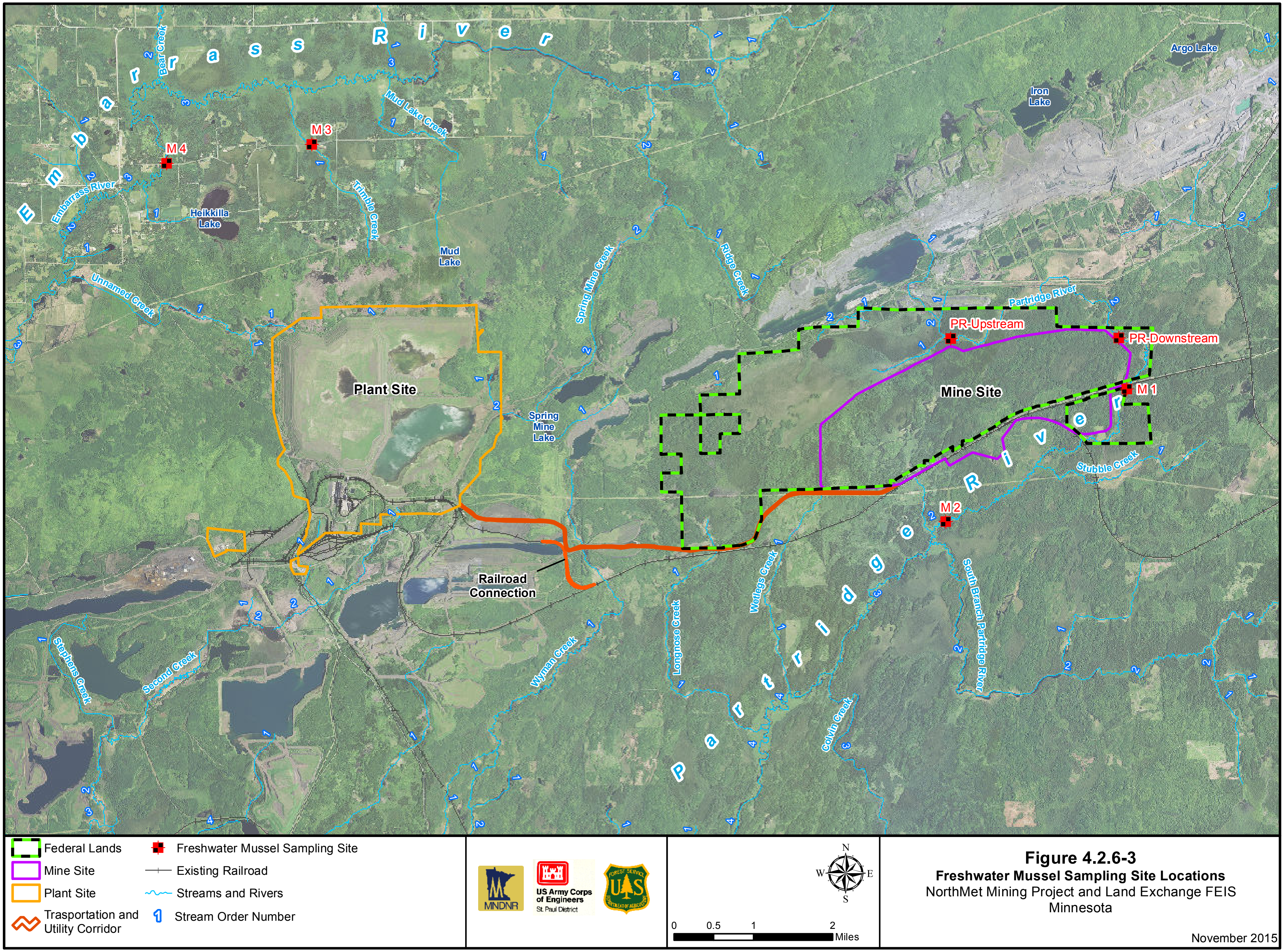

Figure 4.2.6-3

Freshwater Mussel Sampling Site Locations

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4.2.6.1.4 Special Status Fish and Macroinvertebrates

There are no federally listed or state-listed threatened or endangered fish or macroinvertebrate species known to occur in the Partridge River (USFWS 2011).

As with wildlife resources, assessment of fish and macroinvertebrates included consideration of the MCWCS (MDNR 2006d) and RFSS species. The MCWCS identifies SGCN by ecoregion subsections based on a statewide approach, and the RFSS species are identified for the potential to be found within the Superior National Forest. SGCN species identified in the Laurentian Uplands and Nashwauk Uplands, include two unionid mussel species (i.e., creek heelsplitter and black sandshell) and one species of fish (northern brook lamprey, *Ichthyomyzon fossor*), but these species were not found in the NorthMet Project area, though there is potential habitat for these species. These species also are listed by the state as species of special concern and the USFS as RFSS. In addition to the creek heelsplitter and the black sandshell, USFS also lists seven other species as RFSS for Superior National Forest, including three insects and four fish (see Table 4.2.6-9). Each of these RFSS species are briefly described below. No invasive fish or macroinvertebrate species are known to exist within the federal parcel.

Table 4.2.6-9 SGCN and RFSS Species Identified within Portions of the Laurentian Uplands – Nashwauk Uplands Ecoregion or Superior National Forest

Scientific Name	Common Name	Laurentian and Nashwauk Uplands Ecoregion SGCN	RFSS
Insects			
Chilostigma itascae	Headwaters chilostigman caddisfly		X
Somatochlora brevicincta	Quebec Emerald		X
Williamsonia flechen	Ebony boghaunter		X
Fish			
Acipenser fulvescens	Lake sturgeon		X
Coregonus nipigon	Nipigon cisco		X
Coregonus zenithicus	Shortjaw cisco		X
Ichthyomyzon fossor	Brook lamprey	X	X
Mussels			
Lasmigona compressa	Creek heelsplitter	X	X
Ligumia recta	Black sandshell	X	X

Sources: MDNR 2006d and USFS 2012f.

<u>Headwaters Chilostigman Caddisfly</u>

This species of caddisfly has only been discovered in two locations within Minnesota where it is also listed as a state endangered species. In 1994, it was documented in a slow-moving, silt-dominated headwater stream in Itasca State Park and in 2005 in rich swamp to poor fen habitats within a large, acid to minerotrophic peatland complex in Finland State Forest (MDNR 2011L). Little is known about the headwaters chilostigman caddisfly. Headwater habitats are present at the Mine Site; however, since the distribution of this caddisfly appears to be very limited, it is unlikely to occur in the NorthMet Project area.

Quebec Emerald

The Quebec emerald dragon fly occurs in lentic habitats typically associated with bogs, fens, and heaths near water-saturated or water-suspended sphagnum (USFS 2007a). This species has been found within the Superior National Forest. Little distribution information is known regarding this species due to lack of completed surveys. The known required habitat is likely present within the federal parcel near the bogs associated with the headwater stream, Yelp Creek; however, this species was not found in the benthic macroinvertebrate surveys. The likelihood of observing Quebec emerald individuals or populations in the vicinity of the federal parcel and Mine Site is low.

Ebony Boghaunter

The ebony boghaunter shares a similar habitat description with the headwaters chilostigman caddisfly described above; however, the distribution is likely more widespread than the caddisfly (MDNR 2011L). Habitat likely exists for this species in the NorthMet Project area in sphagnum dominated bogs; however, this species has not been identified in the benthic macroinvertebrate surveys conducted to date.

Lake Sturgeon

The lake sturgeon is a large fish that is broadly distributed throughout the Mississippi River, Great Lakes, and Hudson Bay drainages (Scott and Crossman 1973a; Wilson and McKinley 2005). Lake sturgeon typically inhabit large lakes and rivers and are usually found in waters that are 15 to 30 ft deep (Wilson and McKinley 2005). Spawning takes place in swift-flowing water 2 to 15 ft in depth, often at the base of a low waterfall that blocks further migration upstream (Scott and Crossman 1973a). The species has been classified as threatened in both Canada and the United States by a special committee of the American Fisheries Society (Williams et al. 1989) and is a species of special concern in Minnesota.

Historically, lake sturgeon migrated approximately 14 miles upriver from Lake Superior in the St. Louis River (Auer 1996). Spawning occurred between the falls near Fond du Lac, which formed a natural barrier to upstream migration, and Bear Island located a few miles downstream (Goodyear et al. 1982; Kaups 1984; Schram et al. 1999). The lake sturgeon was extirpated from the St. Louis River during the early 1900s (Schram et al. 1999).

The St. Louis River currently is one of 17 tributaries to Lake Superior identified by the Great Lakes Fishery Commission as a priority stream where lake sturgeon rehabilitation should be focused, and the St. Louis is one of only six rivers identified by the Great Lakes Fisheries Commission as a priority for lake sturgeon stocking (Auer 2003). A stocking program was initiated in 1983 to reintroduce lake sturgeon to the St. Louis River; however, stocking was reduced in 1995 and discontinued in 2000 (MDNR 1995). The stocking has resulted in an increase in lake sturgeon abundance in the St. Louis River estuary near Duluth (Schram et al. 1999). Two separate observations of juvenile lake sturgeon were observed by Fond du Lac and MDNR biologists near the Fond du Lac dam in 2011 and 2014, respectively, which indicates recruitment from naturally reproducing adult lake sturgeon, since no stocking has occurred below the dam since 2000 (MDNR, Pers. Comm., November 7, 2014). Fond du Lac has stocked lake sturgeon into the St. Louis River above the Fond du Lac dam near the confluence with the Cloquet River and within the Cloquet River near Independence, Minnesota. Fond du Lac has 2012 through 2014 lake sturgeon telemetry data, which indicates juvenile and adult sturgeon have been located near Floodwood, Minnesota, downstream from the confluence of the Whiteface River and St. Louis River (MDNR, Pers. Comm., January 12, 2015). No fish have been observed upstream of this location and migration of lake sturgeon from this location would be blocked by the dam at Forbes, Minnesota, approximately 14 miles downstream of the Embarrass River confluence with the St. Louis River.

There are no known occurrences of lake sturgeon and no likely habitat for lake sturgeon within the NorthMet Project area (see Appendix D).

Nipigon Cisco

The nipigon cisco is found in waters of Lake Nipigon, Black Sturgeon Lake, Saganaga Lake, and other lakes of northwest Ontario and Quebec (Hubbs and Lagler 2007). Saganaga Lake is the only lake in this list shared with Minnesota and Ontario and is a deep, oligotrophic lake covering approximately 13,800 acres (MDNR 2011d). There are no known occurrences or likely habitat for nipigon cisco within the NorthMet Project area.

Shortjaw Cisco

Formerly found in deep waters of several of the Great Lakes (Scott and Crossman 1973c), the shortjaw cisco has been eliminated from Lakes Erie, Huron, and Michigan and is in decline in Lake Superior (COSEWIC 2003). The species is also found in Gunflint and Saganaga lakes (MDNR 2006d), which are two of the deepest natural lakes in Minnesota. Invasive species, habitat degradation, and competition or predation may be factors that are limiting recovery (Pratt and Mandrak 2007). There are no known occurrences or likely habitat for shortjaw cisco within the NorthMet Project area.

Northern Brook Lamprey

The northern brook lamprey is a small, nonparasitic, jawless fish. This species' typical habitat is creeks and small rivers, apparently avoiding small brooks and large rivers (Scott and Crossman 1973b). There are no known occurrences of this species in or near the NorthMet Project area. Cochran and Pettinelli (1987) identified northern brook lamprey at a site south of Cloquet, Minnesota, approximately 75 miles south of the NorthMet Project area. Since 1986, it has been collected from six other sites in the Lake Superior drainage (Hatch et al. 2003). Suitable habitat for northern brook lamprey is likely to exist in the NorthMet Project area; however, the nearest known occurrence of this species is far removed from the NorthMet Project area.

Freshwater Mussels

No special freshwater mussel species were observed during the mussel surveys described in Heath (2011). As discussed above, it is unlikely the habitats required for the black sandshell exist in the vicinity of the NorthMet Project area. The habitat for the creek heelsplitter likely exists in portions of the NorthMet Project area, but no creek heelsplitter mussels have been identified in 2 years of baseline survey efforts.

4.2.6.2 Whitewater Reservoir and Colby Lake

This section describes the aquatic resources found in Colby Lake and Whitewater Reservoir. Colby Lake and Whitewater Reservoir are the two lentic (standing) waterbodies potentially affected by water discharges and withdrawals associated with the NorthMet Project Proposed Action. The Partridge River flows through Colby Lake. Whitewater Reservoir is hydraulically connected to Colby Lake by a diversion works, and water moves between the two waterbodies either by controlled gravity-fed flow or by pumps, depending on the relative water levels in the two lakes (see Section 4.2.2 for more details).

Colby Lake is a Class 11 lake with a surface area of 539 acres and a littoral (water depth up to 15 ft) area of 377 acres. Maximum depth is 30 ft. In the most recent habitat characterization, the dominant littoral substrates were boulders (diameter greater than 10 inches), rubble (diameter 3 to 10 inches), and gravel (size unspecified) (MDNR 2010c). Aquatic plants were moderately abundant, dominated by water lilies (*Nympheadeae*), pondweed (*Potamogeton* sp.), and water shield (*Brasenia schreberi*). Average Secchi depth was 2 ft, and submersed plants grew to a maximum depth of 6 ft. The non-native curly-leaf pondweed (*Potamogeton crispus*) was found in the west end of the lake. During the most recent fisheries survey conducted in July 2010 (MDNR 2010c), surface water temperature was 76^{o}F, and the bottom temperature was 53^{o}F. Oxic water (dissolved oxygen concentration greater than 2 parts per million [ppm]) supporting fish extended to a depth of 15 ft where the temperature was 62^{o}F. A heated water plume (greater than or equal to 100^{o}F at the surface) extended from the Laskin Energy Center power plant discharge.

Fish species collected in Colby Lake through the latest July 2010 survey are listed in Table 4.2.6-10. The latest survey found species typically found in a lake Class 11 fish community assemblage, with one exception. Channel catfish were abundant in Colby Lake, which is unique for Class 11 lakes. Channel catfish, by weight, were the most abundant fish sampled in 2010. There was a low-density, quality-sized population of northern pike and a representative array of panfish species including bluegill, black crappie, and yellow perch. Historically, the walleye population has been highly variable. The 2010 catch was the lowest on record and below the 25th percentile value for lake Class 11. There is an MDH consumption advisory for fish in Colby Lake due to high levels of mercury.

Whitewater Reservoir is a Class 7 lake that encompasses a total surface area of 1,210 acres and a littoral area of 564 acres with a maximum depth of 73 ft. The dominant littoral substrate was gravel, rubble, and sand during the most recent habitat characterization (MDNR 2007c). Aquatic plants were moderately abundant along the shore and in shallow bays. The dominate taxa were cattails (*Typha* sp.), sedges (*Cyperaceae*), northern milfoil (*Myriophyllum sibericum*), and pondweed. Average Secchi depth was 12 ft, and submersed plants grow to a maximum water depth of 8 ft. During the more recent MDNR fisheries survey in mid-August 2012, the surface water temperature was 73^{o}F, and the bottom water temperature was 47^{o}F. Oxic water extended to a depth of 23 ft where the water temperature was 69^{o}F.

Walleye were introduced to the reservoir following impoundment in 1955, and stocking continued through 1984. Fish species collected in the Whitewater Reservoir by the MDNR surveys are listed in Table 4.2.6-10. The fish population in 2012 was dominated by walleye, northern pike, and bluegill and the total gillnet catch for each was above average among similar lake classes in northeast Minnesota that share similar ecological characteristics (MDNR 2012m). As is the case for Colby Lake, Whitewater Reservoir contains a similar MDH consumption advisory for fish due to high levels of mercury. Colby Lake water quality is summarized in Section 4.2.2, which identifies water quality exceedances for aluminum, iron, and manganese, which is believed to be naturally occurring. Both Colby Lake and Whitewater Reservoir are listed on the Minnesota 303(d) TMDL list because of high mercury concentrations in fish tissue.

Table 4.2.6-10 Fish Species Collected in Colby Lake and Whitewater Reservoir by MDNR Fisheries Surveys[1]

Scientific Name	Common Name	Colby Lake[2]	Whitewater Reservoir[3]
Ameiurus melas	Black bullhead		X
Pomoxis nigromaculatus	Black crappie	X	X
Lepomis macrochirus	Bluegill	X	X
Ameiurus nebulosus	Brown bullhead		X
Lota lota	Burbot		X
Ictalurus punctatus	Channel catfish	X	
Luxilus cornutus	Common shiner	X	
Lepomis hybrids	Hybrid sunfish		X
Micropterus salmoides	Largemouth bass	X	X
Esox lucius	Northern pike	X	X
Lepomis gibbosus	Pumpkinseed	X	X
Ambloplites rupestris	Rock bass	X	X
Moxostoma macrolepidotum	Shorthead redhorse	X	X
Notropis hudsonius	Spottail shiner	X	
Sander vitreus	Walleye	X	X
Catostomus commersonii	White sucker	X	X
Ameiurus natalis	Yellow bullhead	X	
Perca flavescens	Yellow perch	X	X

Notes:
1 Collection methods included gillnets, trapnets, and shoreline seining.
2 Surveys conducted in 1968, 1985, 2005, 2010, and 2012.
3 Ten surveys conducted post-impoundment, 1967-2002.

Little information exists on the macroinvertebrate assemblages of Colby Lake and Whitewater Reservoir. Sampling conducted in many lakes in the region (including Colby and Whitewater) as part of the MEQB Regional Copper-Nickel Study (MEQB 1979) found that nearly all of the taxa collected in the littoral zone of lakes were also collected in the streams of the region. The littoral zone of the lakes had a more diverse macroinvertebrate fauna than did the profundal (deep water) zone. Gastropods (snails) were collected from the littoral zone of Colby Lake and pelecypods (clams) were collected from the profundal zone (Johnson and Lieberman 1981). The most frequently collected and most abundant taxa collected from the profundal zone of Colby Lake were the phantom midge (*Chaoborus* sp.), a mayfly species (*Hexagenia limbata*), and two midge taxa (*Procladius* sp. and *Chironomus* sp.), similar to other lakes of the region and are characteristic of good water quality (Johnson and Lieberman 1981).

4.2.6.3 Embarrass River Watershed

This section describes the aquatic resources found within the Embarrass River Watershed portion of the NorthMet Project area.

4.2.6.3.1 Surface Water Features

Surface water features within the Embarrass River Watershed and within the NorthMet Project area include the Embarrass River and several of its tributaries draining the existing LTVSMC

Tailings Basin including the first-order streams Mud Lake Creek, Trimble Creek, and Unnamed Creek. Mud Lake Creek and Trimble Creek originate from the wetlands and bogs to the north and northwest of the existing LTVSMC Tailings Basin, respectively. Unnamed Creek originates from the northwest corner of the existing LTVSMC Tailings Basin.

Aerial photograph review of these streams indicates a mix of disturbed and vegetated riparian buffers with human impact effects on the landscape and stream courses apparent. Major channel habitat and substrate characteristics for these streams are summarized in Table 4.2.6–11. Study locations are included in Figure 4.2.6-1.

Table 4.2.6-11 Major Channel Characteristics at Biological and Habitat Survey Stations for Streams within the Vicinity of the Plant Site

	Location	Channel Characteristics						
Water Body/ Reference	**Site**	**Stream Order**	**Catchment (mi^2)**	**Dominant Substrate**	**Width (cm)**	**Depth (cm)**	**Velocity (m^3/s)**	**QHEI[1]**
Trimble Creek (Breneman 2005)	B6[2]	1	7.4	Sand and Silt	190	58.70	0.10	65
Trimble Creek (Barr 2011b)	PM-19[2]	1	--	Sand and Silt	250[(3)]	53.3[(3)]	0.09	46
Unnamed Creek (Barr 2011b)	PM-11	1	--	Muck and detritus	183	58	0.08	59
Spring Mine Creek	PM-12.1	1	--	Sand and detritus	213[(3)]	29[(3)]	0.01[(3)]	--

Sources: Adapted from Breneman 2005, Barr 2011b, Barr 2011i, Barr 2011m. Referenced from Figure 4.2.6-1.

Notes:

[1] QHEI (Rankin 1989) is designed to provide an integrated evaluation of physical habitat characteristics important to fish communities and ranges from 0 (low) to 100 (high).

[2] Sample sites B-6 and PM-19 are the same sampling location; however, data was collected in separate years during different studies.

[3] Averaged between two study dates (September 2010 and June 2011).

4.2.6.3.2 Existing Water Quality

Water quality sampling has occurred at PM-12 (upstream of all mining influences); PM-12.1 (on Spring Mine Creek); PM-12.2, PM-12.3, and PM-12.4 (between PM-12 and PM-13), and PM-13 (downstream of all NorthMet Project Proposed Action influences), as well as three tributary streams that drain the existing LTVSMC Tailings Basin (Mud Lake Creek, Trimble Creek, and Unnamed Creek) (see Figure 4.2.6-2 and Section 4.2.2.3.2 for additional sample information). As summarized in Table 4.2.6-12, water quality evaluation criteria exceedances were found for aluminum and mercury at most locations, as well as elevated concentrations for sulfate, especially at Spring Mine Creek. The Embarrass River, from its headwaters to Embarrass Lake, and Spring Mine Creek, from Ridge Creek to the Embarrass River, are both included on the 2012 TMDL list for aquatic life based on Fishes Bioassessment and, in the case of Spring Mine Creek, also aquatic macroinvertebrate bioassessment. Section 4.2.2 describes the water quality of the Embarrass River in more detail.

Table 4.2.6-12 Average Existing Water Quality Concentrations in the Embarrass River

Parameter	Units	Evaluation Criteria[1]	PM-12	PM-12.1	PM 12.2	PM-12.3	PM-12.4	PM-13
General								
Chloride	µg/L	230	4.7	2.5	3.4	4.7	5.0	5.8[(3)]
Specific Conductivity	umhos/cm	NA	138	980	490	263	264	258
TDS	mg/L	700	130	521	-	-	-	210
Temperature	ºC	-	10.6	9.1	10.7	10.7	10.6	11.3
Metals								
Aluminum	µg/L	125	99.8	57.4	80.2	**130**	122	**188**
Antimony	µg/L	31	0.51	0.25	-	-	-	0.53
Arsenic	µg/L	53	1.6	0.38	-	-	-	1.2
Boron	µg/L	500	24.0	37.7	-	-	-	32.7
Cadmium	µg/L	2.5[(2)]	0.094	0.055	-	-	-	0.10
Cobalt	µg/L	5	1.0	0.10	-	-	-	0.46
Copper	µg/L	9.3[(2)]	1.1	0.61	-	-	-	1.4
Lead	µg/L	3.2[(2)]	0.26	0.15	-	-	-	0.28
Mercury	ng/L	1.3	**5.1**	**4.8**	-	-	-	**4.3**
Nickel	µg/L	52[(2)]	1.4	1.2	-	-	-	1.5
Selenium	µg/L	5	0.87	0.10	-	-	-	0.76
Silver	µg/L	1	0.20	0.10	-	-	-	0.21
Sulfate	mg/L	10[(4)]	7.2	**388**	**131**	**50.2**	**42.8**	**39.4[(5)]**
Thallium	µg/L	0.56	0.19	0.10	-	-	-	0.20
Vanadium	µg/L	NA	1.5	-	-	-	-	1.5
Zinc	µg/L	120[(2)]	9.5	3.0	-	-	-	7.9

Source: Barr 2014d.

Notes:
Bold font indicates exceedance of the Class 2B water quality standards evaluation criteria.
2010 data not collected for all parameters. Includes non-detects at half the detection limit.
1 Section 5.2.2 includes a detailed discussion of evaluation criteria.
2 Water quality standard for this metal is hardness-dependent. Listed value assumes a concentration of 100 mg/L.
3 Excludes single outlier value of 94.8 mg/L from November 8, 2006.
4 In a draft MPCA staff recommendation, the MPCA identified the waters within and downstream from Embarrass Lake, the northernmost tip of Wynne Lake, and the segment of the Embarrass River from Sabin Lake to the Highway 135 bridge as waters used for production of wild rice, so the 10 mg/L sulfate evaluation criterion is only applicable to that portion of the Embarrass River (PM-13).
5 Excludes 688 mg/L value from November 8, 2006.

4.2.6.3.3 Aquatic Biota Studies

Breneman (2005) collected fish and macroinvertebrate community information at three sites in the Embarrass River Watershed. Fish and macroinvertebrate data were also collected by Barr at Spring Mine Creek, Trimble Creek, and Unnamed Creek. The results of these sampling events are summarized in Tables 4.2.6-13 and 4.2.6-14.

Fish Communities

Sampling location PM-20 (Bear Creek) was used for a reference or control study site to compare results for aquatic biota sampling locations PM-12.1 (Spring Mine Creek), PM-19 (Trimble Creek), and PM-11 (Unnamed Creek). As part of an additional study, aquatic biota data was collected from two additional sites on Unnamed Creek (B-5 and B-7) and a resampling of the Trimble Creek site (B-6). The MPCA also conducted aquatic biota studies for five locations, one of which was also conducted on Bear Creek near PM-20. A limited number of pollution-intolerant fish were identified among the various sample locations, including the Bear Creek control site. One pollution-intolerant species was found at Spring Mine Creek and one was identified at an Embarrass River sampling location. IBI scores ranged from moderate to poor for the various sampling locations, indicating impairment for aquatic life within these study reaches. Aerial photograph review of the B-5, B-6, and B-7 sampling sites exhibits a mix of disturbed and vegetated riparian buffers with human impact effects in the wetland landscape and stream courses, which likely limits the quality and diversity of the fish habitat present at these locations. Muck and silt were listed as dominant substrates within most of sample locations, which is consistent with headwater stream characteristics in the region. Sampling location PM-12.1 was located within a second-order section of Spring Mine Creek where sand and detritus were the dominant substrate.

Table 4.2.6-13 Fish Species Collected at Sampling Sites within the Vicinity of the Plant Site and Transportation and Utility Corridor

Scientific Name	Common Name	Tolerance Designation[1]	Bear Creek		Unnamed Creek			Trimble Creek		Spring Mine Creek			Embarrass River				
			PM-20	**09LS098**	**PM-11**	**B-7**	**B-5**	**PM-19[2]**	**B-6[2]**	**09LS101**	**09LS101**	**PM-12.1**	**10EM045**	**10EM045**	**97LS005**	**97LS005**	**09LS100**
Catostomus commersonii	White sucker	Tolerant	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Luxilus cornutus	Common shiner	Intermediate				X				X		X			X	X	
Notemigonus crysoleucas	Golden shiner	Tolerant	X	X											X	X	
Lota lota	Burbot	Intermediate		X				X	X	X	X	X			X	X	X
Margariscus margarita	Pearl dace	Intermediate									X	X					
Phoxinus eos	Northern redbelly dace	Intermediate			X	X	X		X							X	
Phoxinus neogaeus	Finescale dace	Intermediate				X	X										
Pimephales promelas	Fathead minnow	Tolerant				X	X										
Etheostoma nigrum	Johnny darter	Intermediate	X	X				X				X			X	X	
Perca flavens	Yellow perch	Intermediate										X	X		X	X	
Esox lucius	Northern pike	Intermediate	X	X										X	X		X
Culaea inconstans	Brook stickleback	Intermediate			X	X	X		X	X	X					X	
Umbra limi	Central mudminnow	Tolerant	X	X	X	X	X	X	X	X	X	X				X	X
Semotilus atromaculatus	Creek chub	Tolerant			X	X		X	X	X	X	X					
Ambloplites rupestris	Rock Bass	Intermediate		X									X		X	X	
Notropis heterolepis	Blacknose Shiner	Intolerant								X	X				X		
Ameiurus melas	Black Bullhead	Intermediate		X													X
Study year			2010	2009	2010	2004	2004	2010	2004	2009	2009	2010	2009	2010	1997	1997	2009
Species observed			5	8	5	8	5	5	6	7	7	8	3	2	9	10	5
# intolerant species[3]			0	0(1)	0	0	0	0	0	1(2)	1(2)	0	0	0	1(2)	0(1)	0(1)
Total Abundance			20	38	121	441	222	13	67	88	22	21	6	8	35	97	31
IBI[4]			--	43	--	--	--	--	--	37	37	--	0	0	50	54	31
Substrate			Muck and detritus	--	Muck and detritus	--	--	Sand and silt	Silt	--	--	Sand and detritus	--	--	--	--	--

Sources: Breneman 2005, Barr 2011b, and MPCA 2011c.

Notes:
1 Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish - Second Edition EPA 841-B-99-002 (USEPA 2012b). Tolerance values indicate qualitative tolerances of physical and chemical disturbances.
2 Sample sites PM-19 and B-6 are the same sampling location; however, data was collected in separate years during different studies.
3 Number in parentheses represents MPCA classification (MPCA 2011c).
4 IBI is the sum of study specific metrics where 0 represents the worst fish assemblage conditions and 100 represents the best fish assemblage conditions (USEPA 2011b).

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Macroinvertebrate Communities

The assemblages observed in the survey are typical of those sampled elsewhere in the northeast region of Minnesota (Breneman 2005). Total taxa, abundance, %EPT, and %Diptera totals are quite variable among the sites. Most sampling locations exhibited significant percentages of stonefly, mayfly, and caddisfly populations, which, unlike the fish community data, indicate desirable, non-degraded stream characteristics are likely present. Study sites PM-12.1 and PM-19 exhibited 44 and 41 percent EPT, respectively, which indicated some riffle/run habitat was likely present, although this was not reflected from the substrate data provided in Table 4.2.6-13 or at least was not a dominant habitat within the study stretch. The HBI scores exhibited variable results, indicating fair to good macroinvertebrate habitat was present within these study stretches. The exception to these results was the impairment for invertebrate life in Spring Mine Creek, which resulted in the MPCA listing of “Impaired” in 2012.

Table 4.2.6-14 Composition of Macroinvertebrate Assemblages for Sites in the Embarrass River Watershed

Name	Year	Site	Total Taxa	Abundance	%EPT[1]	%Diptera[2]	HBI[3]	IBI[4]
Embarrass River wetland (upstream)	2004	B-5	54	2,529	17	47	--	--
Embarrass River	1997	97LS005	21	--	--	8	2.7	55
Embarrass River	2009	97LS005	31	--	--	25	5.7	69
Embarrass River	2009	10EM045	21	--	--	8	2	39
Embarrass River	2010	10EM045	16	--	--	9	1.3	41
Embarrass River	2009	09LS100	24	--	--	29	3.7	61
Spring Mine Creek	2009	09LS101	20	--	--	23	5.7	46
Spring Mine Creek	2010	PM-12.1	33	2,494	44	20	5.3	--
Trimble Creek	2004	B-6[5]	64	654	0.5	27	--	--
Trimble Creek	2010	PM-19[5]	36	6,998	42	49	5.5	--
Unnamed Creek	2004	B-7	37	1,549	2	65	--	--
Unnamed Creek	2010	PM-11	22	2,484	31	25	6.5	--
Bear Creek	2009	09LS098	25	--	--	21	4.3	67
Bear Creek	2010	PM-20	32	2,787	24	30	6.4	--

Sources: Data and functional group assignments from Breneman 2005, Barr 2011b, Barr 2011i, Barr 2011m, Barr 2011n, and MPCA 2011c.

Notes:
1 %EPT indicates the percent of mayflies, stoneflies, and caddisflies within the macroinvertebrate sample. High EPT percentages of the population typically indicates degraded habitat conditions are not present.
2 %Diptera indicates the percent of true flies and bloodworms present within the macroinvertebrate sample. High percentages of the population typically indicates low habitat diversity and predominant silty habitats often present within slow-moving, headwater streams.
3 HBI is the measure of macroinvertebrate assemblages tolerance toward organic (nutrient) enrichment. Decreasing values indicate improving biotic condition. Higher values indicate fewer biological stressors (scale of 100).
4 IBI derived by the MPCA (MPCA 2011c).
5 Sample sites B-6 and PM-19 are the same sampling location; however, data was collected in separate years during different studies.

4.2.6.3.4 Special Status Fish and Macroinvertebrates

No special status fish or macroinvertebrates are known to occur within the Embarrass River Watershed, although the same potential SGCN, federal, and RFSS special status species described for the Partridge River Watershed would also apply to these areas. Suitable habitat is likely present for the same species discussed in Section 4.2.6.1.4.

No invasive fish or macroinvertebrate species are known to occur within the Embarrass River or its tributaries near the Plant Site.

4.2.6.4 Mercury Concentrations in Fish

As discussed in Section 4.2.2, Section 303(d) of the CWA requires states to publish a list of waters that are not meeting one or more water quality standards. The Partridge River is not listed as an impaired water body for mercury on the 303(d) list; however, fish tissue mercury concentrations in the Partridge River were indicative of an impaired waterbody (See Table 4.2.6-15). Standard sampling practices for mercury advisories in the State of Minnesota are performed in accordance with standard protocols to perform a single sampling event that will generally characterize the overall fish mercury concentrations within a river. Therefore, it should be noted that these data only represent one sampling event and may not be representative of the overall fish tissue mercury concentrations within the Partridge River Watershed.

Most of the St. Louis River is listed for “mercury in fish tissue” impairment. Similarly, the Embarrass River is not on the 303(d) list for mercury; however, several lakes downstream of the NorthMet Project area (within the Chain of Lakes), through which the Embarrass River flows, are listed for “mercury in fish tissue” impairment. It should be noted that portions of the Embarrass River, from the headwaters to Embarrass Lake, are listed on the 303(d) list as impaired for “Fishes Bioassessment,” a category not related to mercury. Fish consumption advisories have been issued for “mercury in fish tissue” impaired waters by the MDH to provide site-specific consumption guidance on the quantity and frequency of fish species consumed. For waters not listed on the 303(d) list for “mercury in fish tissue,” statewide consumption advisories still apply because these waters have not been tested and it is assumed that fish within these waters could potentially contain mercury in sufficient quantities to warrant a consumption advisory. Table 4.2.2-2 provides a summary of impaired waters within the Embarrass River and Partridge River watersheds.

Table 4.2.6-15 Mercury Concentrations in Fish Species Collected During 2014 MDNR Partridge River Fish Surveys

Sample Size	Scientific Name	Common Name	Mercury (ppm)
6	*Perca flavescens*	Yellow Perch	**0.25**[(1)]
4	*Catostomus commersonii*	White Sucker	0.16
6	*Sander vitreus*	Walleye	**0.63**[(1)]
8	*Esox lucius*	Northern Pike	**0.62**[(1)]

Source: MDNR 2015f.

Note:
Bold values indicate mercury concentrations in fish that are indicative of impaired waters (MPCA 2014).
[1] Mercury concentrations above 0.2 ppm indicate an impaired water (MPCA 2014).

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4.2.7 Air Quality

The NorthMet Project Proposed Action is subject to various federal and State of Minnesota air quality regulations. These regulations are designed to protect the general climate and air quality within the affected region of the NorthMet Project area. The USEPA has promulgated National Ambient Air Quality Standards (NAAQS) for seven common pollutants found in the ambient air, known as "criteria" pollutants. These standards are designed to ensure human and environmental health criteria are met for the ambient air quality. Minnesota has also promulgated Minnesota Ambient Air Quality Standards (MAAQS) to further protect human health. Minnesota has been granted air permitting authority by the USEPA, so the NorthMet Project Proposed Action would be issued a single permit by the MPCA.

The affected region can vary depending upon the specific regulations and the federal and state jurisdictions. For the purpose of this section, the extent of the affected region would be bounded by the Federal Land Managers' (FLMs') request to assess effects for all USEPA-defined Class I areas within a 300-kilometer (km) radius of the NorthMet Project area. The remainder of this section summarizes the regional climate, local meteorology, and the existing ambient air quality for the affected region.

4.2.7.1 Regional Climate and Meteorology

The climate for the NorthMet Project area and Minnesota, in general, is defined as continental. The region is subject to continental polar air masses throughout most of the year and, during the cold season, is subject to more frequent Arctic air masses. During the summer months, the southern portion of the state gives way to warm air entering northward from the Gulf of Mexico. As Pacific Ocean air masses move across the western United States, relatively mild and dry weather can be observed throughout the year, depending upon the strength of the air mass.

Based upon surface data taken at the Hibbing Monitoring Station (see Figure 4.2.7-1), predominant winds are from the north-northwest through west-northwest, occurring approximately 25 percent of the time. Winds from the south-southeast through southeast show a secondary predominance, occurring approximately 15 percent of the time. Average monthly temperatures range from 4^{o}F in the coldest month (January in northwest Minnesota) to 85^{o}F in the hottest month (July in southwest Minnesota). Mean annual temperatures range from 36^{o}F in the extreme north to 49^{o}F in the southeast along the Mississippi River. Extreme temperatures throughout the state can vary from 114^{o}F in the summer to -60^{o}F in the winter (NCDC 2010). During the three coldest months (December through February), maximum daily temperatures are below 32^{o}F for 24 days per month. Temperatures in the summer months rarely reach maximum temperatures above 90^{o}F (only 5 to 6 days per year).

Approximately two-thirds of the precipitation occurs between May and September, with annual precipitation ranging from 35 inches in the southeast and gradually decreasing to 19 inches in the extreme northwest. Northeastern Minnesota generally receives approximately 70 inches of snow per year, decreasing to 40 inches per year near the south and eastern border states. Snow cover occurs in Minnesota an average of 110 days per year with 1 inch or more on the ground, although there is a marked difference between the northern (where the NorthMet Project area is located) and southern portions of the state, ranging from 140 days per year to 85 days per year of snow cover, respectively.

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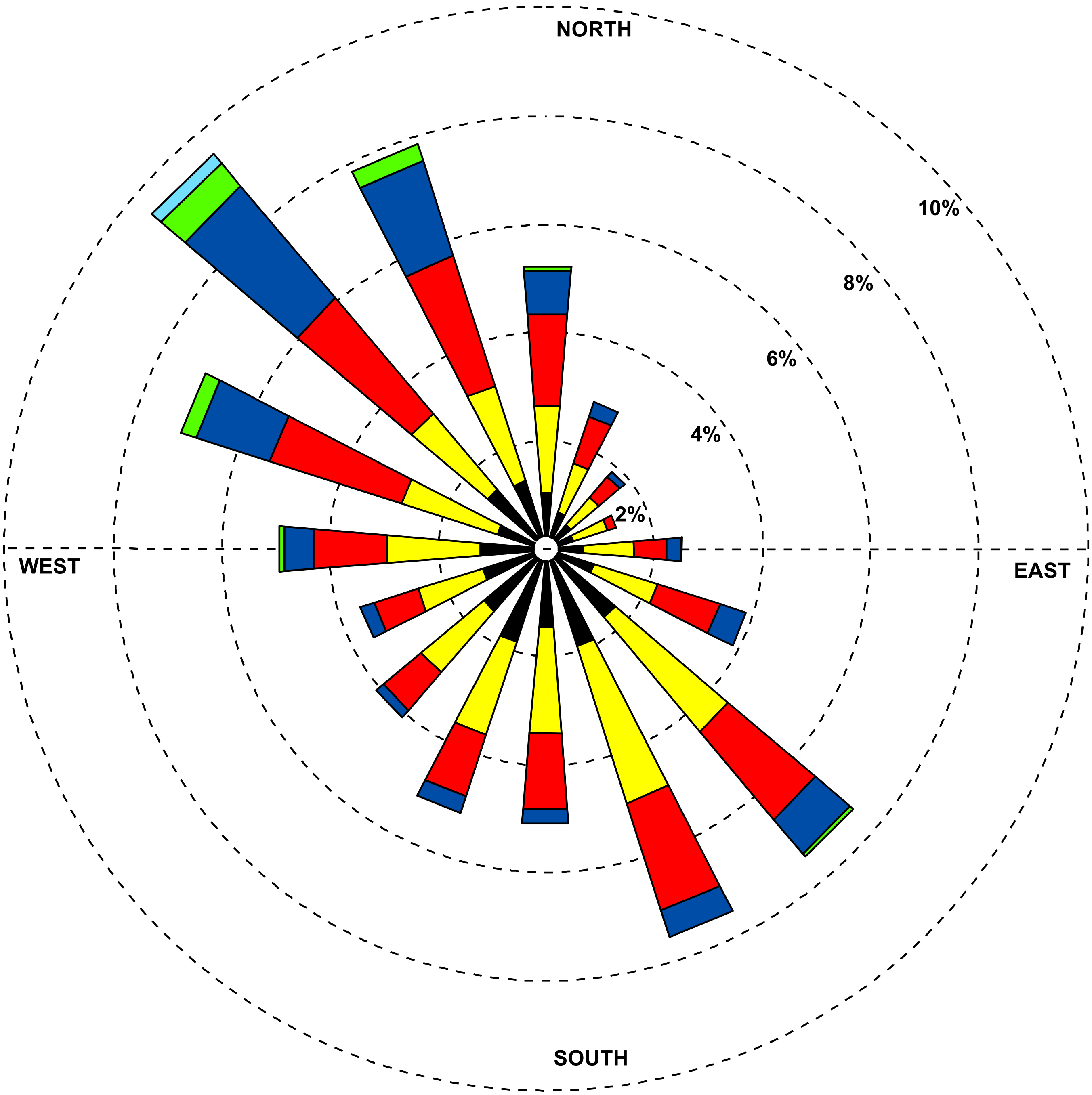

Wind Speed (m/s)

- > 11.1
- 8.8 - 11.1
- 5.7 - 8.8
- 3.6 - 5.7
- 2.1 - 3.6
- 0.5 - 2.1

MNDNR

US Army Corps of Engineers St. Paul District

Figure 4.2.7-1

Wind Frequency Distribution Plot for Hibbing, Minnesota (2001-2005)

NorthMet Mining Project and Land Exchange FEIS

Minnesota

November 2015

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4.2.7.2 Local and Regional Air Quality

The MPCA monitors air quality at a number of stations throughout the state. The data collected helps the state determine major sources of air pollution as well as assess compliance with NAAQS and MAAQS. Per requirements of the federal CAA, monitoring is done for the criteria pollutants. The MPCA also monitors for a range of chemicals, referred to as air toxics, which, like the criteria pollutants, potentially affect human health.

As of 2012, air quality was monitored at 52 locations throughout Minnesota. Not all locations monitor all pollutants; rather, the selection of monitoring locations and parameters reflects consideration of a number of factors including population, pollutants of concern in the area, and wind direction. Table 4.2.7-1 provides the monitored background concentrations for the period 2008 to 2010 at monitoring stations within or close to the 300-km area of the NorthMet Project Proposed Action. Both the Duluth and Virginia locations are considered urban; the Cloquet site is rural, while the Voyageurs site is within Voyageurs National Park. The Virginia monitoring location has been in operation since 1968. In addition to demonstrating compliance with NAAQS and MAAQS, the monitoring site was also established to characterize metals concentrations and identify emissions sources from mining activities. The Cloquet site is three miles west of the city near several large forest products industries. Land use near the Voyageurs site is managed for recreation, timber, and wilderness. Pulp and paper mills in International Falls and Fort Frances, Ontario are approximately 95 miles northwest of the NorthMet Project area.

As seen from the table, all reported air quality data meet the NAAQS and the MAAQS, indicating that existing ambient air quality concentrations are below levels that are known to cause health-based impacts for these pollutants. These levels demonstrate that the general air quality area is considered in attainment under federal regulations.

Table 4.2.7-1 Monitored Background Concentrations (2008–2010)

Pollutant	Averaging Period	Monitored Background Concentration	Standard Value	Standard Type	Monitoring Station
Carbon Monoxide	8-Hour	1.9 ppm	9 ppm	Primary	Duluth – Torrey Building
	1-Hour	4.1 ppm	35 ppm 30 ppm[1]	Primary Primary and Secondary	Duluth – Torrey Building
Nitrogen Dioxide	Annual	0.002 ppm	0.05 ppm[2]	Primary and Secondary	Cloquet
	1-Hour	0.014	0.10 ppm[2]	Primary	Cloquet
Ozone (O_3)	8-Hour	0.072 ppm	0.08 ppm	Primary and Secondary	Voyageurs National Park
Lead	Quarterly	0.005 $\mu g/m^3$	1.5 $\mu g/m^3$	Primary and Secondary	Virginia
Total Suspended Particulate (TSP)[1]	Annual	30 $\mu g/m^3$	75 $\mu g/m^3$ 60 $\mu g/m^3$	Primary Secondary	Virginia
	24-Hour	83 $\mu g/m^3$	260 $\mu g/m^3$ 150 $\mu g/m^3$	Primary Secondary	Virginia

Pollutant	Averaging Period	Monitored Background Concentration	Standard Value	Standard Type	Monitoring Station
PM_{10}[3]	Annual	14 $\mu g/m^3$	50 $\mu g/m^3$	Primary and Secondary	Virginia
	24-Hour	36 $\mu g/m^3$	150 $\mu g/m^3$	Primary and Secondary	Virginia
$PM_{2.5}$	Annual	5.8 $\mu g/m^3$	12 $\mu g/m^3$	Primary and Secondary[6]	Virginia
	24-Hour	16.5 $\mu g/m^3$	35 $\mu g/m^3$	Primary and Secondary	Virginia
Sulfur Dioxide	Annual	0.001 ppm	0.03 ppm 0.02 ppm[1]	Primary Secondary	Rosemount
	24-Hour	0.007 ppm	0.14 ppm	Primary and Secondary	Rosemount
	3-Hour	0.021 ppm	0.5 ppm 0.35 ppm	Primary and Secondary[4] Secondary[5]	Rosemount
	1-Hour	0.024 ppm	0.075 ppm	Primary	Rosemount

Source: MPCA, Pers. Comm., October 28, 2011.

Notes:
1 Minnesota State Ambient Air Quality Standard only.
2 Data available for only year 2010.
3 The USEPA revoked the annual PM_{10} standard (effective December 17, 2006). However, it is still reflected in the State of Minnesota's regulations.
4 Secondary standard for Air Quality Control Regions 128, 131, and 133.
5 For Air Quality Control Regions 127, 129, 130, and 132.
6 Updated to the December 2012 standard.
$\mu g/m^3$ = Micrograms per cubic meter

4.2.8 Noise and Vibration

This section addresses baseline noise and vibration conditions at the Mine Site and Plant Site, including a brief introduction to noise concepts and terms.

Noise is generally defined as unwanted sound. Sound travels in a mechanical wave motion and produces a sound pressure level. This sound pressure level, also referred to as loudness or intensity, is measured in decibels (dB). The dB scale is logarithmic such that each 10 dB increase represents a tenfold increase in noise intensity. For example, if sound energy is doubled, there is a 3 dB increase in noise because the two sound levels are added logarithmically, not linearly or arithmetically (e.g., 70 dB plus 70 dB equals 73 dB, not 140 dB). Sound measurement is further refined by using an A-weighted scale that emphasizes the range between 1,000 and 8,000 cycles per second, which is the range of sound frequencies most audible to the human ear. Unless otherwise noted, all dB measurements presented in this FEIS are A-weighted (dBA) on a logarithmic scale. This measurement is an expression of the relative loudness of sounds in air as perceived by the human ear. In the A-weighted scale, the dB values of sounds at low frequencies are reduced compared with unweighted dB, in which no correction is made for audio frequency. This correction is made because the human ear is less sensitive at low audio frequencies, especially below 1,000 hertz (Hz), than at high audio frequencies. A sound increase of 3 dBA is barely perceptible to the human ear, while a 5 dBA increase is clearly noticeable and a 10 dBA increase is heard as twice as loud (MPCA 2008a; Bies and Hansen 2009; IDOT 2011). Noise emissions diminish or attenuate with distance from the source depending on the nature of the source. When distance from a point source, such as a building, is doubled, the sound level decreases by 6 dB. However, when distance from a line source, such as a busy roadway, is doubled, the sound level decreases by 3 dB (MPCA 2008a).

The dB levels of common noise sources are shown in Table 4.2.8-1.

Table 4.2.8-1 Decibel Levels of Common Noise Sources

Common Noise Source	dB Levels
Jet Engine (at 25 meters)	140
Jet Aircraft (at 100 meters)	130
Rock Concert	120
Pneumatic Chipper	110
Jackhammer (at 1 meter)	100
Chainsaw, Lawn Mower (at 1 meter)	90
Heavy Truck Traffic	80
Business Office, Vacuum Cleaner	70
Conversational Speech, typical TV Volume	60
Library	50
Bedroom	40
Secluded Woods	30
Whisper	20

Source: MPCA 2008a.

A comparison of typical outdoor noise levels by land use category for daytime and nighttime is shown in Table 4.2.8-2.

Table 4.2.8-2 Typical Outdoor Sound Levels by Land Use Category

Land Use Category	L_{dn} (dBA)	L_d (dBA)	L_n (dBA)
Rural and sparsely populated areas	35 - 50	35 - 50	25 - 40
Quiet suburban (630 people/mi^2, remote from large cities and from industrial activity and trucking)	50	50	40
Normal suburban community (2,000 people/mi^2 not located near industrial activity)	55	55	45
Urban residential community (6,300 people/mi^2 not immediately adjacent to heavily traveled roads and industrial areas	60	59	52
Noisy urban residential community (near relatively busy road or industry or 20,000 people/mi^2)	65	62	58
Very noisy urban residential community (63,000 people/mi^2)	70	67	63

Source: USEPA 1974.

Notes:
L_{dn}, or day-night sound level, is the average equivalent A-weighted sound level during a 24-hour time period with a 10-dB weighting applied to equivalent sound level during the nighttime hours of 10 p.m. to 7 a.m.
L_d, or daytime L_{eq}, is the average equivalent sound level for daytime (7 a.m. to 10 p.m.).
L_n, or nighttime L_{eq}, is the average equivalent sound level for nighttime (10 p.m. to 7 a.m.).
L_d and L_n values were determined from the L_{dn} values using methods described in the 1974 USEPA document referenced above (based on data from 63 sets of background measurements conducted at various land-use areas across the United States).

Vibration is defined as regularly repeated movement of a physical object about a fixed point. Blasting is an activity associated with mining that could result in vibration. There are two types of vibration associated with mine blasting: ground vibration and air vibration or airblast overpressure. The magnitude of ground vibration is expressed in terms of peak particle velocity (PPV) and is measured in inches per second (in/s) or millimeters per second (mm/s). Airblast overpressure is measured in linear-weighted decibels (dBL).

4.2.8.1 Types of Noise

Noise may be classified as steady, non-steady, impulsive, or low-frequency depending on the temporal variations in sound pressure level. The various types of noise are described below.

- **Steady noise** is a noise with negligibly small fluctuations of sound pressure level within the period of observation. Steady noise with audible discrete tones is called discrete frequency noise or tonal noise. **Tonal noise** is characterized by one or two single frequencies and is much more annoying than broadband noise, which is characterized by energy at many different frequencies and of the same sound pressure level as the tonal noise. Tonal noise is caused by rotating parts of machines such as fans, internal combustion engines, transformers, and pumps. **Broadband noise** is steady noise without discrete frequency tones. Sounds are of longer duration and vary little over time (e.g., large gas turbines and road traffic).
- **Non-steady noise** is a noise that occurs when its sound pressure levels shift significantly during the period of observation. This type of noise can be divided into **fluctuating noise** (i.e., noise for which the level changes continuously and to a great extent during the period of observation such as surface grinding, welding, and component assembly) and **intermittent**

noise (i.e., noise that returns to the ambient or background level several times during the period of observation such as air compressors and automatic machinery during a work cycle).

- **Impulsive noise** consists of one or more bursts of sound energy, each of a duration less than approximately 1 second (i.e., sounds of short duration with high peak pressures). This type of noise can be divided into **highly impulsive sounds** (i.e., sound from one of the following enumerated categories of sound sources: small-arms gunfire, metal hammering, wood hammering, drop hammering, pile driving, drop forging, pneumatic hammering, pavement breaking, metal impacts during rail-yard shunting operation, and riveting); **high-energy impulsive sound** (i.e., sound from one of the following enumerated categories of sound sources: quarry and mining explosions, sonic booms, demolition and industrial processes that use high explosives, military ordinance, explosive ignition of rockets and missiles, explosive industrial circuit breakers, and any other explosive source where the equivalent mass of dynamite exceeds 25 grams); and **regular impulsive sound** (i.e., impulsive sound that is not highly impulsive sound or high-energy impulsive sound) (ANSI 2005).
- **Low-frequency noise** or sounds with strong low-frequency content produce greater annoyance than is predicted from A-weighted sound levels. Generally, annoyance is minimal when octave-band sound pressure levels are less than 65 dB at 16, 31.5, and 63 Hz midband frequencies. Annoyance to sounds with strong low-frequency content is virtually only an indoor problem (ANSI 2005).

4.2.8.2 Regional Setting

Noise exposure goals for various types of land use reflect the varying noise sensitivities associated with each of these uses. Residences, hospitals, and guest lodging are most sensitive to noise intrusion and therefore have more stringent noise exposure targets than industrial or commercial uses that are not subject to effects such as sleep disturbance. The land use in the Superior National Forest is mostly for forest. The region surrounding the Mine Site has traditionally supported various mining activities, as well as logging, on federal, state, county, and private forest lands. Noise sources associated with logging activities include skidders, feller bunchers, and log loaders. Noise sources associated with mining activities include drills, explosives, dump trucks, excavators, crushers, and power generators. Considering the attenuation effect of the surrounding forest and the fact that most of the mining and logging activities typically occur several thousand feet away from each other, the noise levels are localized (rather than regional) and diminish very quickly with distance due to geometric divergence or spreading losses. In addition to the spreading losses, dense vegetation (foliage) in the Superior National Forest also helps to attenuate noise from the mining and logging activities.

4.2.8.3 Mine Site

The Mine Site is situated mostly on federal land in the Superior National Forest, except for the privately owned land bordering Dunka Road to the south of the Mine Site. As indicated above, the region surrounding the Mine Site has traditionally supported various mining activities, as well as logging, on federal, state, county, and private forest lands. The Northshore Mine and Mesabi Nugget Phase I Plant are located approximately 1 mile north and 8 miles west of the Mine Site, respectively. Dunka Road, which provides access to the Mine Site, is an existing private road located south of the Mine Site, with no public access and little usage. The existing LTVSMC railroad grade is also located south of the Mine Site.

Review of the most up-to-date aerial maps indicates that there are no noise-sensitive areas or receptors (e.g., residences, campgrounds, schools, churches, or wilderness areas) within the Mine Site and surrounding federal lands. However, there are a few receptors outside the Mine Site. The closest noise-sensitive receptor to the Mine Site is the City of Babbitt, located approximately 6 miles to the north. A Boy Scout camp is located near the Mine Site on Colby Lake, approximately 10 miles southwest of the Mine Site. Other noise-sensitive receptors in the general area of the Mine Site include: Skibo (a small residential area), approximately 8 miles to the south; the City of Hoyt Lakes, approximately 9 miles to the southwest; and the City of Aurora, approximately 13 miles to the south. The BWCAW is part of the national wilderness preservation system where sensitivity to human-caused sound and noise effects are important considerations. It is approximately 20 miles (in a northeasterly direction) from the Mine Site to the closest portion of the BWCAW. The cities of Ely and Tower are also located close to the BWCAW and are approximately 21 miles north-northeast and 19 miles northwest of the Mine Site, respectively. The Bois Forte Reservation is located near Tower. In addition to the receptors identified above, other receptors such as recreational sites (family campgrounds, campsites, boating, fishing, swimming, and family picnic areas), wildlife corridors, trails, and MPCA staff-recommended wild rice waters/beds (used by tribal members for harvesting) are also within the Mine Site vicinity. The closest recreational site is a family picnic area located approximately 9 miles south of the Mine Site (near Skibo). The closest wildlife corridor and trail (Stony Spur Snowmobile Trail) are located approximately 1 mile northwest and 6 miles northeast of the Mine Site, respectively. The closest MPCA staff-recommended wild rice waters/beds are located approximately 5.5 miles north (Mud Lake) and 7 miles northeast (Birch Lake) of the Mine Site. Figure 4.2.8-1 shows the locations of the closest receptors to the Mine Site. Though not depicted on Figure 4.2.8-1 due to sensitivity regarding cultural resources and locations, the federal Co-lead Agencies have identified a few archaeological sites in consultation with the SHPO and the Bands. Although barely discernible in some cases, a few well-defined trail segments of the BBLV Trail and two other unnamed trail segments (BBLV Trail Segment #1) represent the trail corridors that cross the Mine Site and Plant Site, as well as the NorthMet Project area (see Section 4.2.9, Cultural Resources).

Since the Mine Site is located in a rural and sparsely populated environment, the existing ambient steady L_{eq} for all nearby sensitive receptors (except the BWCAW), are expected to range from 35 to 50 dBA or approximately 45 dBA (daytime) and 25 to 40 dBA or approximately 35 dBA (nighttime) (see Tables 4.2.8-2 and 4.2.8-3). The ambient L_{eq} assumed for receptors outside the Mine Site area account for existing noise from the Northshore Mine located approximately 1 mile north of the Mine Site. Since the BWCAW is located in a natural environment that is generally quieter than areas outside the wilderness, the existing ambient L_{eq} at the BWCAW area is expected to be lower than the levels for other receptors surrounding the Mine Site area. In February 2011, the USFS Superior National Forest unit conducted an ambient sound level survey at Little Gabbro Lake in the western part of the BWCAW (ambient data provided by USFS staff via email in June 2013). In March 2011, the Superior National Forest unit also conducted an ambient sound level survey at Royal Lake in the eastern part of the BWCAW (USFS 2012e). The ambient data at both sites are comparable, but the data at Royal Lake is slightly lower. For the purpose of the NorthMet Project Proposed Action, the Royal Lake ambient data has been used to provide a conservative natural ambient level at BWCAW (see Table 4.2.8-3). In addition to the fact that the Royal Lake ambient data are more conservative (i.e., lower than Gabbro Lake data), the USFS staff indicated that the measured ambient data at

Gabbro Lake has not been reviewed by the National Park Service, but the measured data at Royal Lake has been reviewed and used by the National Park Service soundscape program for some recent work they did to model noise effects on the BWCAW.

Minnesota's noise standards are based on statistical calculations that quantify noise levels according to duration over a 1-hour monitoring period. The L_{10} is the noise level that is exceeded for 10 percent, or 6 minutes, of the hour, and the L_{50} is the noise level exceeded for 50 percent, or 30 minutes, of the hour. There is not a limit on maximum noise (MPCA 2008a). For the purposes of this assessment, the estimated baseline L_{eq} levels for the nearest receptors (except for the BWCAW, where measured percentile data were available) were converted to other noise percentile metrics, such as L_{50} and L_{10} using a USEPA calculation methodology (USEPA 1974). The calculation was based on an assumed standard deviation of 3 dB for the sound level statistical distribution. A summary of the estimated existing daytime and nighttime ambient levels (i.e., L_{eq}, L_{50}, and L_{10}) expected at receptors closest to the NorthMet Project area is presented in Table 4.2.8-3. As indicated above, natural ambient levels for the BWCAW were based on measured L_{50} and L_{10} data taken from Royal Lake in the eastern part of the BWCAW (USFS 2012e).

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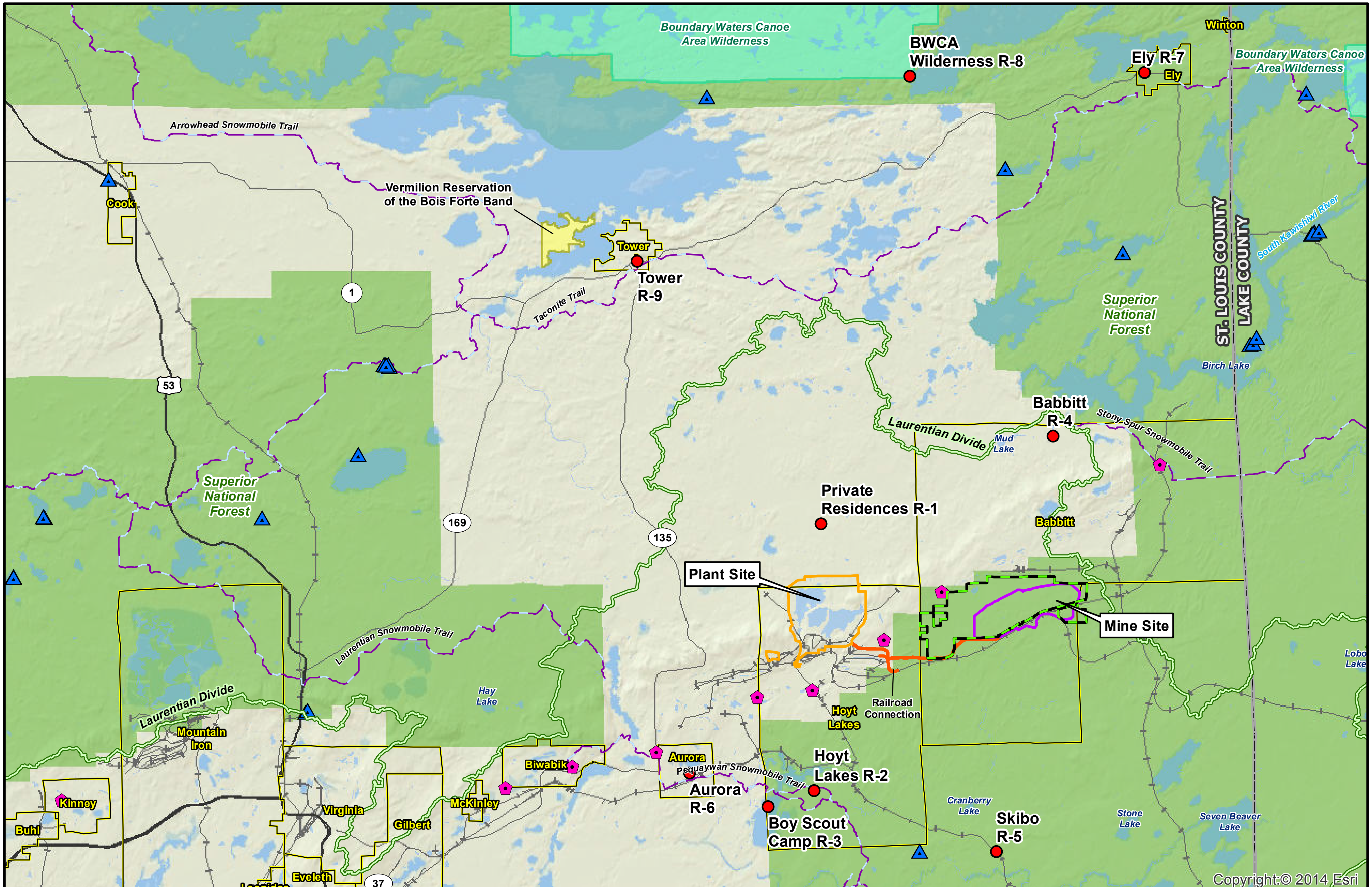

Noise Sensitive Receptor
Plant Site
Mine Site
Transportation and Utility Corridor
Recreational Site
Federal Lands
Native American Reservation
Municipality
Boundary Waters Canoe Area Wilderness
National Forest
Wildlife Travel Corridor
Existing Railroad

MNDNR | US Army Corps of Engineers St. Paul District | Forest Service U.S. Department of Agriculture

N W E S

0 1.5 3 6 Miles

Figure 4.2.8-1

Nearest Noise Sensitive Receptors to the NorthMet Project Area

NorthMet Mining Project and Land Exchange FEIS

Minnesota

November 2015

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Table 4.2.8-3 Summary of Estimated Existing Ambient Noise Levels at the Closest Receptors to the NorthMet Project Area, including the BWCAW

Ambient Noise Levels	Daytime (dBA)	Nighttime (dBA)
All Receptors except the BWCAW[1]:		
L_{eq}	45.0	35.0
L_{50}	44.0	34.0
L_{10}	48.8	37.8
BWCAW[2]:		
L_{eq}	34.0	34.0
L_{50}	23.4	23.4
L_{10}	33.2	33.2

Notes:
1 Source: USEPA 1974.
2 Source: USFS 2012e.

Currently, no ground- or air-vibrating sources or activities (e.g., mine blasting, piling, etc.) occur at the Mine Site. The closest vibration-generating activity is blasting at the Northshore Mine. Like noise emissions, ground and air vibration effects diminish with distance from the source. Because of the distance from the operating mine, existing baseline levels of vibration at the Mine Site and nearby receptors are expected to be negligible.

4.2.8.4 Plant Site

The Plant Site is situated on private land located 8 miles west of the Mine Site. The closest noise-sensitive receptors to the Plant Site include a few private residences located approximately 3.5 miles north; the City of Hoyt Lakes, located approximately 5 miles south; and the City of Aurora, located approximately 8 miles southwest. A Boy Scout camp, which is only used occasionally, is located approximately 10 miles south-southwest. In addition to the receptors identified above, other receptors such as recreational sites, wildlife corridors, trails, archaeological sites (used by tribal members for cultural and spiritual purposes), and sites used by tribal members for harvesting of wild rice are also within the Plant Site vicinity. The closest recreational site is a family picnic area located approximately 9 miles south of the Plant Site (near Skibo). The closest wildlife corridor and trail (Pequaywan Snowmobile Trail) are located approximately 2 miles south and 6 miles southeast of the Plant Site, respectively. The closest draft MPCA staff-recommended wild rice waters/beds are located approximately 6 miles west (Hay Lake) of the Plant Site. Figure 4.2.8-1 shows the locations of the closest receptors to the Plant Site. Though not depicted on Figure 4.2.8-1 due to sensitivity regarding cultural resources and locations, the federal Co-lead Agencies have identified a few archaeological sites in consultation with the SHPO and the Bands. These archaeological sites include the Spring Mine Lake Sugarbush (a natural maple-basswood stand of cultural significance, less than 1 mile east of the Plant Site) and the *Mesabe Widjiu* (a long, linear landform running the length of the Mesabi Iron Range, and intersecting portions of the Laurentian Divide and northeast of the Plant Site near the Tailings Basin), and possess important spiritual and cultural significance to the Ojibwe people. Although barely discernible in some cases, a few well-defined trail segments of the BBLV Trail and two other unnamed trail segments (BBLV Trail Segment #1) represent the trail corridors that cross the Mine Site and Plant Site, as well as the NorthMet Project area (See Section 4.2.9, Cultural Resources).

Like the Mine Site, the Plant Site is also located in a rural and sparsely populated environment; therefore, the daytime and nighttime ambient levels (i.e., L_{eq}, L_{50}, and L_{10}) for all nearby sensitive receptors, such as residential houses, are expected to be similar to the levels shown in Table 4.2.8-3. The closest noise-generating sources are the coal and flux pulverizer, rotary hearth furnace, and cooling towers at Mesabi Phase I Plant in Hoyt Lakes, which is approximately 1 mile west-southwest of the Plant Site. The baseline noise levels of the identified receptors near the Plant Site (see Table 4.2.8-3) already capture or account for noise from the Mesabi Phase I Plant.

Currently, no ground- or air-vibrating sources or activities (e.g., mine blasting or pile driving) occur at the Plant Site. The closest vibration-generating sources are the coal and flux pulverizer and rotary hearth furnace at the Mesabi Phase I Plant in Hoyt Lakes, which is approximately 1 mile west-southwest of the Plant Site. Since ground and air vibration effects diminish with distance from the source, existing baseline levels of vibration at the Plant Site and the nearest sensitive receptors are expected to be negligible.

4.2.9 Cultural Resources

4.2.9.1 Introduction

The MDNR, USACE, and USFS have prepared this joint state-federal FEIS for the proposed NorthMet Project Proposed Action and Land Exchange Proposed Action. USEPA, the Fond du Lac Band of Lake Superior Chippewa, the Bois Forte Band of Chippewa, and the Grand Portage Band of Lake Superior Chippewa (herein referred to as the Bands) participated as cooperating agencies based on regulatory authority and/or subject matter expertise. Cooperating agencies have not participated in endorsement of any components of the EIS or the NorthMet Project.

The Co-lead Agencies committed to providing an appendix in this FEIS that contains the Tribal Cooperating Agencies' comments and supporting documentation representing major differences of opinion (MDOs) for the SDEIS. See Appendix C for comments and supporting documentation from the Bois Forte, Grand Portage, Fond du Lac, GLIFWC, and the 1854 Treaty Authority. These take the form of eight position papers and a Co-lead Agencies Preliminary SDEIS comment disposition spreadsheet for the Tribal Cooperating Agencies.

The Tribal Cooperating Agency submittals in Appendix C are provided verbatim and in identical form as they were for the SDEIS. They were considered in the development of this FEIS. Refer to Chapter 8 for more information.

4.2.9.2 Cultural Resources

"Cultural resources" is a very general term that can include a wide range of resources. There is no legal or generally accepted definition of "cultural resources" under NEPA or any other federal law, but it is commonly used in connection with the identification of historic properties in compliance with Section 106 of the National Historic Preservation Act (NHPA). However, historic properties are only a subset of cultural resources, and are but one aspect of the "human environment" defined by the NEPA regulations.

Under NEPA, the human environment includes the natural and the physical (e.g., structures) environment, and the relationships of people to that environment. A NEPA review must address the cultural context in which the project effects would occur. Management policies, and guidance within federal and state agencies, seek to identify and consider all types of cultural resources and balance the need for development with the need to protect cultural resources.

The intent of this section is to describe the affected environment within this cultural context. Cultural resources within this context include historic properties (including those of potential religious and cultural significance to the Bands), which are considered under the NHPA, and natural resources of cultural significance to the Bands that may not otherwise be governed by the NHPA. A discussion of treaty rights under the 1854 Treaty is also provided as part of this cultural context to understand the significance of the Ceded Territory to the Bands.

In accordance with the CEQ's guidance, *NEPA and NHPA: A Handbook for Integrating NEPA and Section 106* (March 2013), the NHPA Section 106 process has proceeded on a parallel path to the NEPA process. The federal Co-lead Agencies have consulted with the Bands as part of the NHPA process, and this consultation has informed the development of the cultural resources sections of the EIS.

4.2.9.2.1 National Historic Preservation Act Overview

The NorthMet Project Proposed Action is considered an undertaking as defined in 36 CFR 800, the regulation implementing Section 106 of the NHPA. A more narrow view of cultural resources is necessary for these regulatory requirements. The intent of Section 106, as set forth in the impending regulations, is for federal agencies to take into account the effects of a proposed undertaking on historic properties and to consult with the Advisory Council on Historic Preservation (ACHP), State Historic Preservation Offices (SHPOs), federally recognized tribes, other federal agencies with concurrent undertakings in connection with the project, applicants for federal assistance, local governments, and any other parties with a demonstrated interest in the proposed undertaking and its potential effects on historic properties.

Section 106 establishes a process for identifying historic properties that may be affected by the proposed undertaking; assessing the undertaking's effects on those resources; and engaging in consultation that seeks ways to avoid, minimize, or mitigate adverse effects on properties that are either listed on, or considered eligible for listing on, the National Register of Historic Places (NRHP). The area in which effects on resources are evaluated is the Area of Potential Effect (APE). The APE is defined as, "… the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of the undertaking and may be different for different kinds of effects caused by the undertaking" (36 CFR § 800.16(d)).

A historic property is defined as any district, site, building, structure, or object that is either listed, or eligible for listing, in the NRHP.

To be eligible for listing in the NRHP, a cultural resource must meet at least one of the four criteria for eligibility. The criteria (36 CFR 60.4(a–d)) used to evaluate the significance of a cultural resource are as follows:

a) It is associated with events that have made a significant contribution to the broad patterns of history;

b) It is associated with the lives of past significant persons;

c) It embodies the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

d) It has yielded or may be likely to yield, information important in history or prehistory.

Properties also need to exhibit integrity of location, materials, setting, design, association, workmanship, and feeling and commonly be at least 50 years old. However, under Criteria Consideration G, a property achieving significance within the past 50 years is eligible if it is of exceptional importance.

Historic properties can include properties of traditional religious and cultural significance to Indian tribes; these properties are commonly referred to as Traditional Cultural Properties (TCPs). Because the cultural practices or beliefs that give a TCP its significance are typically still observed in some form at the time the property is evaluated, it is sometimes perceived that the intangible practices or beliefs themselves, not the tangible property, constitute the subject of evaluation. There is naturally a dynamic relationship between tangible and intangible. The beliefs or practices associated with a TCP are of central importance in defining its significance. However, it should be clearly recognized at the outset that the NRHP does not include intangible resources themselves. The entity evaluated must be a tangible property—i.e., a district, site, building, structure, or object. A property must meet several preconditions in order to meet the federal definition of TCP as articulated in National Register Bulletin 38. These conditions include the ongoing use of a property in spiritual practice or other traditional activities. TCPs are defined in National Register Bulletin 38 as a place "eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (National Register Bulletin 38:1). It is difficult to identify properties of traditional cultural significance, since they are often kept secret. It is through consultation with Native American tribes themselves that historic properties of religious and cultural significance can be properly identified and evaluated (ACHP 2008).

Local, state, tribal, and federal agencies shall be consulted as appropriate in findings and determinations made during the Section 106 process, as specified in 36 CFR 800. This includes any SHPO whose state would physically include any portion of the APE. The SHPO is appointed by each state to protect the interests of its citizens with respect to issues of cultural heritage. In addition to the SHPO, the lead federal agencies have an obligation, as appropriate, to work with state and local governments, and private organizations, applicants, or individuals with a demonstrated interest from initiation to completion of the review under Section 106 of the NHPA.

Once the lead federal agencies have identified the appropriate SHPO, 36 CFR 800.3(f)(2) requires the federal agencies to identify Native American tribes that may attach religious and cultural significance to historic properties within the APE and invite them to be consulting parties.

If a historic property were affected, the federal Co-lead Agencies would follow the provisions of 36 CFR 800.5 to determine whether the effect were adverse. If an effect were adverse, the USACE and the USFS would consult with the parties identified above to resolve the adverse effect either through avoidance of the effect or mitigation of the effect pursuant to 36 CFR 800.6. Prior to the federal agencies taking an action, whether it is the issuance of a USACE CWA permit or a USFS land exchange in connection with the NorthMet Project Proposed Action, the federal agencies must comply with Section 106 of the NHPA. Such compliance can be achieved by, among other things, avoiding an adverse effect on historic properties or developing appropriate mitigation measures and executing a Memorandum of Agreement (MOA) requiring such mitigation.

4.2.9.2.2 Identification of Consulting Parties

The USACE invited 15 federally recognized tribes, as listed in the Native American Consultation Database (maintained by the Department of the Interior, National Park Service) for St. Louis County, Minnesota, and select state and federal agencies by letter to consult on the NorthMet Project Proposed Action and notified the consulting parties that the USACE would be the lead federal agency. Another letter from the USACE sent May 2006 invited Native American tribes that had not responded to the initial invitations. Those federally recognized tribes that did not respond to the first or second written invitations were contacted via phone.

As a result of this initial round of consultation, the Bois Forte Band of Chippewa Indians and Fond du Lac Band of Lake Superior Chippewa had requested to be included as cooperating agencies for the NorthMet Project Proposed Action under NEPA. Following this initial round of consultation, the Grand Portage Band of Chippewa requested to be included as a cooperating agency. The federal Co-lead Agencies have consulted with the Bands, Minnesota SHPO, and PolyMet as determinations were made concerning NRHP eligibility of identified cultural resources, effects of the NorthMet Project Proposed Action on historic properties, and resolution of any adverse effects, as required under 36 CFR 800. The federal Co-lead Agencies are currently consulting with these parties on development of an MOA to resolve adverse effects. The federal Co-lead Agencies also continue to consult on cultural resource issues outside of the NHPA, including other issues pertinent to this FEIS.

4.2.9.2.3 Methods for Identifying Historic Properties

The NorthMet Project Proposed Action is considered an *undertaking* as defined in 36 CFR 800.16. The Co-lead Agencies must consider effects on historic properties before an undertaking were to occur. The intent of Section 106 is for federal agencies to take into account the effects of a proposed undertaking on any historic properties situated within the APE and to consult with the ACHP, SHPOs, federally recognized Native American tribes and their Tribal Historic Preservation Officers, local governments, applicants, and any other interested parties regarding the proposed undertaking and its potential effects on historic properties.

Area of Potential Effect

The APE is the area in which a federal agency has identified historic properties that may be affected by the undertaking. For the purpose of any discussion pertaining to historic properties, direct effects physically alter the historic property in some way and indirect effects are further removed in time or space and diminish some aspect of the historic property, but do not physically alter it. Direct effects on archaeological sites and historic structures would occur in a fairly circumscribed area. Indirect effects could occur within a more geographically expansive area that typically reflects potential effects resulting from visual, audible, or atmospheric changes.

Typically, cultural resource surveys are only done within the area where direct effects would occur. However, for the NorthMet Project Proposed Action, the Co-lead Agencies conducted cultural resource surveys in some areas within the APE where both direct and/or indirect effects could occur.

The APE for the NorthMet Project Proposed Action was developed using the analysis discussed below and in other resource-specific sections of this FEIS. The APE includes potential effects areas for both direct and indirect effects (see Figure 4.2.9-1). The purpose of this summary is to address the APE for the NorthMet Project Proposed Action and discuss the rationale behind the areas that were included in the APE. As discussed in this section, cultural resources may include components that are, in part or entirely, natural resources. Therefore, to address indirect visual, audible, or atmospheric effects on all types of cultural resources, the APE includes aspects related to aesthetics, water, air, and noise. The Co-lead Agencies have consulted with the SHPO, Bands, and PolyMet on the APE utilized in the FEIS.

The DEIS was issued in October 2009. From 2007 to 2009, archaeological and architectural surveys were conducted for the NorthMet Project Proposed Action, as discussed below. Those surveys focused on the existing Plant Site area and the proposed Mine Site area (see Figure 4.2.9-2). As discussed further, several cultural resources studies were completed within or adjacent to the NorthMet Project and Land Exchange areas before 2007. Some of the studies were conducted prior to the development of the NorthMet Project Proposed Action, and some were conducted specifically for the NorthMet Project Proposed Action.

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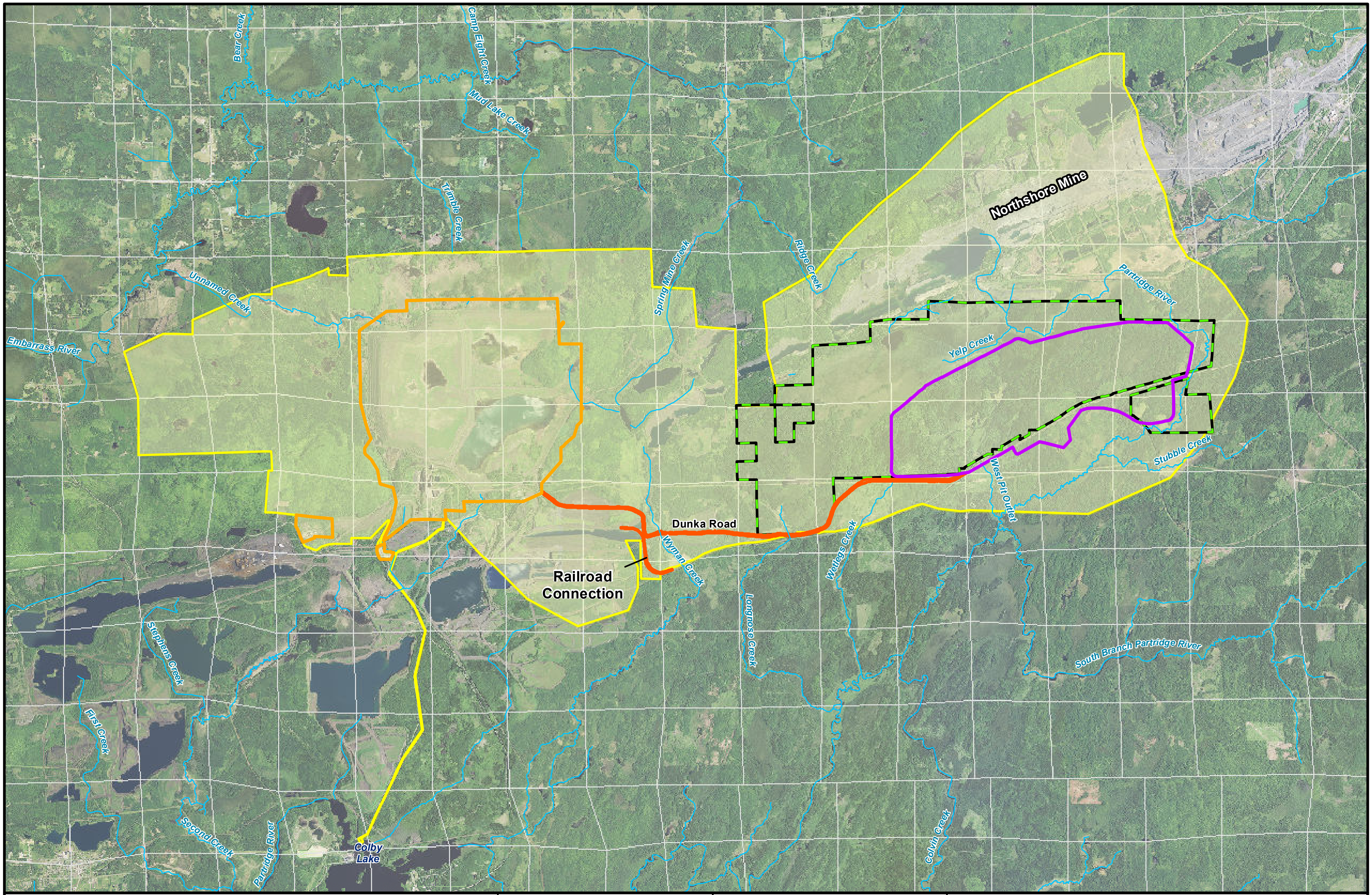

Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Stream/River
Section Boundary
Cultural Resources Area of Potential Effect

MNDNR
US Army Corps of Engineers St. Paul District

N W E S

0 0.5 1 2 Miles

Figure 4.2.9-1
Cultural Resources Analysis - Area of Potential Effect
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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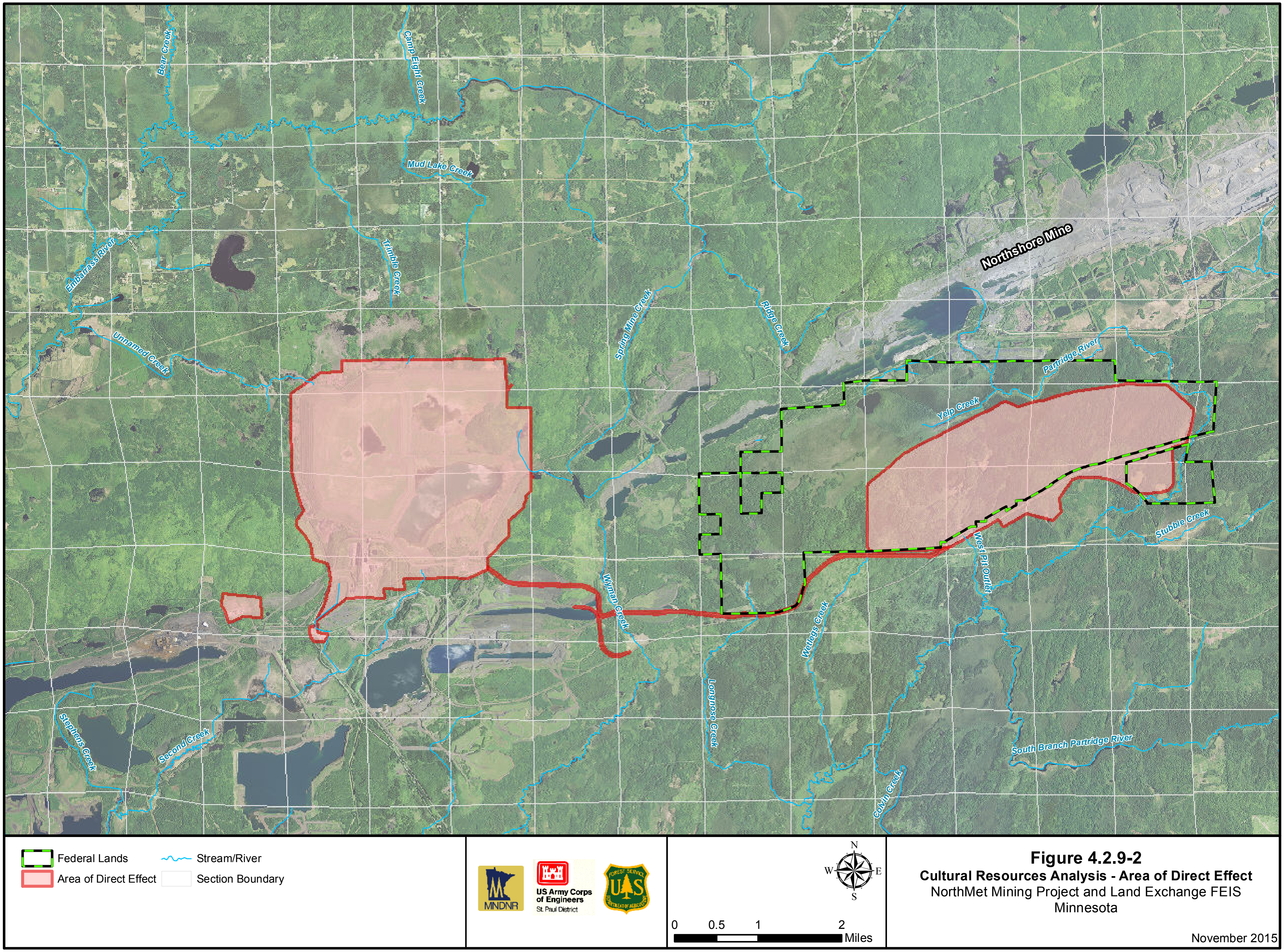

Figure 4.2.9-2

Cultural Resources Analysis - Area of Direct Effect

NorthMet Mining Project and Land Exchange FEIS

Minnesota

November 2015

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In early 2009, the consulting Bands proposed the 1854 Ceded Territory as a historic property. Prior to that, the Bands reiterated their concerns about effects on water quality and quantity, for both surface water and groundwater. At that point in the NorthMet Project Proposed Action review, data were not available on which to reasonably extrapolate the APE. The result was an APE that included a large area inclusive of portions of the Partridge River and Embarrass River watersheds, extending down the St. Louis River to Lake Superior.

As consultation progressed with the Bands, it became apparent that further identification efforts were warranted. Supplemental field investigations focused on the areas around the proposed Plant Site and Mine Site. Since this initial effort, the Co-lead Agencies have received the results of water quality and quantity modeling. The APE has been revised based on these results.

The NorthMet Project Proposed Action would meet ambient air quality standards at the property boundary. Compliance with ambient air quality standards suggests that there would be no significant effects on vegetation or soils. Therefore, it was suggested that the property boundaries at both the Plant Site and the Mine Site be used to define the maximum extent of NorthMet Project Proposed Action air impacts that would have the potential to affect historic properties (see Section 5.2.7.2.3; Figure 4.2.9-3). In 2013, during analysis for the SDEIS, the Co-lead Agencies refined the NorthMet Project Proposed Action APE to include this larger ambient air boundary. Within the redefined APE, modeling shows where fugitive dust from the Plant Site, Tailings Basin, and Mine Site stockpiles is predicted to settle. Areas of fugitive dust deposition that extend beyond the APE would not exceed the ambient air quality standard (see Section 5.2.7.1.3). The intra-property APE for air is defined by these fugitive dust deposition areas (see Figure 4.2.9-4). Therefore, in 2015, at the request of the consulting Bands and SHPO, the federal Co-lead Agencies conducted additional Phase IA (historic aerial photography) desktop survey for portions of the APE adjacent to the proposed Plant Site. This survey coverage focused on areas outside of the previously disturbed mining district that are within the NorthMet Project Proposed Action's ambient air boundary.

With the proposed engineering controls, the water quality model predicts that the NorthMet Project Proposed Action would not cause any significant water quality impacts because: 1) exceedances of the P90 threshold did not occur, 2) the NorthMet Project Proposed Action concentrations were no higher than concentrations predicted for the Continuation of Existing Conditions scenario, 3) the frequency or magnitude of exceedances for NorthMet Project Proposed Action conditions was within an acceptable range, or 4) the effects were not attributable to NorthMet Project Proposed Action discharges. Figure 4.2.9-5 shows surficial groundwater flowpaths with the potential to transport mine- and Tailings Basin-affected groundwater from source areas to surface waters. Therefore, these distances around the mine pit and Tailings Basin define the APE for potential changes to groundwater and surface water quality (see Figure 4.2.9-5).

Changes to groundwater quantity due to groundwater drawdown resulting from mine pit dewatering are not predicted to occur beyond 3,200 ft from the mine pit (see Section 5.2.2.3.2). Therefore, this distance around the mine pit defines the APE for changes to groundwater quantity (see Figure 4.2.9-6).

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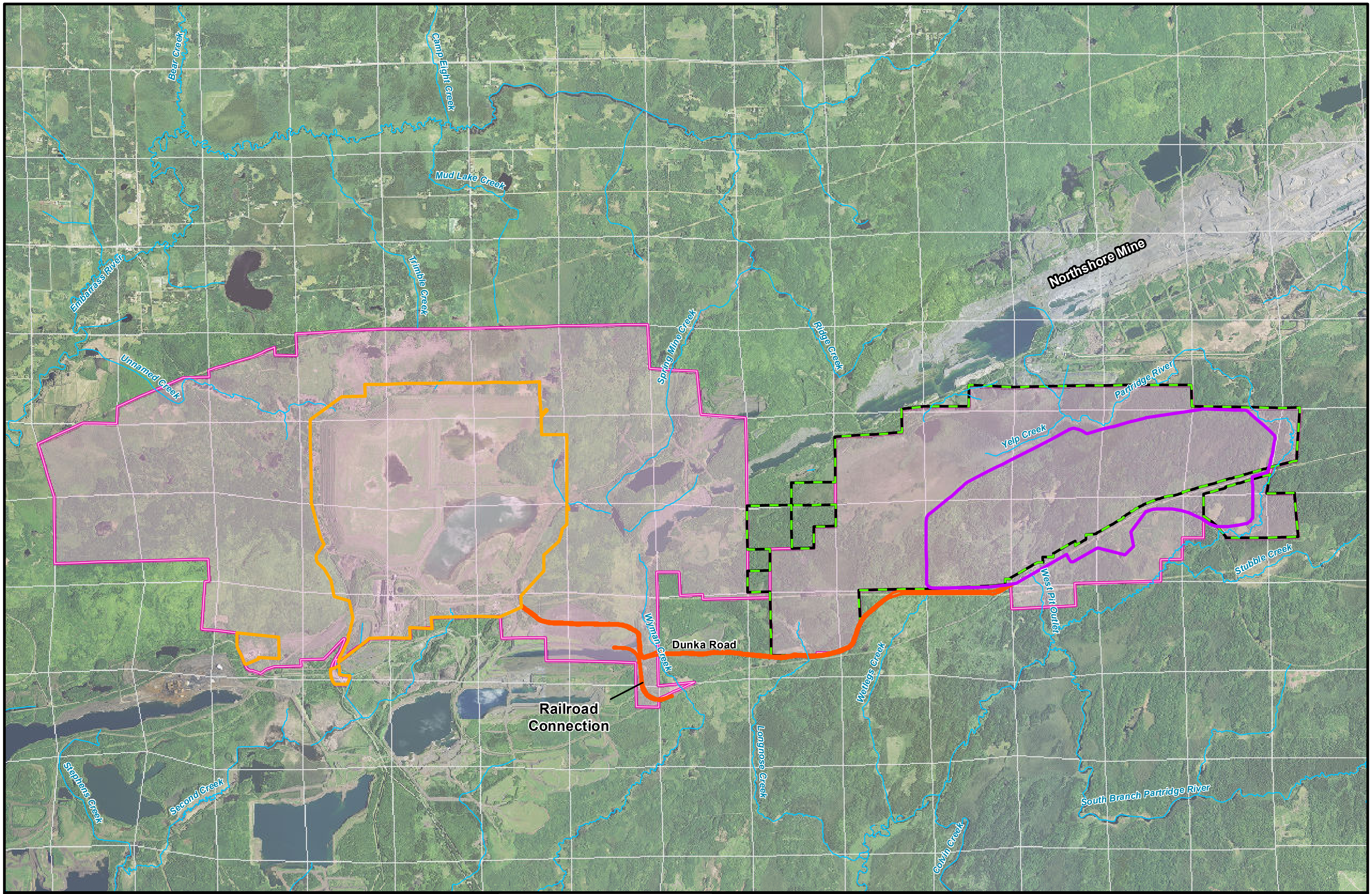

Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Stream/River
Section Boundary
Air Quality Area of Potential Effect

MNDNR
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

0 0.5 1 2 Miles

Figure 4.2.9-3
Cultural Resources Analysis - Air Quality Area of Potential Effect
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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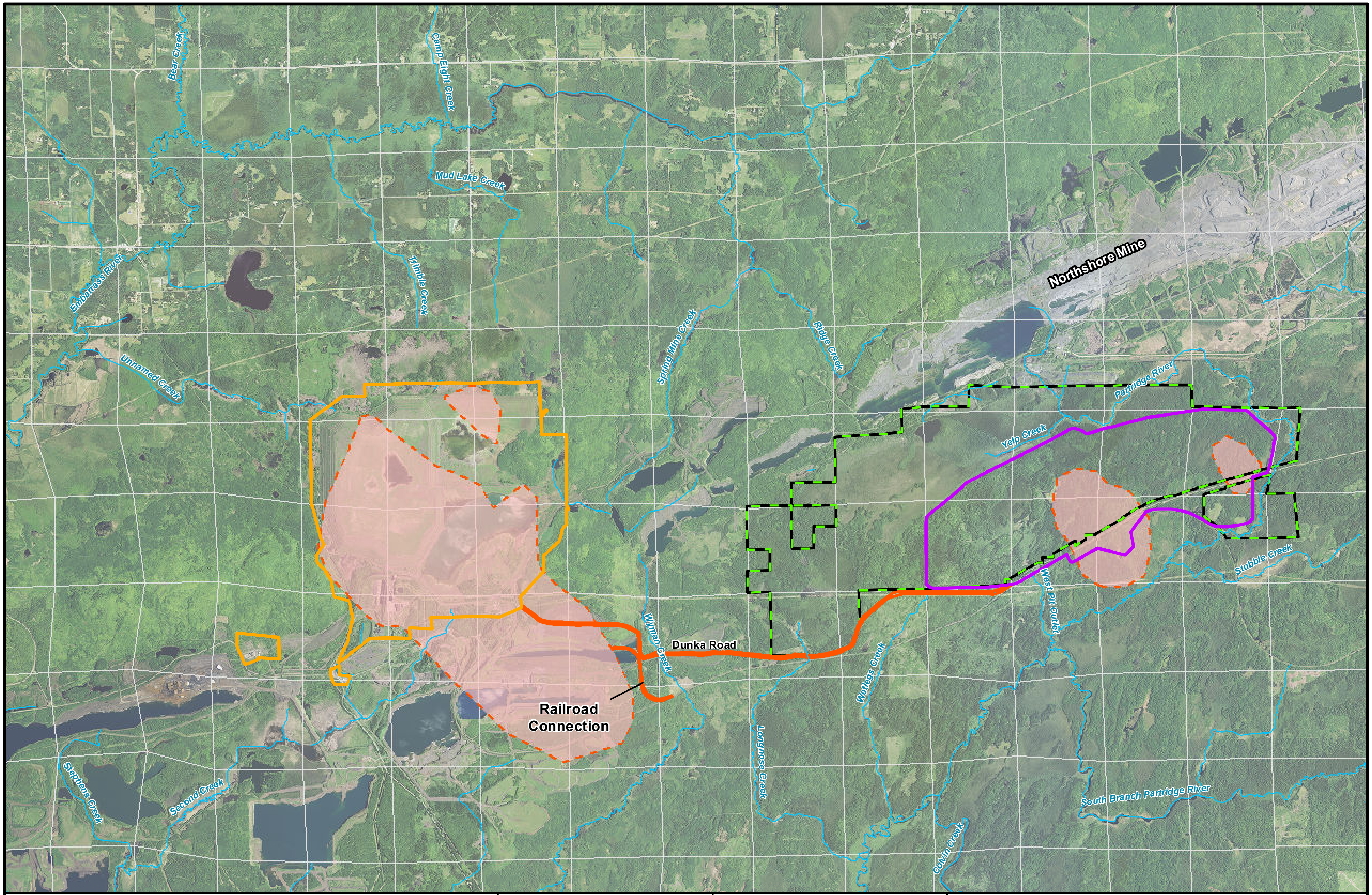

Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Stream/River
Section Boundary
Fugitive Dust Area of Potential Effect

N W E S

0 0.5 1 2 Miles

Figure 4.2.9-4
Cultural Resources Analysis - Fugitive Dust Area of Potential Effect
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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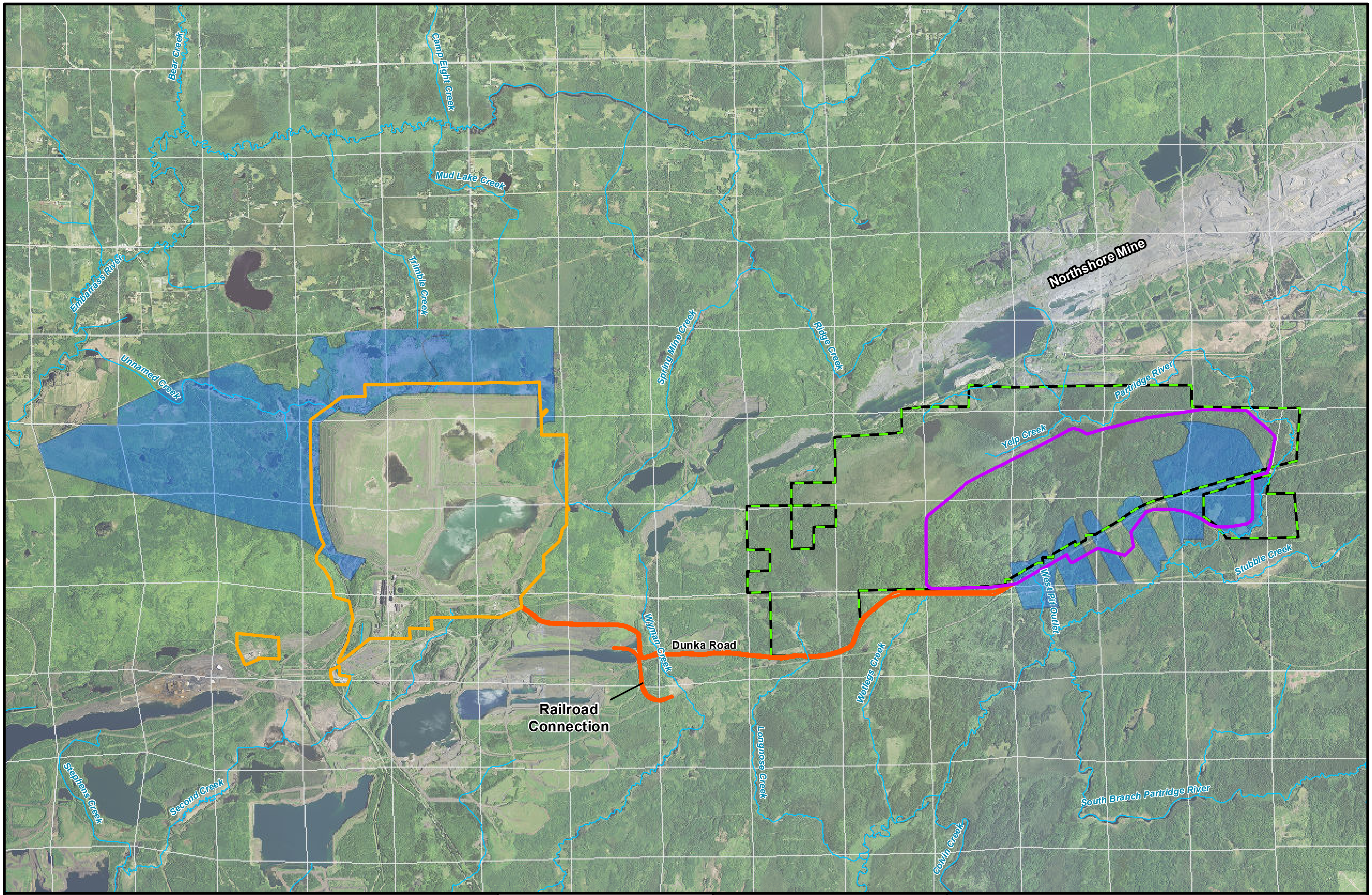

Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Stream/River
Section Boundary
Groundwater Quality Area of Potential Effect

MNDNR
US Army Corps of Engineers St. Paul District

N W E S

0 0.5 1 2 Miles

Figure 4.2.9-5
Cultural Resources Analysis - Surficial Groundwater Quality Area of Potential Effect
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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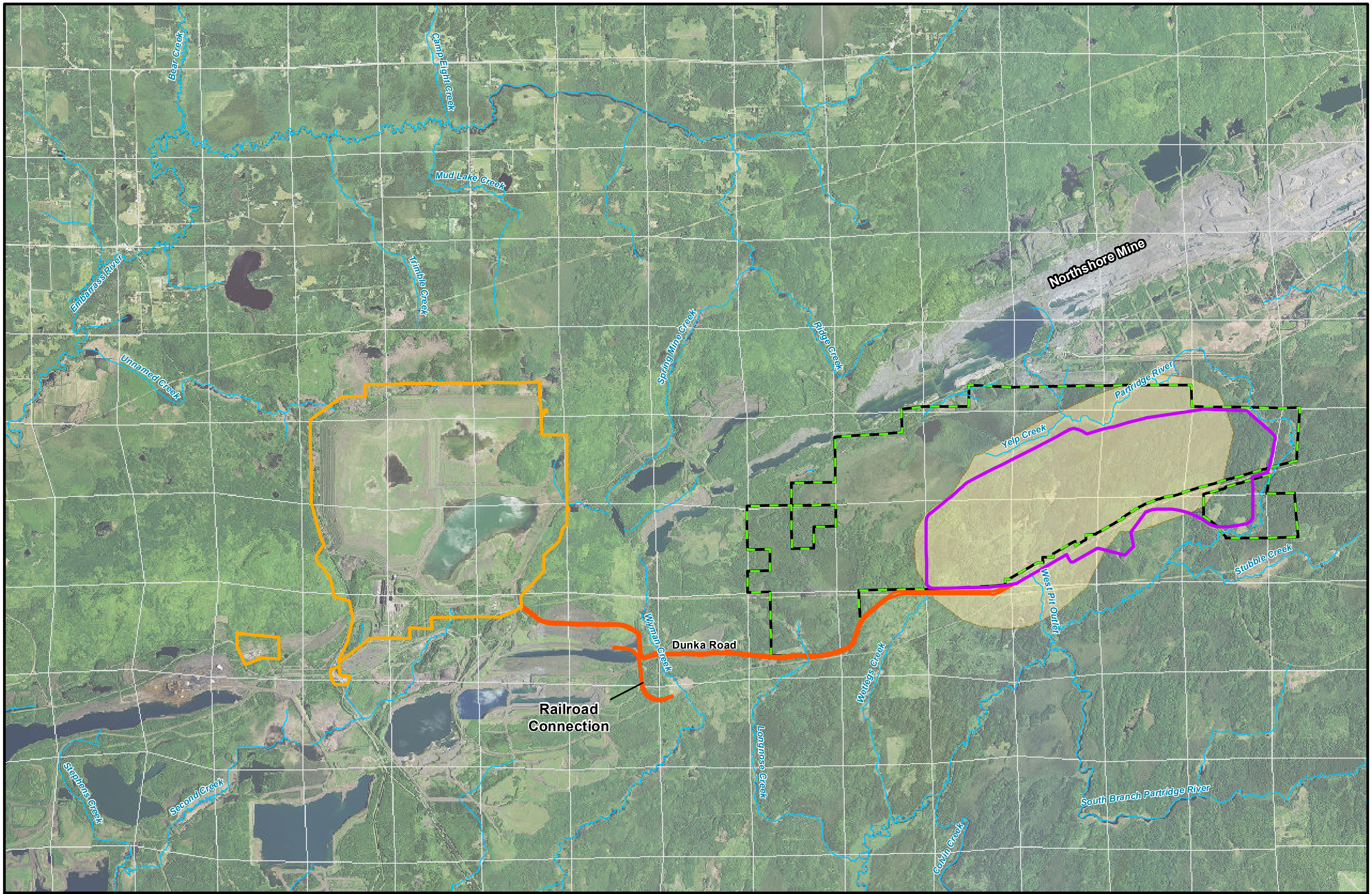

Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Stream/River
Section Boundary
Groundwater Drawdown Area of Potential Effect

MNDNR
US Army Corps of Engineers St. Paul District

N W E S

0 0.5 1 2 Miles

Figure 4.2.9-6
Cultural Resources Analysis - Groundwater Drawdown Area of Potential Effect
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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The APE for visual effects was based on a cultural resource-specific analysis completed for the NorthMet Project Proposed Action by the federal Co-lead Agencies. At a distance of approximately 12 miles on a prominent landform (Skibo Scenic Overlook), the NorthMet Project Proposed Action stockpiles would be visible as a thin line on the horizon. The existing Plant Site buildings are visible from the same location. However, proposed construction at the Plant Site would not result in changes to the existing Plant Site profile visible in the distance. At intermediate distances between Skibo and the Mine Site, the elevations are lower and the Mine Site would not be visible. Therefore, the visual APE for the Mine Site is bounded by the crest of the Laurentian Divide (*Mesabe Widjiu*) and an area about 1 mile from the Mine Site on the eastern, western, and southern sides (see Section 5.2.11.2.2). The visual APE for the existing LTVSMC Tailings Basin at the Plant Site is not considered to be expansive, because the proposed Tailings Basin would be, for the most part, coincident with the existing basin and would not extend to an elevation higher than the existing LTVSMC Tailings Basin (see Figure 4.2.9-7).

To determine the combined noise effect of the NorthMet Project Proposed Action, the total noise generated from operations at both the Mine Site and Plant Site was added to the existing ambient daytime and nighttime baseline levels. Noise effects from rail transport were also assessed, but qualitatively. Blasting at the Mine Site would be a source of intermittent or non-continuous noise and vibration. Blasting noise is not included in the noise level estimates shown in the noise analysis because mine-blasting is typically an instantaneous event (not continuous or steady), and would occur only during daytime periods.

Operations at the Mine Site and Plant Site would occur 24 hours per day. The analysis showed total noise that would be experienced at any receptor location during the daytime (7 a.m. to 10 p.m.) and nighttime (10 p.m. to 7 a.m.) would be well below the Minnesota daytime and nighttime noise standards. In all cases, the NorthMet Project Proposed Action, when mining, hauling, and ore-crushing operations occur, would comply with the applicable Minnesota noise standards.

More specific information on noise-related effects is included in Section 5.2.8, for effects on humans, and Section 5.2.5, for effects on wildlife.

The Co-lead Agencies recognized that several refinements were needed in order to finalize the APE. These refinements included the addition of the Dunka Road corridor, inclusion of 206.96 acres of federal parcels included in the Land Exchange Proposed Action, and inclusion of the Colby Lake Pumphouse and pipeline refurbishment.

Identification of Historic Properties

The SHPO maintains the official inventory of historic properties in Minnesota, as specified in the NHPA and *Minnesota Statutes* 138.081. This inventory is physically housed in two separate sets of files: the History/Architecture files contain records of buildings, structures, and landscapes, and the Archaeological Site files contain records of archaeological sites. A review of SHPO and USFS files and all previous cultural resources studies was conducted for the area covered by the APEs.

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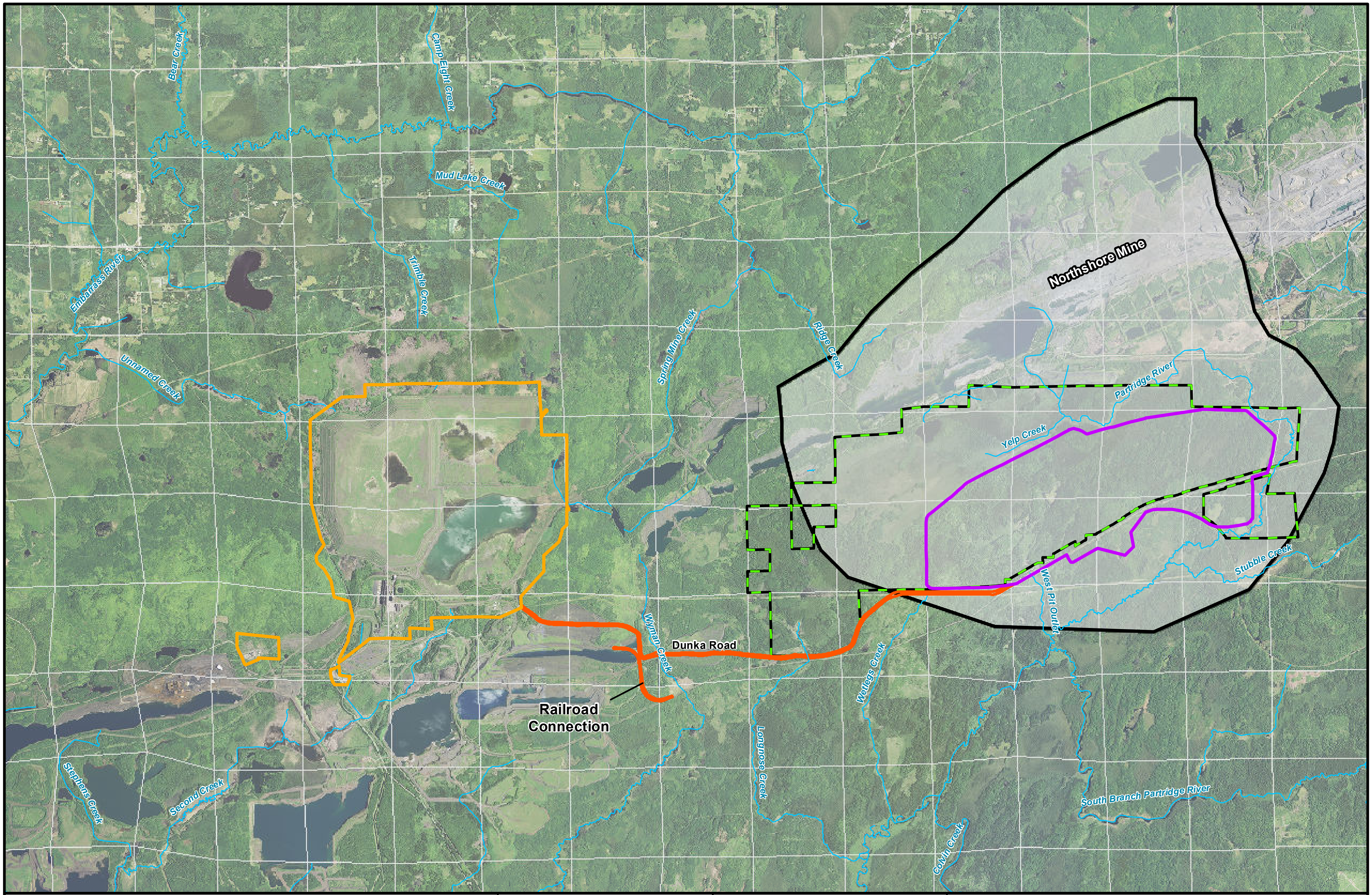

Federal Lands
Mine Site
Plant Site
Transportation and Utility Corridor
Stream/River
Section Boundary
Visual Area of Potential Effect

MNDNR
US Army Corps of Engineers
St. Paul District

N W E S

0 0.5 1 2
Miles

Figure 4.2.9-7
Cultural Resources Analysis - Visual Area of Potential Effect
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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Cultural Context

This section provides a basis for understanding the identification and evaluation of historic properties as it relates to existing conditions. An emphasis is also placed on understanding Ojibwe history and traditions because of a greater emphasis on environmental effects and their potential to affect resources of importance to the Bands. This section provides context to understand the process of identification and evaluation of historic properties of religious and cultural significance to the Bands.

Paleoindian (Circa 13,300 to 9,000 Before Present)

The earliest evidence for human occupation in North America is referred to as the Paleoindian Period. The beginning of this period largely coincides with the transition from the Pleistocene to the Holocene about 11,700 years before present (BP), which marks the transition out of the last glaciation. The Paleoindian Period spans from about 13,300 to 9,500 BP and is generally associated with finely made fluted, lanceolate-shaped projectile points.

This was a period of rapid environmental change as the climate was warming. The ice probably began to retreat about 17,000 BP and, by 9,000 BP, had largely retreated to the Hudson Bay Lowland. Thinning of the ice allowed changes in atmospheric circulation patterns, further affecting climate change (Teller 1987).

Proglacial lakes formed from the meltwater of the ice sheets as its flow was blocked by vast amounts of glacially deposited sediment at the terminal positions of the ice. As the ice continued its retreat, the outlets to the glacial lakes down-cut, lowering lake levels and developing well-defined drainage ways, leading to rapid hydrologic change. Areas where stagnant blocks of ice were buried in glacial sediment developed spruce forests on them and persisted for thousands of years.

The people during this time lived in a subarctic environment that has no direct analogue in the world today. The animals of this environment included mammoths, giant bison, and other now-extinct species. In ice-free areas during this early period, there were variations of fluted, lanceolate-shaped projectile points, as found on archaeological sites. The first published discovery of these projectiles in association with mammoth and an extinct form of bison occurred at archaeological sites in New Mexico.

These early people are thought of as highly mobile big-game hunters who traveled in small bands. Tools were light, efficient, and remarkably similar across great distances (Mason 1981), which suggests that there was a rapid spread of people across the continent at that time.

Radiocarbon dates on mammoth bone collagen and wood associated with stone tools place people in the southeast Lake Michigan Basin by at least 12,500 BP. In Minnesota, the lack of excavated or recorded early Paleoindian sites makes it difficult to identify site types or assess their distribution across the landscape. The known sites appear to be oriented toward the current waterbodies, but that may reflect survey coverage as opposed to actual site distribution. The small number of sites suggests there was a small population in Minnesota or that a large number of sites were destroyed or were deeply buried as the landscape evolved (Mather and Lindbeck 2011).

The late Paleoindian Period is better represented in Minnesota and adjacent parts of Canada. Sites on paleo-shoreline features of proglacial lakes in the Great Lakes region are a well-documented aspect of early settlement patterns such as at the Lakehead Complex sites at Thunder Bay, Ontario dating to roughly 9,500 BP; sites on the Campbell beaches of Lake Agassiz in the Quetico Provincial Park and Boundary Waters Canoe Area Wilderness (Julig et al. 1990); and on a beach ridge of Glacial Lake Aitkin in Aitkin County (Allan 1993). Julig suggests that the beach ridges may have been used for travel routes around the large glacial lake basins (Julig 1988; Julig et al. 1990).

The Reservoir Lakes northwest of Duluth are well-known for extensive surface collections that include Late Paleoindian and Archaic Points (Harrison et al. 1995). Dates from the Bradbury Brook site in Mille Lacs County place the site occupation at about 10,000 to 9,000 BP (Malik and Bakken 1993).

The Bradbury Brook investigation and analysis of other late Paleoindian assemblages suggest a preference for the use of Knife Lake Siltstone, which is a preference that may extend to much of northeast Minnesota and is reflected in the collections from the Reservoir Lakes.

Archaic (Circa 9,000 to 2,500 Before Present)

By 9,000 BP, climatic conditions were probably similar to that of present day, as inferred from the pollen record (Wright 1974). Around 9,400 BP, Lake Superior was dropping rapidly from its Minong levels (Julig et al. 1990) and by 9,000 BP, Lake Agassiz was retreating northward.

At the beginning of this period, lakes covered substantially larger areas and open water would have occupied areas of present day peatland (Hohman-Caine and Goltz 1995). Water levels in the larger pro-glacial lakes receded as streams developed and down cut their outlets. As post-glacial warming continued, hydrology and vegetation changed. About 7,000 years ago, much of Minnesota was dominated by prairie and lakes may have periodically dried up during summer droughts (Wright 1974; Watts and Winter 1966; Webb et al. 1983). With changes to the composition of plant communities and shifts in the ranges and varieties of animal species, human adaptations to the environment changed, as well. Moose and caribou were probably replaced by bison in many locations.

Less predictable resources during the mid-Holocene may have resulted in populations concentrating in areas around the largest lakes and streams (Mason 1981) and a shift from a foraging to a collector strategy, with greater use of local environments as task groups ranged from camps located near predictable resources (Hohman-Caine and Goltz 1995; Dobbs 1989).

The Itasca Bison Kill Site is an Early Archaic site located at the headwaters of the Mississippi River. It is the only archaeological site in Minnesota where the remains of extinct bison (*Bison occidentalis)* were found in association with cultural material. The bison were killed on the shore of a now-extinct lake. Radiocarbon dates suggest the site dates to about 8,000 years ago. Pollen and macrofossils preserved at the site indicate that the surrounding countryside was an open, pine-dominated woodland giving way to expanding prairie (Shay 1971).

Early Archaic sites in the Canadian-Shield/boreal forest areas are somewhat rare when compared to areas south of the Great Lakes (Mason 1981). The lack of Archaic sites was striking in the results of an archaeological survey on Rainy Lake (Gibbon and Woolworth 1977). In general, the Shield Archaic assemblages lack the complexity found in other regions. Assemblages do include some woodworking tools such as trihedral adzes.

The Shield Archaic is a cultural tradition showing in place continuity over thousands of years with late Paleoindian antecedents as opposed to an intrusion of new people. It appears to be a gradual succession of individual small-scale adaptations to new conditions (Mason 1981; Dobbs 1989).

Population levels during the mid-Holocene may have been lower than those during the late Paleoindian period, because the closed, coniferous forests would have been relatively resource poor (Mason 1981). The lack of recorded sites may be the result of large portions of the archaeological record for this period being submerged as lake levels rose to modern levels, being deeply buried under alluvial sediment, or eroded as stream flows changed (Michlovic 1982; Bettis and Thompson 1981; Overstreet and Kolb 2003).

Woodland Tradition (Circa 2,500 Before Present to European Contact)

This stage in prehistory is characterized by the initial appearance of earthen mounds and ceramics, although it is not certain if mound-building and the adoption of ceramics are related and occur at the same time. The most important cultural trends during this time are increasing population growth, intensification of regional identity, increasingly efficient use of local raw materials and food resources, and the intrusion of ideas and technologies. Dobbs (1989) suggested that, in northern Minnesota, ceramic use seems like more of a "veneer" that overlays a basic Archaic hunting and gathering lifestyle.

Initial Woodland populations in northern Minnesota are represented by a net-impressed ceramic type known as Brainerd Ware, which spans a period of from about 3,000 BP to 1,600 BP. The distribution of Brainerd Ware is well-known in the Mississippi River headwaters, extending west onto the plains. Brainerd Ware is also represented on some sites in St. Louis County (Hamilton 2009; Hohman-Caine and Goltz 1995). Mather and Lindbeck (2011) suggest that this development occurred roughly at the same time wild rice was migrating from the lakes of southern and central Minnesota into the lakes of northern Minnesota. Residue from Brainerd vessels has produced rice phytoliths and radiocarbon dates of 2,000 years ago (Justin and Thompson 1995) and 2,700 BP to 2,800 years ago.

Many of the Brainerd sites are found on beach ridges associated with higher lake levels of this period. The remains of elk, bison, deer, and possibly caribou from a site near Leech Lake suggest the people who made Brainerd Ware were highly adapted to the prairie-forest ecotone (Hohman-Caine and Goltz 1995).

The first burial mounds in northern Minnesota are associated with the Laurel Culture (Arzigian 2008). While the cultural relationship between Brainerd and Laurel is poorly understood, radiocarbon dates suggest that Brainerd precedes Laurel. Laurel dates range from 2,000 to 1,000 years ago. At the Big Rice site north of Virginia, Minnesota, wild rice grains were recovered from three pit features containing only Laurel ceramics and produced radiocarbon dates of about 2,035 to 1,700 years ago (Valppu and Rapp 2000).

In stylistic terms, Laurel is comparable to other woodland manifestations to the south and east. Laurel distribution is extremely broad, extending from west-central Quebec to east-central Saskatchewan, including northern Minnesota, where it is common in the Superior National Forest (Hamilton 2009). The best-known concentrations of Laurel occur in the Rainy River, Rainy Lake, and Vermillion River drainages and the Mississippi headwaters (Arzigian 2008).

Extensive surveys in Voyageurs National Park and the Superior National Forest have identified numerous Laurel sites, with 94 percent of those sites in the MDNR Laurentian Mixed Forest province and concentrated in the Border Lakes subsection of the Northern Superior Uplands. Most sites are in lacustrine settings (lakeshore, islands, and peninsulas), less than 20 percent are in riverine settings, and only 3 percent are in uplands.

During the Terminal Woodland, there are increases in site size and density, suggesting a population increase. The period begins in northern Minnesota, with the Blackduck-Kathio-Clam River cultures comprising stylistically similar ceramics. Kathio ceramics are primarily from the central lakes area of Minnesota, and Clam River ceramics are found mostly on tributaries to the St. Croix River in western Wisconsin. Early Blackduck begins about 1,400 years ago in the Mississippi headwaters and on the Rainy River, ending about 900 to 1,000 years ago.

The stratigraphic relationship of Blackduck ceramics to Laurel and the later Sandy Lake Ware is fairly well-known. Laurel and Blackduck may have coexisted for several hundred years. There have been no well-stratified sites excavated with components transitional between Laurel and Blackduck (Johnson and Schaaf 1978) and it is unclear whether Blackduck represents in situ evolution of Laurel (Thomas and Mather 1996) or the replacement of Laurel by a separate group of people (Stoltman 1973).

The most recent pre-contact archaeological culture in northern and central Minnesota is the Psinomani, dating from 900 to 360 years ago. It is associated with Sandy Lake and Ogechie ceramics. Sandy Lake ceramics are similar to other woodland ceramic types throughout North America, but Ogechie ceramics are most similar to Oneota ceramic types produced by the agricultural communities to the south. These groups were north of areas where corn agriculture was practiced successfully, particularly on major lakes and waterways of the Mississippi River headwaters: the Rainy River – Rainy Lake, and Boundary Waters systems and eastward to Lake Superior, with some sites in the prairie region to the west. The larger site size and greater population density is often attributed to the use of wild rice, but evidence also suggests use of the prairie forest ecotone and prairie, which includes seasonal bison hunts. The differences in the archaeological assemblages in the prairie region versus the central lakes area may represent the seasonal round, as opposed to different subsistence strategies.

Psinomani archaeological sites in the Mille Lacs area have been linked to the historic Mdewakanton Dakota through early historic records and artifact assemblages that include French trade goods.

In the Mille Lacs area, the end date for the Psinomani is based on the historic record for the displacement of Dakota people by the Ojibwe in 1750 AD. In the Rainy River area at the Long Sault Site, Sandy Lake pottery was found in association with historic trade goods, overlying a Blackduck component that dated to 1750 AD. At the Creech site on Leech Lake, there were levels with both Sandy Lake and Blackduck stratigraphically above levels containing only Blackduck ceramics (Johnson 1991) and at Mitchell Dam, Sandy Lake was described as associated with Blackduck (Cooper and Johnson 1964).

The practice of these Eastern Woodland lifeways was disrupted during the mid-17th century as European explorers and trade goods began to enter the region.

Ojibwe Context

The Ojibwe people were living in the upper Great Lakes region when European explorers first entered the area. Some archaeologists associate Blackduck ceramics with the Algonkian-speaking groups, including the Cree and Ojibwe (Johnson 1969; Steinbring 1980), while others have suggested association with Siouan-speaking Assiniboine. More recently, archaeologists believe that the makers of Blackduck ceramics were most likely Algonkian speakers, but the ethnic divisions of Cree and Ojibwe are historical constructions with little validity in prehistory (Greenberg and Morrison 1982).

The ancestral Ojibwe were part of a large clan-based group of people that referred to themselves as Anishinabe (original people). This Algonquian-speaking group was spread over a vast area of the subarctic region of southern Canada and the northern United States, a territory much larger than that of any other Native American tribe in North America (Tanner 1986).

Subsistence patterns depended, to some extent, on the location any one particular group inhabited and varied greatly across the territory occupied. The groups were not connected by a uniform subsistence base, but by a clan network. These clan groups were seasonally mobile, autonomous groups for centuries prior to the arrival of Europeans in North America. The earliest accounts talk of a number of distinct, but related groups, such as the Saulteur, the Outchibou, or Marameg (Tanner 1994). These people became known as "Ojibway" after the publication in 1885 of William Warren's *History of the Ojibway People* (Warren 1984).

Their story starts prior to arrival of Europeans in North American, when the Anishinabe were living along the eastern seaboard. It was during that time, according to the Anishinabe sacred migration story, that a man beheld a vision from the Creator that foretold of the destruction of the Anishinabe and called on them to move west until they found the place "where food grows on the water:"

> While we were on the east coast, a man had a dream or a vision if you will. In this dream, he was told a number of things. The first was, he was to leave the area and take as many people as would go with him. The second was, if people did not leave many would perish. The third was, to travel towards the west and to follow the great megis shell when it rose out of the water, or sand, and to stop when it lowered back into the water, or sand, or if something reminded them of a turtle. The fourth was that their journey would end when they found the food that grows on water.
>
> He left with many following him, and went down the St. Lawrence River and waterways that led to the Great Lakes area. While in the central part of the Great Lakes area, two peoples split off from us. They are the Potawatomi and the Ottawa, who went into Canada, Michigan, and Wisconsin. The Anishinabe continued on to the edge of Lake Superior. Once we came inland, we never saw the megis shell again. This journey took over five hundred years and the prophecy that was told while we were on the east coast was kept alive orally from generation to generation by traditional storytelling. On our journey, we stopped seven times, sometimes for five days, sometimes for five years, it all depended on the megis shell. (Tribal Historic Preservation Office [THPO], Pers. Comm., August 14, 2012)

Pressures from European trade and from their Iroquois neighbors are often cited as motivation for this move (Risjord 2005). However, this explanation for westward migration is a Euro-American perspective and contrary to oral history (THPO, Pers. Comm., August 14, 2012).

Anishinabe oral tradition relates a 500-year journey, beginning in about 900 AD on the east coast. Near the end of this journey, the fifth of the seven stopping places was in the area that is now the location of Sault Ste. Marie, Michigan, where a group stayed because of the rich fisheries. From Sault Ste. Marie, the Ojibwe split into two groups. One traveled north around Lake Superior and the other south around the lake. They met at Spirit Island in the St. Louis River Estuary, the sixth stopping place, where they found wild rice.

From Spirit Island, some moved east along the southern shore of Lake Superior to find the seventh stopping place, which was at Madeline Island—the last point on the migration.

Perhaps because the last part of the migration occurred during the time of European explorations, early accounts of settlement locations and how they relate to the migration and first arrival in the western Great Lakes are difficult to interpret. Oral tradition places the Ojibwe in the Lake Superior region as early as 1400 AD (Benton-Banai 1988:102). Other sources place the Ojibwe on the north shores of Lake Superior and the Upper Peninsula of Michigan by 1500 AD (Clifton et al. 1986).

The first known encounter with Europeans was at Sault Ste. Marie in 1609, when Samuel Champlain, founder of New France, established relations, intending to set up trading partnerships. As the Ojibwe began to focus on trapping for furs to trade, the once-autonomous bands reorganized into village-centered sociopolitical entities. This was an important demographic consequence of French influence and endemic native wars. Villages were established along the southern shore of Lake Superior in Keweenaw Bay, La Point, and Sault Ste. Marie, and probably represented only a fraction of the population dispersed across the Western Great Lakes and interior waters (Zedeño et al. 2001).

As the fur trade gained momentum in the east, increased conflict resulted as the beaver supply was being exhausted. In the mid-1600s, the British-allied Iroquois pushed the Huron out of their land and into the Tionontati, Erie, and Ottawa regions, which also affected the Ojibwe presence at Sault Ste. Marie. Subsequently, throughout the early 1700s, many groups moved into areas previously vacated because of the Iroquois threat. The Fox began an aggressive campaign against the French in the Detroit area, who were thought to prevent the Fox from carrying on trade with the Dakota. The Fox and the Dakota were allied in their interests in Plains resources. The Ojibwe went to the aid of the French as a sign of their loyalty. The final battle between the Fox and the Ojibwe was fought at St. Croix Falls in 1755. The Ojibwe conflict with the Fox had affected Dakota-Ojibwe relations.

After the second Treaty of Paris in 1783 sealed the victory of the American Revolution, the new Americans felt that the land ceded to them in the treaty included the land where the Ojibwe and other Great Lakes tribes lived (Tanner 1986). Warfare between the Ojibwe and the Dakota made merchants extremely cautious of moving to land west of Michigan (Hickerson 1970). In order to end continuing land disputes between the Ojibwe and the Dakota, and secure a peaceful frontier for settlers, the United States encouraged the signing of the 1825 Prairie du Chien Treaty. The treaty defined boundaries of land owned by the Ojibwe, and set the stage for the United States to obtain mineral rights to the Ojibwe territory defined under the 1825 Prairie du Chien Treaty (Kappler 1904).

As more settlers pushed into the Lake Superior region in search of timber and minerals, the United States government bought land from the Ojibwe through cession treaties. The Treaty of 1836 ceded land in Michigan's Upper and Lower Peninsulas and parts of the Great Lakes, and the Treaty of 1837 ceded land in north-central Wisconsin and east-central Minnesota. The Treaty of 1842 ceded land in northern Michigan and Wisconsin and the western part of Lake Superior; and the 1854 Treaty ceded land in northeastern Minnesota, and created reservations for many Ojibwe bands. These treaties reserved the rights of the Ojibwe to hunt, fish, and gather on lands they sold to the United States (Kappler 1904).

History of the Iron Range

Minnesota became the thirty-second state in 1858, which spurred an ever-increasing flow of European-American settlement and the establishment of towns, cities, and enterprises other than fur trade (Mason 1981). Wheat surpassed corn as the principal crop in 1860, with much of it being exported out of state. White pine and red pine were sought after by loggers, and were harvested in the Fort Snelling area as early as 1820. By 1870, there were 207 saw mills in Minnesota. In 1877, a law allowing sale of timber off state lands further opened the state for logging. The logging boom had tapered off by the early 1900s (Risjord 2005).

In 1865, the newly appointed Minnesota state geologist, Augustus Hanchett, with the help of his assistant, Thomas Clark, issued a report generally describing copper ore deposits in the Lake Superior area and iron ore deposits at Lake Vermilion (Hanchett and Clark 1865). The following year, Henry H. Eames replaced Hanchett as state geologist and issued a report confirming the presence of gold ore around Lake Vermilion, creating a short-lived Minnesota gold rush during which other Minnesota ores were ignored (Lamppa 2004). Discovery of iron ore in the Vermilion Range led the Pennsylvania industrialist Charlemagne Tower to buy large tracts of land on the Vermilion Range. In 1882, Tower organized the Minnesota Iron Company and, by 1884, shipped the first ore from the Soudan Mine by rail on the company's Duluth and Iron Range Railroad to Lake Superior (Risjord 2005).

The Merritt Brothers of Duluth laid groundwork for their Mountain Iron Mine through their explorations during the 1890s (Minnesota Historical Society 2008). Up to that point, only the far-eastern portion of the Mesabi Range had been mined for iron, and not on a large commercial scale, with mostly hand tools being employed (Walker 1979; Atkins 2007). They opened their second mine in 1891 near Biwabik. By 1892, they shipped their first carload of ore on their Duluth, Missabe, and North Railroad to dock in Superior, Wisconsin (Minnesota Historical Society 2008). A loan from John D. Rockefeller to the Merritts to expand the railroad ultimately led to the transfer of all of their mining and rail properties to Rockefeller. Shortly thereafter, all of the mining interests in Minnesota were owned by eastern interests, with J.P. Morgan consolidating the Rockefeller and Carnegie holdings in 1901 under U.S. Steel (Risjord 2005).

By 1890, when the Mesabi Iron Range deposits were discovered, nearly 300 iron mining companies had been incorporated in Minnesota. By 1900, the Mesabi Range was the most extensive iron ore mining area in the world, supplying increasing demand by steel mills throughout the Great Lakes states (Hall 1987). Early mining ventures in the Mesabi Iron Range focused on hematite, a soft granular rock rich in iron that could be mined with steam shovels and required limited processing. More than 95 percent of the iron deposits in the Mesabi Range consist of taconite, a hard iron-bearing rock that must be pulverized and processed for mineral extraction (Risjord 2005).

In the late 1920s, increased mechanization reduced the number of workers needed and increased productivity. However, due to the Great Depression, iron ore production in the Iron Ranges dropped dramatically by the early 1930s (Lamppa 2004). A cost-effective technology for taconite processing was developed by the late 1930s. Taconite mining was made even more economically feasible by two factors: 1) legislation passed in 1941, replacing property taxes within the Iron Range with taxes on actual ore mined, and 2) increased demand due to World War II. The Reserve Mining Company was formed in 1942 (Risjord 2005). In 1964, when interest in taconite pellet use in steel manufacture prompted interest in increasing taconite pellet production, an amendment was passed that guaranteed that the tax advantages of the 1941 taconite legislation would be maintained (Lamppa 2004).

In 1957, the Erie Mining Company opened its concentration plant at Hoyt Lakes. This plant was Minnesota's second large-scale taconite plant, and it remained in operation through 2001, with a change in ownership to LTVSMC in the 1980s, and then to Cleveland Cliffs in 2001 (Zellie 2007). While six new taconite plants were built on the Iron Range in the 1960s and '70s, inexpensive imports changed the industry and decreased demand by two-thirds (Risjord 2005).

Cultural Resources Investigations

Several cultural resources studies have been completed within or adjacent to the NorthMet Project and Land Exchange areas (see Figure 4.2.9-8). This section presents previous investigations that have been conducted prior to the development of the NorthMet Project Proposed Action, as well as investigations conducted specifically for the NorthMet Project Proposed Action.

<u>Previous Investigations</u>

In 1985, the USFS conducted a Phase I cultural resources survey as part of the Yelp Lake Timber Sale (USFS 1985). The survey consisted of a desktop review of historical aerial photographs and pedestrian reconnaissance survey of manmade features such as clearings, roadways, and trails, as well as landforms exhibiting the potential for containing archaeological sites. Overall, the area was considered to have low potential for containing prehistoric and historic archaeological sites, as well as architectural structures. During the Phase I cultural resources survey, one historic period resource (SHPO ID 09-09-01-115) was identified. The resource was only described as being related to the historical railroad and logging context and does not fall within the current NorthMet Project or Land Exchange areas.

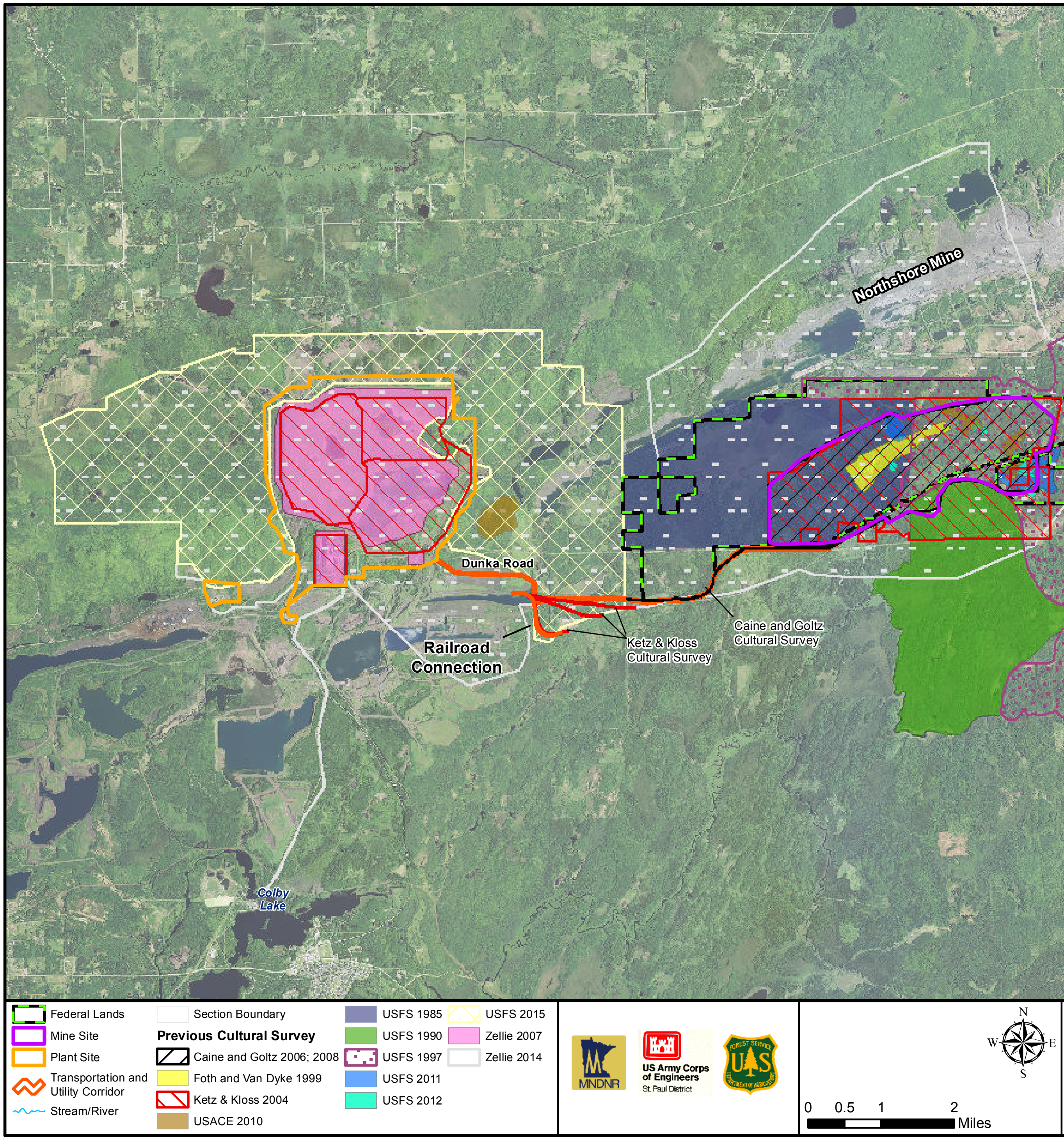

Figure 4.2.9-8

Cultural Resources Analysis - Previous Investigations

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In 1990, the USFS conducted a Phase I cultural resources survey as part of the Stubble Creek Timber Sale (USFS 1990). The survey consisted of a desktop review of historical aerial photographs, helicopter flyover, and pedestrian reconnaissance survey of manmade features such as clearings, roadways, trails, and structures, as well as landforms exhibiting the potential for containing archaeological sites. Overall, the area was considered to have moderate potential for containing historic archaeological sites and architectural structures and a low potential for containing pre-contact archaeological sites, with the exception of areas adjacent to the Partridge River. During the Phase I cultural resources survey, no previously recorded cultural resources were noted within the NorthMet Project area; however, three new cultural resources were identified (SHPO IDs 09-09-01-362, 09-09-01-363, and 09-09-01-364). All three resources are associated with the historic period, though the report is unclear as to whether these resources are archaeological sites, standing architectural structures, or both. The North Partridge Camp (SHPO ID 09-09-01-362) and the Stubble Creek Mill (SHPO ID 09-09-01-364) were not evaluated and the South Branch Bridge (SHPO ID 09-09-01-363) was recommended not eligible. None of these resources fall within the current NorthMet Project or Land Exchange areas.

In 1997, the USFS conducted a Phase I cultural resources survey as part of the Laird/LTV II Project (USFS 1997). The survey consisted of a desktop review of historical aerial photographs, helicopter flyover, and pedestrian reconnaissance survey of manmade features such as clearings, roadways, and trails, as well as landforms exhibiting the potential for containing archaeological sites. During the Phase I cultural resources survey, no new cultural resources were identified; however, five previously identified cultural resources were noted. None of these five previously identified resources fall within the current NorthMet Project or Land Exchange areas.

Investigations Conducted for the NorthMet Project Proposed Action

In 1999, Foth and Van Dyke completed a Phase I archaeological survey within the proposed Mine Site where exploratory drilling was to take place (Foth and Van Dyke 1999). The survey area covered approximately 20 acres. The Phase I archaeological survey involved the excavation of 166 shovel tests placed at 15-meter intervals along the proposed drilling transects with exception to areas exhibiting standing water or exposed bedrock. No new or previously identified archaeological resources were identified within the survey area; however, the literature review portion of the investigation indicated that three historic logging camps (including the Knot Camp Site) and a mill were located to the south and east of the proposed Mine Site.

In 2004, The 106 Group Ltd (106 Group) conducted a cultural resources assessment for the NorthMet Project Proposed Action (Ketz and Kloss 2004). The assessment included the lease area (an area approximating the Mine Site), the former LTVSMC processing plant, the Tailings Basin, and three proposed railroad interconnection alternatives. The 106 Group found that no pre-contact archaeological sites had been previously identified within the 2004 study area. It was also concluded that the pre-contact archaeological potential for most of the study area is poorly understood, but likely of low potential. However, several upland areas located adjacent to the Partridge River and large wetland complexes were considered to have high potential for pre-contact archaeological resources. The 106 Group noted the presence of one previously reported (not field-verified) historic archeological site, the Knot Logging Camp (21SLmn), as well as the potential for two early historic Native American trails as noted on historical maps (Ketz and Kloss 2004; Trygg 1966). The 2004 study also identified several architectural history resources associated with the former LTVSMC processing plant. These resources include the former Erie

Mining Company Taconite facility and associated mining features including an associated rail line. The 106 Group recommended that a Phase II architectural history evaluation be completed for the LTVSMC site (Ketz and Kloss 2004).

In 2005, Soils Consulting conducted a Phase I archaeological survey for the NorthMet Project Proposed Action (Hohman-Caine and Goltz 2006). The investigation entailed the archaeological survey of select landscape features determined by Hohman-Caine and Goltz to have the highest potential for pre-contact archaeological sites. Additionally, a survey was also carried out in areas noted on historical maps and/or in previously identified archaeological site files as containing historical features, such as Native American trails or logging camps. During the investigation, one new archaeological site (NorthMet Archaeological Site) was identified and one previously identified archaeological site (Knot Logging Camp [21SLmn]) was revisited. The NorthMet Archaeological Site was found to contain four lithic artifacts. This newly identified site was recommended as potentially eligible for listing on the NRHP under Criterion D for its potential to yield important information regarding the pre-contact use of the region's landscape (Hohman-Caine and Goltz 2006). The Knot Logging Camp was reported to have been affected by recent logging activities and was recommended as not eligible for listing on the NRHP due to its lack of integrity.

Additionally, a deeply worn trail was identified during the 2005 investigation (Hohman-Caine and Goltz 2006). Soils Consulting suggested that the worn trail may represent a section of a historical Native American trail as noted on a map compiled by John W. Trygg from the original GLO surveys (Trygg 1966). There is the potential that this trail could represent a historical Native American trail connecting Lake Vermilion to Beaver Bay. Shovel testing was completed along the potential historical trail; however, no archaeological resources were identified (Hohman-Caine and Goltz 2006).

In 2007, Soils Consulting conducted a Phase I archaeological survey for the NorthMet Project Proposed Action focusing on the Dunka Road Expansion and Substation areas, as well as a Phase II archaeological evaluation of the previously identified NorthMet Archaeological Site (Hohman-Caine and Goltz 2008). The Phase I archaeological survey consisted of a pedestrian reconnaissance survey of areas considered to have potential for containing archaeological sites. No areas were designated as requiring subsurface testing. No archaeological resources were identified during the Phase I archaeological survey of the Dunka Road Expansion and Substation areas (Hohman-Caine and Goltz 2008). The Phase II archaeological evaluation of the NorthMet Archaeological Site consisted of the placement of three shovel tests and four 1-meter by 1-meter excavation units and one ¼-meter by ¼-meter excavation unit. The Phase II investigation rendered three potential lithic artifacts consisting of one possible basalt core, one possible siltstone flake, and one fragment of quartz. No features or concentrations, such as fire-cracked rock or discolored soils, were noted and the site area was documented as having been previously disturbed by a 10-meter-wide road cut. Upon completion of the Phase II archaeological evaluation of the NorthMet Archaeological Site, Soils Consulting found that the site was unlikely to yield additional information important to the understanding of the past. Therefore, Soils Consulting recommended that the NorthMet Archaeological Site be considered not eligible for listing in the NRHP (Hohman-Caine and Goltz 2008). The USACE and SHPO subsequently concurred with this recommendation.

In 2007, Landscape Research LLC (Landscape Research) conducted a Phase I architectural history survey and developed a historic context to evaluate the architectural resources at the former LTVSMC processing plant that could be affected by the NorthMet Project Proposed Action (Zellie 2007). Through consultation with the USACE and SHPO, it was determined that these were the appropriate steps for evaluating the architectural resources that could be affected. The Phase I architectural history survey identified 17 properties, two of which (the Erie Mining Company Concentrator Building [SL-HLC-008/046] and segments of the Erie Mining Company Railroad mine and track [SL-HLC-015/053]) were recommended eligible for listing in the NRHP. The former LTVSMC processing plant as a whole, however, was not recommended as eligible for listing as an NRHP historic district due to the previous demolition of the pelletizing building. The pelletizing building was a critical component of taconite production and its demolition significantly altered the historic integrity of the plant complex. Landscape Research also recommended that the Erie Mining Company Concentrator Building (SL-HLC-008/046), as well as other key plant buildings and structures, be appropriately recorded prior to their mandated (Rule 6132-1300 E 4 c) post-mining demolition. The SHPO concurred with these recommendations in 2009, but an MOA that includes these properties has yet to be finalized.

In 2014, Landscape Research on behalf of PolyMet examined areas that had been added to the APE based on further air and water quality studies presented in the SDEIS (PolyMet 2014b). The supplemental Phase I architectural survey work was conducted to ensure there were no survey gaps as a result of the change from the original APE to the refined APE published in the SDEIS. The supplemental Phase I architectural survey analyzed 12 properties, three of which (Duluth, Missabe, and Iron Range [DM&IR] Segment [SL-HLC-pending], three segments of the Erie Mining Company Railroad [SL-HLC-015/053], and the Erie Mining Company Administration Building [SL-HLC-pending]) were recommended eligible for listing in the NRHP. The findings of the investigation indicated that potential effects from the NorthMet Project Proposed Action on the three additional segments of the Erie Mining Company Railroad (SL-HLC-015/053) would consist of refurbishment for reuse during operations. At the time of the investigation, the potential effects on the DM&IR Segment (SL-HLC-pending) were not known; however, the reuse of segment portions was thought likely. No potential effects were identified for the Erie Mining Company Administration Building (SL-HLC-pending) as a result of the NorthMet Project Proposed Action.

In 2015, the Co-lead Agencies carried out historical document research and Phase IA desktop survey to further assess a location identified as an “Indian Encampment” on the Trygg Maps (Trygg Land Office-GLO composites Map, Sheet 17, 1966). The Bands expressed concern that the location, which they often referred to as a “rice camp,” might be impacted by the NorthMet Project Proposed Action. The Co-lead Agencies plotted the precise location of the reported site by using the running notes from the 1873 survey of Township 60 North, Range 14 West (USFS, Pers. Comm., January 26, 2015). Based on this analysis, the Co-lead Agencies confirmed that the site was buried during the construction of Erie’s tailings basin. The Phase IA desktop survey, which utilized the 1937 (partial coverage), 1948, and 1961 aerial images, did not identify any standing structures or historic features in the analysis area.

Efforts to Identify Properties of Religious and Cultural Significance

At a consultation meeting in July 2008 to discuss the results of the surveys conducted by Soils Consulting as referenced above, the Bands voiced general concerns about archaeological survey coverage and specific concerns with the Indian trails shown on the Trygg Maps.

The Bands and USACE worked together to develop a plan for the identification of properties of religious and cultural significance (Plan). In April 2010, the USACE consulted with the Bands and PolyMet concerning the implementation of the Plan. The Plan consisted of four components:

1. Interviews to be conducted by the Bands with Band elders to gather information concerning past use of the NorthMet Project area.
2. Baseline ethno-historical research pertaining to Ojibwe use of the APEs would be used in a cultural landscape assessment of the NorthMet Project area and surrounding vicinity. Background research to identify cultural and natural landscape features would include, at a minimum, the original GLO survey notes and maps developed by Trygg, along with other historic maps of the NorthMet Project area and surrounding vicinity, relevant historic documents and literature.
3. Classification of plant communities by the identification of canopy species using aerial infrared photography and the identification of understory, shrub, and herbaceous layers using existing plant lists of specific community types, based on the MDNR’s ECS. This also included ground-truthing to determine accuracy for classification and gathering of additional information on AOCs to the Bands.
4. A field survey to locate and assess the cultural and natural features identified as a result of the background research, elder interviews, and plant classification.

The intent of the Plan was to use plant community classification to identify plant resource areas of interest to the Bands and facilitate identification of historic properties. The archival research was to provide historic documentation and context for the historic Native American trail system and possibly identify other places important to the Bands. The elder interviews then would be used to further identify and understand tribal use areas and places of importance. The field investigation component was to be informed by the results of those efforts.

The field review primarily focused on a reconnaissance-level investigation of the trail corridors as mapped by Trygg (1966) and specific trail locations recorded during the Land Office surveys. Reconnaissance of the trail corridors was conducted by the federal Co-lead Agencies with participation from the Bands. Barr participated in a portion of this fieldwork to gather information for completing the classification of plant communities. Barr also continued their effort to gather plant data aside from the trail reconnaissance.

During 2010 and 2011, PolyMet contracted the Bois Forte, Fond du Lac, and Grand Portage to conduct interviews with Band elders. The Fond du Lac and Grand Portage bands have not made the results of the interviews available for use, though the Bois Forte interviews have been considered during this identification process. The Bois Forte interviews did not provide any specific locations, but some general information was provided. Elders recalled that some Band members had utilized the general NorthMet Project area for hunting, fishing, and plant gathering of wild rice, maple-sugar, berries, and birch bark; however, they could not provide specific locations or uses within the NorthMet Project area.

The federal Co-lead Agencies recognize the importance of natural resources such as wild rice beds as both ecological communities and as important traditional cultural resources for the Ojibwe people. However, those resources must meet NRHP criteria to be considered historic properties and receive further consideration under Section 106. The federal Co-lead Agencies have considered effects on wild rice and other natural resources, as discussed in other resource-specific sections of this FEIS and below in Sections 4.2.9.2.4 and 5.2.9.

The results of the elder interviews, archival research, and plant surveys are discussed in a report titled *NorthMet Project Cultural Landscape Study for PolyMet* (Zellie 2012). The report has been reviewed and coordinated with the USACE, USFS, and Bands. The USFS conducted a historic context study of the Beaver Bay to Lake Vermilion (BBLV) overland trail, which was provided as an appendix to the final report. As a result of the field reconnaissance, archival research, and elder interviews, a number of properties of religious and cultural significance have been identified within the APE. These properties include the Spring Mine Lake Sugarbush, the *Mesabe Widjiu* (Laurentian Divide), the Overlook location, and the BBLV Trail Segment.

4.2.9.2.4 Identified Cultural Resources

Cultural resources investigated within the NorthMet Project area—such as architectural history properties, archaeological sites, and properties of religious and cultural significance to the Bands—are discussed in this subsection. The investigations completed to date in the NorthMet Project area have identified cultural resources as summarized in Table 4.2.9-1.

Table 4.2.9-1 Cultural Resources Identified in the NorthMet Project Area

Resource ID	Resource Name	Resource Type	NRHP Determination by Co-lead Agencies	SHPO Concurrence with Co-lead Agencies' Findings
SL-HLC-002/040	Erie Mining Company Coarse Crusher	Architectural Property	Not Eligible	Concur
SL-HLC-003/041	Erie Mining Company Fine Crusher	Architectural Property	Not Eligible	Concur
SL-HLC-004/042	Erie Mining Company Conveyor and Drive House	Architectural Property	Not Eligible	Concur
SL-HLC-005/043	Erie Mining Company General Shops	Architectural Property	Not Eligible	Concur
SL-HLC-006/044	Erie Mining Company Reservoir	Architectural Property	Not Eligible	Concur
SL-HLC-007/045	Erie Mining Company Water Tower	Architectural Property	Not Eligible	Concur
SL-HLC-008/046	Erie Mining Company Concentrator Building	Architectural Property	Eligible	Concur
SL-HLC-009/047	Erie Mining Company Tailings Thickener Tank	Architectural Property	Not Eligible	Concur
SL-HLC-010/048	Erie Mining Company Pelletizing Building (razed)	Architectural Property	Not Eligible	Concur

Resource ID	Resource Name	Resource Type	NRHP Determination by Co-lead Agencies	SHPO Concurrence with Co-lead Agencies' Findings
SL-HLC-011/049	Erie Mining Company Central Heating Plant	Architectural Property	Not Eligible	Concur
SL-HLC-012/050	Erie Mining Company Fuel Oil Tanks	Architectural Property	Not Eligible	Concur
SL-HLC-013/051	Erie Mining Company Pellet Stockpile and Stacker	Architectural Property	Not Eligible	Concur
SL-HLC-014/052	Erie Mining Company Mine Area No. 2 Shops	Architectural Property	Not Eligible	Concur
SL-HLC-015/053	Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment	Architectural Property	Eligible	Concur
SL-HLC-016/054	Erie Mining Company Tailings Basin	Architectural Property	Not Eligible	Concur
SL-HLC-017/055	Erie Mining Company Mine Area No. 1 Shops	Architectural Property	Not Eligible	Concur
SL-HLC-018/056	Erie Mining Company Concentration Plant Complex	Historic District	Not Eligible	Concur
SL-HLC-pending	DM&IR Segment	Architectural Property	Eligible	Concur
SL-HLC-pending	Erie Mining Company Colby Lake Pumping Station and Pipeline	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Erie Mining Company Administration Building	Architectural Property	Eligible	Concur
SL-HLC-pending	Spring Mine and Stockpiles	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Erie Mining Company Mine Area No. 2	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Erie Mining Company Mine Area No. 3	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Erie Mining Company Mine Area No. 5	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Erie Mining Company Dunka	Architectural Property	Not Eligible	Concur

Resource ID	Resource Name	Resource Type	NRHP Determination by Co-lead Agencies	SHPO Concurrence with Co-lead Agencies' Findings
	Road Segment			
SL-HLC-pending	Erie Mining Company High Voltage Transmission Line Segment	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Reserve Crusher No. 2 (Northshore Mining)	Architectural Property	Not Eligible	Concur
SL-HLC-pending	Erie Mining Company Hoyt Lakes Operation Mining Landscape Historic District	Historic District	Eligible	Concur
21SLpending	Spring Mine Lake Sugarbush	Archaeological Site	Eligible	Concur
SL-HLC-065	*Mesabe Widjiu* (Laurentian Divide)	Cultural Landscape	Eligible	Concur
SL-HLC-pending	Overlook	Natural Feature	Not Eligible	Concur
SL-HLC-069	BBLV Trail Segment[1]	Archaeological Site	Eligible	Concur
21SLpending	NorthMet Archaeological Site	Archaeological Site	Not Eligible	Concur
21SLmn	Knot Logging Camp	Archaeological Site	Not Eligible	Concur

Note:
[1] USFS designation BBLV Trail Segment #1 (USFS #01-569).

Erie Mining Company Concentration Plant Complex

SL-HLC-018/056 consists of the primary Erie Mining Company Concentration Plant buildings, such as the coarse and fine crushers and the concentrator; mine and plant track segments of the Erie Mining Company railroad; a Tailings Basin; pellet stockpile area; and mine areas. Treated as a mining complex or district, the property's integrity is diminished by the loss of the pelletizing plant (SL-HLC-010/048), a central component. Its qualities of association, design, and related aspects of feeling and setting are lost without this key component (Zellie 2007). Although some components of the property may be determined eligible individually, the Erie Mining Company Concentration Plant Complex (SL-HLC-018/056), as a complex/district, was determined not eligible for inclusion in the NRHP.

The Concentrator Building (SL-HLC-008/046) is a key property within the complex and reflects Erie Mining Company's decades of experimentation in production and engineering design (Zellie 2007). The Concentrator Building is recommended as being individually eligible for inclusion in the NRHP under Criterion A in the areas of Industry and Engineering, and also under Criterion C in the area of Engineering. The building retains a good level of historic integrity, including qualities of location, design, setting, materials, workmanship, and feeling.

The quality of association is fair due to the removal of the pelletizer. At the interior, much of the layout and equipment dates to original construction (Zellie 2007).

The Administration Building (SL-HLC-pending) remains a well-preserved component of the original taconite plant design. It is significant under NRHP Criterion A in the areas of Industry and Engineering and is associated with the statewide historic context: *Minnesota's Iron Ore Industry, 1880s-1945*, and also under Criterion C. The period of significance is 1954 to 1969.

The Erie Mining Company railroad (SL-HLC-015/053) is a 74-mile railroad system created solely for the transportation of ore for shipment to Taconite Harbor. The railroad was in operation during the plant's period of significance (1954 to 1969) and directly linked pellet production with shipping facilities. The period of significance spans from the start of railroad construction, circa 1954 to 1957, through 1964, the date of Dunka Railroad construction. Identified segments of the Erie Main Line Railroad and Mine and Plant Track, as well as Dunka Railroad within the APE, are recommended as eligible for inclusion in the NRHP under Criterion A in the areas of Commerce, Industry, and Transportation, and also under Criterion C.

The following structures, all of which are associated with the plant complex, have been determined individually not eligible for inclusion in the NRHP:

- Coarse Crusher (SL-HLC-002/040);
- Fine Crusher (SL-HLC-003/041);
- Conveyor and Drive House (SL-HLC-004/042);
- General Shops (SL-HLC-005/043);
- Reservoir (SL-HLC-006/044);
- Water Tower (SL-HLC-007/045);
- Tailings Thickener Tanks (SL-HLC-009/047);
- Pelletizing Building (SL-HLC-010/048);
- Central Heating Plant (SL-HLC-011/049);
- Fuel Oil Tanks (SL-HLC-012/050);
- Pellet Stockpile and Stacker (SL-HLC-013/051);
- Mine Area No. 2 Shops (SL-HLC-014/052);
- Tailings Basin (SL-HLC-016/054);
- Mine Area No. 1 Shops (SL-HLC-017/055);
- Colby Lake Pumping Station and Pipeline (SL-HLC-pending);
- Mine Area Nos. 2, 3, and 5 (SL-HLC-pending);
- Dunka Road Segment (SL-HLC-pending); and
- High Voltage Transmission Line Segment (SL-HLC-pending).

Erie Mining Company Hoyt Lakes Operation Mining Landscape Historic District

The portion of the Erie Hoyt Lakes operation located within the APE, including the Erie Concentration Plant Complex, retains the necessary elements to contribute to a larger NRHP-eligible Erie Mining Company Hoyt Lakes Operation Mining Landscape Historic District. The APE for the NorthMet Project Proposed Action includes structures, topographic features, small-scale features, vegetation patterns, and patterns of circulation that are associated with incipient taconite production and shipment on Minnesota's Mesabi Range, circa 1954 to 1969. The features within the APE associated with Erie taconite operations are also emblematic of a purposefully modified and developed landscape that retains integrity and is associated with a significant historic event. In addition, these features retain the ability to inform about the post-World War II industrial process of low-grade iron ore extraction and refinement, and the ultimate shipment of finished taconite pellets to Great Lakes steel mills.

Given the dynamic nature of markets and evolving technologies, mining landscapes often contain complex arrangements of features that may date to several distinct mining periods. The scope of this evaluation is the portion of the Erie Hoyt Lakes taconite operations located within the APE for the NorthMet Project Proposed Action that are associated with the period of significance from 1954 to 1969. This includes a subsidiary rail system serving the Mine Site and Plant Site, as well as a segment of the Erie main line (Dunka segment), the Concentration Plant Complex, expansive mine pits and stock piles representative of large-scale taconite extraction, and many other still extant buildings, structures, and objects associated with power generation, water supply, maintenance, administration, traffic control for both rail and vehicle, and security, all of which are associated with the industrial process of taconite production on the Mesaba Range from the period of 1954 to 1969.

The overall Erie Hoyt Lakes taconite operation conveys significance through the components (Hoyt Lakes, concentration Plant Site/Mine Site, railroad system, and Taconite Harbor shipping facility) that represent implementation of the comprehensive planning effort for one of the largest mining operations of its time. The loss of the pelletizer does not compromise the overall integrity of the larger property. The portion of the Erie Mining Company within the APE retains a high degree of integrity and an ability to convey significance through the composite effects of location, design, setting, materials, workmanship, feeling, and association and contributes to a potentially larger Erie Mining Company Mining Landscape Historic District. The identified landscape components, transportation features, and structures associated with the 1954 to 1969 period of significance contribute to the Erie Mining Company Landscape Historic District and are eligible to the NRHP under Criterion A at a state level for their association with Mining Development on the Mesaba Iron Range, as well as under Criterion C.

With respect to the integrity of the contributing historic properties identified in Erie Mining Company Landscape Historic District, the structures and features associated with Erie operations during the period of significance retain integrity of location, association, setting, workmanship, feeling, and materials and individually contribute to an historic mining landscape. Several structures, features, and transportation corridors associated with post-1969 taconite development that have been identified within the NorthMet APE do not, however, contribute to this historic landscape and are not considered as contributing elements for the purposes of this review. The monumental scale of the concentrator building, the considerable number of buildings remaining at the concentration Plant Site, and the mine pits, transportation infrastructure, stockpiles, and Tailings Basin that define the landscape convey the significance of the Erie Mining Company taconite operation from the 1954 to 1969 period of significance. The numerous other buildings and objects associated with the Erie Mining Company within the APE, including the railroad system that defines circulation patterns and provides a linkage between many of these resources, also contribute.

Table 4.2.9-2 provides a list of historic resources from the investigations completed to date that are contributing/non-contributing components of the larger Erie Mining Company Landscape Historic District.

Table 4.2.9-2 Historic Resources Associated with the Erie Mining Company Historic District

Resource ID	Resource Name	Individual Eligibility	Landscape District
SL-HLC-002/040	Erie Mining Company Coarse Crusher	Not Eligible	Contributing
SL-HLC-003/041	Erie Mining Company Fine Crusher	Not Eligible	Contributing
SL-HLC-004/042	Erie Mining Company Conveyor and Drive House	Not Eligible	Contributing
SL-HLC-005/043	Erie Mining Company General Shops	Not Eligible	Contributing
SL-HLC-006/044	Erie Mining Company Reservoir	Not Eligible	Contributing
SL-HLC-007/045	Erie Mining Company Water Tower	Not Eligible	Contributing
SL-HLC-008/046	Erie Mining Company Concentrator Building	Eligible	Contributing
SL-HLC-009/047	Erie Mining Company Tailings Thickener Tanks	Not Eligible	Contributing
SL-HLC-010/048	Erie Mining Company Pelletizing Building (razed)	Demolished	N/A
SL-HLC-011/049	Erie Mining Company Central Heating Plant	Not Eligible	Contributing
SL-HLC-012/050	Erie Mining Company Fuel Oil Tanks	Not Eligible	Contributing
SL-HLC-013/051	Erie Mining Company Pellet Stockpile and Stacker	Not Eligible	Contributing
SL-HLC-014/052	Erie Mining Company Mine Area No. 2 Shops	Not Eligible	Contributing
SL-HLC-015/053	Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment	Eligible	Contributing
SL-HLC-016/054	Erie Mining Company Tailings Basin	Not Eligible	Contributing
SL-HLC-017/055	Erie Mining Company Mine Area No. 1 Shops	Not Eligible	Contributing
SL-HLC-018/056	Erie Mining Company Concentration Plant Complex	Not Eligible	Contributing

Resource ID	Resource Name	Individual Eligibility	Landscape District
SL-HLC-pending	Erie Mining Company Colby Lake Pumping Station and Pipeline	Not Eligible	Contributing
SL-HLC-pending	Erie Mining Company Administration Building	Eligible	Contributing
SL-HLC-pending	Spring Mine and Stockpiles	Not Eligible	Non-Contributing
SL-HLC-pending	Erie Mining Company Mine Area No. 2	Not Eligible	Contributing
SL-HLC-pending	Erie Mining Company Mine Area No. 3	Not Eligible	Non-Contributing
SL-HLC-pending	Erie Mining Company Mine Area No. 5	Not Eligible	Non-Contributing
SL-HLC-pending	Erie Mining Company Dunka Road Segment	Not Eligible	Non-Contributing
SL-HLC-pending	Erie Mining Company High Voltage Transmission Line Segment	Not Eligible	Contributing

Duluth, Missabe, and Iron Range Segment

This approximately 3.5-mile-long DM&IR (previously D&IR and now CN) segment within the NorthMet Project Proposed Action APE is a portion of the former 97-mile-long, primarily single-track roadbed constructed in 1884 between Two Harbors and the Soudan Mine east of Tower, Minnesota. The evaluated DM&IR segment predates the Erie Mining Company Plant at Hoyt Lakes (1957) by more than 80 years. The D&IR (and its successor line, the DM&IR) was built as a shipping line for the Vermilion iron range to the northeast. Beginning in the early 1950s, it also provided Erie and its successor, LTVSMC, with construction and mining supplies and raw materials used in the Erie plant. The approximately 3.5-mile-long DM&IR segment is significant under NRHP Criterion A for its association with the development of Vermilion iron range mining and lumber industries and the development of Tower, Soudan, and Ely from 1884 to 1964. The segment retains integrity of location, design, and, in some places, integrity of materials.

Spring Mine and Stockpiles

The Spring Mine is located northeast of the Erie Mining Company Plant Site. The Spring Mine is a natural ore mine. It was opened as an underground mine in 1906, possibly by the Kingston Mining Company, and it produced a soft, gray Bessemer hematite. This small, open pit natural ore mine and its stockpiles appear to be typical of those on the Mesabi Iron Range and do not represent advancements in mining technology. This mine does not appear to possess significance as an important example of an early 20th-century natural ore mine under Criterion A in the area of Industry and Engineering. The mine is not known to be associated with persons significant in local, state, or national history and is not significant under Criterion B. It is not significant under Criterion C in the area of Engineering. It has not yielded, nor is it likely to yield, information important in prehistory or history and is significant under Criterion D. Therefore, the Co-lead Agencies have determined that the Spring Mine and stockpiles are ineligible for the NRHP.

Reserve Mining Company's Crusher #2

Reserve Mine, originally known as Peter Mitchell Mine, is currently operated by the Northshore Mining Company, which actively mines taconite adjacent to the proposed NorthMet Mine Site. In relation to the APE, a waste rock stockpile from the Mine Site is within the viewshed of the adjacent Northshore Mine associated with Reserve Mining Company activities circa 1956 to 1965. Crusher #2, built by Reserve Mining Company in 1963, appears to have served in a supplemental role to Reserve Mining Company's primary crusher (Crusher #1) constructed in 1956. The structure is not significant under Criterion A in the areas of Industry and Engineering. The federal Co-lead Agencies have determined that the structure does not possess significance under Criterion B, C, or D. Therefore, the agencies have determined that Crusher #2 is ineligible for the NRHP. The Co-lead Agencies have determined that the inventory conducted in the visual effects APE is adequate and commensurate with the anticipated effects.

Spring Mine Lake Sugarbush Site

Although not located within the Plant Site, the Spring Mine Lake Sugarbush Site (SL-HLC-pending) is located within the APE to the west of the Mine Site. Field investigations as early as 1969 (Loftus 1977) had identified a "Late Historic Period Chippewa Sugar Maple Camp," south of the intersection of the BBLV Trail Segment and east of the New Indian Trail (Trygg 1966). This sloping, approximately 80-acre site appears to be a natural maple-basswood stand of cultural use and significance. The site was reported to have a structure in the interior of a maple grove that was constructed of pine logs secured with round iron nails. Stockpiled birchbark baskets and basswood wedges[sic] or paddles and "various other containers" were interspersed with metal pots and pans within the structure, (Loftus 1977:73). The report concluded that the site was culturally significant because it allowed "for a comparison of Late Historic Chippewa sugaring practices with those of the Early Historic Period." Recent visits to the site by USACE staff and Band members identified it as a large multi-component site with evidence of maple sugaring activity from a range of time periods. Various types of historic artifacts and features demonstrated the continued use of the site into the middle part of the 20th century. The stand itself contains trees that may be up to 200 years old, according to the Erie Mining Company forester (Loftus 1977). During the 2010 survey, many large maple trees were observed that exhibited scaring from repeated tapping. The trunks on these trees were flattened at about 4 to 8 ft above the ground, with visible interior decay on many trees that was most likely the result of the long-term effect of repeated tapping for sap collection. Also, the site has more than 75 percent sugar maple, less than 5 percent basswood, and less than 1 percent yellow birch. This community type in its natural state would have about 35 percent sugar maple, 10 to 25 percent basswood, and some yellow birch (Zellie 2012). The traditional practice of sugaring includes an emphasis on the use of basswood for paddles and troughs.

The Spring Mine Lake Sugarbush Site possesses good historic integrity, notably an integral relationship to traditional cultural practices or beliefs, and retains artifactual evidence of prior use as a sugarbush. Based on the site's tie to recent oral histories by Ojibwe elders, its location near the BBLV and New Indian trails mapped by Trygg (1966), photographic evidence of use by Ojibwe families as early as 1941 (Latady and Isham 2011), and its potential role as part of a once-extensive system of sugarbush locations in St. Louis County, the Spring Mine Lake Sugarbush is determined eligible for inclusion in the NRHP under Criterion A. It functioned as a place for sharing and maintaining traditional Ojibwe knowledge of and spiritual connections to the world, which were fundamental to the cultural identity of the Bois Forte Band. Under Criterion D, the site is significant for its potential to answer important questions about possible 19th and 20th century Ojibwe maple sugaring practices.

The Partridge River Section of Mesabe Widjiu

Mesabe Widjiu, or the Laurentian Divide (SL-HLC-pending), is regarded as a sacred place to the Bands, possessing cultural significance for the Ojibwe. Often referred to by various names, such as the Giant's Range or Mesabi Heights, the *Mesabe Widjiu* is a long linear landform running the length of the Mesabi Iron Range and into the area of Thunder Bay, Ontario. Figure 4.2.9-9 depicts the location of the *Mesabe Widjiu*. It should be noted that the depiction of the culturally significant landform from the eastern end of the Iron Range to Thunder Bay is only a representation based on topographic features and was not informed by historical and/or ethnographic information. This portion of the Mesabi Range and Laurentian Divide, parts of which intersect the Plant Site, occupies the crest of a line of low, rugged, Precambrian rock hills where the divide separates the watershed of streams that flow north to the Arctic Ocean from the watershed of streams that flow south through the Great Lakes to the Atlantic Ocean (Ojakangas and Matsch 1982). Based on the elder interviews, the *Mesabe Widjiu* is part of the Band's oral history and cosmology explaining the origin of the hills and the separation of waters along the divide. The *Mesabe Widjiu* is also the path that the Thunderbirds follow. The various granite-capped outcrops and ledges are used for traditional practices because of the *Widjiu*'s spiritual significance. Despite distant views of mining features to the east that include the skyline of the Erie Mining Company plant, the *Mesabe Widjiu* viewshed possesses good historic integrity, notably an integral relationship to traditional cultural practices or beliefs. *Mesabe Widjiu* is determined eligible for inclusion in the NRHP under Criterion A for its association with important Ojibwe spiritual and cultural practices.

In connection with *Mesabe Widjiu*, a granite bedrock outcrop (SL-HLC-pending) providing an east-facing Overlook is located at the site of the proposed Tailings Basin within the Plant Site. Recent visits to the Overlook by USACE staff and Band members identified the presence of oak trees and a number of potentially important natural features, including a spring. In addition, the Overlook is situated at the junction of two trails identified on Trygg maps. However, the location of the trails is not corroborated by the GLO land survey notebooks from that township.

Band elders have noted the cultural significance of both oak trees and east-facing overlooks in the Ojibwe tradition. An outcrop such as this might have been used by Ojibwe for spiritual reasons. Because there is no confirmed use of this location, the Overlook is determined not individually eligible for inclusion in the NRHP, but included as part of the *Mesabe Widjiu*.

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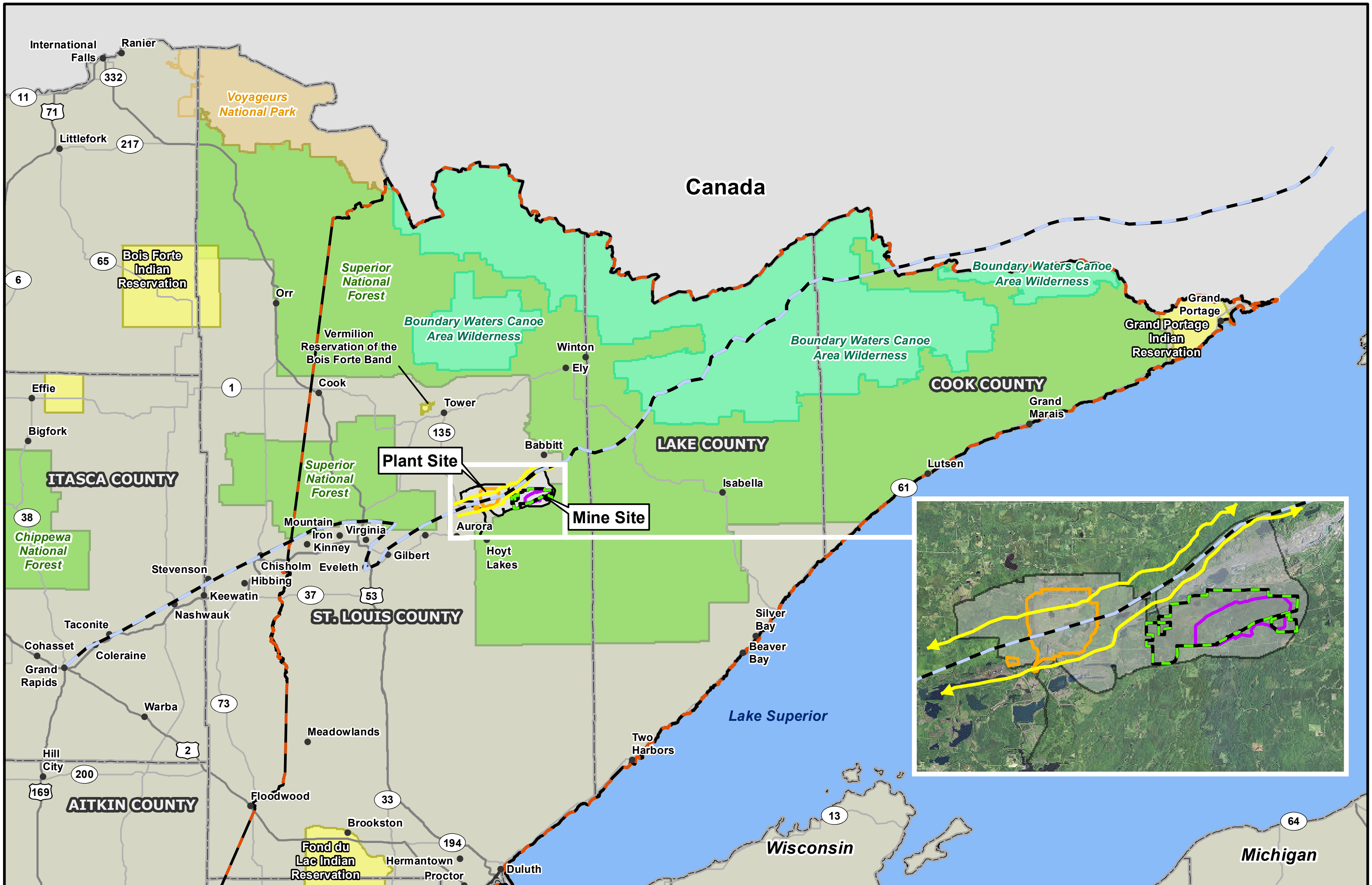

Mine Site	Mesabe Widjiu, Preliminary Full Extent *	National Park
Plant Site	Cultural Resources Area of Potential Effect	Boundary Waters Canoe Area Wilderness
Federal Lands	1854 Ceded Territory	National Forest
Approximate Site Boundary of Mesabe Widjiu, Partridge River Section	Native American Reservation	City/Town

* Preliminary depiction of full extent based on topographic analysis and not cultural/historical information.

MNDNR — US Army Corps of Engineers St. Paul District

0 5 10 20 30 Miles

Figure 4.2.9-9
Cultural Resources Analysis - Mesabe Widjiu
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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The Partridge River Segment of the Beaver Bay to Lake Vermilion Trail

Overland trail systems, such as the 75-mile-long BBLV Trail Segment, were frequently referenced during late 19th century GLO surveys in the western Superior Basin (Trygg 1966). Despite mention in the historic record, the trails themselves, and the role they played as transportation systems prior to development of railroad transportation in the region, are underrepresented in the literature. The available literature would suggest, however, that overland trails played a prominent role within a regional transportation system that included interior waterways, short-haul portages, and overland portages leading from Lake Superior to points inland. While the vast majority of the transportation networks in the Western Superior Basin are recognized as routes that maximized waterborne transportation, the BBLV Trail Segment represents one of the few overland trail corridors where lakes and rivers appear to have been minimally utilized. Within this context, it would appear that the route functioned as a winter transportation corridor, or perhaps an expedient summer route from the Lake Superior Watershed into Lake Vermilion. Support for the BBLV Trail Segment's function as a winter route comes from several sources, both primary and anecdotal in nature. Christian Wieland, who conducted the GLO survey of T59N, R13W in the winter of 1872 noted crossing the "Trail from Beaver Bay to Lake Vermilion" at three locations while conducting the survey (GLO 1873).

Historic records also suggest that overland trails were utilized by both local Ojibwe and mineral prospectors from at least the mid-19th century through the early 20th century (Skillings 1972; Lancaster 2009). Historic overland trails are best viewed as a component of an interrelated transportation system where trails and water routes interconnect to form a large and intricate system of communication and transportation (Burns 1985). The southeastern head of the overland trail is situated at Beaver Bay, which had a significant Ojibwe population from at least 1854 to 1930 (Davis 1968; Skillings 1972; Lancaster 2009). Beaver Bay provided access from a mid-point on Lake Superior, located about halfway between Grand Portage and Fond du Lac, the two primary, historic ingress points to the interior portions of Northeastern Minnesota.

The significance of the BBLV Trail Segment to the Ojibwe of Northeastern Minnesota is perhaps more nuanced than the significance ascribed by archaeologists, whose focus remains on attaching significance to physical manifestations of historic events. Consultation with the Bands elicited the importance of both how the trails connected past Ojibwe community in a physical sense and the ability for trails to also connect communities in a contemporary sense. Statements of significance were predicated on the fact that in the 19th century, Ojibwe residence in the newly ceded territory was highly mobile, and families enrolled at locations at which they happened to be when the rolls were being populated. "In a sense, Ojibwe from scattered locations throughout the ceded territory may have enrolled at a location that was far away from their place of primary residence … at the time, social organization was very fluid, and marriages, disagreements, and the opportunities for wage labor caused folks to move around a lot." There is a general agreement among tribal consultation partners that the trails, or in the case of some, the trail corridors themselves, function as "physical manifestations of the social fluidity that existed among northeastern Minnesota's Ojibwe communities at that time." Consulting partners stated that the trails are "like a lifeline that permeates all aspects of history. That the overland trails are something entirely different than functional trails that are present today, trails that some would refer to as coming and going trails, in that you use them for a purpose and then you return home. The Beaver Bay to Lake Vermilion Trail is viewed as something different … it is viewed as a trail that connects you to who you are, in that they are important signature of cultural identity and reconnection to past ways" (THPO, Pers. Comm., August 14, 2012).

A trail remnant, approximately 75 meters long and 10 to 14 inches wide, was identified in the Mine Site area, and a boulder-sized glacial erratic topped by a smaller rock was identified by the Bands as a potential trail marker. Based on the Trygg map, the 1873 GLO survey notes, and the results of the archaeological surveys described above, these two features have been identified as defining a segment of the BBLV Trail. Although interrupted by Euro-American agriculture, logging, and mining, as well as road and townsite development, the trails remain an important cultural and spiritual connection for the Bands. Recent oral histories by Band elders substantiate this significance. This segment is potentially part of a once-extensive system of overland trails that were in use during hundreds of years of Ojibwe occupation. Therefore, the BBLV Trail Segment is significant for the role it played in the broad patterns of Ojibwe land use and early mineral exploration. It is eligible for inclusion in the NRHP under Criterion A.

NorthMet Archaeological Site

The NorthMet Archaeological Site (21SL pending) is located at the Mine Site. The site was identified through subsurface testing and consisted of pre-contact lithic artifacts. Due to the sparse nature of the artifacts and lack of features, it was determined that the site was unlikely to yield any further information significant to the understanding of past cultural history, and therefore was determined to be not eligible under Criterion D. As a result, the site was determined to be not eligible for inclusion in the NRHP.

Knot Logging Camp

The Knot Logging Camp (21SLmn) is located outside the NorthMet Project area, although within the APE of the NorthMet Project Proposed Action. The historic site was originally identified by USFS staff through historic aerial photography analysis. Field investigations at the site identified pit features and historic debris typical of a logging camp, including stove parts, cans, and other metal materials. The site had been reported to be severely affected by recent and historic logging activities. No obvious remnants of previously identified berms were evident. Historic research failed to uncover anything regarding the individual camp itself other than its affiliation with a brief period in the logging industry in northeastern Minnesota. Thus, the site was determined to be not eligible under Criterion A. Due to the sparse nature of the artifacts and lack of significant features, it was determined that the site was unlikely to yield any further information significant to the understanding of past cultural history, and therefore was determined to be not eligible under Criterion D.

Summary of Results Coordination

The USACE has coordinated the results of the archaeological surveys discussed above with the SHPO (USACE 2007; USACE 2009; SHPO 2007; USFS and USACE 2014a, 2014b, 2015) and, based on strategic sampling of the NorthMet Project area, the SHPO and USACE concurred that no further efforts were required to identify archaeological resources within the APE. However, the Bands had concerns about the survey coverage (see section above for additional detail).

Through consultation with the USACE and SHPO, it was determined that Phase I architectural history surveys, coupled with the development of a historic context, were appropriate steps for evaluating the architectural resources that may be affected by the NorthMet Project Proposed

Action. The initial Phase I architectural history survey identified two properties that were recommended eligible for listing in the NRHP: the Erie Mining Company Concentrator Building (SL-HLC-008/046) and segments of the Erie Mining Company Railroad mine and track (SL-HLC-015/053). Within the refined APE, additional sections of the Erie Mining Company Railroad Mine and Plant Track, Main Line Segment, and Dunka Railroad Segment were identified. The federal Co-lead Agencies consulted with SHPO concerning properties identified as part of additional Phase I architectural history survey. The federal Co-lead Agencies have determined four properties eligible for listing in the NRHP: the Erie Mining Company Administration Building (SL-HLC-pending), Erie Mining Company Landscape Historic District (SL-HLC-pending), Erie Mining Company Railroad Corridor Historic District (SL-HLC-pending), and DM&IR Segment (SL-HLC-pending).

The federal Co-lead Agencies have consulted with the Bands and the SHPO concerning the results of identification efforts for properties of religious and cultural significance to the Bands. Consultation focused on applying NRHP criteria to the properties identified, discussion of property boundaries for those meeting the criteria, as well as discussions to further understand the traditional religious and cultural significance of those properties. As a result, the Spring Mine Lake Sugarbush, the BBLV Trail Segment, and *Mesabe Widjiu* were determined eligible. The Overlook location was not considered by the Co-lead Agencies to be eligible in itself, but eligible as part of the *Mesabe Widjiu*.

At various times during consultation for the NorthMet Project Proposed Action, the Bands have proposed a historic district that includes the above properties as well as others that have been reported outside of the APEs. The historic district, proposed by the Grand Portage Band in a June 27, 2013 letter, and supported by consulting parties representing Bois Forte and Fond du Lac Bands, consists of an approximately 216,000-acre area, which extends from Lake Vermilion south to Duluth by way of the St. Louis River. The Co-lead Agencies, at this time, have determined that additional identification and evaluation efforts within this area would be outside of the scope of the NorthMet Project Proposed Action.

To summarize, the federal Co-lead Agencies have followed the initiation and identification processes outlined in 36 CFR 800.3 and 36 CFR 800.4, respectively, and have included consulting parties in the finding and determination process completed to date. Multiple historic property identification efforts have occurred over a 15-year period within the proposed NorthMet Project area. These identification efforts have included both standard field inventory and assessment and identification of properties of cultural and religious significance to consulting Bands.

4.2.9.3 Cultural Identity: Natural Resources as Cultural Resources

For most Native American tribes, subsistence is synonymous with culture and identity. Subsistence activities generally constitute a way of being and relating to the world, and thus comprise an essential component of Native American identity and culture. Because Native Americans consider subsistence activities such as obtaining, processing, and distributing natural resources as essential components of maintaining their cultural customs and traditions, one cannot be distinguished from the other. Therefore, Native Americans generally consider an effect on subsistence resources and/or the ability to hunt, fish, or gather these resources as an effect on associated and perhaps fundamental aspects of cultures and traditions.

The spiritual connection to natural resources, and the manner in which these resources are harvested, is an essential part of Ojibwe culture. Potential effects on subsistence resources or resources harvested for traditional purposes could therefore impact the culture and tradition of the Ojibwe. For instance, subsistence practices in a particular area could be affected by a loss of hunting, fishing, or gathering opportunities, thereby affecting the traditional or cultural practice that takes place in that area. Effects on natural resources in areas where traditions are practiced may have an effect on the ability of individuals or families to pass those traditional practices, knowledge, and beliefs to future generations. The identity of Ojibwe as a people is dependent on the transmission of that knowledge and belief system to the next generation.

4.2.9.3.1 Federal Tribal Trust Responsibility

The federal government has a unique legal relationship with the federally recognized Native American tribes, which has been set forth in the U.S. Constitution, treaties, statutes, court decisions, and EOs. This legal relationship is often referred to as the "Federal Trust Doctrine" or "Federal Tribal Trust Responsibility," which is a body of law defining the relationship of federal government with federally recognized Native American tribes.

Beginning in the mid-19th century, the government of the United States made treaties with the Ojibwe that ceded areas of land in northern Minnesota to the federal government. In return, specific reservations were created for the tribes' use and other considerations specified. The treaties also preserved the right of the Ojibwe bands to hunt, fish, and gather off the reservations within these ceded territories. The federal trust responsibility requires that federal agencies consider their actions with respect to tribal rights, particularly reserve rights, where they exist.

In 1854, the Chippewa of Lake Superior entered into a treaty (1854 Treaty of La Pointe or 1854 Treaty; Kappler 1904) with the United States whereby the Chippewa ceded to the United States ownership of their lands in northeastern Minnesota. These lands are generally known as the 1854 Ceded Territory. Article 11 of the 1854 Treaty provides, *"...and such of them as reside in the territory hereby ceded, shall have the right to hunt and fish therein, until otherwise ordered by the President."* The Chippewa of Lake Superior who reside in the 1854 Ceded Territory are the Fond du Lac, Grand Portage, and Bois Forte Bands. The NorthMet Project area is within the 1854 Ceded Territory, and thus federal agencies must consult on a government-to-government basis with interested signatories to the 1854 Treaty to understand how the proposed federal actions may impinge on or abrogate treaty rights.

Natural resources and the lands on which they are gathered are important to the Bands for a number of reasons, including cultural, spiritual, and/or historical meanings, and will be considered under federal agency tribal trust responsibilities as outlined above and also as cultural resources under NEPA.

4.2.9.3.2 Perspectives on the Environment

This FEIS uses different criteria and methods to describe how the NorthMet Project Proposed Action would affect the environment. These systems are used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features. The systems primarily use associations of biotic and environmental factors, including climate, geology, topography, soils, hydrology, and vegetation.

The integration of ecosystems models with greater emphasis on the relationship of people to the land has become popular with Tribal natural resource and landscape planning. The integration of Native American traditional values regarding the natural world as a whole landscape system encompasses physical aspects of the land along with values such as cultural relationships and spirituality.

The wildlife and vegetation sections describe the natural environment by using the MDNR's ECS, which follows the NHFEU. The NorthMet Project area is within the Laurentian Mixed Forest province, covering northern Minnesota, Wisconsin, and Michigan, as well as southern Ontario and portions of New England. More specifically, the NorthMet Project area is located along the border of the Laurentian Uplands and Nashwauk Uplands subsections.

The Laurentian Uplands and Nashwauk Uplands subsections are characterized by till plains, moraines, peatlands, and flat outwash plains (MDNR 2011g; MDNR 2011i). The Continental Divide separates the Nashwauk Uplands subsection, with waters flowing north to Hudson Bay, west to the Mississippi River, or south to Lake Superior. Land cover within these subsections is described in Table 4.2.9-3 below.

Table 4.2.9-3 Laurentian Uplands and Nashwauk Uplands Subsections

Subsection/Land Cover	Total Acres	Percent of Total Area in Subsection
Nashwauk Uplands	810,028	
Aquatic Environments	283,510	35
Disturbed	40,501	5
Forest	437,415	54
Cropland/Grassland	48,602	6
Laurentian Uplands	567,280	
Aquatic Environments	113,456	20
Disturbed	5,673	1
Forest	448,151	79
Cropland/Grassland	0	0

Sources: MDNR 2011g; MDNR 2011i.

Both subsections are dominated by forest habitat (e.g., upland and lowland deciduous and coniferous forests) and aquatic environments (e.g., open water, wetlands), with a smaller amount of disturbed and cropland/grassland. 1854 Treaty resources—including vegetation, wildlife, and fish— are discussed below within the context of these land cover types.

4.2.9.3.3 1854 Treaty Resources

Another perspective on natural resources of cultural importance can be viewed through the relationship of the federal government with the Bands. The Land Exchange Proposed Action represents an exchange of private and federal land, but it is also represents an exchange of access to natural resources expressed in treaties made between the United States and Bands of Ojibwe Indians in the 19th century. The 1854 Treaty was signed by Henry C. Gilbert and David B. Herriman for the United States and representatives of the Lake Superior Chippewa on September 30, 1854, and proclaimed on January 29, 1855. The 1854 Treaty ceded all of the Lake Superior Chippewa lands in the Arrowhead Region of Northeastern Minnesota to the United States, in exchange for reservations for the Lake Superior Chippewa in Wisconsin, Michigan, and Minnesota. The signatory tribes retain hunting, fishing, and gathering rights within this region.

The rights to capture or gather (or take) subsistence resources within the 1854 Ceded Territory are provided to the Bands on a usufruct basis. The concept of individuals not owning specific land, but using the resources on land controlled by larger cultural groups, represented this usufruct basis that was implicit to the survival of the Ojibwe everywhere in Minnesota prior to arrival of Europeans. As a usufructuary created by the 1854 Treaty, the Bands are allowed to use resources from land owned by others. The NorthMet Project area and Land Exchange area fall within the territory ceded as part of the 1854 Treaty between the U.S. government and the Chippewa of Lake Superior. Rights for hunting and fishing under the 1854 Treaty are exercised on lands within this territory. It is therefore important to address what these resources are and what cultural importance they have to the Bands.

Interpretations of the 1854 Treaty resources range from an emphasis on hunting and fishing to efforts by the courts to determine Ojibwe land use prior to the treaties that lists virtually every resource in the 1854 Ceded Territory that was utilized by the Ojibwe (Lac Courte Oreilles III, 653 F. Supp. 1420, 1424). While this provided an extensive list of possible resources, the emphasis on certain natural resources such as wild rice, moose, white-tailed deer, rabbit, maple sugar, certain fish and aquatic species, and certain well-known medicinal plants heightens their level of cultural importance. Table 4.2.9-4 shows other animal and plant species that have historically been, and/or could potentially be, harvested in the 1854 Ceded Territory.

Table 4.2.9-4 Species Potentially Harvested in 1854 Ceded Territory

Mammal/Reptile					
white-tailed	beaver	snowshoe hare	moose	otter	elk
deer	marten	cottontail rabbit	woodchuck	lynx	bison
black bear	mink	badger	squirrel	fox	turtles
muskrat	fisher	porcupine	raccoon	wolf	turtle eggs
Bird					
ducks	songbirds	turkeys	eagles	owls	partridges
geese	grouse (various)	hawks			
Fish					
whitefish	chubs	turbot	walleye	sturgeon	perch
herring	lake trout	in-shore suckers	pike	muskie	
Plant/Plant Materials					
adder's mouth	choke cherry	ground pine	mountain holly	shield fern	Virginia
agrimony	climbing bitter-	harebell	mountain maple	shin leaf	waterleaf
alternate-leaved	sweet	hare's tail	mullein	shining willow	white campion
dogwood	cocklebur	hawthorn	musquash root	slender ladies’	white lettuce
American dog	common	hazelnut	nannyberry	tresses	white oak
violet	burdock	heal-all	navy bean	slippery elm	white pine
arbor vitae	common	heart-leaved	northern	small bedstraw	white sage
(white cedar)	milkweed	umbrella-wort	clintonia	small cleaver	white spruce
arum-leaved	common	hemlock	Norway pine	small Solomon's	white sweet
arrow-head	plantain	highbush	Ojibwe potato	seal	clover
balsam fir	common thistle	blackberry	Ojibwe squash	smooth	wild balsam-
balsam poplar	corn	highbush	ox-eye daisy	gooseberry	apple
basswood	cow parsnip	cranberry	panicled	smooth	wild bergamot
beaked hazelnut	cow wheat	hog peanut	dogwood	juneberry	wild black
beech	crack willow	hop	paper birch	smooth rose	currant
black ash	cranberry	horseweed	pearly	smooth sumac	wild cherry
black oak	cranberry pole	hound's tongue	everlasting	snowberry	wild columbine
black snakeroot	bean	Indian cup plant	Philadelphia	speckled alder	wild geranium

black spruce	creamy	Indian turnip	fleabane	speckled elder	wild ginger
black-eyed	vetchling	jack pine	pin cherry	sphagnum moss	wild leek
Susan	cucumber	Joe-Pye weed	pitcher-plant	spotted touch-	wild mint
bloodroot	curled dock	Labrador tea	poison ivy	me-not	wild onion
blue cohosh	cursed crowfoot	large-flowered	prickly ash	spreading dog-	wild parsnip
blue flag	daisy fleabane	bellwort	prickly	bane	wild plum
blueberry	dandelion	large pie	gooseberry	squash	wild red currant
bluewood aster	downy	pumpkin	prince's pine	stag-horn sumac	wild rice
bog rosemary	arrowwood	large-toothed	purple meadow	starflower	wild sarsaparilla
bog willow	Dudley’s rush	aspen	rue	star-flowered	wild strawberry
box elder	entire-leaved	large toothwort	quaking aspen	Solomon’s	winterberry
brake	groundsel	large-leaved	rattlesnake grass	seal	wintergreen
bristly crowfoot	esser cat's foot	aster	red ash	steeple bush	wood betony
bunch berry	evening	large-leaved	red baneberry	sugar maple	wood horsetail
bur oak	primrose	aven	red elderberry	swamp	wood nettle
bush	false spikenard	leather leaf	red haw apple	persicaria	wool grass
honeysuckle	female fern	lichens	red maple	sweet cicely	woolly yarrow
butternut	field horsetail	lima bean	red oak	sweet fern	yarrow
Canada	flowering	low birch	red raspberry	sweet flag	yellow birch
anemone	spurge	Lyall’s nettle	rein orchis	sweet gale	yellow ladies’
Canada	fragrant	marsh	reindeer moss	sweet grass	slipper
hawkweed	goldenrod	bellflower	river-bank grape	sweet white	yellow lotus
Canada	fragrant golden-	marsh cress	rough cinquefoil	water lily	yellow water
mayflower	rod	marsh five-	sand cherry	tall blue lettuce	lily
Canada	giant puffball	finger	scouring rush	tamarack	
moonseed	ginseng	marsh marigold	sensitive fern	tansy	
Canada thistle	golden corydalis	marsh skullcap	sessile-leaved	tansy-mustard	
Canada violet	golden ragwort	marsh vetchling	bellwort	thimble-weed	
Carey’s	goldthread	meadow-sweet	shell bark	tower mustard	
persicaria	goose grass	moosewood	hickory	twisted stalk	
carrion flower	gourds			Virginia creeper	
catnip	great bulrush			Virginia grape	
cat-tail	great willow-			fern	
	herb				

Source: FEIS Appendix C.

The 1854 Treaty resources can be more accurately characterized by examining how they are being currently regulated by the Bands. Governance of hunting, fishing, trapping, management, and gathering of natural resources by the Fond du Lac Band of Lake Superior Chippewa within the 1854 Ceded Territory is demonstrated in the Fond du Lac Ceded Territory Conservation Code (Fond du Lac 1992). The purpose of the Code is to provide a system for tribal control and regulation of hunting, fishing, and gathering within the Ceded Territory, provide a means to promote public health and safety through the conservation and management of natural resources within the Ceded Territory, and to promote and protect the rights of the Fond du Lac retained under the 1854 Treaty.

The 1854 Treaty Authority is an Inter-tribal Natural Resources Management Organization that manages the off-reservation hunting, fishing, and gathering rights of the Grand Portage and Bois Forte Bands of Lake Superior Chippewa in the territory under legal agreement with the State of Minnesota. The 1854 Treaty Authority’s mission statement is to “provide an Inter-Tribal natural resource program to ensure that the rights secured to member Native American tribes by treaties of the United States to hunt, fish, and gather within the 1854 Ceded Territory shall be protected, preserved and enhanced for the benefit of present and future member Native American tribes in a manner consistent with the character of such rights, through provisions of services." The 1854 Treaty Authority's management of natural resources generally focuses on some of the most commonly hunted, fished, or gathered natural resources; therefore, an analysis of subsistence use by the Bands cannot be all-encompassing. The 1854 Treaty Authority and the natural resources which they manage and regularly report on are being used merely as a way to better quantify an analysis of potential natural resource use by the Bands within the NorthMet Project area.

As discussed above, Fond du Lac has its own regulations applicable to the 1854 Ceded Territory. The discussion of 1854 Treaty Authority-regulated species or resources presented in the sections below is not inclusive of all species important to the Bands. Instead, the lists serve as the most updated and best available data for the most common game species or tribally harvested resources within the 1854 Ceded Territory.

Vegetation

The 1854 Treaty Authority developed a Code for Treaty Gathering (2007) to facilitate Treaty-related gathering of wild plants or forest products on lands and waters open to the public within the 1854 Ceded Territory (see Table 4.2.9-5). The gathering activities conducted under this code are for subsistence use only. Subsistence levels are identified for each resource, and any gathering beyond those levels is considered commercial harvesting. Band members may gather other plant species not listed in the table below, but may not gather threatened or endangered species. If the state, county, or federal government prohibits gathering in a forest campground, wildlife management area, SNA, State of Minnesota-designated old growth stand, state park, wayside, beach, water access, plantation, or other specially designated area such as the BWCAW, then gathering by Band members is also prohibited (1854 Treaty Authority 2007).

Plant species or resources discussed in this code were grouped according to their habitat or cover types, and presented along with the area (in acres) of each habitat type located in the NorthMet Project area (see Table 4.2.9-5 and Section 4.2.4). This provides an estimate of how much of each 1854 Treaty Authority-regulated resource or species could be present in the NorthMet Project area based on predominant cover types.

Table 4.2.9-5 Cover Types of Associated Species and Resources Regulated by the 1854 Treaty Authority in the NorthMet Project Area

Cover Types	Associated Plant Species or Resource	Mine Site (Acres)[1]	Transportation and Utility Corridor (Acres)[1]	Plant Site (Acres)[1]
Upland coniferous forest	Conifer boughs, princess pine, birch bark, firewood, other plants or forest products	1,195.5	2.6	99.8
Lowland coniferous forest	Conifer boughs, princess pine, firewood, other plants or forest products	781.2	0.2	41.9
Upland deciduous forest	Princess pine, ginseng, birch bark, firewood, other plants or forest products	648.0	2.7	647
Shrubland	Firewood, other plants or forest products	241.7	7.7	333.8
Disturbed	NA	128.0	94.4	2,755.5
Aquatic environments	Wild rice, other plants or forest products	12.7	2.7	636.8
Cropland/Grassland	NA	4.9	9.8	0.0
Upland conifer-deciduous mixed forest	Conifer boughs, princess pine, ginseng, birch bark, firewood, other plants or forest products	2.4	0.0	0.0
Lowland deciduous forest	Princess pine, birch bark, firewood, other plants or forest products	0.1	0.0	0.0
Total	**NA**	**3,014.5**	**120.2**	**4,514.4**

Source: 1854 Treaty Authority 2007.

Note:
1 Acres from Section 4.2.4.

Specific plant surveys were also completed to assess "the degree to which the [NorthMet Project area] provides opportunities to gather a variety of plant species for use in traditional Ojibwe cultural practices" (Zellie 2012). More than 152 plant species were identified during these surveys; the five most common plant species were identified in at least half of the 43 sample plots, while another 21 plant species were identified in at least one-quarter of the plots. Balsam fir (*Abies balsamea*) was the most frequently encountered species within the sample plots, followed by black spruce (*Picea mariana*), bigleaf aster (*Eurybia macrophyllus*), bunchberry dogwood (*Cornus canadensis*), and Canada mayflower (*Maianthemum canadense*).

The 152 species identified were also grouped into seven distinct ECS community types (Zellie 2012). Three plant species were found in five of the seven ECS community types, including balsam fir, speckled alder (*Alnus incana*), and low-bush blueberry (*Vaccinium angustifolium*). Eleven species were found in four of the seven ECS community types, and 12 species were found in three of the seven ECS community types (see Table 4.2.9-6). These 26 species occur in a larger range of habitat types and are thus more likely to occur in the NorthMet Project area. Plant species found in multiple community types would generally be more broadly available to gatherers of plants, whereas plant species found in only one community type would require a trip to that specific community to gather it (Zellie 2012). Of the 26 species listed in Table 4.2.9-6, only one (blue-joint grass) does not have a traditional Ojibwe use according to *Plants Used by the Great Lakes Ojibwa* (Meeker et al. 1993).

Table 4.2.9-6 Plant Species Found in At Least Three ECS Vegetation Community Types

Number of ECS Community Types Found In	**Common Name (Scientific Name)**
Five	Balsam fir, speckled alder, low-bush blueberry
Four	Lady fern (*Athyrium filix-femina*), paper birch (*Betula papyrifera*), creeping snowberry (*Gaultheria hispidula*), tamarack (*Larix laricina*), Labrador tea (*Ledum groenlandicum*), black spruce, blue-joint grass (*Calamagrostis canadensis*), goldthread (*Coptis trifolia*), bunchberry dogwood, beaked hazelnut (*Corylus cornuta*), wild red raspberry (*Rubus idaeus*)
Three	Northern white cedar (*Thuja occidentalis*), twinflower (*Linnea borealis*), red maple (*Acer rubrum*), mountain maple (*Acer spicatum*), serviceberry (*Amelanchier sanguinea*), wild sarsaparilla (*Aralia nudicaulis*), blue-bead lily (*Clintonia borealis*), bigleaf aster, three-lobed bedstraw (*Galium trifidum*), Canada mayflower, quaking aspen (*Populus tremuloides*), rosy twisted-stalk (*Streptopus roseus*)

Source: Zellie 2012.

According to the *NorthMet Project Cultural Landscape Study* (Zellie 2012), the “Ojibwe organized their economy around wild rice and the seasonal cycle of fishing, sugaring, trapping, and hunting.” Reliance on wild rice varied with the availability and cycle of abundance, but because of its shelf life of up to 10 years, it was a staple food for native peoples and early explorers and fur traders. Wild rice is included in Table 4.2.9-5 as an 1854 Treaty Authority-regulated resource, as it is a culturally important plant species. The annual harvest of wild rice totals more than 2 million pounds, and involves thousands of tribal members, demonstrating its continuing role in Ojibwe spiritual practices, culture, livelihood, and identity (Zellie 2012). Wild rice is not known to occur within the Plant Site, Transportation and Utility Corridor, or the Mine Site. However, it was identified through surveys in isolated patches in the Upper Partridge River upstream of Colby Lake, in the Partridge River downstream of Colby Lake, in isolated patches on the Embarrass River above Embarrass Lake, and downstream of Embarrass Lake. See Sections 4.2.2 and 4.2.4 for further discussions of wild rice near the NorthMet Project area.

Similarly, the sugar maple (*Acer saccharum*) is a culturally important plant species, as it has traditionally been and is still tapped to make maple syrup and sugar. “The sugar, in granular form or syrup, provided seasoning for grains and breads, stews, teas, berries, and vegetables” (Zellie 2012). A stand of sugar maple was located southwest of Spring Mine Lake between the Mine Site and Plant Site. This site, called the Spring Mine Lake Sugarbush, appears to be a natural maple-basswood stand that has been utilized during the past two centuries. Many of the sugar maple trees at this site display evidence that they have been tapped for maple syrup in the past, including misshapen boles from 4 to 8 ft off the ground. Small groups of sugar maple were also identified near the overlook area northeast of the Plant Site, but nowhere else, including the Mine Site.

In addition to sugar maple and wild rice, the Ojibwe also relied on spruce root, birch and cedar bark, sage, hazelnuts, and blueberries and other berries (Zellie 2012). Many of these species also had medicinal uses besides being used as food sources. This is consistent with the 1854 Treaty Authority-regulated resources listed in Table 4.2.9-5, and many of these species were identified in multiple ECS community types during surveys (see Table 4.2.9-6).

Wildlife

The 1854 Treaty Authority developed a Ceded Territory Conservation Code (2012) to regulate hunting, fishing, trapping, and gathering of resources for subsistence use in the 1854 Ceded Territory. The wildlife species regulated by the 1854 Treaty Authority are listed in Table 4.2.9-6, and are categorized by the habitat type they typically utilize. Table 4.2.9-7 also lists the acreage of these habitats present at the Mine Site, Transportation and Utility Corridor, and Plant Site.

Table 4.2.9-7 Key Habitat, Cover Types, and Associated Species Regulated by the 1854 Treaty Authority in the NorthMet Project Area

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species Regulated by the 1854 Treaty Authority	Mine Site (Acres)	Transportation and Utility Corridor (Acres)	Plant Site (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Snowshoe hare, bobcat, fisher, pine marten, ruffed grouse, spruce grouse	2,627.2	5.5	789.3
2. Open Ground, Bare Soils: disturbed/developed (no MIH)		128.0	94.4	2,755.5
3. Grassland and Brushland, Early Successional Forest (no MIH)	American badger, sharp-tailed grouse	246.6	17.5	333.8
4. Aquatic Environments: Tailings Basin, Partridge River, Embarrass River, former LTVSMC mine pits, wetlands (MIH 14)	American mink, muskrat, beaver, river otter, sora, Virginia rail, Wilson’s snipe, Canada goose, snow goose, redhead, northern pintail, canvasback, mallard, American black duck, red-breasted merganser, American coot, common gallinule	12.7	2.7	636.8

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species Regulated by the 1854 Treaty Authority	Plant Site (Acres)	Mine Site (Acres)	Transportation and Utility Corridor (Acres)
5. Multiple Habitats (MIHs 1-14)	White-tailed deer[1] (1, 3), moose (1, 3, 4), black bear (1, 3), coyote (1, 3), red fox (1, 3), raccoon (1, 3, 4), gray fox (1, 3), eastern cottontail rabbit (1, 3), eastern fox squirrel (1, 3), eastern gray squirrel (1, 3), Virginia opossum (1, 3), Canada lynx (1-4), wild turkey (1, 3, 4), American crow (1-4), mourning dove (1, 3), American woodcock (1, 3), ring-necked pheasant (3, 4), Canada goose (3, 4), snow goose (3, 4), greater white-fronted goose (3, 4), brant (3, 4), wood duck (1, 4), greater scaup (3, 4), lesser scaup (1, 3, 4), hooded merganser (1, 4), common merganser (1, 4)			
Total[2]		3,014.5	120.1	4,515.4

Sources: 1854 Treaty Authority 2013; 1854 Treaty Authority 2012.

Notes:
[1] Numbers refer to the Key Habitat Types (1-5) where those species may occur or are known to occur.
[2] Total acres may be more or less than presented due to rounding.

Mature upland and lowland forest is the most common habitat type at the NorthMet Project area (primarily at the Mine Site). Section 4.2.4 provides a more detailed discussion of vegetation cover and habitat types. Species that may be present include snowshoe hare, bobcat, fisher, pine marten, ruffed grouse, and spruce grouse. These species represent a group that generally requires large forested blocks and/or minimal human intrusion.

Areas of open ground and bare soils are rare at the Mine Site but are abundant at the Plant Site due to former LTVSMC operations or deposition in the existing LTVSMC Tailings Basin. Both open ground and bare soils are considered non-natural habitats. No 1854 Treaty Authority-regulated species are specifically associated with this habitat type.

Brush/grassland and very early successional forest are uncommon at the Mine Site and Plant Site (ENSR 2005) and, where present, are typically small patches resulting from recent logging. The revegetation of the existing LTVSMC Tailings Basin is counted as grassland, though it is disturbed habitat and is unlikely to be heavily used by wildlife species. The species listed in Table 4.2.9-7 include the American badger and sharp-tailed grouse, which are generally associated with large patches of grassland and savanna habitats that are not present in the NorthMet Project area. The USFS has indicated that American woodcock has been observed at the Mine Site.

The Mine Site and adjacent federal lands contain a large expanse of wetland habitat consisting primarily of coniferous and open bogs. Species that utilize this habitat include semi-aquatic mammals, shorebirds, and waterfowl. Currently, there are no bodies of open water at the Mine Site. At the Plant Site, open water and aquatic communities are confined to the existing LTVSMC Tailings Basin. The Tailings Basin attracts Canada geese and other waterfowl, though the NorthMet Project area does not otherwise appear to provide good habitat for waterfowl or shorebirds.

Multiple habitats are not mapped as such, but are made up of combinations of other key habitat types. This category is used for 1854 Treaty Authority-regulated species that are known to use multiple habitats during a season, such as white-tailed deer, bear, moose, and multiple other species listed in Table 4.2.9-7.

Other wildlife species may be considered culturally important, including but not limited to the gray wolf and bald eagle, and are discussed in Section 4.2.5.

Aquatic Species

As mentioned above, the 1854 Treaty Authority manages the off-reservation fishing rights of the Grand Portage and Bois Forte Bands of Lake Superior Chippewa in the 1854 Ceded Territory. They have developed the *1854 Treaty Authority Fishing Seasons, 2013-2014* (2013) document to address fishing seasons and limits on waters open to the public within the 1854 Ceded Territory. Fish species with a season and limit are presented in Table 4.2.9-8 below, along with fish species that have been collected at sites in the vicinity of the NorthMet Project area. Five fish species that are regulated by the 1854 Treaty Authority (i.e., northern pike, white sucker, burbot, black bullhead, and yellow perch) occur near or on the NorthMet Project areas; the remaining species collected near the Mine Site, Transportation and Utility Corridor, or Plant Site include species more typical for first- and second-order streams (e.g., minnows, darters, etc.). Section 4.2.6 describes in more detail the species collected and the stream and shoreline habitat available.

Table 4.2.9-8 Fish Species Regulated by the 1854 Treaty Authority and Collected in the NorthMet Project Area

1854 Treaty Authority-Regulated Fish Species[1]
Northern pike, *white sucker*, *burbot*, *black bullhead*, *yellow perch*, walleye, sauger, muskellunge, largemouth/smallmouth bass, rock bass, black/white crappie, sunfish/bluegill, white/yellow bass, flathead/channel catfish, yellow/brown bullhead, lake whitefish, rainbow smelt, lake sturgeon, ruffe, white perch, round goby, lake trout, chinook/pink/coho salmon, brook/brown/rainbow trout, splake, carp, bigmouth buffalo, sheepshead/freshwater drum, bowfin, cisco, gar, goldeye
Species Collected in the Vicinity of the NorthMet Project Area[1, 2]
Northern pike, *white sucker*, *burbot*, *black bullhead*, *yellow perch*, longnose dace, common shiner, Johnny darter, brassy minnow, northern redbelly dace, brook stickleback, blacknose dace, pearl dace, tadpole madtom, central mudminnow, fathead minnow, mottled sculpin, golden shiner, finescale dace, creek chub

Sources: 1854 Treaty Authority 2013; 1854 Treaty Authority 2012.

Notes:
[1] Species in common between the 1854 Treaty Authority fishing season list and those collected in the NorthMet Project area are listed in italics.
[2] Species list from tables in Section 4.2.6.

The lake sturgeon is a culturally important fish species that has a season and limits enforced (1854 Treaty Authority 2013), and it is also listed as a USFS RFSS. However, lake sturgeon are not known to occur near the NorthMet Project area, and there is no likely habitat for them on the federal lands. Though lake sturgeon have been stocked into the St. Louis River above the Fond du Lac dam, upstream migration would be blocked by a dam downstream of the Embarrass River confluence with the St. Louis River. See Section 4.2.6 for a more thorough discussion of lake sturgeon and their management.

Access to the NorthMet Project Area for Subsistence Use

The Mine Site is entirely surrounded by private restricted property, roads, and railroads. There are access points to the NorthMet Project area, however, via a Forest Service road, the Partridge River, and various trails segments. The Plant Site and the Transportation and Utility Corridor are owned by either Cliffs Erie LLC or PolyMet, and are not open to the public. Entry points are gated and/or guarded, and crossing the corridor is prohibited. As such, current subsistence use in the NorthMet Project area is limited, but not restricted.

4.2.10 Socioeconomics

The Arrowhead region of northeastern Minnesota, which includes Cook, Lake, and St. Louis counties, contains the well-known Mesabi Iron Range. Precious metal mining in this region can be dated to the late 1800s, with St. Louis County in particular having a long mining heritage. Many local communities were established to support these iron mining operations. While mining is still a major component of the area's economy and culture, the same can also be said for the region's other natural resources. As with much of Minnesota, timber production has a long history in this area. Tourism, much of it centered on the BWCAW and the region's other outstanding public lands, is an important and growing economic sector and is deeply ingrained in the region's culture.

The study area for socioeconomics extends beyond the area of direct potential project effects to include all of Cook, Lake, and St. Louis counties (see Figure 4.2.10-1). This geography includes the proposed Mine Site, Transportation and Utility Corridor, and Plant Site as well as the non-federal tracts included in the Land Exchange Proposed Action.

Socioeconomic data are not available, and thus are not reported for the Mine Site, Transportation and Utility Corridor, and Plant Site on an individual basis. Socioeconomic data in this section are instead collected and analyzed at the county level and, where appropriate, for cities (Aurora, Babbitt, Biwabik, Duluth, Ely, Hibbing, Hoyt Lakes, Tower, and Virginia), as well as the unincorporated area known as Soudan (all of which are located in St. Louis County, and which are collectively referred to hereafter as "study area communities"). While other portions of northeastern Minnesota could experience some socioeconomic effects from the NorthMet Project Proposed Action, these cities were chosen for several reasons. Duluth, which is approximately 2 hours driving distance from the NorthMet Project area, is included because its population is a large share of St. Louis County's overall population. Other larger cities are those within approximately a 1 hour driving distance. These are the population centers most likely to provide labor and housing (temporary and permanent) and thus are the most likely to be impacted by the NorthMet Project Proposed Action.

Data and observations for the Fond du Lac (St. Louis and Carlton counties), Grand Portage (Cook County), and Bois Forte (St. Louis and Koochiching counties) reservations and off-reservation areas are also included where information was available. While portions of these reservations are outside of the study area, tribal members nonetheless exercise usufructuary rights to hunt, fish, and gather plants within the 1854 Ceded Territory.

4.2.10.1 Mine Site, Transportation and Utility Corridor, Plant Site

4.2.10.1.1 Demographics

This section describes the demographics of the three-county study area in terms of population, age, race, income, poverty, and educational statistics.

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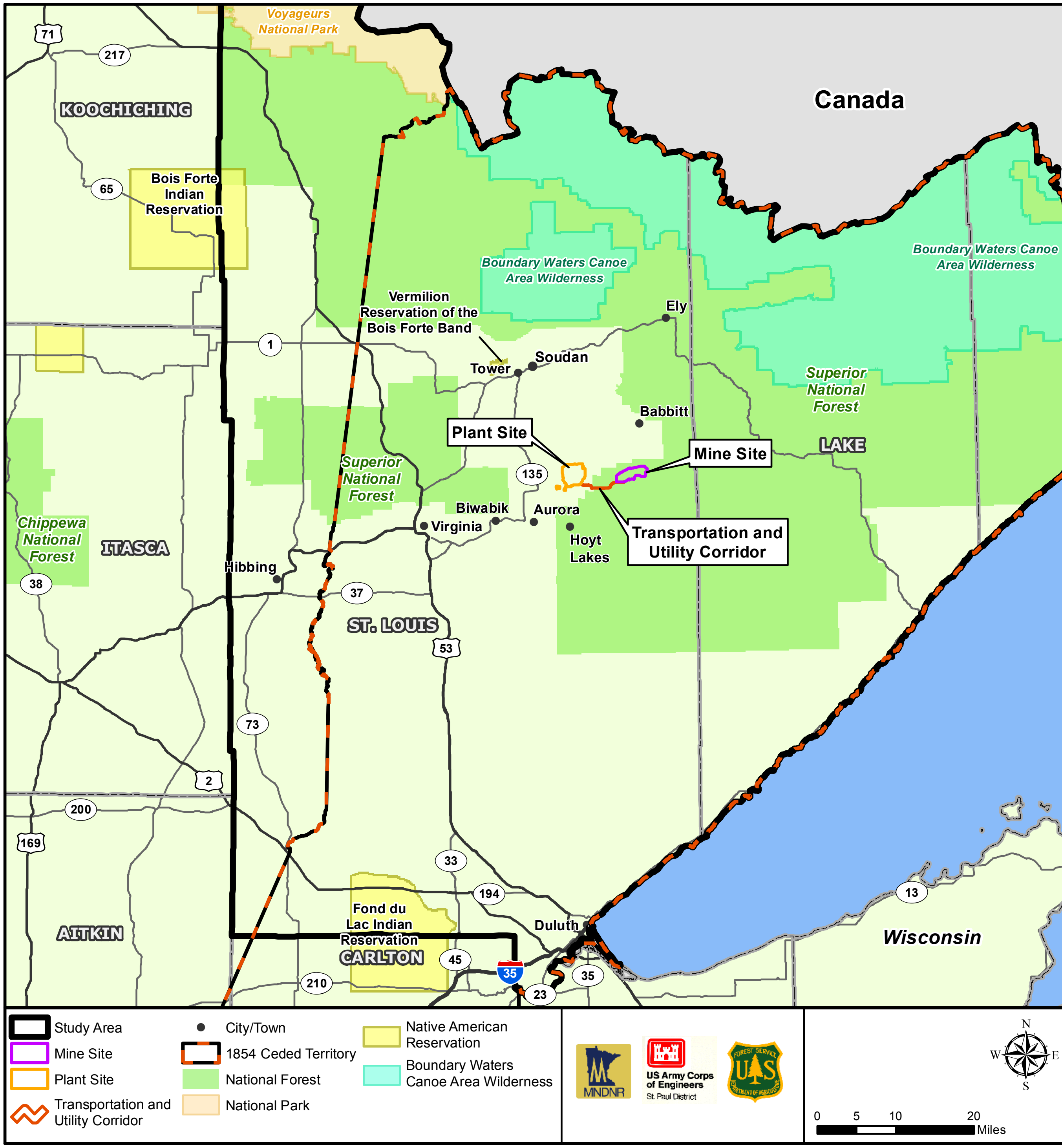

Figure 4.2.10-1
Socioeconomic Study Area
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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Population, Age, and Race

Population and population trends for the study area from 1980 through 2010 are shown in Table 4.2.10-1. The population of St. Louis County is concentrated in and around the City of Duluth, approximately 65 miles south of the NorthMet Project area, with smaller, secondary centers in the Iron Range communities of Ely, Hibbing, and Virginia. Lake and Cook counties have few large population centers near the NorthMet Project area. The population of the study area and its individual communities has declined by nearly 10 percent since 1980 (from more than 239,000 in 1980 to 216,000 in 2010), while the population of the state as a whole has increased by more than 30 percent. In individual communities listed in Table 4.2.10-1, population has declined substantially compared to the study area as a whole. At least some of this population decline may be attributable to "the out-migration of previous residents after the decline in economic opportunity represented by the loss of so many iron industry jobs" (Power 2007). The exceptions are the Fond du Lac, Grand Portage, and Bois Forte reservations, where populations have increased since 1990.

Table 4.2.10-1 Population of Study Area Communities 1980 to 2010

	Year				Change (1980–2010)[1]	
Geography	**1980**	**1990**	**2000**	**2010**	**Number**	**%**
Minnesota	4,075,970	4,375,099	4,919,479	5,303,925	1,227,955	30.10
Cook County	4,092	3,868	5,168	5,176	1,084	26.50
Lake County	13,043	10,415	11,058	10,866	-2,177	-16.70
St. Louis County	222,229	193,433	200,528	200,226	-22,003	-9.90
Study Area	**239,364**	**207,716**	**216,754**	**216,268**	**-23,096**	**-9.60**
Aurora	2,670	1,965	1,850	1,682	-988	-37.00
Babbitt	2,435	1,562	1,670	1,475	-960	-39.40
Biwabik	1,428	1,097	954	969	-459	-32.10
Bois Forte Reservation	na	358	657	874	516	144.10
Duluth	92,811	85,493	86,918	86,265	-6,546	-7.10
Ely	4820	3,968	3,724	3,460	-1,360	-28.20
Fond du Lac Reservation	na	3,229	3,728	4,240	1,011	31.30
Grand Portage Reservation	na	306	557	565	259	84.60
Hibbing	21193	18,046	17,071	16,361	-4,832	-22.80
Hoyt Lakes	3,186	2,348	2,082	2,017	-1,169	-36.70
Soudan	na	502	372	446	-56	-11.20
Tower	640	502	469	500	-140	-21.90
Virginia	11056	9,410	9,157	8,712	-2,344	-21.20

Sources: U.S. Census Bureau 1980, 1990, 2000, and 2010b.

Notes:
[1] Population data for 1980 were not available for Soudan, Minnesota and the three Native American reservations. In these cases, the population change reflects the 1990–2010 time period.
na = Not available

As shown in Table 4.2.10-2, the median age of the population in study area counties and cities (typically age 40 to 45) is substantially higher than that of the state (age 35). Moreover, the median age of study area communities has grown at a more rapid pace than the state as a whole. Minnesota's median age grew by two full years between 2000 and 2010, while the median age of most study area communities—with the exception of Duluth, Hibbing, and Virginia—grew by 3 to 5 years. Again, with the exception of Duluth, study area communities tend to have (as a percentage of the total population) fewer children under 18, fewer adults (18 to 64), and more senior citizens (age 65 or older) than the state as a whole.

The study area is more than 93 percent Caucasian (see Table 4.2.10-3), compared to 85 percent for the state as a whole. However, Native Americans comprise 2 percent of the study area's population compared to 1 percent of the state's overall population.

Table 4.2.10-2 Age Characteristics of Study Area Residents, 2010

Geography	Median Age, 2000	Median Age, 2010	Population Segments (% of total) 0-17 yrs.	18-64 yrs.	65+ yrs.
State of Minnesota	35.4	37.4	24	63	13
Cook County	44.0	49.8	17	63	20
Lake County	42.9	48.3	19	59	22
St. Louis County	39.0	40.8	30	64	16
Study Area	**na**	**na**	**29**	**64**	**16**
Aurora	45.2	48.4	19	56	24
Babbitt	46.8	51.1	17	52	31
Biwabik	41.5	46.8	20	58	22
Bois Forte Reservation	31.6	34.1	33	55	13
Duluth	35.4	33.6	19	68	14
Ely	40.8	45.3	16	61	23
Fond du Lac Reservation	33.5	36.5	28	60	12
Grand Portage Reservation	36.5	39.2	23	67	10
Hibbing	41.0	42.5	22	61	18
Hoyt Lakes	45.6	49.3	20	55	25
Soudan	na	46.7	18	62	20
Tower	45.3	48.4	19	57	24
Virginia	43.2	44.9	19	59	22

Sources: U.S. Census Bureau 2000 and 2010b.

Notes:
Percent totals may be greater or less than 100% due to rounding.
na = Not available

Table 4.2.10-3 Racial Characteristics of Study Area Residents, 2010

Geography	Total Population	White (%)	African American (%)	Native American (%)	Asian (%)	Hawaiian/ Pac. Islander (%)	Other (%)	Multiple Races (%)	Hispanic[1] (%)
State of Minnesota	5,303,925	85	5	1	4	<1	2	2	5
Cook County	5,176	88	<1	8	<1	<1	<1	2	1
Lake County	10,866	98	<1	<1	<1	<1	<1	1	<1
St. Louis County	200,226	93	1	2	<1	<1	<1	2	1
Study Area	**216,268**	**93**	**1**	**2**	**<1**	**<1**	**<1**	**2**	**1**
Aurora	1,682	98	<1	<1	<1	0	0	1	<1
Babbitt	1,475	98	<1	<1	<1	0	<1	1	<1
Biwabik	969	98	<1	<1	<1	0	<1	<1	<1
Bois Forte Reservation	874	26	<1	70	<1	0	<1	3	3
Duluth	86,265	90	2	3	2	0	<1	3	2
Ely	3,460	96	1	<1	<1	0	<1	2	1
Fond du Lac Reservation	4,240	55	<1	39	<1	0	<1	6	2
Grand Portage Reservation	565	27	1.1	68	2	0	<1	2	<1
Hibbing	16,361	96	<1	<1	<1	0	<1	2	1
Hoyt Lakes	2,017	98	<1	<1	<1	0	0	1	<1
Soudan	446	96	1	<1	<1	0	0	<1	<1
Tower	500	95	<1	2	<1	0	<1	2	1
Virginia	8,712	92	2	3	<1	0	<1	3	2

Source: U.S. Census Bureau 2010b.

Notes:
[1] Hispanic status is considered separately from racial identification.
Percent totals may be greater or less than 100% due to rounding.

Educational Attainment

Table 4.2.10-4 shows the educational attainment of residents in the study area. Educational attainment in the study area as a whole and in most study area communities (as measured by the percentage of residents age 25 and over who achieved degrees beyond a high school diploma) was lower in these communities than in St. Louis County as a whole and the state in 2010. Whereas 41 percent of state residents (age 25 and older) and 37 percent of St. Louis County residents had achieved Associate's degrees or higher in 2010, approximately 15 to 30 percent of residents of study area communities (except for Duluth, Ely, and Soudan) had achieved similar degrees.

Table 4.2.10-4 Educational Characteristics of Study Area Residents, 2010

Geography	Total[1]	No High School Diploma (%)	High School Diploma and/or Some College (%)	Associate's Degree (%)	Bachelor's Degree (%)	Advanced Degree (%)
State of Minnesota	3,450,999	9	50	10	21	10
Cook County	4,091	7	52	8	20	13
Lake County	8,167	7	63	10	14	6
St. Louis County	133,796	8	56	11	18	8
Study Area	**146,054**	**8**	**56**	**11**	**17**	**8**
Aurora	1,146	11	64	13	9	3
Babbitt	1,047	14	68	12	5	2
Bois Forte Reservation	759	10	63	14	10	3
Biwabik	425	22	61	5	9	4
Duluth	51,753	8	51	9	21	11
Ely	2,333	8	53	14	20	6
Fond du Lac Reservation	2,472	14	61	13	10	3
Grand Portage Reservation	314	26	57	9	5	4
Hibbing	11,454	12	62	10	11	5
Hoyt Lakes	1,612	7	66	14	12	2
Soudan	348	6	49	28	12	4
Tower	315	5	67	13	9	5
Virginia	6,347	11	56	15	13	5

Source: U.S. Census Bureau 2010a.

Notes:
[1] Data are for residents age 25 or older.
Percent totals may be greater or less than 100% due to rounding.

Income and Poverty

Table 4.2.10-5 shows income and poverty characteristics for the study area communities. The median income of individual study area communities is significantly lower than that of the state as a whole, with the exception of Soudan. It is also the case that the median income of individual communities is generally lower than that of St. Louis County. The median income in Babbitt and Hoyt Lakes—the communities closest to the NorthMet Project area—are two-thirds and four-fifths, respectively, of the state median income. In some study area communities, such as Ely and Tower, the median household income is slightly more than half of the state total. Poverty rates are also higher in the study area as a whole than in the state. In many individual communities, poverty rates are as high or higher than the state (with the exceptions of Hoyt Lakes, Soudan, and Tower).

Table 4.2.10-5 Income and Poverty Characteristics of Study Area Communities in 2010

Geography	Median Household Income ($)	Percentage of State Median Household Income	Population with Income Below Poverty Level[1, 2]	Percentage of Population Below Poverty Level[1,2]
State of Minnesota	57,243	na	542,133	11
Cook County	49,162	86	463	9
Lake County	46,765	82	1,252	12
St. Louis County	44,941	79	28,931	15
Study Area	**na**	**na**	**30,646**	**15**
Aurora	45,285	79	182	12
Babbitt	37,500	66	133	10
Biwabik	40,417	57	197	19
Bois Forte Reservation	32,656	71	100	15
Duluth	41,092	72	16,339	20
Ely	31,905	56	561	18
Fond du Lac Reservation	41,300	72	893	22
Grand Portage Reservation	33,056	58	82	17
Hibbing	36,585	64	2,737	17
Hoyt Lakes	45,338	79	89	5
Soudan	65,000	114	27	7
Tower	31,607	55	21	5
Virginia	32,664	57	1,759	21

Source: U.S. Census Bureau 2010a.

Notes:
1 Percentage based on the "Population for whom poverty status is determined" which is less than the total population.
2 The United States Census Bureau defines poverty status using a set of monetary standards (consistent with *Office of Management and Budget Statistical Policy Directive 14*) that vary by family size and composition (e.g., marital status and number of children). Poverty thresholds are updated annually to reflect economic conditions. Poverty thresholds in 2009 (the year for which the data in this table are presented) can be found at:
http://www.census.gov/hhes/www/poverty/data/threshld/thresh09.html
Percent totals may be greater or less than 100% due to rounding.
na = Not available

4.2.10.1.2 Employment

This section evaluates two different measures of employment. At-place employment describes jobs that exist in a given location, regardless of where job-holders live. It is a measure of the economic activity in a community. However, workers in northeastern Minnesota are often accustomed to driving long distances to jobs, particularly in the mining industry (Power 2007). Thus, information about at-place employment is supplemented with information about jobs held by residents. This second measure describes the extent to which a community's residents are employed.

At-place Employment

Tables 4.2.10-6 and 4.2.10-7 show at-place employment trends for the study area by major industry classification. Data from 1980 and 1990 are reported by SIC (see Table 4.2.10-6), while 2009 data reflect industries as defined by the North American Industrial Classification System

(NAICS) (see Table 4.2.10-7), which replaced the Standard Industrial Classification (SIC) system in 1997.

Table 4.2.10-6 At-place Historical Employment by Major SIC Industry in 1980 and 1990

Major Industry	**Minnesota**		**Cook County**		**Lake County**		**St. Louis County**	
Year	1980	1990	1980	1990	1980	1990	1980	1990
Agricultural services	3,950	6,812	na	na	A[1]	B	93	152
Metal mining	16,182	7,437	0	A	F	E	12,208	5,317
Construction	82,673	76,200	75	101	E	B	4,305	2,577
Manufacturing	392,742	394,202	122	C	366	621	8,595	6,162
Transportation, communications, utilities	84,967	106,166	22	A	113	122	3,360	3,713
Wholesale trade	114,717	133,464	A	A	74	B	4,247	2,907
Retail trade	322,153	395,801	265	459	590	633	16,457	16,602
Finance, insurance, real estate	101,314	133,678	34	82	102	C	3,211	2,805
Services	367,202	573,009	358	F	455	595	16,716	22,598
Public administration	8,780	5,387	A	A	18	A	366	184
Total	1,494,680	1832,156	895	1,401	2,985	2,555	69,558	63,017

Source: UVGSDC 2008.

Notes:
[1] Letter codes indicate suppression flags in the original data set—cases where exact data were withheld by the United States Census Bureau in order to protect company-confidential data. As a result, study area data cannot be calculated. Flags indicate approximate employment, as follows: A: 0-19 employees; B: 20-99 employees; C: 100-249 employees; E: 250-499 employees; F: 500-999 employees.
na = Not available

Table 4.2.10-7 At-place Employment by Major NAICS Industry in 2009

	Minnesota		Cook County		Lake County		St. Louis County	
Major NAICS Industry	**Number**	**% of Total**	**Number**	**% of Total**	**Number**	**% of Total**	**Number**	**% of Total**
Forestry, fishing, hunting	2,462	<1	A[1]	na	A	na	172	<1
Mining, quarrying, oil/gas	4,703	<1	B	na	C	na	3,151	4
Utilities	13,711	<1	120	6	B	na	921	1
Construction	99,101	4	B	na	96	3	3,261	4
Manufacturing	307,822	13	9	<1	F	na	4,378	5
Wholesale trade	131,638	5	283	14	B	na	2,279	3
Retail trade	291,328	12	A	na	332	11	12,583	15
Transportation, warehousing	75,384	3	59	3	A	na	1,934	2
Information	64,096	3	36	2	C	na	2,187	3
Finance and insurance	148,621	6	B	na	179	6	3,655	5
Real estate	36,296	2	B	na	84	3	1,017	1
Professional, sci., tech. svcs.	139,270	6	26	1	B	na	3,269	4
Management	118,124	5	42	2	41	1	937	1
Admin., support, waste mgt.	123,915	5	C	na	B	na	3,212	4
Educational services	66,458	3	304	15	E	na	2,360	3
Health care, social assistance	421,935	18	641	33	54	2	21,789	27
Arts, entertainment, recreation	39,550	2	46	2	607	21	1,221	2
Accommodation, food svcs.	213,136	9	A	na	174	6	9,308	11
Other svcs.	119,334	5	-	0	-	0	3,995	5
Industries not classified	290	<1	-	0	-	0	5	<1
Total	2,417,174	100.0	1,975	100.0	2,955	100.0	81,634	100.0

Source: U.S. Census Bureau 2009.

Notes:
[1] Letter codes indicate suppression flags in the original data set—cases where exact data were withheld by the United States Census Bureau in order to protect company-confidential data. As a result, study area data cannot be calculated. Flags indicate approximate employment, as follows: A: 0-19 employees; B: 20-99 employees; C: 100-249 employees; E: 250-499 employees; F: 500-999 employees.
Percent totals may be greater or less than 100% due to rounding.
na = Not available

In 2009, the top employment sectors in the study area were health care and social assistance, retail trade, manufacturing, educational services (which does not include public schools or other public education functions), and accommodation and food services. SIC and NAICS data are available for counties, whole zip codes, and Metropolitan Statistical Areas, but not for the specific geographic areas considered in this chapter (i.e., most of the study area communities occupy only a portion of a zip code; thus, the data for the whole zip code are not appropriate). Therefore, only county-level data are used. The U.S. Census Bureau withholds some data for smaller geographies (such as cities); therefore, study area totals cannot be calculated.

Mining employment has declined consistently in all three study area counties, from more than 12,000 in 1980 to approximately 3,000 in 2009 in St. Louis County. Mining-related employment is volatile and fluctuates from year to year due to the market price of commodities being extracted. Since mining employment can vary greatly from one year to the next, the decline observed from 1980 and 2009 does not represent a steady reduction in mining-related employment. At the same time, service-related employment in the study area (which includes the NAICS categories for professional services, management, health care, education, arts/entertainment, and accommodation/food) has increased substantially since 1980, mirroring broader state and national trends.

Industry Concentrations

Certain industries, particularly mining and utilities, are more concentrated in the study area, particularly St. Louis County, than in the state as a whole. Sector concentration can be measured by the location quotient (LQ), which is the ratio between the local economy and the economy of a reference unit, such as the state. For this analysis, the LQ was calculated using each study area county as a local economy and the state as the reference unit. Given the number of industry totals that were suppressed by the U.S. Census Bureau in Tables 4.2.10-6 and 4.2.10-7, a combined study area LQ could not be calculated. A LQ of 1.00 indicates that a given industry is exactly as strong, in terms of employment, in the local economy as it is in the reference economy. A LQ below 1.00 indicates a relatively weak local industry, while a LQ above 1.00 indicates a relatively strong local industry.

As illustrated by Table 4.2.10-8, the LQ for the mining industry in St. Louis County is nearly 20, meaning that mining employment in the county is approximately 20 times as concentrated as in the state as a whole. As noted above, LQs for the study area as a whole could not be calculated because of data confidentiality. However, this concentration has been declining in recent years. In 1980 (see Table 4.2.10-6), St. Louis County accounted for approximately 75 percent of the state's mining employment. In 2009 (see Table 4.2.10-7), that share had fallen to approximately 66 percent of state mining employment. Mining employment in other study area counties was minimal.

The high LQ for the utilities industry is likely tied to power plants and utility infrastructure that support the region's mining activity. Other relatively high LQ values vary by county, but generally include educational services, health care and social assistance, and arts/entertainment. Forestry, fishing, and hunting have high LQ values in St. Louis County, while Real Estate has a high LQ value in Lake County. Industries with particularly low LQ values include manufacturing and management. These findings support stakeholder observations about the strength of the region's tourism economy (real estate in Lake County, arts, entertainment, accommodation, and food).

Regional Tourism

Tourism is rooted in the Arrowhead region's unique recreation opportunities such as the BWCAW, and is more broadly dependent on recreational opportunities such as hunting, fishing, boating, sightseeing, and wilderness experiences provided by the region's high-quality natural environment.

Mining and tourism have coexisted in the study area for decades. As shown in Table 4.2.10-7, industries associated with tourism (arts, entertainment, recreation, accommodation, and food) account for nearly 13 percent of all employment in St. Louis County (data could not be summed for the entire study area). The "attractive landscape and climatic features [of the region have] attracted recreationists, retirees, and other new residents" (Power 2007). In particular, retirement income (from individuals who move to the Arrowhead region for its recreational and scenic resources) has been an important source of economic vitality for the region's communities (Power 2007). These non-mining economic gains have occurred in the presence of active mining activity (including the Northshore Mine adjacent to the NorthMet Project area) and the remnant landscape of past mining activity.

Retirees

The demographic data in Section 4.2.10.1.1, as well as some of the industry clusters identified above, support the views, expressed by some stakeholders, that the study area is an increasingly attractive location for retirees. The median ages in nearly all study area communities increased between 2000 and 2010, and are, in most cases, higher than the state median (see Table 4.2.10-2). The relative strength of the Health Care and Social Assistance industry category is also consistent with an older population in need of such services.

The employment status data in Table 4.2.10-9 may also support this conclusion about retirees: statewide, 71 percent of residents over the age of 16 participate in the workforce (i.e., they hold or are actively looking for a job). By comparison, only 62 percent of the over-16 population in the study area is in the workforce. While some of this difference is likely attributable to long-term unemployment (which often leads workers to drop out of the workforce entirely), this gap may also suggest the presence of retired individuals, who are, by definition, no longer in the workforce.

Research also shows links between the presence of recreation and natural amenities and increased retirement throughout the United States (see McGranahan 1999). The economic data cited above, combined with the amenities present in and near the study area—such as BWCAW, Superior National Forest, and the other resources described throughout this FEIS—are consistent with the findings of this type of research.

Table 4.2.10-8 Location Quotients for Major NAICS Industries in the Study Area, 2009

Industry	Cook County	Lake County	St. Louis County
Forestry, fishing, hunting	na	na	2.07
Mining, quarrying, oil/gas	na	na	19.84
Utilities	10.71	na	1.99
Construction	na	0.79	0.97
Manufacturing	0.04	na	0.42
Wholesale trade	2.63	na	0.51
Retail trade	na	0.93	1.28
Transportation, warehousing	0.96	na	0.76
Information	0.69	na	1.01
Finance and insurance	na	0.99	0.73
Real estate	na	1.89	0.83
Professional, scientific, technical services	0.23	na	0.70
Management	0.44	0.28	0.23
Admin., support, waste mgt.	na	na	0.77
Educational services	5.60	na	1.05
Health care, social assistance	1.86	0.10	1.53
Arts, entertainment., rec.	1.42	12.55	0.91
Accommodation, food services	na	0.67	1.29
Other services	NA	NA	0.99
Industries not classified	NA	NA	0.51

Source: U.S. Census Bureau 2009.

Notes:
LQs compare county employment to statewide employment. LQs for the entire study area cannot be calculated.
na = Not available

Jobs Held by Residents

Employment data for residents of study area communities is shown in Table 4.2.10-9. Unemployment rates in Lake and Cook counties were generally consistent with or lower than statewide unemployment. However, unemployment in St. Louis County and particularly in individual St. Louis County communities was generally much higher than in the state as a whole. These data are estimates based on information collected by the U.S. Census Bureau from 2005 to 2009, and thus may not fully capture the depth of the unemployment effects that the study area has experienced as a result of the national recession during and following that time period.

Occupation (e.g., general type of work) and industry classifications of jobs held by study area residents are shown in Tables 4.2.10-10 and 4.2.10-11. These data show that management, science, business, arts, sales, education, health, manufacturing, and retail make up a large percentage of the jobs held by study area residents. The sectors of agriculture, forestry, fishing and hunting, and mining (including metal mining such as the NorthMet Project Proposed Action) account for a higher share of locally held jobs than the statewide average. This is especially true for communities closer to the mine (e.g., Aurora, Babbitt, Biwabik, and Hoyt Lakes).

Occupational categories are provided for each community per the U.S. Census Bureau's SIC definitions. The occupation categories also show the prevalence of management and service job functions as opposed to more traditional production and manufacturing activities typically associated within mining.

Table 4.2.10-9 Employment Status of Study Area Communities, 2009

Geography	Total Population ≥16 Years	In Civilian Labor Force[1]	Employed	Unemployed	Unemployment Rate (%)
State of Minnesota	4,111,966	2,916,931	2,730,721	186,210	6
Cook County	4,455	2,875	2,741	134	5
Lake County	9,143	5,596	5,395	201	4
St. Louis County	164,849	102,619	94,402	8,217	8
Study Area	**178,447**	**111,090**	**102,538**	**8,552**	**7.7**
Aurora	1,264	681	641	40	6
Babbitt	1,167	579	544	35	6
Biwabik	508	318	240	78	25
Bois Forte Reservation	850	481	445	36	8
Duluth	71,606	46,415	42,629	3,786	8
Ely	3,064	1,751	1,617	134	8
Fond du Lac Reservation	3,089	1,935	1,662	273	14
Grand Portage Reservation	331	227	218	9	4
Hibbing	13,222	7,166	6,531	635	9
Hoyt Lakes	1,740	996	834	162	16
Soudan	397	273	256	17	6
Tower	353	201	178	23	11
Virginia	7,157	3,814	3,413	401	11

Source: U.S. Census Bureau 2010a.

Notes:
[1] Excludes armed forces personnel, and individuals who reported that they were not seeking employment.
Percent totals may be greater or less than 100% due to rounding.

Table 4.2.10-10 Employment in Study Area Communities by Occupation

Geography	Civilian Employed Pop. ≥16 Years	Occupation (% of total employed population)				
		Management, Science, Business, Arts	Services	Sales/ Office	Natural Resources	Production/ Transportation
State of Minnesota	2,730,721	38	16	25	9	13
Cook County	2,741	33	18	27	13	9
Lake County	5,395	27	22	22	14	15
St. Louis County	94,402	34	21	24	11	10
Study Area	**102,538**	**34**	**21**	**24**	**11**	**10**
Aurora	641	25	21	17	21	16
Babbitt	544	21	19	27	14	18
Biwabik	445	22	30	17	16	15
Bois Forte Reservation	240	22	26	29	14	10
Duluth	42,629	37	23	24	7	9
Ely	1,617	25	31	29	10	5
Fond du Lac Reservation	1,662	24	25	23	11	17
Grand Portage Reservation	218	21	38	24	15	2
Hibbing	6,531	27	23	28	13	10
Hoyt Lakes	834	20	21	20	18	21
Soudan	256	22	28	20	14	17
Tower	178	26	29	17	19	8
Virginia	3,413	31	22	25	16	6

Source: U.S. Census Bureau 2010a.

Note:
Percent totals may be greater or less than 100% due to rounding.

Table 4.2.10-11 Employment in Study Area Communities by Industry

Geography	Civilian Employed Population ≥16 Years	Industry (% of total employed population)												
		Forestry, Fishing, Hunting, and Mining	Construction	Manufacturing	Wholesale	Retail	Transportation and Utilities	Information	Finance, Insurance, Real Estate	Professional, Scientific, Management, Administration	Education, Health	Arts, Entertainment, Recreation, Accommodation, Food	Other Services, except Public Administration	Public Administration
Minnesota	2,730,721	2	6	14	3	12	5	2	7	9	24	8	4	3
Cook County	2,741	2	10	7	1	14	2	1	9	10	13	20	4	9
Lake County	5,395	8	7	9	1	10	5	2	6	6	27	13	4	3
St. Louis County	94,402	4	7	7	2	12	6	2	5	6	31	11	4	5
Study Area	**102,538**	**4**	**7**	**7**	**2**	**12**	**5**	**2**	**5**	**6**	**30**	**11**	**4**	**5**
Aurora	641	15	14	8	2	8	9	1	5	4	25	8	0	1
Babbitt	544	17	5	7	2	11	4	1	6	6	19	12	6	5
Biwabik	445	15	5	4	2	16	4	1	3	3	35	10	2	1
Bois Forte Reservation	240	5	8	5	1	4	6	0	1	3	16	35	2	14
Duluth	42,629	1	5	6	2	12	5	2	5	7	35	12	4	4
Ely	1,617	6	5	3	1	12	1	1	5	13	20	19	8	6
Fond du Lac Reservation	1,662	1	7	12	4	11	3	1	4	4	21	16	3	12
Grand Portage Reservation	218	0	5	2	1	19	2	0	14	6	15	25	2	9
Hibbing	6,531	7	6	9	2	13	7	1	4	6	27	9	6	4
Hoyt Lakes	834	13	8	12	0	14	9	0	6	8	21	5	3	3
Soudan	256	7	8	12	2	4	5	0	8	1	23	26	0	5
Tower	178	1	2	8	2	8	0	0	7	1	19	33	12	7
Virginia	3,413	6	8	7	1	12	5	2	7	7	28	8	4	5

Source: U.S. Census Bureau 2010a.

Note:
Percent totals may be greater or less than 100% due to rounding.

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Income

Table 4.2.10-12 shows the average income earned by employees in each major NAICS industry. Mining and utilities pay very high average wages statewide and in St. Louis County. However, wages paid to health care and social services workers account for more than one-quarter of the total wages paid by private companies in St. Louis County and for more than 16 percent of statewide wages.

4.2.10.1.3 Public Finance

Sales and use tax revenues from study area counties by all industries and the mining industry are summarized in Table 4.2.10-13. This table illustrates the relative sales and use tax contribution from the mining industry in the state.

The mining and processing of base and precious metals in the state are not currently subject to production tax. However, mining is subject to the following taxes (MDR 2011):

- Net proceeds tax: tax proceeds are distributed to the state general fund if mined resources do not fall within the taconite assistance area. Taxes paid on mined resources within the taconite assistance area (which includes the NorthMet Project area) are distributed as follows: 5 percent to the city or town where mined, 10 percent to the Municipal Aid Account, 10 percent to the school district, 20 percent to the Regular School Fund, 20 percent to Taconite Property Tax Relief, 5 percent to IRRRB, 5 percent to the Douglas J. Johnson Economic Protection Trust Fund, and 5 percent to the Taconite Environmental Protection Fund.
- Occupation tax: 2.45 percent of the taxable amount (typically the mine value), as determined by the Minnesota Department of Revenue. Revenue generated through the occupation tax is credited to the general fund, with 10 percent designated for the University of Minnesota, 40 percent designated for public elementary and secondary schools, and 50 percent remaining in the state's general fund.
- Sales and use tax: 6.875 percent of all purchases that do not qualify for an exemption.
- Withholding tax on royalty payments: 6.25 percent of royalty payment.

Ad valorem tax is established and collected by the counties, local communities, and school districts according to Minnesota state law.

4.2.10.1.4 Housing

Table 4.2.10-14 illustrates the housing characteristics of the study area. Much of the overall vacancy rate reflects the large number of seasonal (vacation) homes in the region, particularly in Cook and Lake counties where nearly two-thirds of vacant housing units are for seasonal use. Excluding seasonal units, vacancy rates in the study area are somewhat higher than in the state as a whole, although vacancy rates in individual communities vary significantly. There are approximately 5,400 hotel rooms and 1,175 occupied berths and 225 vacant berths in mobile home parks in the study area (Northland Connection 2012). Hotels and mobile homes are often used by mine construction employees, especially those with short-term assignments. The study area has a slightly lower share of owner-occupied housing units than in the state. Household sizes are smaller in the study area than in the state as a whole. These data are consistent with trends (see Section 4.2.10.1.2) suggesting that the study area is becoming increasingly attractive to retirees, who tend to have higher home ownership rates and smaller household sizes than other segments of the population.

Table 4.2.10-12 Payroll ($1,000s) by Major NAICS Industry, 2009

	Minnesota		Cook County		Lake County		St. Louis County	
Industry	**Payroll**	**Avg. per Employee**	**Payroll**	**Avg. per Employee**	**Payroll**	**Avg. per Employee**	**Payroll**	**Avg. per Employee**
Forestry, fishing, hunting	$79,116	$32,135	D	na	$172	na	$4,723	$27,459
Mining, quarrying, oil/gas	$322,301	$68,531	D	na	D	na	$196,993	$62,518
Utilities	$1,085,613	$79,178	$5,043	$42,025	D	na	$73,916	$80,256
Construction	$5,558,534	$56,090	D	na	$2,959	$30,823	$179,640	$55,087
Manufacturing	$14,782,085	$48,022	$483	$53,667	$23,083	na	$187,373	$42,799
Wholesale trade	$8,320,168	$63,205	$6,647	$23,488	D	na	$96,299	$42,255
Retail trade	$6,773,100	$23,249	D	na	$7,672	$23,108	$265,991	$21,139
Transportation, warehousing	$2,938,953	$38,986	$2,589	$43,881	D	na	$73,216	$37,857
Information	$3,920,852	$61,172	$1,518	$42,167	$2,540	na	$82,475	$37,711
Finance and insurance	$10,454,638	$70,344	$804	na	$5,819	$32,508	$146,947	$40,204
Real estate	$1,335,591	$36,797	$796	na	$1,339	$15,940	$25,263	$24,841
Professional, sci., tech. svcs.	$8,121,631	$58,316	$611	$23,500	$1,172	na	$148,666	$45,478
Management	$9,246,827	$78,281	$989	$23,548	$972	$23,707	$59,195	$63,175
Admin., support, waste mgt.	$4,215,273	$34,017	D	na	D	na	$65,069	$20,258
Educational services	$1,661,448	$25,000	$6,027	$19,826	$11,497	na	$50,130	$21,242
Health care, social assistance	$16,303,572	$38,640	$11,675	$18,214	$1,447	$26,796	$822,689	$37,757
Arts, entertainment, rec.	$1,087,163	$27,488	$655	$14,239	$9,972	$16,428	$18,759	$15,364
Accommodation, food svcs.	$3,068,339	$14,396	D	na	$2,722	$15,644	$125,175	$13,448
Other svcs.	$2,898,411	$24,288	$-	na	$-	na	$79,563	$19,916
Industries not classified	$5,619	$19,376	$-	na	$-	na	$169	$33,800
Total	$102,179,234	$42,272	$52,668	$26,667	$86,786	$29,369	$2,702,251	$33,102

Source: U.S. Census Bureau 2009.

Notes:
Letter codes indicate suppression flags in the original data set—cases where exact data were withheld by the United States Census Bureau in order to protect company-confidential data. Flags indicate approximate employment, as follows:
A: 0-19 employees; B: 20-99 employees; C: 100-249 employees; E: 250-499 employees; F: 500-999 employees.
na = Not available

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Table 4.2.10-13 Select Sales and Use Tax Statistics ($1,000s)

	Total Tax (Sales and Use)					
	Cook County		Lake County		St. Louis County	
Year	All Industries	Metal Mining	All Industries	Metal Mining	All Industries	Metal Mining[2]
1995	$3,345	NR[1]	$4,318	NR	$91,008	NR
2000	$4,192	0	$5,390	0	$114,011	$4,150
2009	$5,897	0	$8,515	0	$158,227	$7,210

Source: MDR 2010.

Notes:
[1] NR: Not reported
[2] 2009 data reported as "Mining – All Other".

Table 4.2.10-14 Study Area Housing Unit Characteristics, 2010

Geography	Total HU	Occupied HU (%)	Owner-Occupied HU (%)	Renter-Occupied HU (%)	Vacancy Rate (%)	Vacancy Rate, Non-seasonal (%)	Average Household Size (persons)
Minnesota	2,347,201	89	65	24	11	6	2.48
Cook	5,839	43	32	11	57	5	2.05
Lake	7,681	63	51	12	37	6	2.21
St. Louis	103,058	82	59	24	18	6	2.25
Study Area	**116,578**	**79**	**57**	**22**	**21**	**6**	**2.24**
Aurora	887	88	68	20	12	9	2.09
Babbitt	818	86	74	13	14	9	2.07
Biwabik	543	86	63	24	14	10	2.03
Duluth	38,208	93	57	37	7	6	2.23
Ely	2,022	83	54	29	17	13	1.93
Hibbing	8,200	90	64	26	10	8	2.17
Hoyt Lakes	1,016	87	77	10	13	9	2.27
Soudan	244	84	75	9	16	8	2.18
Tower	331	80	54	26	20	10	1.89
Virginia	4,738	90	51	38	11	10	1.95
Bois Forte Reservation	451	65	46	20	35	5	2.97
Fond du Lac Reservation	1,729	89	66	23	11	3	2.72
Grand Portage Reservation	313	82	41	41	18	4	2.20

Source: U.S. Census Bureau 2010a.

Notes:
Percent totals may be greater or less than 100% due to rounding.
HU = Housing unit(s).

4.2.10.1.5 Public Services and Facilities

Water and Sewer

Table 4.2.10-15 summarizes the condition of public water and sewer facilities throughout the study area. All of the cities evaluated have public water and wastewater systems, with varying degrees of available capacity. Residents and businesses in unincorporated areas typically rely on individual wells and septic systems. Potable water for municipal systems comes from either groundwater or surface water (notably, Duluth obtains its drinking water from Lake Superior). Most of the public water and sewer infrastructure supporting the study area communities was constructed to accommodate larger populations than currently reside in the area (e.g., the 1980 and 1990 populations listed in Table 4.2.10-1).

Table 4.2.10-15 Water and Wastewater Capacity

	Water			Wastewater		
Geography	**Capacity (MGD)**[1]	**Average Demand (MGD)**	**System Issues/Upgrades**	**Capacity (MGD)**	**Average Demand (MGD)**	**System Issues/Upgrades**
Aurora	0.864	0.222	Study underway with Biwabik to identify new water source. Considering building a new facility for both.	0.900	0.200	$7 million upgrade in the last four years.
Babbitt	0.600	0.200	None	0.500	0.200	Consulting firm hired to look into upgrading or rebuilding a new wastewater plant.
Biwabik	0.430	0.128	Study underway with Aurora to identify new water source. Considering building a new facility for both.	0.220	0.160	None
Duluth	40	19	Water tower to go online mid-May 2012 adding 900,000 gallons to the 68 million storage capacity.	100	16	The city is upgrading or replacing two wastewater lift stations each year at an annual cost of $600,000 per year.
Ely	1	0.350	$350,000 rehab work every year.	1.5	0.400	$350,000 rehab work every year.
Hibbing	3.2	2.3	None	4.5	2	Wastewater inflow & infiltration concerns throughout the city; certain neighborhoods have wastewater backups during large rain events.
Hoyt Lakes	1.5	0.307	Minor upgrades to the water plant.	0.650	0.270	Began preliminary engineering for rebuilding wastewater facility.
Soudan/ Tower[2]	0.300	0.0900	Needs new water tower.	0.176	0.13	None
Virginia[3]	5	1.7	None	4.3	2	Starting project to expand wastewater plant and reduce mercury; projected completion 1st quarter 2013.

Source: Northland Connection 2012.

Notes:
1 MGD = million gallons per day.
2 Soudan and Tower share resources
3 Data reflect current wastewater system. Once wastewater upgrade is complete, capacity will increase to 9.9 mg/d and average demand will go up to 3.1 mg/d.

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Emergency Services

Table 4.2.10-16 illustrates the available public safety resources. Each county in the study area has its own sheriff's department, which provides law enforcement and other services for unincorporated areas. Municipalities provide their own police protection, except for Aurora, which contracts with the St. Louis County Sherriff's Office (SLCPD 2012) and Biwabik, which receives law enforcement from Gilbert (Northland Connection 2012). The St. Louis County Sheriff's Office also maintains countywide 911 service, coordinating police, fire, and emergency medical response. Similarly, each community maintains its own fire department, typically a volunteer department. The City of Babbitt fire department provides emergency response to the Northshore Mine, and has up-to-date equipment.

A variety of public and private ambulances provide emergency medical service for the study area. Ambulance service is integrated into some municipal fire departments (such as Babbitt, Duluth, Hibbing, and Virginia). Other municipalities either contract with nearby cities or with private ambulance services.

Table 4.2.10-16 Public Safety

Geography	Police Officers	Firefighters	EMS Ambulance Personnel
Aurora	5	22	7
Babbitt	4	35	25
Biwabik	7[(2)]	21	21
Duluth	152	125	48
Ely	8	32	27
Hibbing	30	23	19
Hoyt Lakes	6	21	23
Soudan/Tower[1]	1	15	19
Virginia	18	21[3]	21[3]

Source: Northland Connection 2012.

Notes:
1 Soudan and Tower share resources.
2 Biwabik receives law enforcement from Gilbert.
3 Firefighters are full-trained EMS and operate ambulance services from fire hall.

Medical Services

The study area communities are served by both medical clinics and hospital facilities. The closest medical facility to the NorthMet Project area is Essentia Health Northern Pines in Aurora. This 16-bed facility has Level IV trauma status, indicating that staff are able to stabilize patients for transport to more advanced trauma centers (Essentia 2012). Other nearby Level IV trauma centers are in Ely and Virginia, while the nearest advanced care (Level II) hospitals are Essentia Health St. Mary's Medical Center and St. Luke's Hospital, both in Duluth (MDH 2011).

Education

Table 4.2.10-17 shows the capacity and enrollment of public schools. As with other public services and facilities, each municipality maintains its own public school system, supplemented with county-run independent school systems. Most public schools in the region are designed to accommodate larger populations. Some jurisdictions, such as the Duluth school district, are choosing to close or repurpose school buildings.

Table 4.2.10-17 Capacity and Enrollment of Public Schools

Geography	Capacity	Enrollment	Facilities to be Upgraded, Replaced, Combined, or Closed
Aurora[1]	1,500	886	The district plans to replace boilers and resurface parking lots at their facilities.
Babbitt	1,200	348	None
Biwabik[1]	1,500	886	The district plans to replace boilers and resurface parking lots at their facilities.
Duluth	9,800	8,308	School district is downsizing and modernizing its facilities, resulting in one less high school, one less middle school, two less elementary schools, and one less K-8 facility.
Ely	1,775	542	None
Hibbing	2,680	2,319	None
Hoyt Lakes[1]	1500	886	The district plans to replace boilers and resurface parking lots at their facilities.
Tower/Soudan[2]	175	94	None
Virginia	1,623	1,623	Considering setting up portable classrooms for fall 2012; community is in the process of securing funding and support to either add or build new facilities.

Source: Northland Connection 2012.

Notes:
[1] These communities are part of the Mesabi School district.
[2] Soudan and Tower share resources.

The region is also served by a number of community and technical colleges (MNSCU 2012):

- **Mesabi Range Community and Technical College (Virginia and Eveleth)**: Offers 50 diploma, certification, or degree (A.A.) programs, with notable specialties in wind energy technology, and human services.
- **Vermilion Community College (Ely):** Offers 30 programs, many focused on environmental programs and outdoor careers, such as water quality science, outdoor therapeutic recreation, sports management, park ranger training.
- **Hibbing Community College:** Offers a mix of more than 40 programs ranging from traditional liberal arts to career-oriented programs.
- **Fond du Lac Tribal and Community College (Cloquet):** Offers nearly 40 programs, ranging from liberal arts and nursing to specialty programs in American Indian studies, geospatial technologies, environmental science, and clean energy technology.
- **Lake Superior College (Duluth):** Offers nearly 100 programs, with heavy emphasis on nursing and other medical specialties, along with a full range of liberal arts and professional training.

The study area is also home to two 4-year institutes of higher learning. These include the University of Minnesota Duluth, with nearly 12,000 enrolled undergraduate, graduate, and other students (University of Minnesota Duluth 2011); and the College of St. Scholastica in Duluth, with more than 4,000 enrolled students (CSS 2012).

4.2.10.1.6 Subsistence

There is no nationwide federal definition of subsistence, nor has the State of Minnesota developed a formal definition. Title VIII of the Alaska National Interest Lands Conservation Act (P.L. 96-487) defines subsistence for rural Alaska residents (regardless of whether they are Native American) as:

> the customary and traditional uses…of wild renewable resources for direct, personal, or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of non-edible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade.

This Alaskan definition is consistent with subsistence activities within the study area as well. For many study area residents, particularly members of Bois Forte, Fond du Lac, and Grand Portage, as well as other Native American bands, subsistence hunting, fishing, trapping, and gathering activities are a significant activity. Individuals participate in subsistence activities for numerous reasons, including food supply, personal income, and the continuance of cultural customs and traditions.

As part of the 1854 Treaty, the Lake Superior Chippewa retain the right to hunt, fish, and gather in the 1854 Ceded Territory, which can be viewed as a continuation of their traditional, subsistence-based economy.

A 2002 study of subsistence activities amongst the Bois Forte and Grand Portage Bands (Vogt 2004) demonstrates the wide variety of species and items collected as part of subsistence activities in the study area, including the following:

- fish: more than 25 species, with the most commonly harvested being walleye, northern pike, lake trout, and crappie;
- birds and mammals: more than 10 species, with the most commonly harvested being deer, grouse, moose, and duck; and
- plants: more than 12 species/items, with the most commonly harvested being wild rice, various berries, and maple sap/syrup.

Among the survey respondents, subsistence activity (including hunting, fishing, and plant gathering) accounted for approximately one meal per week. Subsistence activity typically occurs either on Native American reservations or within other parts of the 1854 Ceded Territory. Fishing and hunting occur throughout the year, although harvesting fish for consumption is more prevalent during warmer months, while harvesting land animals is more prevalent during colder months (Vogt 2004). Grand Portage's subsistence fish consumption averages 144 grams/day, five times higher than the MPCA assumed fish consumption rate of 30 grams/day. Fond du Lac's subsistence fish consumption is on average 60 grams/day, two times higher than the MPCA assumed fish consumption rate (MPCA 2012d). The effects of mercury bioaccumulation on subsistence activity are discussed in Section 5.2.10.2.6.

In addition to the survey results described above, Table 4.2.9-4 in Section 4.2.9 shows other animal and plant species that have historically been and/or could potentially be harvested in the 1854 Ceded Territory.

The 1854 Treaty Authority manages big game (moose, deer, and bear) hunting, as well as furbearer trapping (pine marten, fisher, otter, and bobcat) on behalf of the Bois Forte and Grand Portage bands, in accordance with a 1988 negotiated agreement with Minnesota. Under this agreement, big game harvests are limited. Harvests for all species (including big game and trapping) have generally declined since 1994 (Edwards 2012).

The Mine Site and Transportation and Utility Corridor fall partially within the state-defined moose harvest area, although no moose were harvested by the bands within approximately 20 miles of this location from 1994-2011. The majority of deer hunting and a portion of furbearer trapping occurred in St. Louis County during this time period (Edwards 2012).

4.2.11 Recreation and Visual Resources

This section describes the recreational facilities and activities that typically take place in the NorthMet Project area, as well as the surrounding Arrowhead region. Because recreation in this region is strongly tied to the aesthetic condition of the landscape, this section also describes the visual setting of the NorthMet Project area and surrounding land.

4.2.11.1 Mine Site

4.2.11.1.1 Recreational Facilities and Activities

Surface rights to the Mine Site and adjoining federal lands are held by the USFS, and the Mine Site is part of the Superior National Forest. Management of the physical, biological, and social resources of the Superior National Forest is set forth in the Forest Plan. Intended to ensure that ecosystems are capable of a sustainable flow of beneficial goods and services, the Forest Plan includes guidelines and standards for almost 20 activities and categories of resources within the Superior National Forest including recreation and scenic, or visual, resources.

Recreation opportunities in the Superior National Forest are managed within the framework of the Recreation Opportunity Spectrum (ROS). Using criteria that consider distance to roads, motorized lakes, and trails (i.e., lakes and trails where motorized transportation is permitted), this system includes five ROS classes, each of which prescribes a set of recreational settings, opportunities, and experiences. At one end of the ROS, areas designated “primitive” have little evidence of people and are difficult to access. At the other end of the ROS, “rural” areas are more accessible and provide developed facilities as well as opportunities to interact with other recreationists.

Most of the Mine Site is within the Semi-Primitive Motorized ROS, with a small portion falling within the Roaded Natural ROS. Both ROS designations indicate areas where motor vehicles may be permitted, where interactions between visitors are intended to be infrequent, but where human activity such as timber harvesting may be visible.

While this designation permits recreational activity, the Mine Site is entirely surrounded by private, restricted property, roads, and railroads. In particular, the Northshore Mine borders the Mine Site to the north, the restricted-access Plant Site borders the Mine Site to the west, and the Transportation and Utility Corridor isolates the Mine Site from adjacent portions of the Superior National Forest to the south. Some portions of the Mine Site are contiguous with Superior National Forest and state-owned public land, notably the eastern boundary of the Mine Site. However, these public lands are also encircled by restricted property, roads, and railroads. The Mine Site is accessible by water via the Partridge River, but there is no public land access to, and no practical opportunity to engage in recreational activity at, the Mine Site.

The region surrounding the Mine Site and adjoining federal lands is a popular and highly valued destination for recreation. Recreational activities that typically occur within 25 miles of the federal lands include (but are not limited to):

- Boating and camping in the BWCAW (approximately 20 miles north of the federal lands) and other local, state, and federal lands.
- Hunting, fishing (particularly in the Embarrass and Partridge Rivers), and hiking.

- Year-round recreation, including downhill skiing at the Giants Ridge Golf & Ski Resort (approximately 13 miles east of the Mine Site and eight miles from the Plant Site), cross-country skiing, snowmobiling, mountain biking, hiking, and golf.
- Biking, hiking, and roller-blading on the Mesabi Trail, which spans 70 miles across the Iron Range.

These activities typically do not occur in the immediate vicinity of the Mine Site, Plant Site, and Transportation and Utility Corridor. For example, the nearest designated USFS campgrounds are Cadotte Lake, 16 miles southeast, and Birch Lake, 12 miles north. There are two back-country camping facilities on Stone Lake and Big Lake, approximately 8 miles southeast of the Mine Site. Additionally, there are six backcountry camping facilities on Birch Lake approximately 8 mile north of the mine site. The nearest designated boat launch (Colby Lake) is 5 miles away, and there are also two boat access points on Birch lake approximately 7 miles north of the mine site. The nearest designated USFS trail (including the St. Louis River and Bird Lake Trails) is the Stony Spur ATV/snowmobile trail which is 5 miles from the mine site. The USFS Birch Plantation ski trails are approximately 6 miles from the mine site. The USDA Visitor Use report for the Superior National Forest indicates that the forest received 1.1 million national visits in 2011, with roughly 76 percent of those visits being for recreational purposes. The Visitor Use report defines a visit as "the entry of one person upon a national forest to participate in recreation activities for an unspecified period of time" (USFS 2012). It is important to note that the Visitor Use Report does not contain information about specific types of visitation to specific parts of the Superior National Forest.

4.2.11.1.2 Visual Resources

The NorthMet Project area lies within and adjacent to Superior National Forest, which provides over 3 million acres of rich and varied visual resources (USFS 2007c). The visual character of the NorthMet Project area varies from upland forests and wetlands to developed industrial areas. There are several active, closed, and reclaimed mines near the NorthMet Project area, and evidence of past and ongoing mining (such as reclaimed or abandoned waste rock piles) is present in many parts of the area surrounding the Mine Site.

The Mine Site and the adjoining federal lands are located along the south flank of the Mesabi Iron Range, immediately south of the Giants Range formation (see Figure 1.1-1). The Iron Range supports numerous active mining operations, including the Northshore taconite mine located north of the Mine Site. The Mine Site is relatively flat, with elevations between 1,570 ft and 1,600 ft amsl. The Giants Range formation is the dominant landscape feature in the area. It rises steeply to an average elevation of approximately 1,700 ft amsl (with some elevations above 1,800 ft amsl) along the ridgeline (approximately 1 to 2 miles from the Mine Site), and declines approximately 150 to 200 ft on its northern flank. The One Hundred Mile Swamp, Partridge River, and the Northshore Mine are to the north between the Mine Site and the Giants Range.

The Mine Site is surrounded by wetlands (including the One Hundred Mile Swamp) and mixed deciduous and coniferous upland forests to the east, south, and west. The average canopy height in the upland forest is 30 to 60 ft with occasional white pine and white spruce in excess of 70 ft. In the wetland areas, the coniferous canopy is approximately 30 to 40 ft while the deciduous growth is less than 20 ft tall. The Partridge River makes a horseshoe bend around the north, east, and south sides of the Mine Site.

The nearest potential visual receptors to the Mine Site—places where the public may be able to see the Mine Site on a regular basis, such as homes or public roads with open views—are illustrated on Figure 4.2.11-1. The ability to view the Mine Site is highly dependent on the topography and foliage present at a viewer's specific location, but views of the Mine Site may be present at:

- clusters of rural homes, approximately 7 miles to the south near the unincorporated village of Skibo;
- the City of Hoyt Lakes, approximately 9 miles to the southwest;
- along Lake County Road 2 within the incorporated limits of the City of Babbitt, approximately 12 miles to the east; and
- the Skibo Vista Scenic Overlook, along Lake County Highway 15, approximately 12 miles south (see Figure 4.2.11-2).

The Mine Site may also be visible from Forest Road 112, which passes less than 2 miles from the Mine Site; however, traffic on this road is likely to be low, given the absence of population centers or significant recreational sites along the road.

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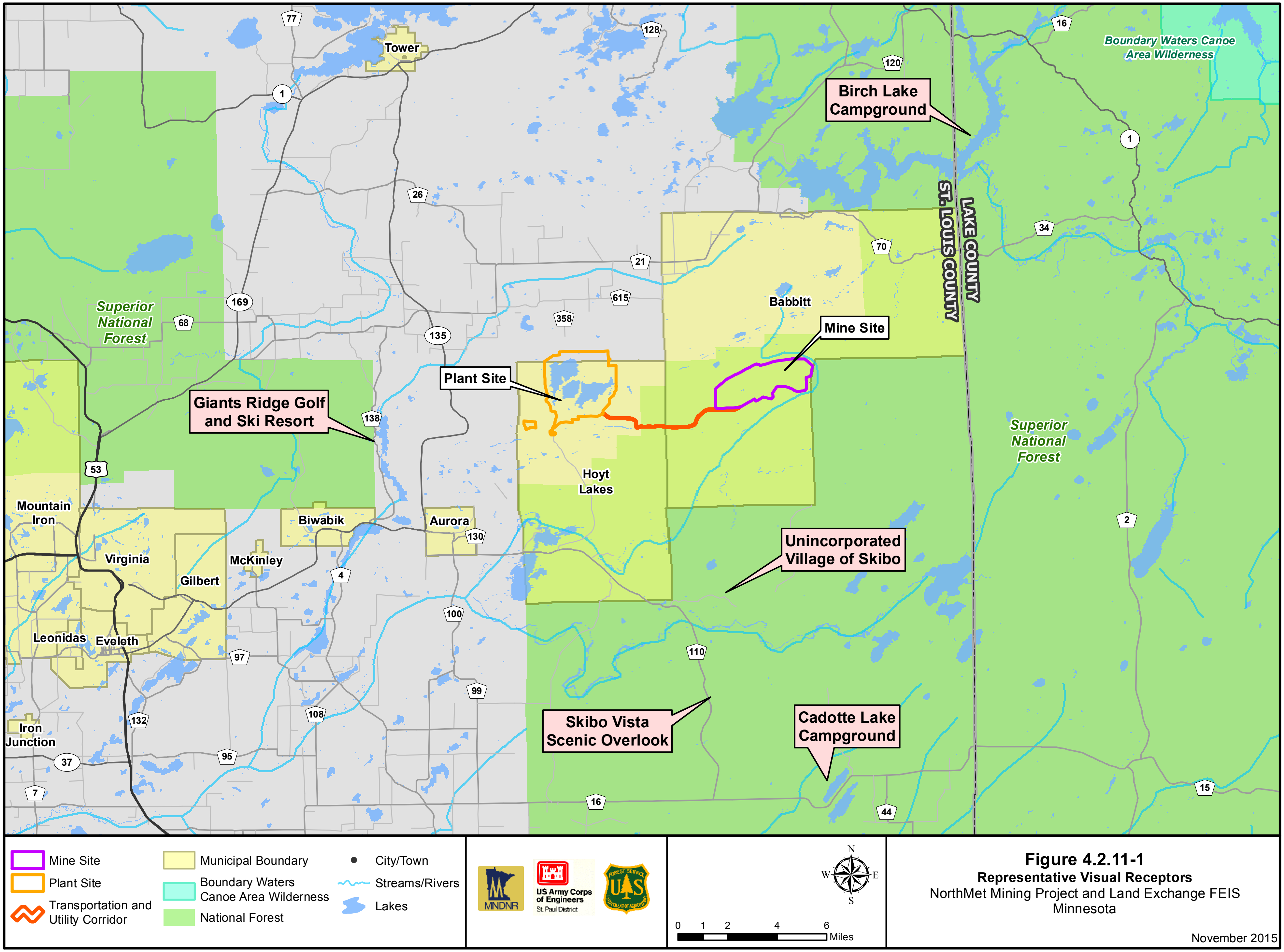

Figure 4.2.11-1
Representative Visual Receptors
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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Figure 4.2.11-2
Mine Site and Plant Site, as Viewed from Skibo Vista Scenic Overlook
NorthMet Mining Project and Land Exchange FEIS
Minnesota
November 2015

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The USFS uses the Scenery Management System to identify desired visual conditions within National Forests. The Scenery Management System uses Scenic Integrity Objectives (SIOs) to express these desired conditions. The SIO designations for Superior National Forest are defined in the Forest Plan. SIO definitions are as follows (based on USFS 1995):

- Low SIO: The landscape appears moderately altered, and non-natural landscape features may begin to dominate.
- Moderate SIO: The landscape appears slightly altered. Non-natural features or activities may be apparent, but do not dominate.
- High SIO: The landscape appears unaltered, essentially in a "natural" state, with minimal evidence of non-natural features or activities.

The Mine Site and adjoining federal lands are designated by the USFS as areas of Low SIO. Within this designation, the landscape appears altered, and non-natural landscape features may begin to dominate. There are no major recreational trails within the portion of Superior National Forest adjacent to the Mine Site that would expose recreational users to views of the mine on a regular basis.

Native American tribal members exercise rights to hunt, fish, and gather on Superior National Forest lands, including lands near the Mine Site. The frequency with which tribal members exercise these rights in portions of Superior National Forest with views of the Mine Site is not known; however, as described in Sections 4.2.9 and 5.2.9, there are several cultural resources and locations adjacent to or potentially within sight of the Mine Site (as well as the Plant Site and Transportation and Utility Corridor), such as the Spring Lake Mine, Sugarbush, Partridge River Segment of the BBLV Trail, and *Mesabe Widjiu*. Note that these sites are not depicted in the figures in this section due to sensitivity regarding cultural resources and locations.

4.2.11.2 Transportation and Utility Corridor

4.2.11.2.1 Recreational Facilities and Activities

The Transportation and Utility Corridor is within an area with a Roaded Natural ROS designation. This designation indicates areas that are mostly natural in appearance (with some modification), and where evidence of other users and interactions between users are somewhat frequent. The Transportation and Utility Corridor is owned or leased by PolyMet, and is not open to the public. Entry points are gated and/or guarded, and crossing the corridor is prohibited. No recreational activity is permitted along the corridor.

4.2.11.2.2 Visual Resources

The Transportation and Utility Corridor follows Dunka Road between the Mine Site and the Plant Site and includes existing road and rail lines. Viewpoints for the corridor are the same as those for the Mine Site and Plant Site. The portions of Superior National Forest near the Transportation and Utility Corridor are within the Low SIO designation. As described in Section 4.2.11.1, users of culturally important locations may have views of the Transportation and Utility Corridor.

4.2.11.3 Plant Site

4.2.11.3.1 Recreational Facilities and Activities

The Plant Site is located at the former LTVSMC processing plant. It is owned by PolyMet, and it is not open to the public. Entry roads are gated and/or guarded. No recreational activity is permitted at this site. Because the Plant Site is not in Superior National Forest, it does not have an ROS designation.

4.2.11.3.2 Visual Resources

Topography at the Plant Site rises from approximately 1,550 ft amsl near the railroad at the south end of the plant to approximately 1,780 ft amsl at the north end adjacent to the Tailings Basin (on the northern flank of the Giants Range). The inactive LTVSMC industrial processing buildings—including crushing, grinding, concentrating, and maintenance and pellet storage/rail loading facilities—were constructed in the 1950s, and dominate the visual landscape at the Plant Site. The nearest potential visual receptors are residences approximately 3.5 miles north of the Plant Site on County Road 358 and County Road 615. These rural residences are outside the incorporated limits of the cities of Babbitt and Hoyt Lakes. The City of Hoyt Lakes is the next closest visual receptor and is approximately 5 miles south of the Plant Site. The Tailings Basin and some buildings at the Plant Site would likely be visible from the ski slopes at the Giants Ridge Golf and Ski Resort, approximately 8 miles west-southwest of the Plant Site.

The existing LTVSMC Tailings Basin is located to the north of the buildings, with legacy mine pits and waste rock stockpile sites to the south and east and a railroad to the west. Second Creek and its headwater wetlands also border the site immediately to the south. The Tailings Basin is surrounded by wetlands and low, forested (mixed coniferous and deciduous) uplands to the north, east, and west. The closest residences to the Tailings Basin are along Beckman Road and Salo Road, approximately 1.5 and 2.5 miles north of the Tailings Basin, respectively. Some of the culturally important locations described above and in Section 4.2.9 are closer: the Sugarbush is approximately 0.5 mile from the Plant Site, the *Mesabe Widjiu* intersects the Plant Site and is less than 2 miles from the Mine Site, and portions of the Partridge River Segment of the BBLV Trail cross both the Mine Site and Plant Site. As described above for the Mine Site, users of these culturally important locations may have views of the Plant Site.

Because the Plant Site is not in Superior National Forest, it does not have an SIO designation.

Figure 4.2.11-1 shows the Plant Site in relation to the Mine Site, from the Skibo Vista Scenic Overlook, approximately 13 miles south of the Plant Site.

4.2.12 Wilderness and Other Special Designation Areas

For this analysis, the term "wilderness" is defined by the Wilderness Act of 1964 (Public Law 88-577) (16 USC §§ 1131-1136). In its planning, management, and monitoring, the USFS identifies four characteristics of wilderness, as defined in the Wilderness Act:

- Untrammeled: The Wilderness Act states that wilderness "[is] an area where the earth and its community of life are untrammeled by man," and "generally appears to have been affected primarily by the forces of nature." This quality monitors human activities that directly control or manipulate the components or processes of ecological systems inside wilderness.
- Undeveloped: The Wilderness Act states that wilderness is "an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation," "where man himself is a visitor who does not remain" and "with the imprint of man's work substantially unnoticeable." This quality monitors the presence of structures, construction, habitations, and other evidence of modern human presence or occupation.
- Natural: The Wilderness Act states that wilderness is "protected and managed so as to preserve its natural conditions." This quality monitors both intended and unintended effects on ecological systems inside a wilderness. The natural quality of wilderness character may potentially be affected by actions located outside the wilderness through effects on water quality and air quality.
- Solitude or a Primitive and Unconfined Type of Recreation: The Wilderness Act states that wilderness has "outstanding opportunities for solitude or a primitive and unconfined type of recreation." This quality monitors conditions that affect the opportunity for people to experience solitude or primitive, unconfined recreation in a wilderness setting. An indicator of this quality is remoteness from occupied and modified areas outside the wilderness, such as noise or visual effects.

Other federal special designation areas are identified by Presidential Designation, Congressional Designation, or Administrative Designation, and define lands that are considered to have remarkable ecological, paleontological, historic, scenic, recreational, geologic, or fish and wildlife value. They include wilderness areas, wilderness study areas, RNAs and cRNAs, national scenic or historic trails, wild or scenic rivers, UBAs, national natural landmarks, national historic landmarks, and national monuments, among others. These special designation areas are managed by federal land management agencies such as the BLM, USFS, National Park Service, and USFWS. The state similarly designates areas for special management due to their wilderness value.

None of the elements of the NorthMet Project Proposed Action are located within or adjacent to any wilderness areas. Similarly there are no special designation areas within or adjacent to the Mine Site, Plant Site, or Transportation and Utility Corridor. While recreation facilities such as parks are listed in this section, recreational use of those facilities is described in Section 4.2.11.

4.2.12.1 Federally Managed Areas

This section discusses federally managed wilderness and special designation areas that are close enough to the NorthMet Project area that they may be affected by activities related to the

NorthMet Project Proposed Action. Isle Royale National Park is outside of the study area for evaluation of Wilderness and Other Special Designation Areas; however, the visibility analyses in Section 5.2.7.2.2 do include Isle Royale National Park.

4.2.12.1.1 Wilderness Areas

The NorthMet Project area is approximately 20 miles south of the BWCAW (see Figure 4.2.12-1). Portions of the BWCAW were formally designated as a wilderness area in 1964 under the Wilderness Act. This wilderness area was further expanded and given its current name in 1978 under Public Law 95-495, and now encompasses more than 1 million acres along the United States' international boundary with Canada. The BWCAW is managed by the USFS as part of the larger Superior National Forest. It attracts more than 250,000 visitors annually and is used year-round for camping, hiking, fishing, canoeing, and hunting. Motorized vehicle use is limited. Activity and access are controlled by use permits managed by the USFS (USFS 2004c).

The BWCAW contains several hundred miles of streams and approximately 1,175 lakes that vary in size from 10 to 10,000 acres. Together, there are about 190,000 acres of open water or 20 percent of the surface area of the BWCAW that provides opportunities for long-distance travel by watercraft. The BWCAW is the only large lakeland wilderness in the National Wilderness Preservation System (USHR 1978).

The wilderness has approximately 80 entry points that provide access to 1,200 miles of designated canoe routes, 18 hiking trails, and nearly 2,200 campsites. There are numerous cultural resources in the BWCAW including camp sites, villages, wild ricing sites, cemetery areas, pictographs, and sites of spiritual and traditional importance. The wilderness also contains evidence of a number of historic European and early Native American activities.

The same 1978 law that created the BWCAW also designated the BWCAW as a Mining Protection Area. This designation prohibits exploration, lease, and exploitation of minerals in the wilderness, and the prohibition of mineral exploration or exploitation on property owned by the United States if that activity could materially change the wilderness characteristics of the BWCAW (USHR 1978).

Voyageurs National Park is adjacent to the BWCAW and is located approximately 50 miles northwest of the NorthMet Project area (see Figure 4.2.12-1). The National Park Service manages nearly 127,500 acres of park lands designated for wilderness study. The BWCAW and Canada's Quetico Provincial Park, which is managed as a wilderness park, are contiguous along the international boundary. Together, these three areas represent 2.39 million acres of managed wilderness area.

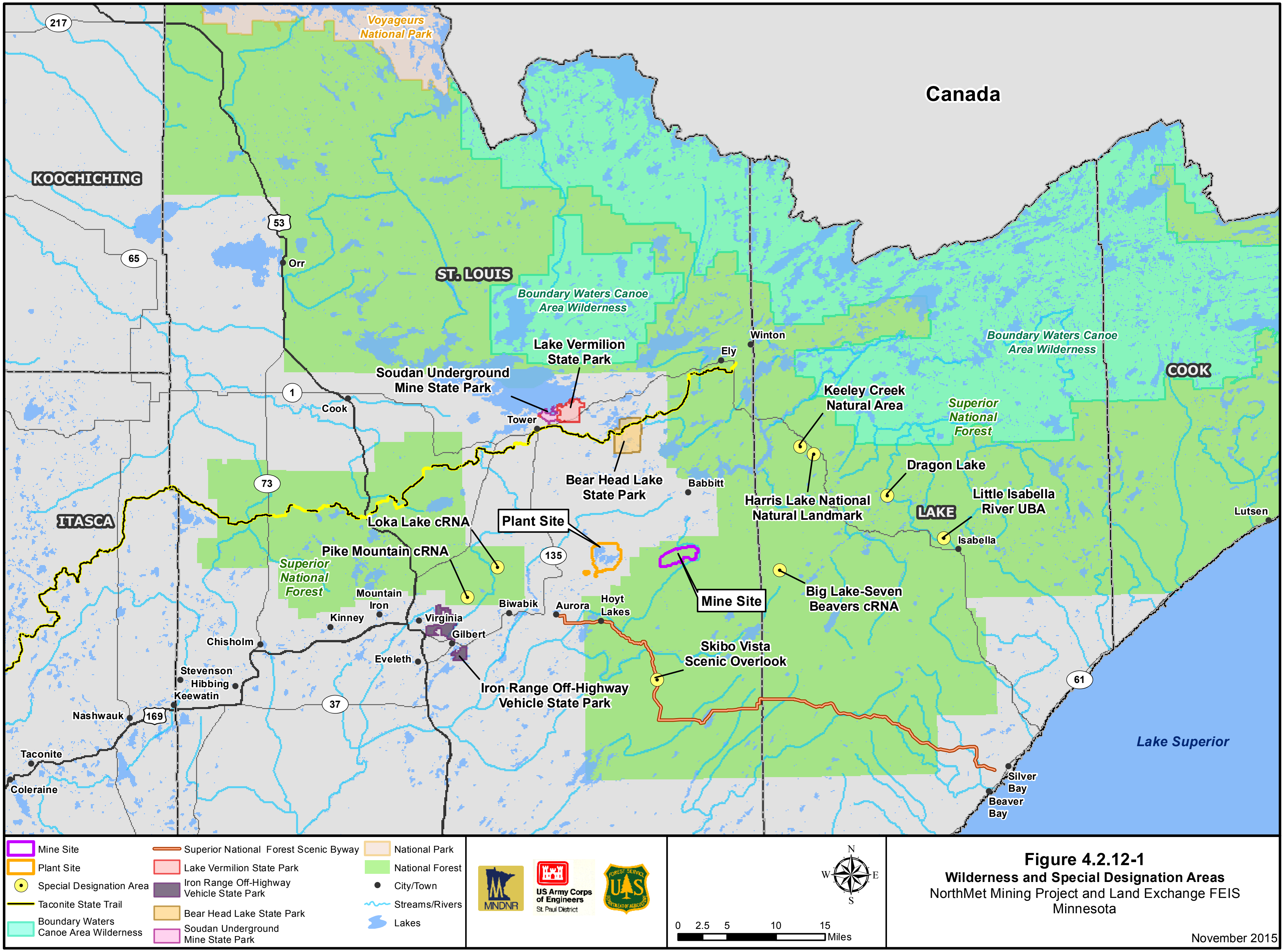

Figure 4.2.12-1
Wilderness and Special Designation Areas
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4.2.12.1.2 Established and Candidate Research Natural Areas

The Forest Service designates and manages RNAs and cRNAs for the purpose of preserving and maintaining areas for ecological research, observation, genetic conservation, monitoring, and educational activities (USFS 2004b). The RNAs may serve as baseline or reference areas for comparison to other similar ecosystems that are subject to a wider range of management activities. They also provide opportunities for low-impact activities designed to educate people about ecological processes. No recreation facilities are provided. Dispersed recreation use occurs but is generally not encouraged. The cRNAs are managed in similar fashion to the RNAs, with the exception that semi-primitive, non-motorized recreation is permitted.

Three RNAs are within 25 miles of the NorthMet Project area: the Big Lake – Seven Beavers cRNA, the Keeley Creek RNA, and the Dragon Lake cRNA.

The Big Lake – Seven Beavers Area includes an excellent representation of a variety of characteristic upland and lowland plant communities, dominated by wetland communities including lowland black spruce, lowland cedar, shrub swamp, and bog, connected to Sand Lake Peatland SNA (managed by the MDNR). The 5,599 acres of the cRNA are located approximately 12 miles east of the NorthMet Project area (USFS 2011h) (see Figure 4.2.12-1). This cRNA (and adjacent Sand Lake Peatland SNA) is located within the St Louis River Watershed headwaters, an area of ecological significance. Due to high biodiversity, low disturbance, and the size and complexity of the peatlands present on the site, it is considered a blueprint for natural resource management in the Laurentian Uplands subsection.

Keeley Creek Natural Area, located within the Superior National Forest in Stony River Township, approximately 25 miles northeast of the NorthMet Project area (see Figure 4.2.12-1), comprises 640 acres designated as an RNA within a larger 1,180-acre area designated as a national natural landmark. The Keeley Creek area contains a large tract of undisturbed mixed pine and black spruce forest with rare mature jack pine stands and significant upland bogs (USFS 2011h).

Dragon Lake is located approximately 25 miles northeast of the NorthMet Project area (see Figure 4.2.12-1). The cRNA comprises 2,075 acres of old growth red pine, upland and lowland black spruce, wetland bog, and wetland shrub swamp communities, as well as former Isabella pinery (USFS 2011h).

4.2.12.1.3 Unique Biological Areas

UBAs are designated by the USFS for their outstanding biological and other special values and managed within the USFS land and natural resource management plans. The common thread to these areas is that they exhibit plant communities, associations, and/or individual species of particular interest. UBAs are primarily managed for interpretive purposes. None are suitable for timber management. The Dry Mesic Jack Pine/Black Spruce and Lowland Conifer Landscape Ecosystems dominate this area in the Superior National Forest. UBAs are protected from actual or potential damage due to public use. Dispersed recreation use may occur, but is generally discouraged, and may be limited to bird watching, orienteering, fishing, hunting, berry picking, plant identification, and wildlife viewing (USFS 2004b).

UBAs within the 25-mile vicinity of the NorthMet Project area include the Little Isabella River UBA (approximately 25 miles east of the NorthMet Project area) and the Harris Lake National Natural Landmark (approximately 20 miles northeast of the NorthMet Project area) (USFS

2004b) (see Figure 4.2.12-1). National Natural Landmark sites are designated by the Secretary of the Interior as sites that contain outstanding biological and geological resources, based on their outstanding condition, illustrative value, rarity, diversity, and value to science and education.

4.2.12.1.4 National Historic Landmark

National Historic Landmarks are nationally significant places designated by the Secretary of the Interior as possessing exceptional value or quality in illustrating or interpreting US heritage. The Soudan Iron Mine has been designated as a National Historic Landmark. It is known as the state's oldest and deepest iron mine and now hosts the Soudan Underground Laboratory. It resides within the Soudan Underground Mine State Park, located approximately 18 miles northwest of the NorthMet Project area, near Tower, on the southern shore of Lake Vermilion (see Figure 4.2.12-1). The park comprises approximately 1,300 acres and receives more than 33,000 visitors annually (MDNR 2011m).

4.2.12.1.5 National Recreation Trail

National Recreation Trails are designated by the Secretary of Interior or the Secretary of Agriculture to recognize exemplary trails of local and regional significance. The Taconite State Trail is designated as a National Recreation Trail and managed by the MDNR. Running from Grand Rapids to the Arrowhead State Trail, the Taconite State Trail is 165 miles long. A segment of the trail is 15 to 17 miles north of the NorthMet Project area, running from the City of Ely westward to Tower (see Figure 4.2.12-1). Spur trails run south from this segment into the City of Babbitt, and then east and west. The trail provides year-round opportunities for hiking, biking, snowmobiling, in-line skating, and other recreational uses (MDNR 2011n).

4.2.12.2 State-Managed Areas

Like the federal government, the State of Minnesota also designates and/or manages for wilderness values a number of areas.

4.2.12.2.1 Boundary Waters Canoe Area Wilderness

In 2003, Minnesota designated 18,000 acres of state-owned lands within the BWCAW as state wilderness. These are state forest lands that are described as an inholding within the federally designated wilderness. The definition of wilderness used by the state is similar to that set forth in the federal Wilderness Act. Legislation passed in 1975 established the state's wilderness program. *Minnesota Statues* 2006, Chapter 86A.05, subdivision 6 contains management guidelines for wilderness areas. However, the state lands now designated as state wilderness are using the management directions of the larger BWCAW and there is no state wilderness management plan for the area (Propst and Dawson 2008).

4.2.12.2.2 Scenic Byway

Minnesota Scenic Byways are roads that feature many of Minnesota's finest cultural, historic, natural, recreational, archaeological, and cultural locations and landscapes. The Superior National Forest Scenic Byway (Forest Highway 11) is a 54-mile long scenic roadway that runs from Aurora to Silver Bay, with the closest segment approximately 9 miles southeast of the NorthMet Project area along County Route 110 (see Figure 4.2.12-1). It is designated as a scenic byway by the State of Minnesota, but is not specifically managed for wilderness values. The majority of the Byway runs through the Superior National Forest, offering access to hiking trails, historic sites, and the Superior National Forest itself. A key feature of the Byway is the opportunity it provides travelers to views of 250-year-old stands of white pine (US DOT 2011). Skibo Vista Scenic Overlook is one of the other key features along the Superior National Forest Scenic Byway. See Section 4.2.11 for further information about visual resources at the Skibo Vista Scenic Overlook.

4.2.12.2.3 State Parks

Soudan Underground Mine State Park is located 18 miles northwest (see Figure 4.2.12-1) of the NorthMet Project area and is home to Minnesota's oldest iron ore mine. The park covers 1,322 acres and has 5 miles of hiking trails. The park is located on a ridge on the south shore of Lake Vermilion and offers a combination of recreational opportunities, including picnicking, hiking, snowmobiling, and tours of a former iron ore mine. There are stands of white and Norway pine—mixed with some balsam, aspen, and birch—that cover the upland areas. The lowlands are dominated by white cedar interspersed with balsam, tamarack, black spruce, ash, and muskeg (MDNR 2011m).

Lake Vermilion State Park is 16 miles northwest of the NorthMet Project area (see Figure 4.2.12-1), on the eastern shores of Lake Vermilion, adjacent to Soudan Underground Mine State Park. Lake Vermilion is just south of the Superior National Forest and BWCAW. The park is Minnesota's newest state park, open since 2010 for recreation opportunities such as hiking, snowshoeing, snowmobiling, and geocaching. It is the first major state park built in Minnesota in more than 30 years. Construction is underway for boat docks, fishing platforms, picnic shelters, roads, parking areas, and a paved bike route that will connect to the Mesabi Trail (MDNR 2012f).

Bear Head Lake State Park, which covers 5,685 acres, is located 11 miles north of the NorthMet Project area, just south of the BWCAW (see Figure 4.2.12-1). The woods are made up of red and white pine, spruce, paper birch, and fir on the highlands and tamarack, black spruce, and white cedar on the lowlands. Small, clear trout lakes similar to those found in the BWCAW provide recreational opportunities such as fishing, swimming, and boating. The park also offers 17 miles of hiking trails, campgrounds, cross-country skiing, snowmobiling, and snowshoeing (MDNR 2012a).

Iron Range Off-Highway Vehicle State Park is located 17 miles southwest of the NorthMet Project area in Gilbert, Minnesota (see Figure 4.2.12-1). The park offers 36 miles of off-highway vehicle trails over 4,064 acres (MDNR 2012b).

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4.2.13 Hazardous Materials

A hazardous material, as defined by the Institute of Hazardous Materials Management (IHMM 2012), is any biological, chemical, or physical item or agent which has the potential to cause harm to humans, animals, or the environment. Categories of hazardous materials include, but are not limited to, explosives, flammables, oxidizers, poisons, irritants, and corrosives. At the federal level, management, handling, and transportation of these materials are regulated by laws and regulations administered by the USEPA, Occupational Safety and Health Administration (OSHA), and DOT, each with its own specific definition of hazardous material. The State of Minnesota also has regulations related to hazardous materials.

In addition, wastes generated from process operations can be classified as hazardous. Minnesota Statutes define a hazardous waste as any refuse, sludge, or other waste material or combinations of refuse, sludge, or other waste materials in solid, semi-solid, liquid, or contained gaseous form, which, because of quantity, concentration, or chemical, physical, or infectious characteristics, may cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness. A waste can also be determined to be hazardous if it poses a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed, or otherwise managed. Hazardous waste does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954, as amended (*Minnesota Statute* 116.06 Subdivision 11). As with hazardous materials, hazardous wastes are subject to state and federal management, transportation, and disposal regulations. Issues relating to the presence of hazardous materials or waste may include the accidental release of these materials during transportation, storage, handling, and/or use and any resulting potential effects on the environment.

There are no current mining or other operations or activities at either the Mine Site or Plant Site that involve the use of hazardous materials. As discussed in Section 4.2.1, there are AOCs associated with contamination by hazardous materials from the former LTVSMC mining operations.

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4.2.14 Geotechnical Stability

This section describes the existing geotechnical conditions for the proposed sites for the material storage facilities proposed as part of the NorthMet Project Proposed Action: the waste rock stockpiles, the Tailings Basin, and the Hydrometallurgical Residue Facility.

The waste rock stockpiles would be constructed on undisturbed highland and lowland areas at the Mine Site that consist of varying layers (thicknesses and material types) of glacial till and surficial peat. The Tailings Basin constructed as part of the NorthMet Project Proposed Action would be located on top of a portion of the existing LTVSMC Tailings Basin and would extend onto the adjacent undisturbed ground. Geotechnical conditions are generally similar along the length of the LTVSMC Tailings Basin dams, with varying layers of coarse tailings, fine tailings, and slimes. The Hydrometallurgical Residue Facility would be constructed partially on top of the existing LTVSMC Emergency Basin and would extend onto the adjacent undisturbed ground. The characteristics and design of the proposed material storage facilities are discussed in Chapter 3.0, while the rationale of the design—including consideration for design criteria, factors of safety, and modeling of geotechnical stability of the existing and proposed features—is discussed in Chapter 5.0. Further information on the geology and hydrogeology associated with the structures is provided in Section 4.2.2.

4.2.14.1 Waste Rock Stockpiles

4.2.14.1.1 Location and Descriptive Overview

The waste rock stockpiles would be located at the Mine Site, an undeveloped site currently affected only by logging and exploration drilling activities.

The locations of the proposed stockpiles are shown in Figure 4.2.14-1. The acreages for the stockpiles would be as follows:

- The permanent Category 1 Stockpile would occupy 526 acres to the north of the West Pit;
- The temporary Category 2/3 Stockpile would occupy 180 acres to the south east of the East Pit;
- The temporary Category 4 Stockpile would occupy 57 acres above the Central Pit (it would be removed and placed into the East Pit prior to mining at the Central Pit); and
- The temporary Ore Surge Pile would occupy 32 acres to the south of the East Pit and west of the Category 2/3 Stockpile.

In addition to the stockpiles listed above, the temporary Overburden Storage and Laydown Area would occupy 31 acres to the southeast of the West Pit.

There are no existing mining facilities or constructed geotechnical features that are at risk of geotechnical instability at the proposed stockpile locations.

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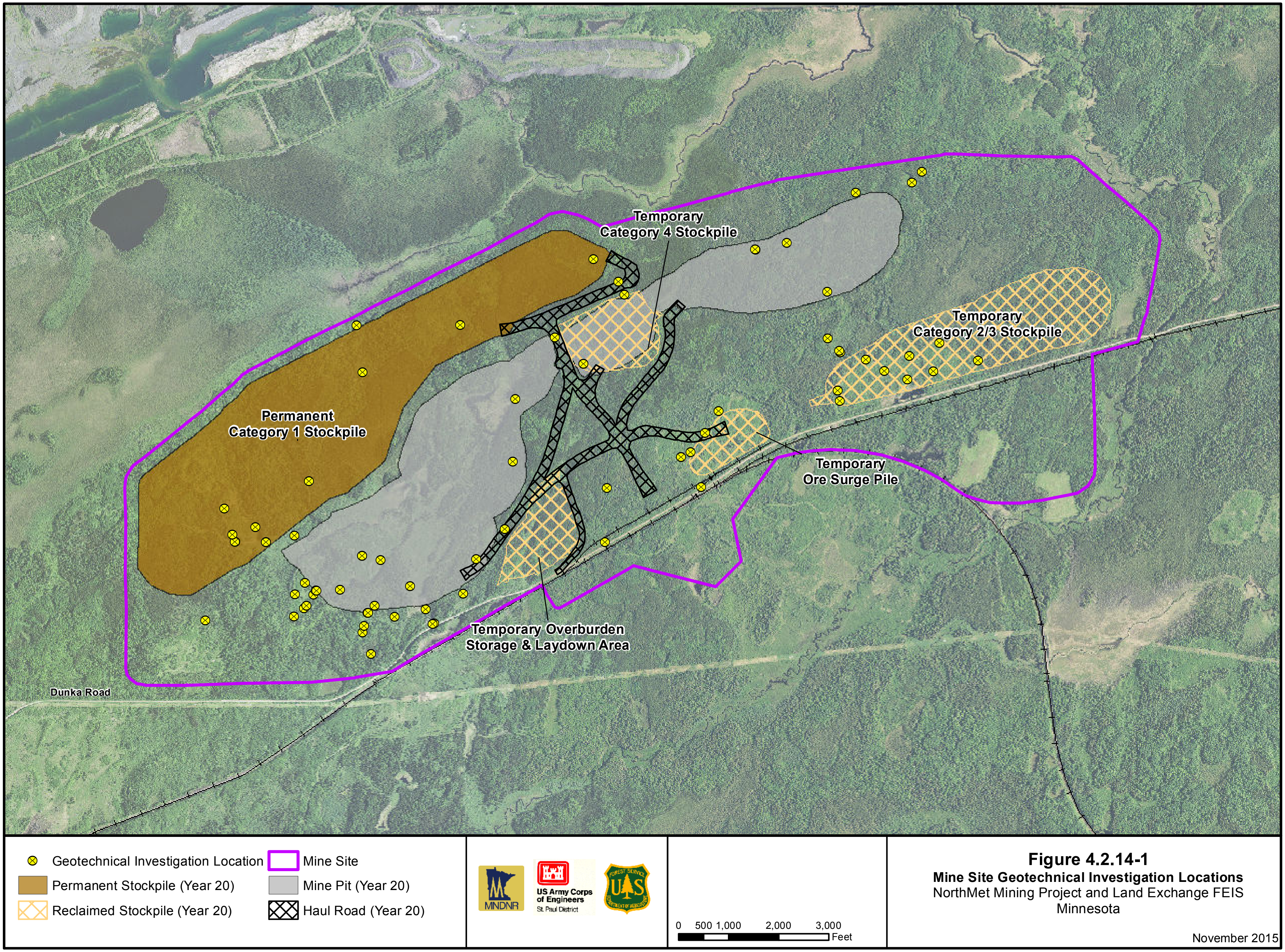

Figure 4.2.14-1

Mine Site Geotechnical Investigation Locations

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4.2.14.1.2 Investigations

The site conditions at the proposed stockpile location have been evaluated and reported by Golder Associates, Inc. for PolyMet (PolyMet 2014p). As shown in Figure 4.2.14-1, geotechnical information for the Mine Site was gathered from a number of borings and test trenches. The site exploration drilling database, drilling logs, and geophysics (electrical resistivity) data were used to develop an estimated depth to bedrock isopach map. Laboratory tests were also conducted to obtain index properties (American Society for Testing and Materials [ASTM] C-117, C-136, D2216) of the samples recovered from the test trenches and boreholes, to confirm field classifications, and for use in developing correlations with engineering properties of the soils encountered.

4.2.14.1.3 Surficial Soils and Geology

Site Conditions for Category 1 Stockpile

Borings and mapping indicate that bedrock depths at the proposed Category 1 Stockpile range from 4 ft in the central part of the northern extent up to 40 ft at the southwestern edge. Soils in the highland areas are glacial tills in origin and the consistency typically varies from coarser material to clays. Geotechnical testing indicates that lowland areas contain horizons of glacial, alluvial, and lacustrine deposits overlain by peat and relatively finer-grained soils.

Site Conditions for Category 2/3 Stockpile

Borings and mapping indicate that bedrock depths at the proposed Category 2/3 Stockpile range from 3.5 to 33 ft below the surface. Soils in the highland areas typically consist of sands and gravel with varying amount of silt. Lowland areas typically contain surficial peat and fine grained soils, underlain by glacial and alluvial deposits.

Site Conditions for Category 4 Stockpile

Borings and mapping indicate that bedrock depths at the proposed Category 4 Stockpile range from 8.0 to 26 ft. The Category 4 Stockpile would be located on highland soils, which typically consist of sands and gravels. Because the soil samples were collected only in the highland areas at the northeastern and the southwestern end of the stockpile, they may differ from foundation soils at other locations within the Category 4 Stockpile footprint, especially in wetland areas.

Site Conditions for Ore Surge Pile

Borings and mapping indicate that bedrock depths at the proposed Ore Surge Pile range from 6.5 to 12 ft. Soil samples were collected only from the highland areas of the stockpile, which may differ from foundation soils at other locations within the Ore Surge Pile stockpile footprint, especially from soils within the lowland areas located on the eastern side of the stockpile.

Site Conditions for Overburden Storage and Laydown Area

The conditions for the Overburden Storage and Laydown Area include wetland areas interspersed with areas of glacial till (typically silty sand) overlying bedrock of varying depth.

NorthMet Waste Rock and Ore Characterization

Analysis of the NorthMet Deposit indicates the average dry density of the waste rock is 1.90 tons per cubic yard with an assumed average of 23 percent porosity (30 percent swell).

Local granular material or crushed rock could be used to provide drainage layers for the stockpiles. Native till could be compacted and supplemented with bentonite to achieve an acceptable permeability relative to *Minnesota Rules*, part 6132.2400, subpart 2A(1) needed for the subgrade and liner layers (along with a geomembrane layer for the Category 2/3 and 4 stockpiles).

4.2.14.1.4 Geotechnical Summary

The majority of the soils collected were non-plastic. Measured in situ moisture contents for non-peat material ranged from 1.0 to 26.9 percent. The permeability of the tested (ASTM D5084, D698) undisturbed native soils ranged from 3.1×10^{-7} to 9.4×10^{-7} cm/sec. The permeability of the tested compacted native soils ranged from 1.1×10^{-7} to 2.0×10^{-7} cm/sec, indicating that the native soils are favorable for use as a compacted soil liner. Typically, the native glacial tills have sufficiently high fines content, and are considered good candidates for materials to be used with the geomembrane cover construction as proposed for the reclamation of the Category 1 Stockpile.

One-dimensional consolidation test (ASTM D2435) and a consolidated-undrained (CU) triaxial shear test (ASTM D4767) were undertaken for one sample taken from the Category 1 Stockpile footprint area. The in situ effective stress strength parameters yielded an effective cohesion of zero with an effective friction angle of 34.6 degrees. The consolidation testing indicated a coefficient of consolidation of 5.3×10^{-1} to 9.6×10^{-1} ft^2/day and a coefficient of compression of 0.05 to 0.13 under the loading range of 1 to 16 kips per square foot (ksf).

Additional geotechnical investigations such as soil borings, test trenches, and geotechnical laboratory tests of on-site materials are required at the locations of the proposed stockpiles to verify the geotechnical information currently available. Examples of information that the additional investigations would yield include: confirmation of the classification of native soils; identification of depths to bedrock and groundwater; identification and delineation of on-site borrow sources; and procurement of additional material samples of waste rock and overburden soils for laboratory testing. This information would be used to modify stockpile and foundation design and confirm the design assumptions and earthwork balance computations. The additional investigations would take place before stockpile construction but cannot be undertaken until the land exchange has been completed, appropriate permitting has been received, and dewatering of the wetland areas has been performed. PolyMet has committed to undertake further investigations as necessary.

4.2.14.2 Tailings Basin

4.2.14.2.1 Location and Descriptive Overview

The Tailings Basin constructed as part of the NorthMet Project Proposed Action would be located on top of the existing LTVSMC Tailings Basin and adjacent undisturbed ground. The LTVSMC Tailings Basin is contained by constructed dams with a small portion on the east and south side of the basin abutting natural higher ground and, as shown in Figure 4.2.14-2, is configured as a combination of three adjacent cells identified as Cell 1E, Cell 2E, and Cell 2W. With an average dam height of 95 ft, Cell 2E is the lowest of the three cells and covers approximately 620 acres in surface area. Cell 1E covers approximately 980 acres and has an average height of 125 ft. Cell 2W is the largest and highest of the three cells, covering approximately 1,450 acres in surface area, with an average dam height of 200 ft.

Additional perimeter dams would be constructed and flotation tailings would be deposited on top of the LTVSMC Tailings Basin, beginning in Cell 2E and then progressing into the combined Cell 2E and 1E when they achieve equal elevation, to a proposed final height of 200 ft. Cell 2W is not proposed for use for tailings deposition. Refer to Chapter 3.0 and Section 5.2.14 for more information on the proposed design of the Tailings Basin.

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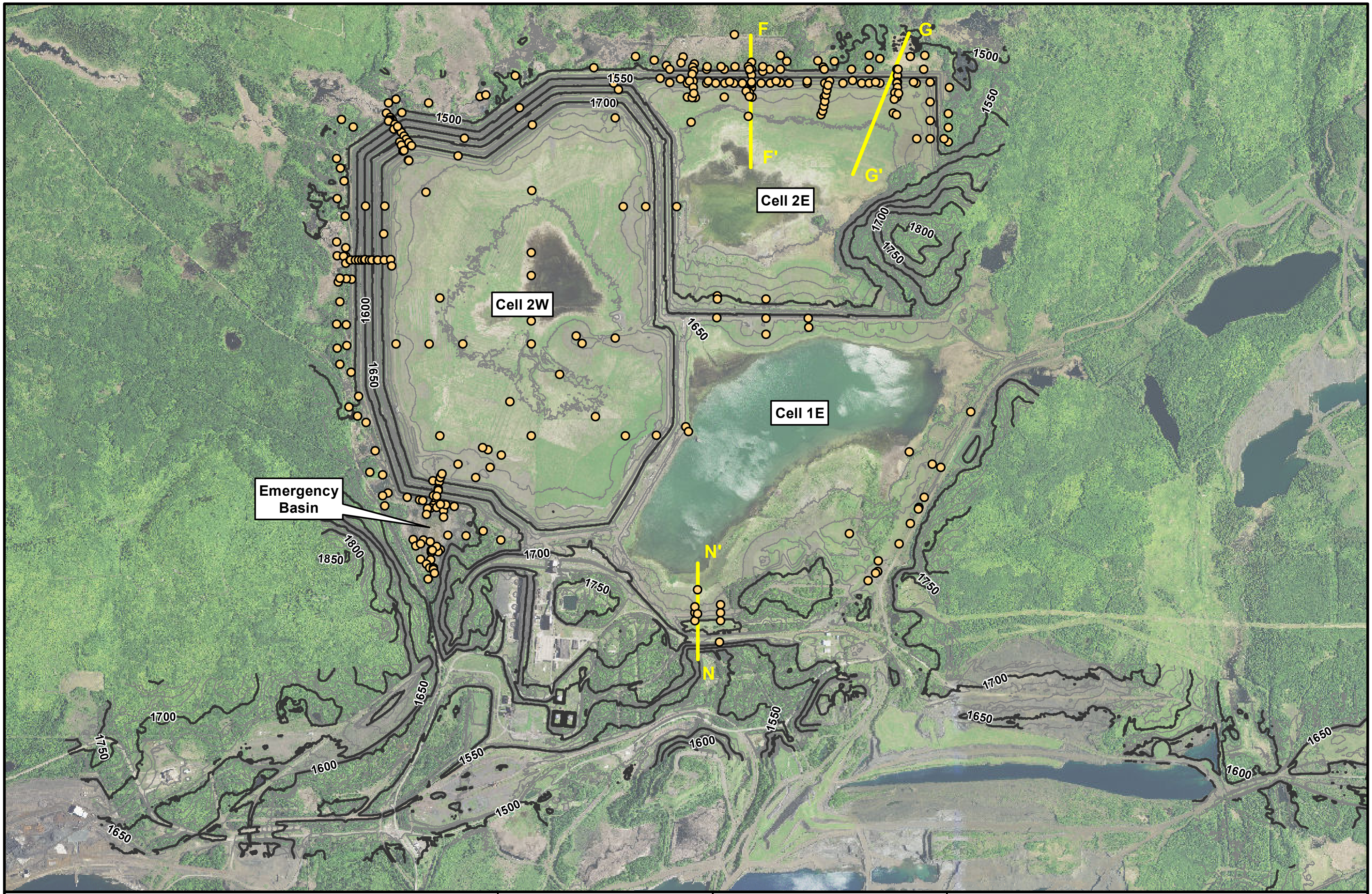

Geotechnical Investigation Locations
Cross Section
Contour - 50 Ft
Contour - 5 Ft

MNDNR
US Army Corps of Engineers St. Paul District

0 1,000 2,000 4,000 Feet

Figure 4.2.14-2
Existing LTVSMC Tailings Basin Layout
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4.2.14.2.2 Development of the Existing LTVSMC Tailings Basin

The existing LTVSMC Tailings Basin was constructed in stages beginning in the 1950s. Constructed perimeter dams were established using a rock, sand, and gravel starter dam over natural surface material (glacial till and fibrous peat in areas). The facility was unlined such that tailings from taconite processing were discharged directly on native material. The basin was filled to near the crest of the original starter dam and then berms were progressively developed on top of the starter dams and deposited tailings using the discharged coarse tailings (upstream construction method).

Upstream tailings basin construction methods generally involve spigotting of tailings in a slurry from the cell perimeter (or dam) into the interior of the cell using a portable spigotting system. Coarse tailings tend to settle out of the slurry near the spigot point near the perimeter of the dam, while the fine tailings and slimes tend to flow further into the basin. Very fine materials such as slimes tend to settle in the interior pond. The base of new lifts were developed inward in the upstream direction, hence the term upstream construction method.

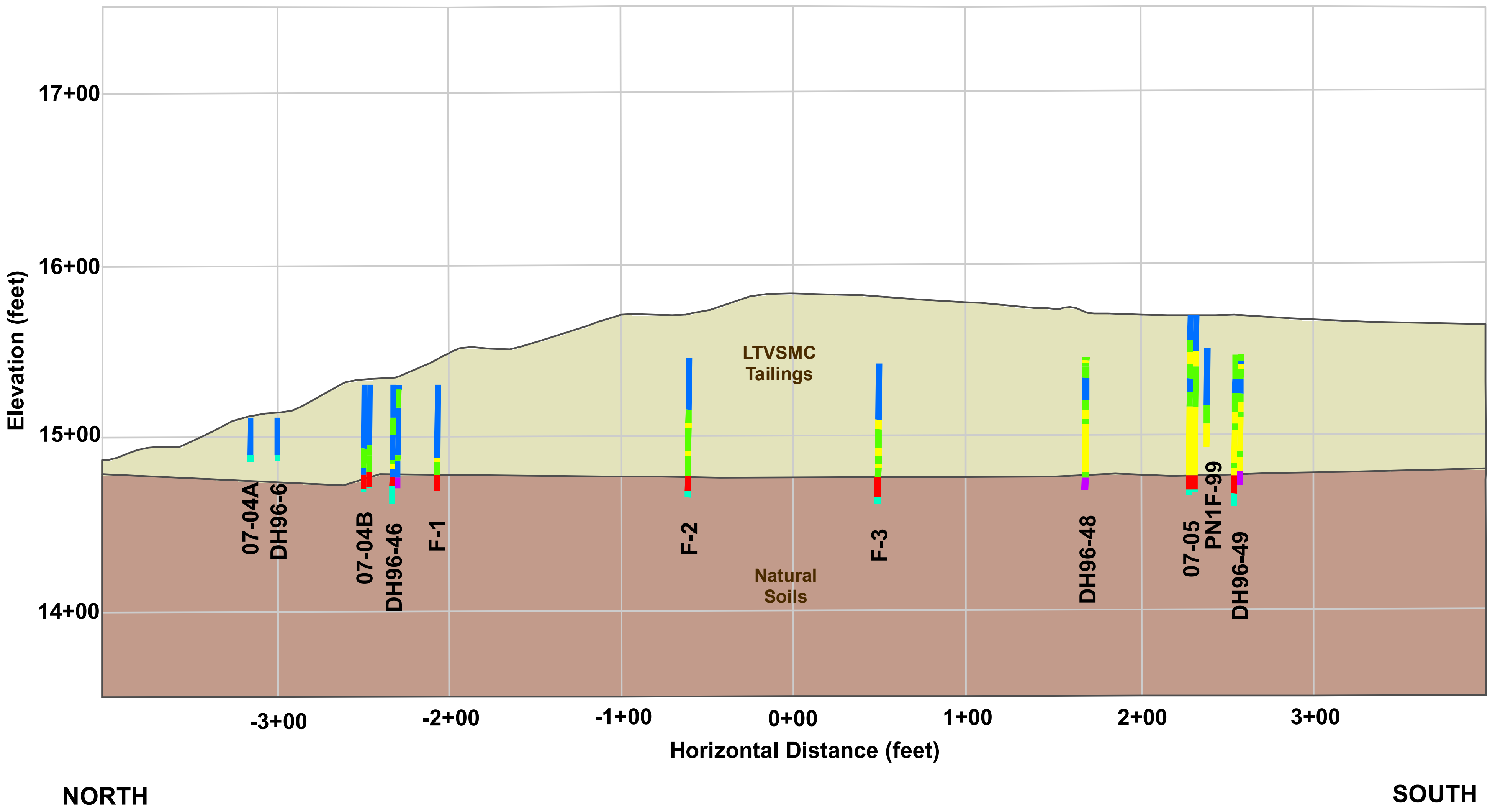
During the spigotting process, some fine tailings and slimes are normally trapped within the coarse tailings near the spigot point. In periods of very high water levels in the tailings pond or during periods of operational difficulties or operator error, additional fines and slimes may be deposited close to the perimeter dams. Typically, the material near the spigot points forms the foundation of future lifts of the shell, and is preferably a well-drained, coarse material that would provide a stronger base while reducing the height of the phreatic head within the shell. The inclusion of relatively large zones of finer-grained tailings within this outer shell reduces the drainage ability of the shell, increasing the phreatic surface, and reduces the localized shear strength due to the generally weaker behavior of the finer-grained tailings. There were instances during the operation of the LTVSMC Tailings Basin where significant amounts of fine tailings and slimes settled near the perimeter dams. These fine tailings and slimes were then covered with coarse tailings as the basin continued to be developed. Figure 4.2.14-3, Figure 4.2.14-4, and Figure 4.2.14-5 show complex and varying layers of materials identified in drilling along Cross Section F, G, and N. It should be noted that these figures provide idealized cross section information that may not be located exactly along the section lines. As such, some information was translated horizontally to provide a more detailed description of the material variability, and some materials may appear out of context (e.g., for Cross Section F, the left-most boreholes show layers of till found within the tailings; however, these layers of till are projected from boreholes that have a native ground surface at a relatively higher elevation than is shown in this figure). Additional investigation and modeling show similar inclusions throughout the basin. This is discussed further in the Surficial Geology section below.

In 1993, approximately 260,000 long tons of higher-sulfur waste rock from the Dunka Mine was mixed with approximately 29,000 tons of limestone and buried under spigotted LTVSMC tailings in the southern part of Cell 2W. Additionally, in Cell 2W, rapid construction in later years of development resulted in oversteepened dams on all sides of Cell 2W. Some seepage has occurred from the dam in this and other areas. Other points along the dams have been subject to erosion due to the leakage from and failure of LTVSMC discharge pipes, and from the natural geomorphological processes such as melting snow, precipitation runoff, soil creep, wind erosion and others. No large-scale failures were reported due to these events and eroded surfaces were filled with available material as needed.

In 1995 and 1996, approximately 1,500 cubic yards of spoil material dredged from Taconite Harbor in Lake Superior was placed in the south-eastern portion of Cell 1E.

Fly ash, dredging spoil, and coal pile cleanup material have also previously been disposed of in a solid waste storage site upgradient to the east of Cell 1E. PolyMet has committed to remove this material prior to inundation of that area by NorthMet tailings.

The LTVSMC Tailings Basin operations were shut down in January 2001 and have been inactive since then except for closure and reclamation activities consistent with an MDNR-approved Closure Plan. Reclamation also includes the use of some parts of Cell 2W as a land farm where contaminated soil is mixed with organics for remediation. These activities are expected to be completed by 2016.



Coarse Tailings
Fine Tailings
Slimes
Clay
Peat
Till

*Colors represent results of boring samples

MNDNR
US Army Corps of Engineers St. Paul District

Figure 4.2.14-3
Tailings Basin - Cross Section F (Existing Conditions)
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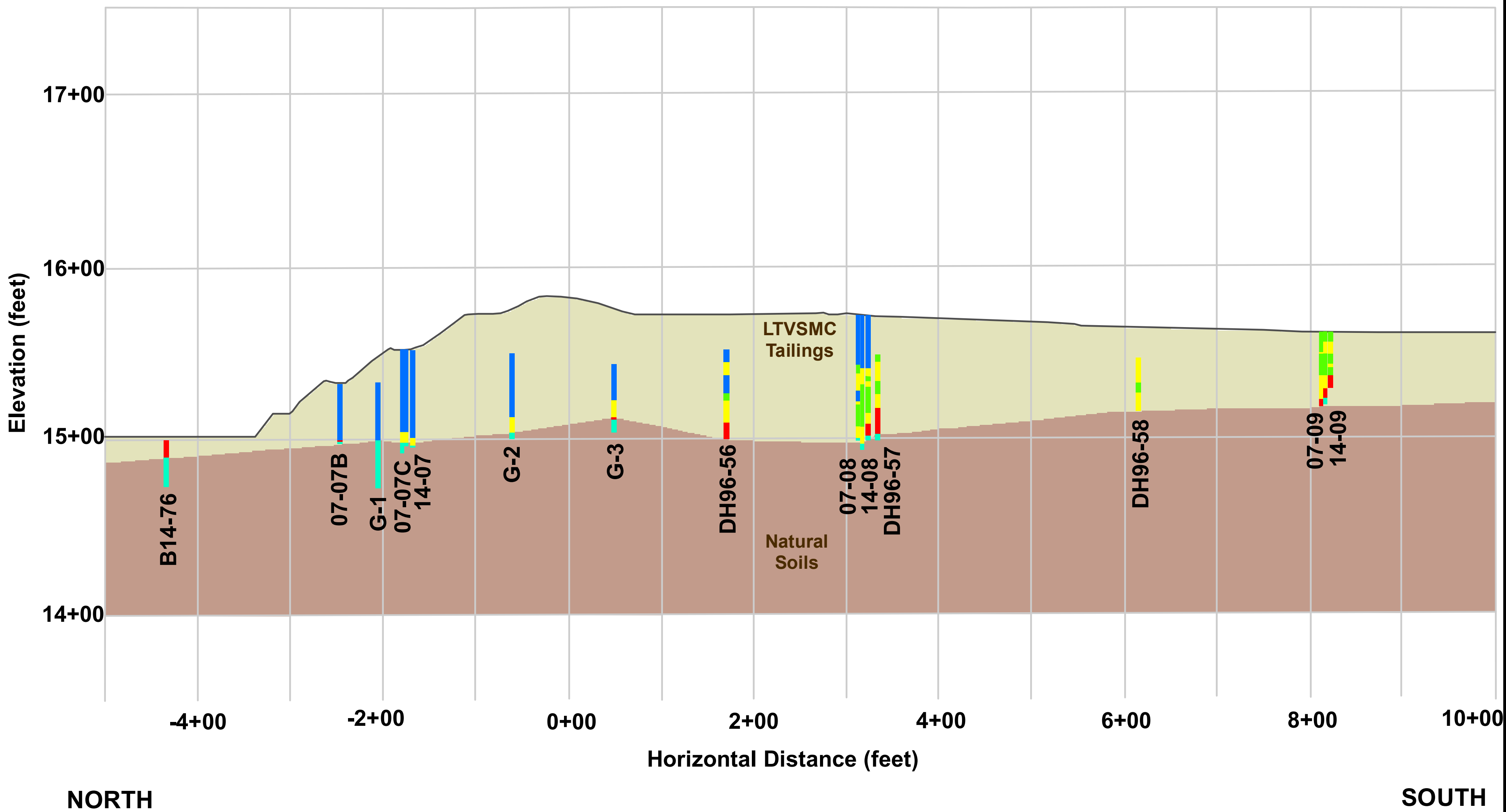

Coarse Tailings
Fine Tailings
Slimes
Peat
Till

*Colors represent results of boring samples

Figure 4.2.14-4
Tailings Basin - Cross Section G (Existing Conditions)
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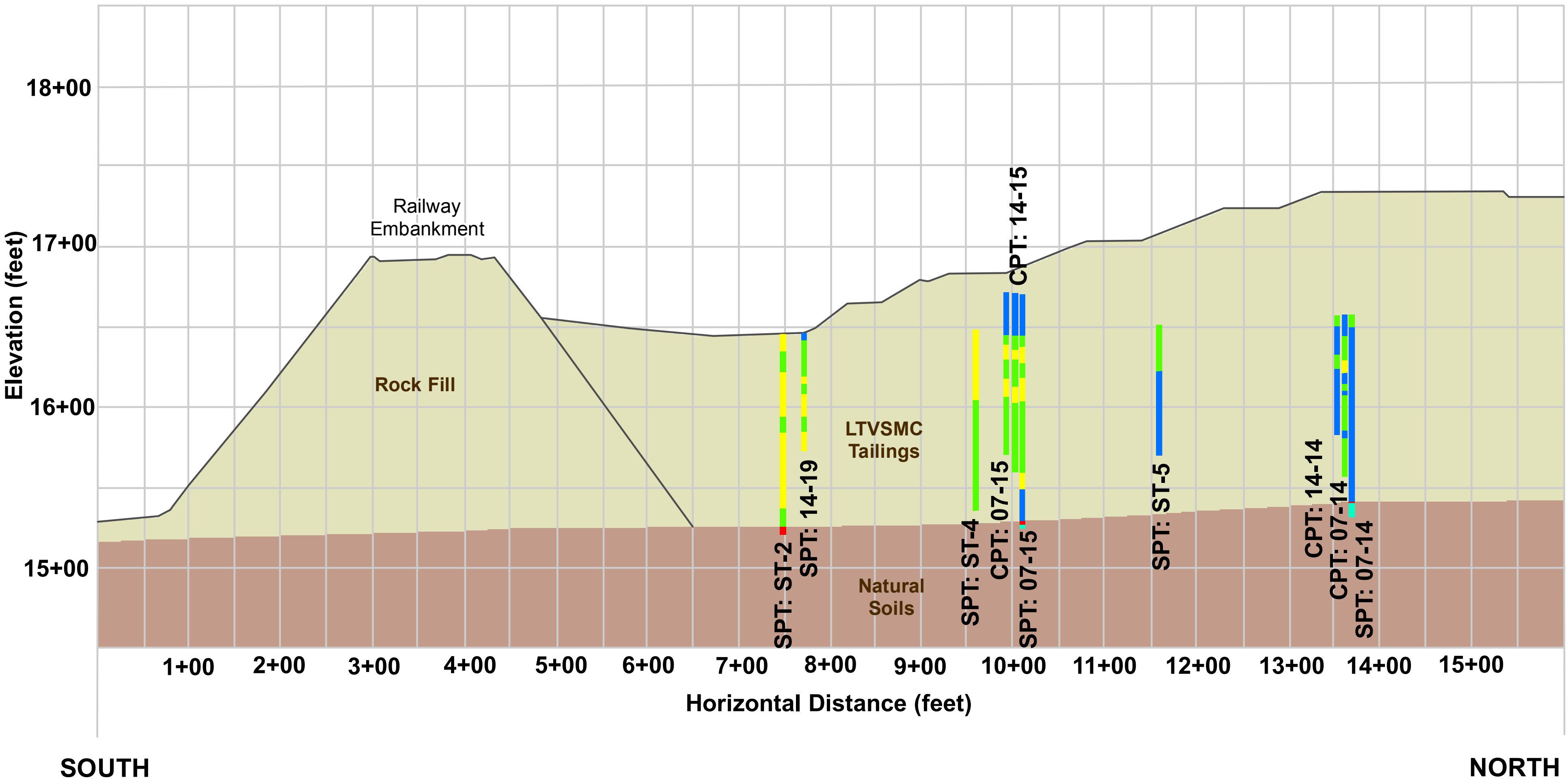

Coarse Tailings
Fine Tailings
Slimes
Peat
Till

*Colors represent results of boring samples

Figure 4.2.14-5

Tailings Basin - Cross Section N (Existing Conditions)

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4.2.14.2.3 Investigations

The site conditions at the LTVSMC Tailings Basin have been evaluated throughout its existence and most recently reported by PolyMet in 2007 and 2014 (PolyMet 2015l). As shown in Figure 4.2.14-2, information has been gathered over several geotechnical investigation efforts at various locations around the basin since its development. Collected site data include:

- cone penetrometer testing (CPT and CPTu) involving probing at 9 points in Cell 1E, 30 points in Cell 2E, and 12 points in Cell 2W; dissipation testing at nearly all CPT locations during the probing in 2007 and 2014;
- seismic shear wave velocity testing conducted at each of the CPT locations during the probing in 2007;
- dilatometer testing in borings approximately 10 ft adjacent to each CPT location in 2007;
- standard penetration test borings at a total of 27 locations near the CPT locations in 2007 and 12 locations along the western and northern sides of Cell 2W and Cell 2E in 2014;
- vane shear testing at various depths performed at nine locations in Cells 1E and 2E in 2007; and
- solid flight auger borings near the western, northern, and eastern crests of the dams around Cell 2W.

Laboratory testing of bulk and undisturbed materials was also undertaken to verify the data collected during in situ testing, as well as to further assess the characteristics of the material for its hydraulic and strength parameters.

Field and laboratory tests have been completed to describe the general geotechnical properties, permeability, and shear strength of the NorthMet tailings. These tests include:

- Atterberg Limits tests (ASTM D4318);
- Physical model studies;
- Falling-head, flexible-wall laboratory permeability testing (ASTM D5084); and
- Triaxial tests (ASTM D2850).

Geotechnical modeling of future conditions of the Tailings Basin (including the seepage and stability analysis) uses material properties obtained from testing. Filter criteria for the tailings were also evaluated to determine the effectiveness of LTVSMC bulk tailings to control water levels within the perimeter dam and to prevent piping.

Other studies performed to investigate the hydrogeology of the site are discussed in Section 4.2.2.

4.2.14.2.4 Surficial Materials, Geology, and Other Existing Structures

LTVSMC Tailings

The existing LTVSMC Tailings Dam generally consists of a shell of LTVSMC coarse tailings, with interbedded fingers of LTVSMC fine tailings and slimes. The interior of the cells consists primarily of layers of LTVSMC fine tailings and slimes, while coarse tailings are generally found near the perimeter of the basin. These interbedded layers vary in thicknesses and extent throughout the basin due to changing of tailings deposition points and durations. The depth of the tailings to the underlying native material varies between each of the cells.

Sampling to date has identified that the stratigraphy is very complex. Figures 4.2.14-3, 4.2.14-4, and 4.2.14-5 show cross sections F, G, and N, respectively. These cross sections illustrate the complexity and variability of the tailings layers within each borehole, and between boreholes. This variability between boreholes also contributes to the uncertainty in determining the depth and continuity of the layers, and therefore, the extent of fine tailings and slimes at various depths near the cell perimeter dams.

The LTVSMC coarse tailings are generally classified as poorly graded fine- to medium-grained sand. The LTVSMC slimes particle sizes have been classified to range from silty sand to lean clay.

The LTVSMC Tailings Basin is abutted in the location of Cross Section N by an existing railway.

Natural Soils and Geology

Native, surficial deposits in the area of the LTVSMC Tailings Basin generally consist of native glacial till material that ranges from clay to gravel. In places, the till is overlain by up to 20 ft of organic peat.

The depth to bedrock (Giant's Range granite) varies throughout the Tailings Basin. The bedrock at the toe of Cross Section F starts at an average of 30 ft below the top of the till. Bedrock along Cross-Section G was modeled as 25 ft below the top of the till at the toe and increases in elevation towards the center of the basin. No borings have been extended to bedrock along Cross-Section N; however, depth to bedrock was assumed as 20 ft below the top of the till and to increase in elevation towards the center of the basin.

NorthMet Tailings Characterization

The tailings from the NorthMet floatation process would be hydraulically deposited and are expected to undergo less hydraulic segregation than the LTVSMC tailings. While some segregation would occur, significant amounts of fines would be captured within the tailings matrix. Therefore, for geotechnical stability modeling (Section 5.2.14), the NorthMet tailings were treated as a single material, rather than defining parameters for coarser and finer portions of the tailings. Based on laboratory testing, a decrease in saturated permeability of the flotation tailings is anticipated with increase in overburden depth. As such, three saturated permeabilities have been used in geotechnical modeling with respect to depth.

4.2.14.2.5 Geotechnical Summary

The selected drained and undrained strength and saturated permeability inputs for the various materials used in modeling (Section 5.2.14.2.2) are summarized in Table 4.2.14-1.

Analyses determined that the LTVSMC coarse tailings are anticipated to behave in a dilative manner (i.e., expand in volume) as they are sheared, and are therefore less conducive to pore water pressure generation during shearing. The fine tailings and slimes are anticipated to behave in a contractive manner (i.e., reduce in volume) as they are sheared and are therefore prone to pore water pressure generation during shearing, resulting in a loss of effective strength. Organic peat has also been characterized as being prone to strength loss during shearing.

The northern dam in Cell 2E has been identified as a potential area of weakness as it is underlain by a layer of fibrous peat up to approximately 20 ft thick that extends north beyond the toe of the dam into a nearby wetland and due to the presence of interbedded layers of contractive fine tailings and slimes. A deposit of glacial till lies beneath the peat. The crest of the dam in this area is approximately 90 ft above the surrounding ground surface and consists mostly of coarse tailings with some weaker layers of interbedded fine tailings and slimes close to the base of the dam.

As part of the NorthMet Project Proposed Action, PolyMet would apply CDSM to increase the shear strength of select zones of the existing LTVSMC fine tailings, slimes, and peat layers. More information regarding the CDSM feature is provided in Sections 3.2.2.3.3 and 5.2.14.2.2. Hydrogeology suggests that the upper portion of bedrock is variably fractured and therefore has a higher saturated permeability compared to bedrock deeper in the formation.

Table 4.2.14-1 Summary of Seepage and Stability Modeling Parameters for the Material at the Existing LTVSMC Tailings Basin and Proposed NorthMet Tailings

	Saturated Permeability		Saturated Unit Weight	ESSA		USSA			
				Cohesion, c'	Friction, ϕ	Cohesion, Su	Friction, ϕ_{cu}	$USSR_{yield}$, $Su(yield)/\sigma'_v$	$USSR_{liq}$, $Su(liq)/\sigma'_v$
Material	**cm/sec**	**ft/sec**	**pcf**	**psf**	**deg**	**psf**	**degree**		
LTVSMC Coarse Tailings	2.44E-03	8.00E-05	135	0	38.5	0	38.5	-	-
LTVSMC Fine Tailings	2.00E-05	6.56E-07	130	0	33.0	-	-	0.25	0.1
LTVSMC Slimes	9.60E-07	3.15E-08	120	0	33.0	-	-	0.22	0.1
LTVSMC Bulk Tailings	8.02E-05	2.63E-06	130	0	38.5	0	38.5	-	0.1
LTVSMC FT/slimes	3.05E-06	1.00E-07	125	0	33.0	-	-	0.24	-
Glacial Till	5.03E-03	1.65E-04	135	0	36.5	0	36.5	-	-
Compressed Peat(1)	3.60E-06	1.18E-07	85	Shear/normal function(2)		-	-	0.23	-
Virgin Peat	1.00E-03	3.30E-05	70						-
Rock Starter Dam	1.52	5.00E-02	140	0	40.0	0	40.0	-	-
Flotation Tailings(3) – 0.45 tsf	1.90E-04	6.23E-06	125	0	33.0	-	-	0.26	0.12
Flotation Tailings(3) – 1.35 tsf	5.61E-05	1.84E-06							
Flotation Tailings(3) – 2.29 tsf	2.00E-05	6.56E-07							
Cement Deep Soil Mix (CDSM)	7.04E-07	2.31E-08	125	9600	0	-	-	-	-

	Saturated Permeability		Saturated Unit Weight	ESSA		USSA			
				Cohesion, c'	Friction, ϕ	Cohesion, Su	Friction, ϕ_{cu}	USSR$_{yield}$, Su(yield)/σ'_v	USSR$_{liq}$, Su(liq)/σ'_v
Material	cm/sec	ft/sec	pcf	psf	deg	psf	degree		
Slimes									
Cement Deep Soil Mix (CDSM) Peat	2.55E-06	8.36E-08	125	-	-	-	-	-	-
Fractured Bedrock	7.19E-04	2.36E-05	140	0	45.0	-	-	-	-
Bedrock	1.92E-05	6.30E-07	Impenetrable						
Rail Grade	1.52	5.00E-02	140	0	45.0	-	-	-	-

Notes:
1 Permeability of the compressed peat (below the dam) was altered for anisotropy, applying a ratio of ky/kx = 0.067.
2 Drained strength of the peat was included as a shear/normal function with $\phi \approx 27$ degrees.
3 Permeability of the tailings was varied based on effective overburden pressure.
ESSA = Effective Stress Stability Analysis
ft/sec = Feet per second
pcf = Pound(s) per cubic foot
psf = Pound(s) per square foot
USSA = Undrained Strength Stability Analysis
USSR = Undrained Sheer Strength Ratio

Further information on the parameters used for the design and modeling of the existing LTVSMC and proposed Tailings Basins is provided in Chapter 5.0 and in the Geotechnical Data Package Volume 1 (PolyMet 2015l).

4.2.14.3 Hydrometallurgical Residue Facility

4.2.14.3.1 Location and Descriptive Overview

As shown in Figure 4.2.14-2, the Hydrometallurgical Residue Facility would be located in a natural low point in the topography adjacent to Cell 2W of the existing LTVSMC Tailings Basin and over the LTVSMC Emergency Basin and the adjacent undisturbed ground. The southern tip of the LTVSMC Emergency Basin begins near the central portion of the Hydrometallurgical Residue Facility, widening and deepening into a former ravine that trends to the north. Seepage from the LTVSMC Emergency Basin occurs to the northwest between Cell 2W and a railroad grade located along the western perimeter of the area. This and additional seepage would be collected in a constructed drainage blanket between the LTVSMC embankment and the Hydrometallurgical Residue Facility embankment, and collected water would be conveyed away from the coincident area.

The southern dam of Cell 2W is approximately 160 ft in height from the surface of the LTVSMC Emergency Basin. It has an overall slope angle of 4 horizontal to 1 vertical (4:1) including mid-slope benches.

4.2.14.3.2 Development of the Existing LTVSMC Emergency Basin

The original purpose of the LTVSMC Emergency Basin was to contain taconite tailings (slimes, and fine and coarse tailings) from the main tailings thickeners in the event of a power failure or plant upset conditions which necessitated draining the tailings delivery system. Accidental overflows, spillage, and floor drainage from the former LTVSMC Concentrator Building was also placed in the LTVSMC Emergency Basin. These materials were deposited by gravity through an underground emergency tunnel terminating at the southeast side of the LTVSMC Emergency Basin. Overflow from sumps in the former LTVSMC booster pump house number 1 was also directed into the LTVSMC Emergency Basin.

Prior to the construction of the LTVSMC Tailings Basin Cell 2W, the LTVSMC Emergency Basin extended roughly 3,000 ft north from its current confinement. The southern starter dam for the LTVSMC Tailings Basin Cell 2W (the same dam as the proposed Hydrometallurgical Residue Facility north dam) was constructed over the unconsolidated emergency tailings in 1970 and 1971. An upstream construction method was used to construct the dam whereby the height of the dam was advanced incrementally by constructing a new lift upstream (into the basin) and above the crest of the dam. The north dam consists predominantly of LTVSMC coarse tailings with occasional inclusions of fine tailings and slimes. LTVSMC tailings were deposited over the emergency tailings in Cell 2W following this time.

4.2.14.3.3 Investigations

The site conditions at the Hydrometallurgical Residue Facility have been evaluated throughout its existence and most recently reported on by PolyMet (PolyMet 2014c).

The geotechnical assessment of the proposed site for the Hydrometallurgical Residue Facility utilized regional geological surveys and maps as well as historical and recent site surveys undertaken at the LTVSMC Tailings Basin as shown in Figure 4.2.14-6.

Residue from the hydrometallurgical process pilot-plant testing was collected to determine the geochemical and geotechnical material properties. The makeup of hydrometallurgical residue and other material proposed for disposal in the Hydrometallurgical Residue Facility process is described in Section 3.2.2.3.7.

4.2.14.3.4 Surficial Materials, Geology, and Other Existing Structures

LTVSMC Emergency Tailings

Existing materials in the LTVSMC Emergency Basin consist of a mixture of coarse tailings, fine tailings, and slimes. This layering is shown in Cross Section A in Figure 4.2.14-7. Deposited materials have experienced relatively minor amounts of self-weight consolidation since cessation of LTVSMC operations in early 2001 as no additional loading has occurred on these materials. There are approximately 50 ft of tailings in the thickest part of the Emergency Basin. A railroad track is also located along the western perimeter of the area.

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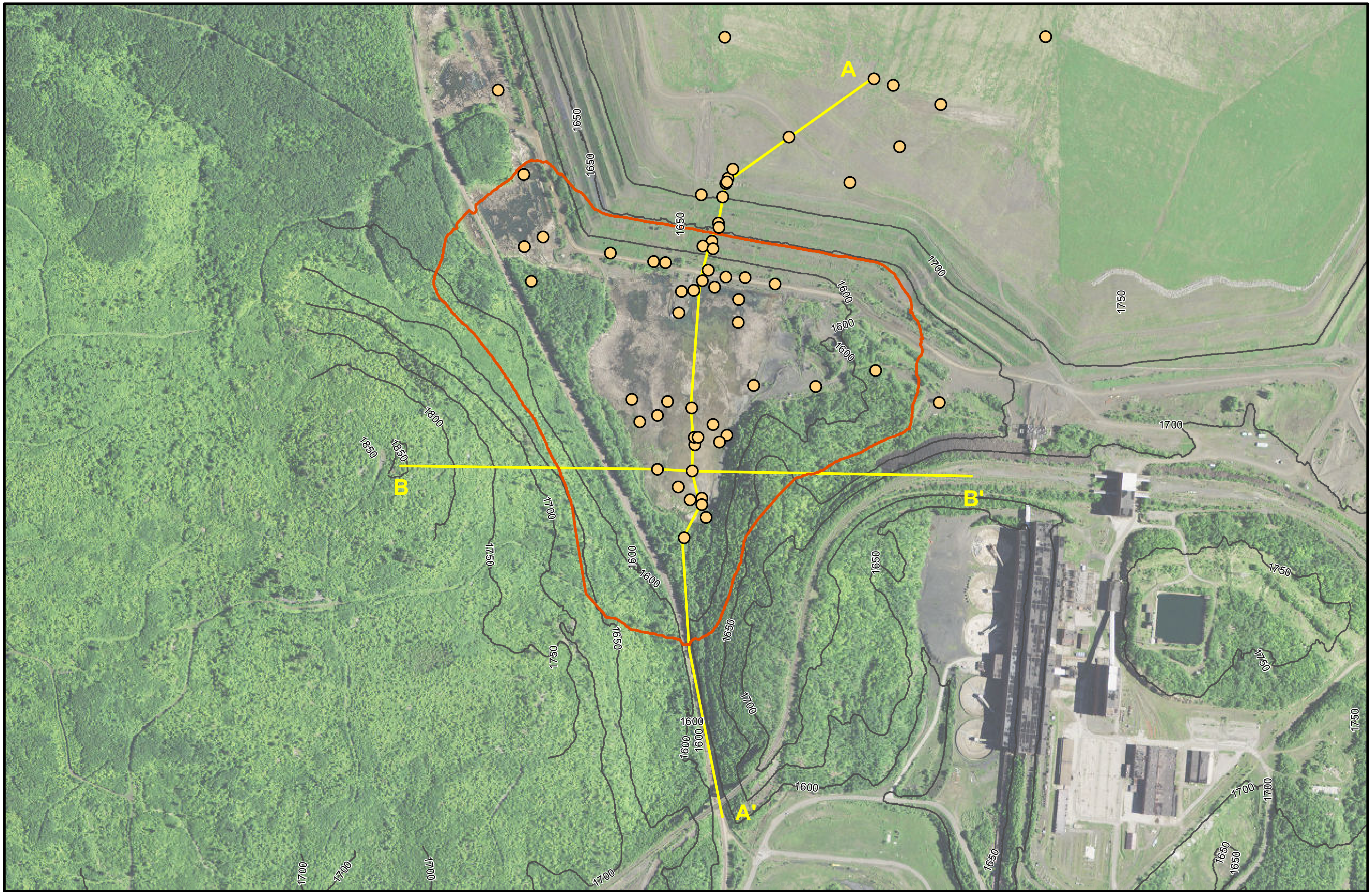

Hydrometallurgical Residue Facility
Geotechnical Investigation Locations
Cross Section

MNDNR
US Army Corps of Engineers St. Paul District

0 250 500 1,000 Feet

Figure 4.2.14-6
Hydrometallurgical Residue Facility - Geotechnical Investigation Locations
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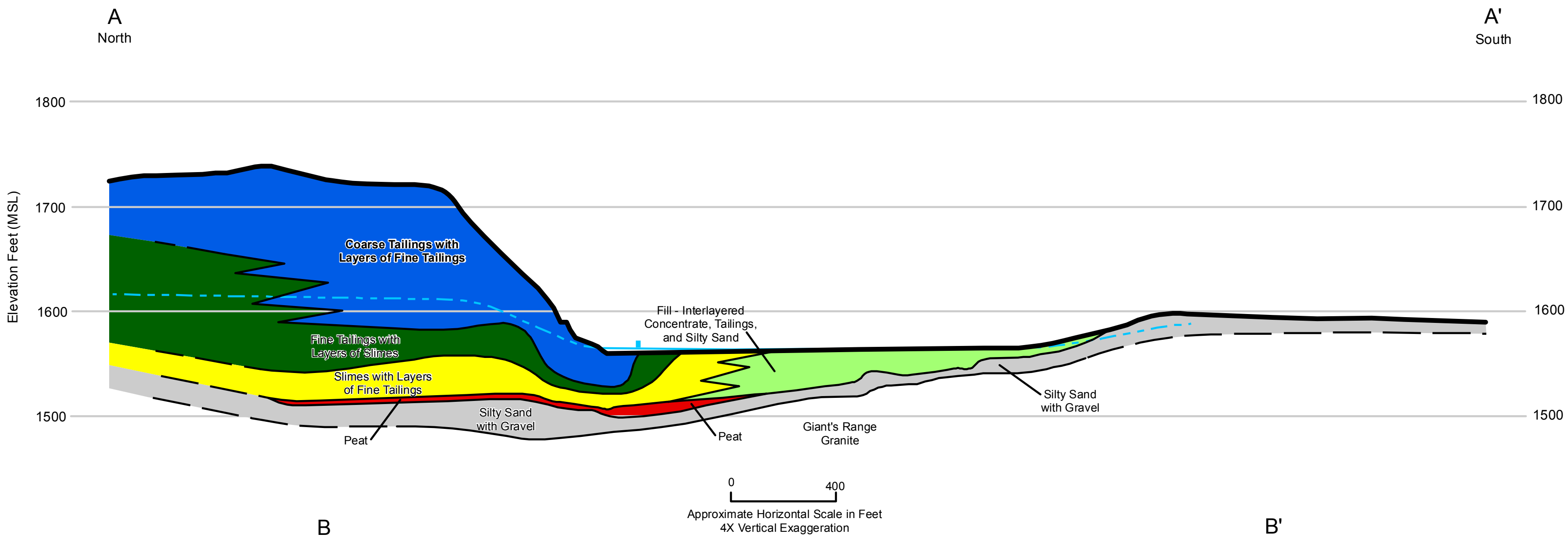

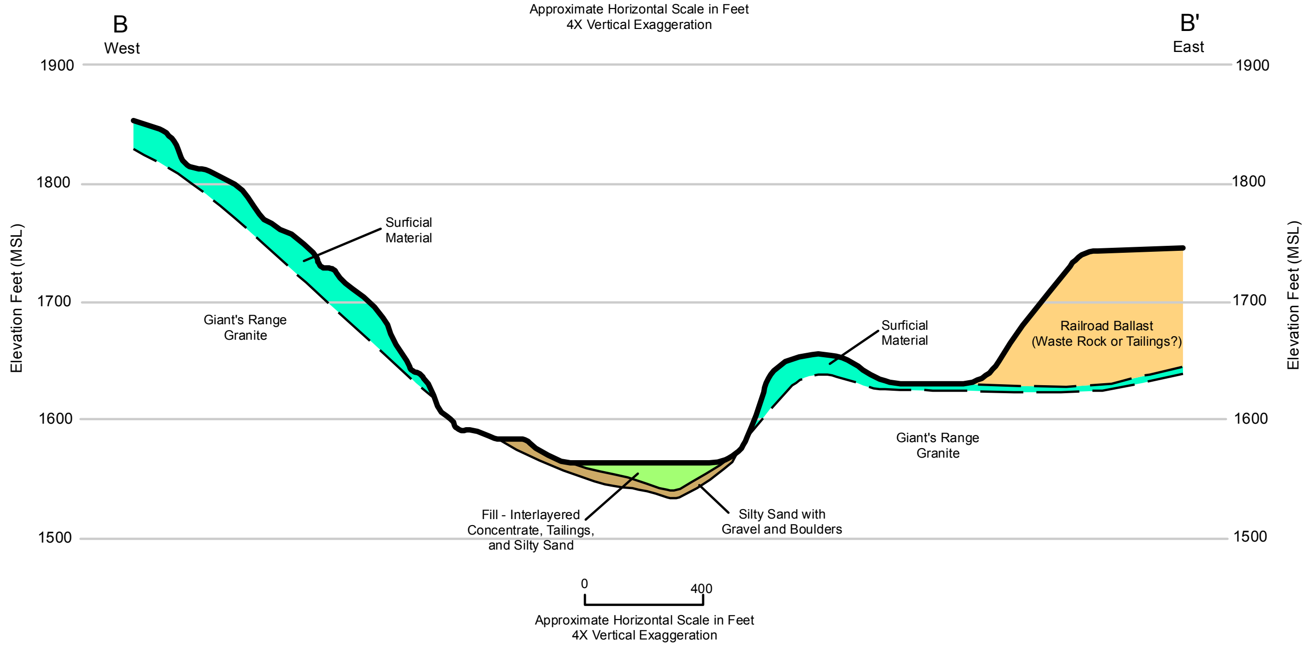

- Coarse Tailings with Layers of Fine Tailings
- Fill - Interlayered Concentrate, Tailings, and Silty Sand
- Slimes with Layers of Fine Tailings
- Fine Tailings with Layers of Slimes
- Railroad Ballast
- Peat
- Silty Sand with Gravel
- Silty Sand with Gravel and Boulders
- Surficial Material

MNDNR
US Army Corps of Engineers
St. Paul District

Figure 4.2.14-7
Hydrometallurgical Residue Facility -
Cross Sections A and B (Existing Conditions)
NorthMet Mining Project and Land Exchange FEIS
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Natural Soils and Geology

In the area of the Hydrometallurgical Residue Facility, bedrock is generally within 25 ft of the existing ground surface, except where surface materials have been built up either to support the former LTVSMC facilities or where emergency tailings have been deposited in the LTVSMC Emergency Basin (see Figure 4.2.14-7). To expedite the consolidation of the in-place LTVSMC tailings so as to provide a more stable base for the Hydrometallurgical Residue Facility, wick drains may be installed within the Emergency Basin. This would reduce drainage path lengths, increase the drainage ability in the LTVSMC tailings and underlying compressed peat, and result in a stronger foundation for the Hydrometallurgical Residue Facility.

Native surficial deposits, which have been sampled and logged at boring locations in and around the LTVSMC Emergency Basin, include silty sands with interbedded coarser grained alluvial deposits and peat. A thin layer of peat below the tailings in the LTVSMC Emergency Basin thickens beneath the toe of the LTVSMC Tailings Basin.

The LTVSMC Emergency Basin is entirely underlain by Giant's Range granite. Bedrock granite has been historically scoured by glaciers creating features such as linear valleys. The location of linear valleys is sometimes interpreted to correspond with the location of potential faults in the bedrock. However, on published geologic maps, the faults in these areas are dashed and identified as conjectural with inferred (not exact) locations. Regional geologic maps of the Iron Range do show the existence of fault lines, but hydrogeologic studies have not provided evidence that any faults that may be present are active, nor do they behave as conduits for groundwater flow.

NorthMet Hydrometallurgical Residue Characterization

The Hydrometallurgical Residue Facility is designed for the storage of residue produced during mill operations. The grain size of the residue would primarily consist of material which would be classified as silt and sand with a small amount of clay. Structural fill used to construct the Hydrometallurgical Residue Facility dams would consist of blasted rock, sand, glacial till, or LTVSMC coarse tailings. Additional materials such as gypsum from the WWTP, lime for residue pH neutralization (if necessary), and coal ash would also be disposed of within the Hydrometallurgical Residue Facility. These additional materials may represent approximately 5 to 10 percent of the facility solids volume. The chemical and physical properties of any non-residue materials proposed to be stored in the Hydrometallurgical Residue Facility would be tested prior to placement to ensure proper containment.

4.2.14.3.5 Geotechnical Summary

The values for the material properties used in geotechnical modeling are discussed in Section 5.2.14 and summarized in Table 4.2.14-2 and Table 4.2.14-3.

There are no structures at the proposed Hydrometallurgical Residue Facility site that appear to be at risk of geotechnical instability.

Further information on the parameters used for the design and modeling of the Hydrometallurgical Residue Facility is provided in Section 5.2.14.

Table 4.2.14-2 Summary of Modeling Permeabilities for the Material Relevant to the Hydrometallurgical Residue Facility Material

	Modeling Permeability	
	cm/sec	**ft/sec**
LTVSMC Coarse Tailings	2.44E-03	8.00E-05
LTVSMC Fine Tailings	2.00E-05	6.56E-07
LTVSMC Slimes	9.60E-07	3.15E-08
LTVSMC Bulk Tailings	8.02E-05	2.63E-06
Glacial Till	5.03E-03	1.65E-04
Sand	1.00E-02	3.28E-04
Residue (used for rate of drainage computation – quantity vs. time)	3.40E-05	1.12E-06
Residue (used for computation of time for drainage to occur)	5.50E-06(1)	1.80E-07(1)
Compressed Peat	3.60E-06	1.18E-07
Bedrock	8.56E-08	2.81E-09
LTVSMC Slimes – with wick drains	2.34E-06	7.69E-08
Compressed Peat – with wick drains	8.75E-07	2.87E-08

Note:
[1] To account for anticipated consolidation (densification) of the residue within the cell and corresponding reduction in residue permeability, average permeability used to estimate time for drainage to occur is assumed.

Table 4.2.14-3 Summary of Shear Strength Parameters for the Material Relevant to the Hydrometallurgical Residue Facility

Material	Model	Unit Weight (pcf)	Elasticity modulus, (psf)	ϕ (deg)[1]	Poisson's ratio, μ	Normal Consol. line slope, λ	Consol. Line slope, Swelling line slope, κ	Initial Void Ratio, e_o
Glacial Till	Linear Elastic	135	5.00E+05	-	0.30	-	-	-
LTVSMC Coarse Tailings	Linear Elastic	135	8.40+05	-	0.30	-	-	-
LTVSMC Fine Tailings	Soft Clay (Modified Cam Clay)	130	-	33	0.30	0.05	0.01	1.07
LTVSMC Slimes	Soft Clay (Modified Cam Clay)	120	-	34	0.30	0.07	0.01	1.14
LTVSMC Slimes – with wick drains	Soft Clay (Modified Cam Clay)	120	-	34	0.30	0.07	0.01	1.14
Residue[2]	Linear Elastic	115	-	30	0.30	0.18	0.03	1.92
Giant's Range Granite	Linear Elastic	165	1.69E+09	-	0.18	-	-	-
Sand	Linear Elastic	120	6.00E+05	-	0.30	-	-	-
LTVSMC Bulk Tailings	Linear Elastic	130	1.00E+06	-	0.30	-	-	-
Bedrock – blasted	Linear Elastic	135	1.00E+06	-	0.30	-	-	-
Compressed Peat	Soft Clay (Modified Cam Clay)	85	-	30	0.30	0.70	0.09	3.84
Compressed Peat – with wick drains	Soft Clay (Modified Cam Clay)	85	-	30	0.30	0.70	0.09	3.84

Note:
[1] The term M (the slope of the critical state line) can be defined by the equation: $M = \frac{6sin\phi'}{3-sin\phi'}$ [2] Other than the Residue Settlement Column, stress-deformation models modeled residue using placeholder linear elastic parameters. These models only require the thickness and unit weight of the residue to be valid. Residue consolidation is considered in the Residue Settlement Column analysis (PolyMet 2014c)
pcf = Pound(s) per cubic foot
psf = Pound(s) per square foot

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4.3 LAND EXCHANGE

4.3.1 Land Use

The federal and non-federal lands were reviewed against parameters similar to the Mine Site and Plant Site, including existing land use plans, zoning designations, public access routes, mineral ownership and economic potential, and title.

Additionally, each tract of the Land Exchange Proposed Action was evaluated for the presence of known existing hazardous material effects and contaminated sites and for the potential for hazardous materials to currently affect the lands. Research to evaluate potential hazardous materials or hazardous material sites on these land areas consisted of review of three types of data sources, depending on the size and geographic spread of the land area. The data sources used include:

- An ASTM/AAI Phase I ESA;
- An Environmental Regulatory Database search, which was conducted by Environmental Data Resources, Inc. (EDR), and consists of a report of federal, state, local, or tribal agency databases; and
- The MPCA website database titled, “What’s In My Neighborhood?”

A Phase I ESA provides a comprehensive review of environmental regulatory databases and includes a physical site visit, interviews with property or adjacent property owners and local officials, and review of historical data such as aerial photographs, topographic maps, fire insurance maps, land title records, or property tax files. Conclusions are drawn based upon the findings to identify recognized environmental conditions based on the comprehensive review and the opinion of the environmental professional.

The Environmental Regulatory Database search defines and summarizes the ASTM databases reviewed in the EDR report and notes whether any sites (including the target property) were identified within a specified search radius. The database sites identified in the EDR report were evaluated with respect to the target land area to determine which sites indicate hazardous material effects.

The MPCA website database identifies potentially contaminated sites through a searchable inventory of properties, as well as sites that have already been cleaned up and those currently being investigated or cleaned up. The website also contains a searchable inventory of businesses that have applied for and received different types of environmental permits and registrations from the MPCA.

4.3.1.1 Federal Lands

4.3.1.1.1 Land Exchange Proposed Action

The boundaries of the federal lands include the Mine Site, as well as land to the north and west, but exclude the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.1.2 provides a discussion of the existing land use on the federal lands.

The Land Exchange Proposed Action includes 6,495.4 acres of federal lands with a perimeter of approximately 23 linear miles. By comparison, Superior National Forest comprises 4,600,831.8 acres, of which 2,171,603.9 acres, with a perimeter of 10,054.8 linear miles (including the federal lands), are managed by the USFS (there are lands within the Superior National Forest boundaries owned by the State, counties, and private owners). The majority of the federal lands are within the General Forest – Longer Rotation Management Area, while the remainder is within the General Forest Management Area (see Figure 4.3.1-1). These management areas are defined in Section 4.2.1.2. Table 4.3.1-1 summarizes the acreage of the federal lands, by management area, for the Land Exchange Proposed Action.

There is no known existing contamination by hazardous materials in the federal lands.

Table 4.3.1-1 Management Area Designations for the Federal Lands under the Land Exchange Proposed Action

Management Area Designation	Total Acreage
General Forest – Longer Rotation	6,140.1
General Forest	355.3

4.3.1.1.2 Land Exchange Alternative B

Under the Land Exchange Alternative B, 4,752.6 acres of federal lands would be exchanged for the 4,926.3-acre Tract 1. Table 4.3.1-2 summarizes the acreage of the federal lands, by management area, for the Land Exchange Alternative B. Section 4.3.1.2.1 describes Tract 1.

Table 4.3.1-2 Management Area Designations for the Federal Lands under Land Exchange Alternative B

Management Area Designation	Total Acreage
General Forest – Longer Rotation	4,397.3
General Forest	355.3

4.3.1.2 Non-federal Lands

The non-federal lands comprise five tracts—each consisting of one or more individual parcels—totaling 7,075.0 acres. The land use conditions of each tract are described below. Tracts 1 and 2 of the Land Exchange Proposed Action include areas with potential conservation value (i.e., cRNA Management Area and Riparian Emphasis Management Area). Some of the parcels within Tract 2, Tract 3, and Tract 4 have limited accessibility by either road or foot trail, although there are segments that show evidence of timber harvesting (see Figures 5.3.1-1 and 5.3.1-2).

4.3.1.2.1 Tract 1 – Hay Lake Lands

Tract 1 is located in central St. Louis County, approximately 3 miles north-northwest of the City of Biwabik. The tract consists of one parcel covering approximately 4,926.3 acres, with a perimeter of approximately 15 linear miles.

Land Use Regulation

Land use in Tract 1 is governed by the St. Louis County zoning ordinance. It is divided among the following zoning districts (St. Louis County 2011):

- **Forest Agricultural Management (FAM-1)**: This district recognizes and promotes the development of forestry and agricultural industry and encourages recreational activity. It is typically applied to areas with very low density land development. This district is located in the northeast corner and occupies approximately 5 percent of the Tract 1 lands.
- **Forest Agricultural Management (FAM-2)**: This district recognizes and promotes the development of forestry and agricultural industry and encourages recreational activity. It is typically applied to areas with very low density land development. Whereas FAM-1 has a minimum parcel size of at least 35 acres, FAM-2 has a minimum parcel size of 17 acres. This district is located throughout the parcel and occupies approximately 57 percent of the Tract 1 lands.
- **Sensitive Areas (SENS-3)**: In addition to the forestry/agriculture focus embodied in the FAM-2 district, the SENS-3 district also recognizes significant areas that are unsuitable for intensive development due to the potential for environmental hazards or other features to negatively affect environmental conditions. This classification surrounds most of Hay Lake and Little Rice Lake, as well as a large portion of the river and riparian areas. This district is located throughout the parcel and occupies approximately 33 percent of the Tract 1 lands.
- **Residential (RES-3)**: This district recognizes and promotes residential development with limited non-residential uses. This district is located northeast and southwest of Hay Lake and occupies approximately 5 percent of the Tract 1 lands.

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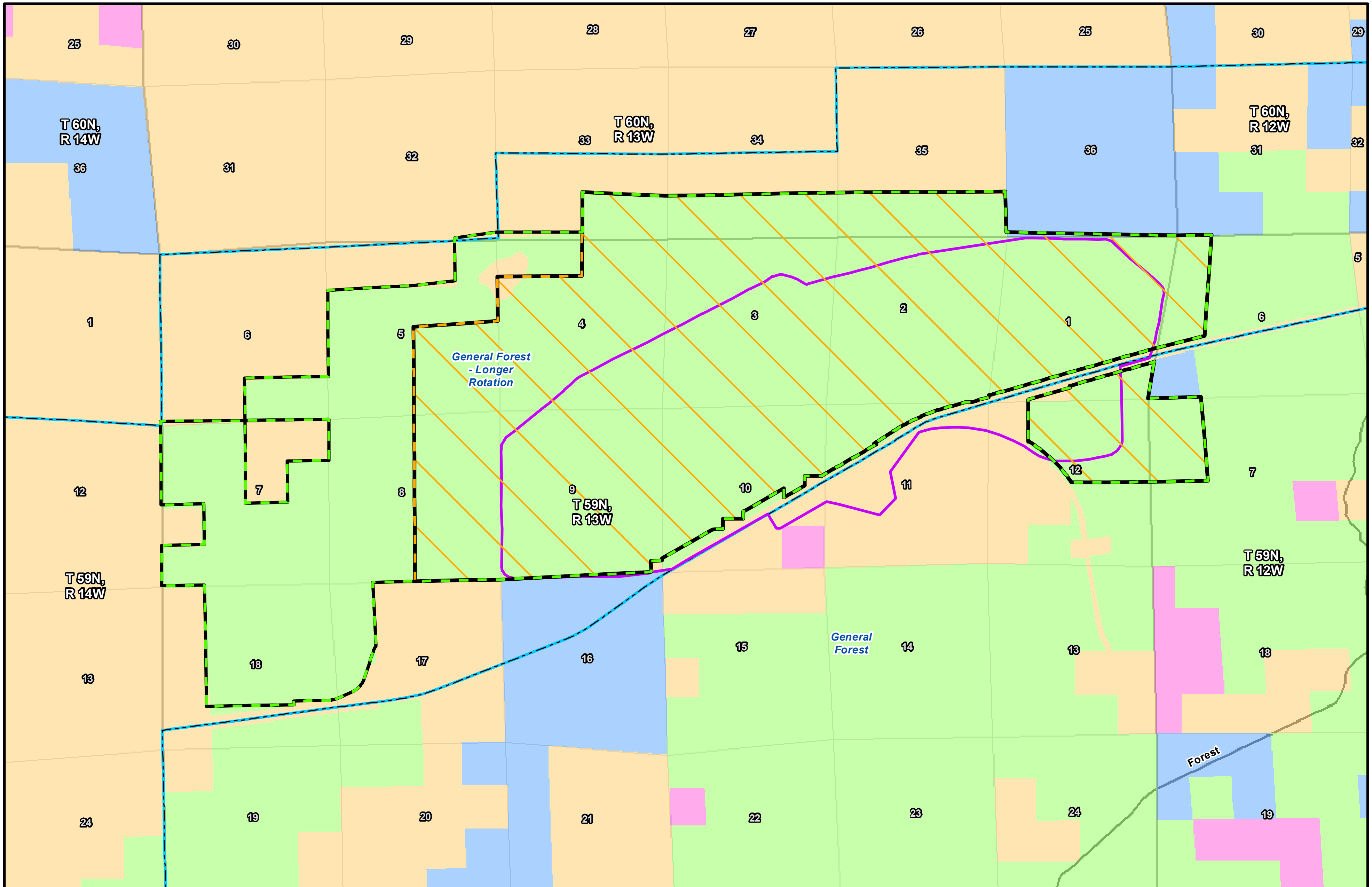

Federal Lands
Alternative B: Smaller Federal Parcel
Mine Site
Management Area
Section Label
Section Boundary
National Forest Ownership
County Ownership
State of Minnesota Ownership
Other Ownership
Road

MNDNR
US Army Corps of Engineers St. Paul District

N S E W

0 0.25 0.5 1 Miles

Figure 4.3.1-1
Ownership of Federal Lands
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Adjacent to Tract 1 on the west and north are Superior National Forest lands that fall within the General Forest Management Area. Two cRNA management areas adjoin the tract: Pike Mountain on the southwest corner and Loka Lake on the northeast corner (USFS 2011b). The cRNAs are designated by the USFS for the purpose of preserving and maintaining areas for ecological research, observation, genetic conservation, monitoring, and educational activities. No recreation facilities are provided in these management areas; while dispersed recreation occurs (see Section 4.3.11.2.4), it is generally discouraged. The Pike Mountain cRNA is characterized by a hardwoods forest plant community. The Loka Lake cRNA is characterized by high-quality lowland black spruce and tamarack swamp (USFS 2011h).

Adjacent to Tract 1 to the south and east are privately owned lands within St. Louis County's Multiple Use Non-Shoreland 4 (MUNS-4) zoning district. This designation allows for a diverse array of development, such as residential, light industry, commercial, livestock, sanitary landfill, airport, and utility facilities, among others (St. Louis County 2011).

As part of the Land Exchange Proposed Action, the non-federal lands were the subject of Phase I ESAs. Potential areas of legacy contamination were discovered on Tract 1. These areas were investigated and remediated through removal and disposal of potentially contaminated soil and materials. Any remnant contamination (limited to two instances where less than 5 gallons of used oil were spilled) is expected to degrade in situ (NTS 2011).

Existing Land Use

Tract 1 includes Hay Lake, identified as a wild rice water by the MDNR, Little Rice Lake, and an unnamed lake (see Figure 4.3.1-2). Approximately eight miles of the upper Pike River flow through Tract 1. An electrical transmission line crosses Sections 19, 20, 21, and a portion of Section 16 (USFS 2011b). CR 715 forms part of the eastern boundary of the tract.

A small boat landing and primitive parking area provide access to the Pike River adjacent to CR 715. Several trails also emanate from CR 715, some with bridges crossing the upper Pike River; all of these trails are gated or bermed. There is evidence that a sand/gravel pit near CR 715 has been used as a dumping site in the recent past, but has been fully remediated and cleared of trash and debris (NTS 2011). The gravel pit area is gated, but there is evidence that it has been used as a shooting range. There are also numerous deer stands on the parcel (Lisson and Gawtry 2011).

Property Rights, Title, and Mineral Resources

PolyMet currently owns surface rights to Tract 1. The tract is subject to a mortgage in favor of Iron Range Resources, which would be satisfied at closing of the Land Exchange Proposed Action (USFS 2011c). Title to this parcel has been reviewed and approved by the USDA Office of General Counsel so long as certain recommended affirmative title insurance is provided (USFS 2011c).

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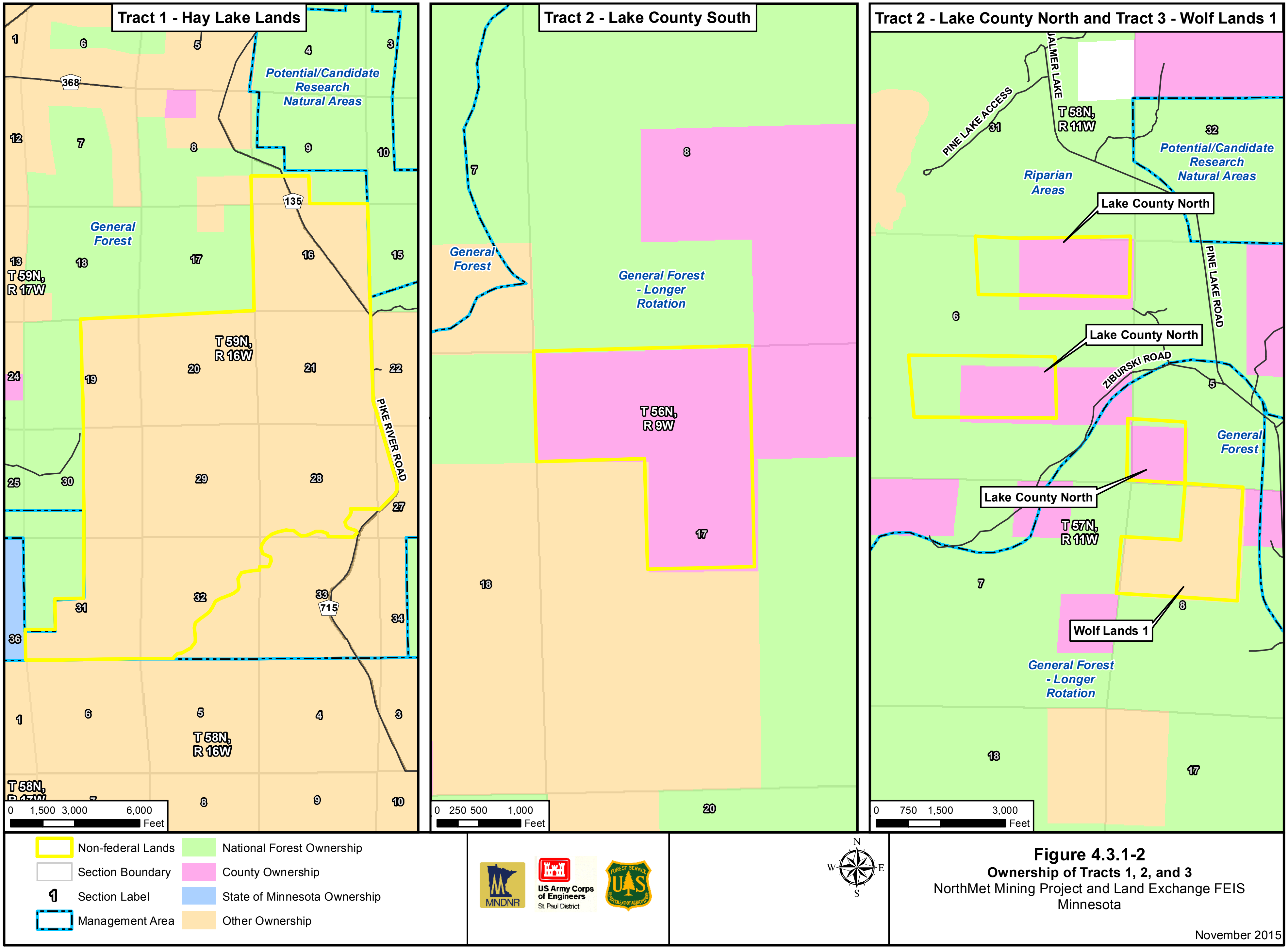

Figure 4.3.1-2

Ownership of Tracts 1, 2, and 3

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Tract 1 was assessed for mineral resource potential as part of the Feasibility Analysis completed in 2009 (USFS 2009c). The geology of the area is mostly granitic rocks with the southwestern-most part underlain by metamorphosed basalts, gabbros, and sedimentary rocks. The mineral potential for the tract was determined to be limited, as granitic rocks are not known to host mineral deposits. The MDNR core library index showed no drilling on or near Tract 1. Additional investigation in 2011 indicates potential for aggregate production from the northeastern corner of the tract along the Pike River. Tract 1 appears to have a low potential for exploration or development of bedrock or surficial deposits (Barr 2011c).

Legacy Pollution

The legacy pollution data review described in Section 4.3.1 found that hazardous materials may be present on Tract 1, specifically along Pike River Drive in the northeastern portion of the tract, and between Hay Lake and CR 715, west of the Pike River. The Phase I ESA for Tract 1 described several areas where releases of hazardous materials may exist due to unauthorized dumping. The EDR report and MPCA database also identified three unauthorized or unpermitted dump sites on Tract 1. The southernmost dump, west of the Pike River, is named Unauthorized Dump-Biwabik. The two remaining dump sites, Unauthorized Dump-2 and Unnamed Dump-Biwabik/2, are north of the first dump site and adjacent to CR 715. These types of dumps are typically old farm, homestead, or municipal disposal sites that accepted household waste. There are no records of inspection or enforcement actions at these sites in the MPCA database (NTS 2010a; EDR 2009a; MPCA 2012d); however, a subsequent Phase II investigation found no evidence of spills or contamination, and found that legacy pollution had been resolved at the site (NTS 2011).

4.3.1.2.2 Tract 2 ‑ Lake County Lands

Tract 2 comprises four parcels in Lake County, southeast of Seven Beaver Lake, totaling 381.9 acres with a perimeter of approximately 7 linear miles. No hazardous material issues were identified at Tract 2 (EDR 2011a; EDR 2011b; MPCA 2012d).

Land Use Regulation

All Lake County parcels fall within Lake County’s Forest-Recreation zoning district (ERM, Pers. Comm., October 10, 2011). The Forest-Recreation district provides for remote residential development distant from public services. It is intended to prevent the destruction of natural or man-made resources, maintain large tracts for forest recreation purposes, provide for the continuation of forest management and production programs, and foster recreational uses and other compatible activities.

The Lake County North parcels are surrounded by land within two Superior National Forest Management Areas (see Figure 4.3.1-2): the General Forest – Longer Rotation Management Area (see Section 4.2.1.2) and the Riparian Emphasis Area Management Area. Lands in the Riparian Emphasis Area are located along rivers and lakes that receive moderate to low levels of recreation use. This designation promotes the restoration, protection, and enhancement of areas sensitive to degradation. Lands surrounding Seven Beaver Lake and adjacent to Tract 2 are the headwaters area of the St. Louis River, and are designated as a Riparian Emphasis Area Management Area.

The Lake County South parcel is largely bordered by lands in the General Forest – Longer Rotation Management Area. Adjacent parcels to the southwest are privately owned land; parcels to the northeast are county land in the Forest-Recreation zoning district.

Existing Land Use

A trail provides access to the Lake County North parcels, but access to the trail is relatively difficult (Lisson and Gawtry 2011). There is evidence of clearcut timber activity on the Lake County North parcels.

There is limited access to the Lake County South parcel due to wetlands and private land restrictions, and little evidence of active use (Lisson and Gawtry 2011).

Property Rights, Title, and Mineral Resources

Tract 2 parcels are tax forfeit lands that are being purchased in the name of Lake-Forest Enterprise, Inc. on a land contract from Lake County. An assignment on file with Andresen and Butterworth, PA assigns all right, title, and interest in these lands to PolyMet (USFS 2011c).

A review of mineral resources on Tract 2 indicates a low potential for exploration or development of bedrock or surficial deposits (Barr 2011c). A title commitment review found that one 40-acre parcel has one-half mineral interest outstanding and that all other minerals will be reserved by the State of Minnesota and subject to the Secretary's Rules and Regulations. Within the Lake County South parcel, one 40-acre parcel is subject to mineral reservation that includes the right to sink, cave, disturb, or remove surface material. Another parcel has one-half outstanding mineral interest with the right to remove but "doing no injury to the surface or else paying for damages." The third and final 40-acre parcel and the remaining one-half mineral interest would be reserved by the State of Minnesota and would be subject to the Secretary's Rules and Regulations (USFS 2011c).

4.3.1.2.3 Tract 3 – Wolf Lands

The Wolf Lands consist of four separate parcels in Lake County totaling 1,575.8 acres with a perimeter of approximately 14 linear miles. No hazardous material issues were identified at Tract 3 (EDR 2011b; EDR 2011c; EDR 2011d; EDR 2011e; MPCA 2012d).

Land Use Regulation

All Tract 3 parcels are within Lake County's Forest-Recreation zoning district, defined in Section 4.3.1.2.3 (ERM, Pers. Comm., October 10, 2011).

Wolf Lands 1, the southernmost parcel, is largely bordered by Superior National Forest land in the General Forest-Longer Rotation Management Area. Adjacent parcels to the southwestern and northeastern corners owned by Lake County are also within the Forest-Recreation district (see Figure 4.3.1-2).

Wolf Lands 2 is bordered to the north and south by Superior National Forest land in the General Forest Management Area. Adjacent parcels to the east are privately owned, in Lake County's Forest-Recreation district. Adjacent parcels to the west and southeast are state-owned land (see Figure 4.3.1-3).

Wolf Lands 3 is adjacent to Superior National Forest land in the General Forest Management Area. Small privately owned parcels to the east and west are within Lake County's Forest-Recreation district (see Figure 4.3.1-3). A timber harvest agreement currently encumbers parts of this parcel (USFS 2011c).

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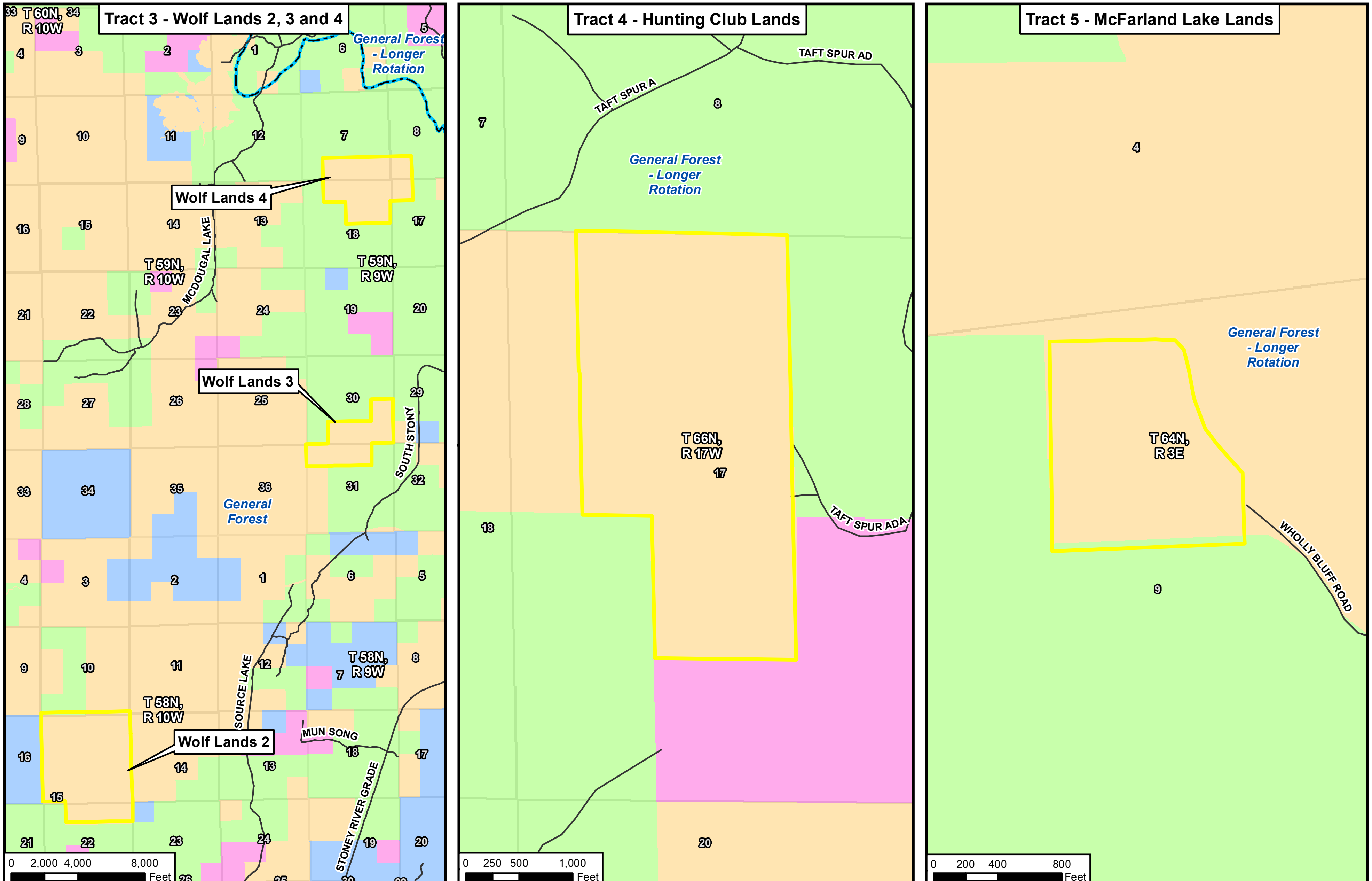

Figure 4.3.1-3
Ownership of Tracts 3, 4, and 5
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Wolf Lands 4 is surrounded by Superior National Forest land in the General Forest Management Area (see Figure 4.3.1-3).

Existing Land Use

Access to Wolf Lands 1 and 2 is limited by the distance from roads and the presence of wetlands surrounding Wolf Lands 2. There is no evidence of any active land use on either of these parcels (Lisson and Gawtry 2011).

Wolf Lands 3 is accessible from a trail off of Forest Road 393. There is evidence of ongoing timber harvesting on this parcel (Lisson and Gawtry 2011).

Wolf Lands 4 is accessible via overland hiking from Forest Road 106, but there is no evidence of active land use (Lisson and Gawtry 2011).

Property Rights, Title, and Mineral Resources

Tract 3 is being purchased in the name of Lake-Forest Enterprise, Inc., through options from Wolf Lands, Inc. An assignment on file with Andersen and Butterworth, PA assigns all right, title, and interest in these lands to PolyMet (USFS 2011c).

There appears to be low potential for exploration or development of bedrock or surficial deposits on the Wolf Lands parcels. There is a moderate potential for aggregate development within Wolf Lands 2, but the parcel's wetland areas and limited access may restrict this opportunity (Barr 2011c).

Within Wolf Lands 1, there is an undivided three-quarter mineral interest reserved by Anton T. Anderson; all remaining mineral interests are held by Kimberly Clark with the right to cave, disturb, damage, or remove the surface while accepting liability for surface damage. The title commitment review indicated that this represents a poor condition of title but may be immaterial because the mineral development potential is low. In addition, there is no timber reservation or agreement in place (USFS 2011c).

Within Wolf Lands 2, 3, and 4, mineral interests are reserved by Duluth & Iron Range Railroad Co. along with the right to sink, cave, disturb, and remove the surface. The title commitment review indicated that this represents a poor condition of title that may be immaterial because the mineral development potential is low.

There are no active timber reservations or agreements in place for the Wolf Lands parcels.

4.3.1.2.4 Tract 4 – Hunting Club Lands

Tract 4 is a single parcel southwest of Crane Lake in St. Louis County. It is composed of 160.0 acres, with a perimeter of approximately 2 linear miles. No hazardous material issues were identified at Tract 4 (EDR 2011f; MPCA 2012d).

Land Use Regulation

Tract 4 is within St. Louis County's Forest Agricultural Management (FAM-1) zoning district. This district is intended to promote the forestry and agricultural industries, as well as recreational uses (St. Louis County 2011). Adjacent parcels on the west and southeast are also in this county zoning district. Adjacent parcels to the southwest, north, and east are Superior National Forest lands in the General Forest– Longer Rotation Management Area (see Figure 4.3.1-3).

Existing Land Use

Tract 4 is accessible by trail from a gravel road northwest of the property. The tract includes portions of two small unnamed lakes. There is no evidence of active land use.

Property Rights, Title, and Mineral Resources

There is low potential for exploration or development of bedrock or surficial deposits within Tract 4 (Barr 2011c). The only title exception is the property's enrollment in the Sustainable Forest Incentive Act Covenant dated September 3, 2002. This status normally includes an 8-year commitment for enrollment (USFS 2011c). The Sustainable Forest Incentive Act Covenant still applies to Tract 4 according to the updated Commitment for Title Insurance for this parcel. The covenant means the property is not and will not be:

- Used for residential purposes;
- Used for agricultural purposes;
- Enrolled in the Reinvest in Minnesota program or in a state or federal conservation reserve or easement reserve program;
- Enrolled in the Minnesota Agricultural Property Tax Law;
- Subject to agricultural land preservation controls or restrictions or the Metropolitan Agricultural Preserves Act; or
- Improved with a structure, pavement, sewer, permanent campsite, or any road (other than a township road), that are used for purposes not prescribed in the forest management plan for the property.

This covenant may need to be extinguished in order for the United States to accept title. The acceptability of the covenant will be determined by the USDA, Office of General Counsel, if a decision is made to proceed with the Land Exchange Proposed Action.

4.3.1.2.5 Tract 5 – McFarland Lake Lands

Tract 5 is a single parcel approximately 3 miles from the US-Canada border in Cook County. It covers approximately 30.8 acres, with a perimeter of approximately one linear mile. No hazardous material issues were identified on Tract 5 (NTS 2010b; EDR 2009b; MPCA 2012d).

Land Use Regulation

Tract 5 is in an unincorporated area in Cook County's Forest/Agriculture Residential (FAR 2) zoning district. This designation is characterized by a mix of forestry, agriculture, residential, and recreational uses (Cook County 2011). Adjacent privately owned parcels to the north and southeast are also within this county zoning designation. The tract is bordered on the west and south by Superior National Forest lands within the General Forest – Longer Rotation Management Area (see Figure 4.3.1-3).

Existing Land Use

Tract 5 was formerly owned and used by Wheaton College. A bunkhouse, fire ring, outhouse, and cistern are present, although these structures are not in active use and would be removed prior to the completion of the Land Exchange Proposed Action. The tract's eastern boundary is formed by McFarland Lake, an entry point to the BWCAW. Access to the property is by water from a landing off CR 16, or by a walking trail from the end of CR 16 (Lisson and Gawtry 2011).

Property Rights, Title, and Mineral Resources

PolyMet owns the surface rights for this tract. The tract is subject to a mortgage in favor of Iron Range Resources, which would be satisfied at closing of the Land Exchange Proposed Action (USFS 2011c).

The tract was assessed for mineral potential and encumbrances as part of the Feasibility Analysis completed in 2009. The geology underlying the tract is composed of gabbro and sedimentary rocks. Studies of the mineral potential in this area are rare because of the proximity to the BWCAW, but this type of formation has not shown mineral potential elsewhere in the county. The MDNR core library index shows no drilling in or near the area. There are no nearby gravel operations that would indicate any potential for surficial materials (USFS 2009c).

There appears to be low potential for exploration or development of bedrock or surficial deposits within Tract 5 (Barr 2011c). Mineral rights to Tract 5 are outstanding, but deeds do not appear to waive the right to subjacent support (USFS 2011c) (i.e., mineral exploration and extraction may not compromise the "lay of the land" by weakening underground support of the surface).

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4.3.2 Water Resources

The federal lands are similar to the Mine Site area previously discussed, but excludes the privately-owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.2 presents a discussion of the existing conditions on the federal lands. The water resources of the federal lands are briefly described in Section 4.3.2.1. Water resources of the non-federal lands are described in Section 4.3.2.2.

4.3.2.1 Federal Lands

4.3.2.1.1 Land Exchange Proposed Action

The Land Exchange Proposed Action consists of exchanging 6,495.4 acres of federal lands (see Figure 3.3-1) for 7,075.0 acres of non-federal lands. Most of the Mine Site is composed of federal lands, with a small portion located south of Dunka Road being non-federal lands. The Land Exchange Proposed Action also includes federal lands located north and west of the Mine Site.

Groundwater

Groundwater resources in and near the Mine Site are discussed in detail in Section 4.2.2.2.1. In general, the glacial aquifer within the Land Exchange Proposed Action federal lands is typically very thin (less than 30 ft) with limited yield; there are no large-scale regional aquifers (MPCA 1995). The Duluth Complex, which immediately underlies the glacial material, is the least fractured of the bedrock units in the area, and therefore has the poorest aquifer characteristics.

Surface Water

Surface water resources in and near the Mine Site are discussed in detail in Section 4.2.2.2.2. Surface water resources within the Land Exchange Proposed Action federal lands include Mud Lake (PW-148P), and 3.8 miles of the Partridge River and 0.7 miles of Yelp Creek (see Table 4.3.2-1), also a MDNR-designated public water resource. There are no known wild rice beds within these public waters.

Table 4.3.2-1 Summary of Surface Water and Wild Rice Beds for Federal Lands

	Federal Lands	
	Land Exchange Proposed Action	**Land Exchange Alternative B**
Public Water Lakes, ac. (mi. shore)	30.5 (0.9)	Approximately 8.9 (0.2)
Public Water Streams, mi. stream	4.5	4.5
Wild Rice Beds, ac.	--	--

Sources: PW data from MDNR 2012j; Wild Rice data from MDNR 2008c.

4.3.2.1.2 Land Exchange Alternative B

Land Exchange Alternative B: Smaller Federal Parcel lands are somewhat smaller than the Land Exchange Proposed Action, totaling 4,752.6 acres, which excludes the far western portion of the Land Exchange Proposed Action federal land area (see Figure 3.3-1). The Land Exchange Alternative B consists of exchanging 4,752.6 acres of federal lands for 4,926.3 acres of non-federal lands.

Groundwater

Groundwater resources of the Land Exchange Alternative B: Smaller Federal Parcel lands are essentially the same as those of the Land Exchange Proposed Action.

Surface Water

Surface water resources of the Land Exchange Alternative B: Smaller Federal Parcel lands are essentially the same as those of the Land Exchange Proposed Action, with the exception that the northwest boundary of the Land Exchange Alternative B bisects Mud Lake, including only about 30 percent of its shoreline.

4.3.2.2 Non-federal Lands

Water resources considered in this evaluation of the five non-federal land tracts proposed for exchange include the following:

- Quality and flow of groundwater;
- Quality and flow of surface water; and
- Quantity of wild rice beds.

4.3.2.2.1 Regional Groundwater Resources

Regional Groundwater Water Quality

There are no known, site-specific groundwater quality data for any of the non-federal Land Exchange Proposed Action lands. However, there were two studies that collected surficial groundwater quality data throughout the region that may be used to generally characterize potential groundwater quality at the exchange sites. The MPCA studied groundwater quality throughout the state, and published several documents that describe the general condition of the groundwater resource in northeast Minnesota. They note that glacial aquifers in this part of the state are commonly thin and limited in their extent and yield; there are no large-scale regional aquifers (MPCA 1995). The Regional Copper-Nickel Study (Siegel and Ericson 1980) generally focused on the area around the Duluth Complex, so data from that study may not be as broadly applicable.

In addition, between 1992 and 1996, the MPCA's Ground Water Monitoring and Assessment Program sampled 21 wells completed in surficial sand and gravel aquifers and 64 completed in buried, confined sand and gravel aquifers within MPCA Region 1, which encompasses seven counties in northeastern Minnesota including St. Louis County (MPCA 1999a). The MPCA study concluded that groundwater quality across the region is generally good. Concentrations of major cations and anions were lower in surficial and buried drift aquifers compared to similar aquifers statewide, while concentrations of trace metals were higher. They noted that since geology controls groundwater quality in the region, trace inorganic constituents commonly found in the bedrock, such as beryllium, manganese, boron, arsenic, and selenium may have naturally elevated concentrations locally. Of the 85 surficial and buried aquifer samples that were collected, MPCA recorded five exceedances of the state drinking water criteria for beryllium, four for manganese, and one for boron. There were no exceedances noted for arsenic or selenium.

Although these data may not be directly applicable to any one of the Land Exchange Proposed Action lands, they can be used to draw general conclusions about the probable range of water quality. Table 4.2.2-6 summarizes Mine Site groundwater quality data and compares it with the MPCA (i.e., Northeast MN Baseline) and copper-nickel (i.e., Cu-Ni Baseline) study data for surficial aquifers. The range of values across the region for the five constituents of concern noted by the MPCA was generally comparable to the ranges monitored at the Mine Site, with the exception of manganese, which was higher for some of the regional samples.

Probable Groundwater Source Areas for the Exchange Lands

As suggested by the MPCA study for the northeast region, all of the exchange tracts, with the possible exception of the Tract 1, appear to be characterized by thin glacial aquifers with limited yield. Source areas of surficial groundwater also appear to be limited, usually within a mile or two of each tract.

The general applicability of the regional, surficial data to the exchange lands is somewhat dependent on the potential for local anthropogenic (man-made) contamination of groundwater. A cursory evaluation of the surficial groundwater source area for each parcel is made in the groundwater discussion for each of the tracts below.

4.3.2.2.2 Surface Water Resources

The five tracts drain either south to the Lake Superior Watershed or north to the Hudson Bay Watershed. Except for timber harvest, they are all generally undisturbed with native forest cover. Little, if any, hydrologic or water quality data has been collected for any of the tracts. The surface water resources of each tract are described below. Table 4.3.2-2 summarizes the surface water and wild rice beds of each tract.

Table 4.3.2-2 Summary of Surface Water and Wild Rice Beds for all Land Exchange Proposed Action Tracts

	Non-federal Lands					**Non-federal Totals**
	Tract 1 – Hay Lake Lands	**Tract 2 – Lake County Lands**	**Tract 3- Wolf Lands**	**Tract 4 – Hunting Club Lands**	**Tract 5 – McFarland Lake Lands**	
Public Water Lakes, ac. (mi. shore)	125.7 (2.8)	--	--	--	0 (0.2)	**125.7 (3.0)**
Public Water Streams, mi. stream	8.1	--	1.0	--	--	**9.1**
Wild Rice Beds, acres.	125.7	--	--	--	--	**125.7**

Sources: PW data from MDNR 2012j; Wild Rice data from MDNR 2008c.

4.3.2.2.3 Tract 1 – Hay Lake Lands

Groundwater

This tract would appear to be the most susceptible of all the tracts to anthropogenic influences since it is located only a few miles away from the Mesabi Iron Range and several local communities. However, a natural topographic and bedrock divide separates most of the Mesabi Iron Range mining activities from the tract, meaning that surficial groundwater flow to the tract is isolated from most mining and community influences. One mining feature within the same watershed (Pike River) is ArcelorMittal Steel's Tailings Basin, located about 0.5 miles to the west. The general topography of the area suggests that groundwater flow from the Tailings Basin is to the northeast, away from the Hay Lake lands. Limited surface water quality data from Hay Lake and Rice Lake indicate that sulfate concentrations vary between less than 1.0 and 3.6 mg/L (Barr 2012a), indicating no influence from the Tailings Basin.

Three piles of household waste and soil with minor oil impacts were removed from the Hay Lake tract by PolyMet. Confirmation soil sampling and analyses indicated all impacted soils were removed, and found no evidence that contamination had migrated to groundwater (NTS 2011).

Surface Water

Hay Lake lands drain to the Pike River, which flows into Lake Vermilion near Tower, Minnesota (see Figure 4.3.2-1). The lands contain two MDNR-designated public water lakes—Hay Lake (PW 69-579P) and Rice Lake (PW 69-578W). Hay Lake is 96.2 acres with 1.9 miles of shoreline; Rice Lake is 29.5 acres with about 1 mile of shoreline. This tract also contains about 8 miles of the Pike River, an MDNR-designated public water stream. Hay Lake, Rice Lake, and the Pike River, all of which contain wild rice beds, lie within the Hay Lake lands. These are the only waterbodies within the proposed non-federal land exchange tracts known to contain wild rice beds. These waterbodies were included in four annual wild rice surveys performed from 2009 to 2012 (Barr 2009b; 2011a; 2012a; 2013m); survey results were similar for 2009-2011 with no apparent trends in density or distribution. Hay Lake was found to have small, low density wild rice beds (density factor 1 of 5) across the entire lake. Rice Lake was found to have many beds across the entire lake with density factor ratings of 3 to 5. Pike River was also found to have beds with density factor ratings of 3 to 5 across the entire river near Rice Lake, with near-bank beds further upstream. The survey performed in 2012 found lower densities of wild rice beds. Hay Lake, Rice Lake, and the Pike River all had density factor ratings of 1. The decreases in density in Rice Lake and the Pike River were consistent with a decrease in wild rice bed density across all areas surveyed in 2012.

ArcelorMittal Steel's Tailings Basin is located about 2 miles northwest of Hay Lake (see Figure 4.3.2-1). Seepage from the basin flows north into Wouri Creek, which is also a tributary to the Sandy River. Three water quality samples taken from Hay Lake during the summer of 2009 all had a sulfate concentration of 1.1 mg/L, and one sample taken in 2010 had a sulfate concentration less than 1 mg/L (Barr 2011a), suggesting that seepage from the ArcelorMittal Steel's Tailings Basin is not reaching the lake. Water clarity was estimated at 6 to 12 ft based on 1999-2001 satellite imagery. Sulfate concentrations in Rice Lake and in the Pike River just downstream of Rice Lake were measured annually from 2009 to 2012 during the wild rice surveys. Sulfate concentrations in Rice Lake ranged from 2.1 to 2.4 mg/L. Sulfate concentrations in the Pike River just downstream of Rice Lake ranged from 2.1 to 3.6 mg/L (Barr 2013l). There are no other known water quality data for this tract.

4.3.2.2.4 Tract 2 – Lake County Lands

Groundwater

The Lake County lands are located near the headwaters of small, tributary streams with local source areas for groundwater. There are no known land-use activities within the source areas that suggest the potential for detrimental effects to groundwater quality.

Surface Water

This tract contains four parcels; three are located in close proximity to each other with a fourth parcel located about 14 miles to the southeast (see Figure 4.3.2-2 and Figure 4.3.2-3). There are no DNR-designated public waters within Tract 2. The three clustered parcels flow to the southwest through a series of small streams that are tributaries to the Cloquet River. The Cloquet River drains into the St. Louis River, which ultimately drains into Lake Superior. The Lake County South parcel flows to a tributary of the Beaver River (MDNR-designated public water stream), which ultimately drains into Lake Superior. There are no known water quality data for this tract.

4.3.2.2.5 Tract 3 – Wolf Lands

Groundwater

The Wolf Lands are located near the headwaters of small, tributary streams with local source areas for groundwater. There are no known land-use activities within the source areas that suggest the potential for detrimental effects to groundwater quality.

Surface Water

This tract consists of four parcels (see Figure 4.3.2-3, Figure 4.3.2-4, Figure 4.3.2-5, and Figure 4.3.2-6). Wolf Lands 1 is located immediately adjacent to the Lake County lands, contains no protected waters, and discharges to the same Cloquet River tributary as the Lake County lands.

Wolf Lands 2 is located adjacent to two creeks that are tributaries to Greenwood Lake; Mary Ann Creek is located to the west and an unnamed creek is located to the southeast. Greenwood Lake flows northerly to the Stony River. There are no public waters within this parcel.

Coyote Creek flows within the northern portion of Wolf Lands 3 and bifurcates Wolf Lands 4. Coyote Creek is a tributary and a MDNR-designated public water stream to McDougal Lake, which eventually flows into Stony River. Wolf Lands 3 contains 0.1 mile and Wolf Lands 4 contains 0.9 mile of Coyote Creek. There are no known water quality data for this tract.

4.3.2.2.6 Tract 4 – Hunting Club Lands

Groundwater

The Hunting Club lands are located near the headwaters of small, tributary streams with local source areas for groundwater. There are no known land-use activities within the source areas that suggest the potential for detrimental effects to groundwater quality.

Surface Water

This entire tract drains into an unnamed tributary of the Vermilion River, which flows north to Crane Lake (see Figure 4.3.2-7). There are no DNR-designated public waters within this land. There are no known water quality data for this tract.

4.3.2.2.7 Tract 5 – McFarland Lake Lands

Groundwater

The McFarland Lake lands may have the most limited groundwater resource of all the tracts due to very shallow glacial material over bedrock. Source areas for groundwater flow to the tract appear to be limited to the tract itself and a small, undeveloped drainage 0.5 mile northwest of the tract. There are no known land-use activities within the source area that could potentially affect groundwater quality.

Surface Water

This tract is tributary to McFarland Lake (MDNR PW 027P), which drains into the border lakes of the BWCAW (see Figure 4.3.2-8). It contains about 0.2 mile of McFarland Lake shoreline. There is no known water quality data for this tract or for McFarland Lake, other than 13 secchi disk (water clarity) readings taken from 1989 through 2008. The average secchi disk reading was 16.1 ft, which is near the high end of the typical range for water clarity in this region of Minnesota. This secchi disk reading indicates that McFarland Lake is about mid-way between oligotrophic and mesotrophic, which suggests that the lake has relatively low nutrient enrichment.

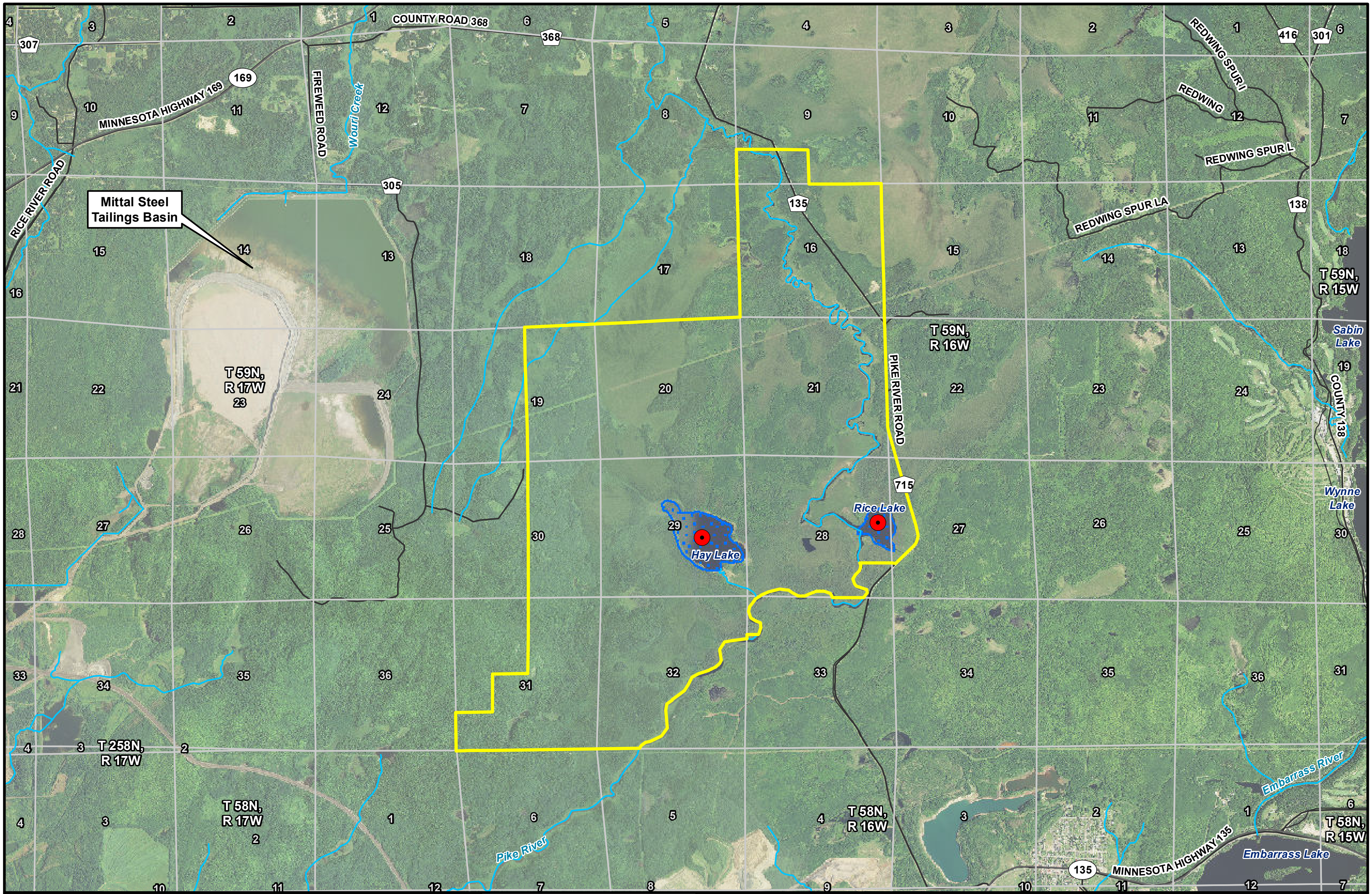

Figure 4.3.2-1
Surface Water
Tract 1 - Hay Lake Lands
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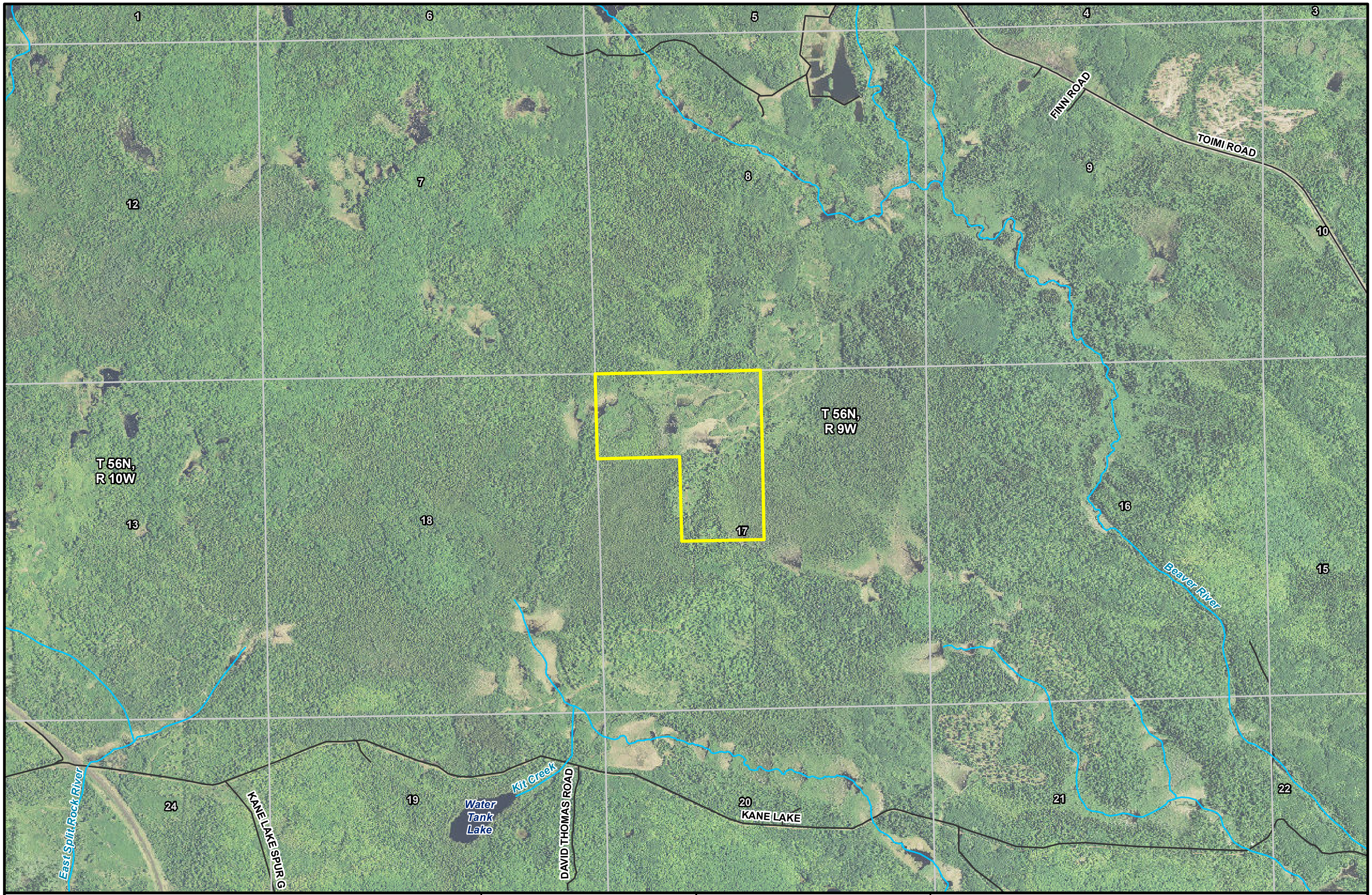

Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
Section Label
Road

N
W E
S

0 0.125 0.25 0.5 Miles

Figure 4.3.2-2
Surface Water
Tract 2 - Lake County South Lands
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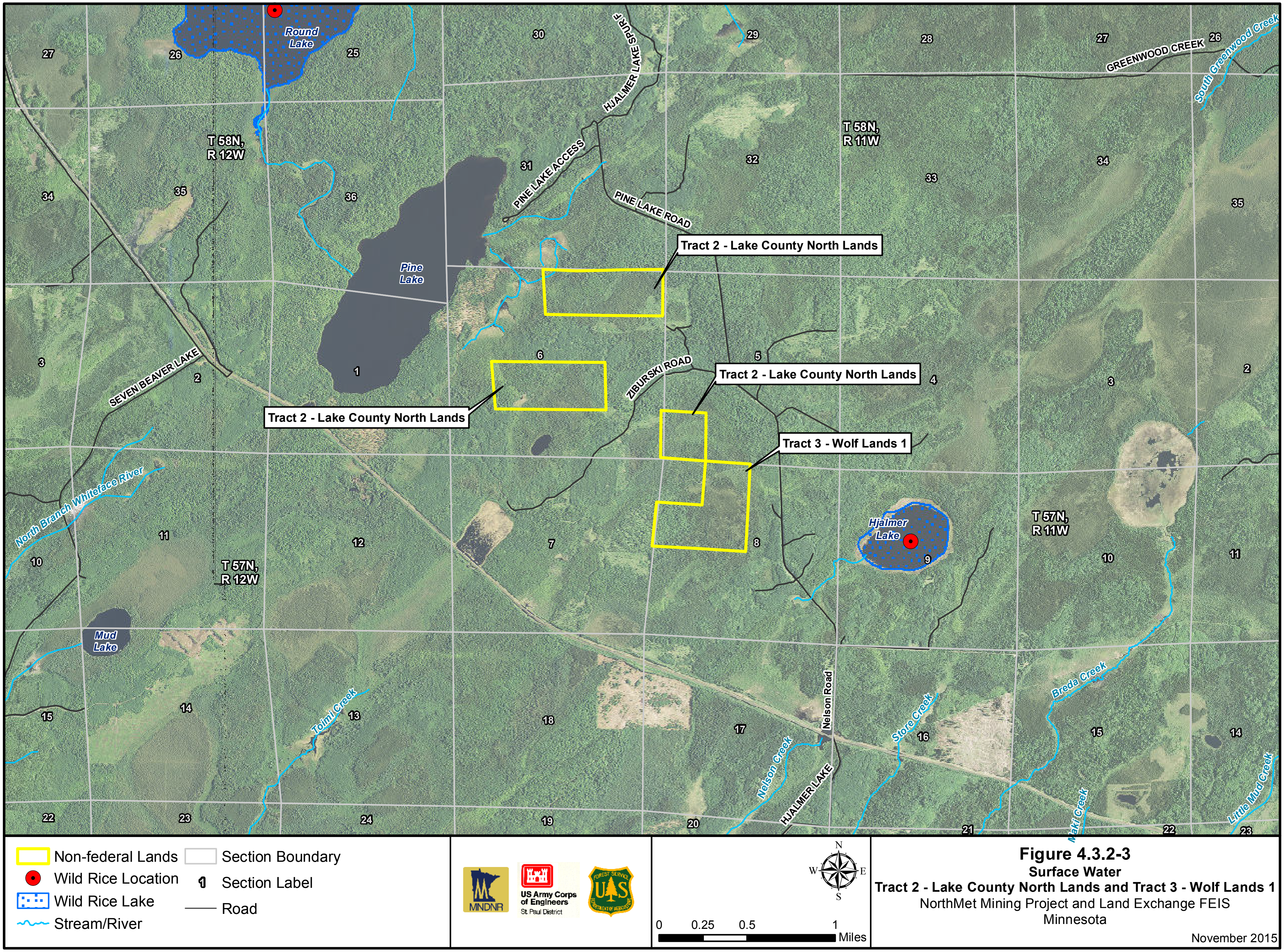

Figure 4.3.2-3
Surface Water
Tract 2 - Lake County North Lands and Tract 3 - Wolf Lands 1
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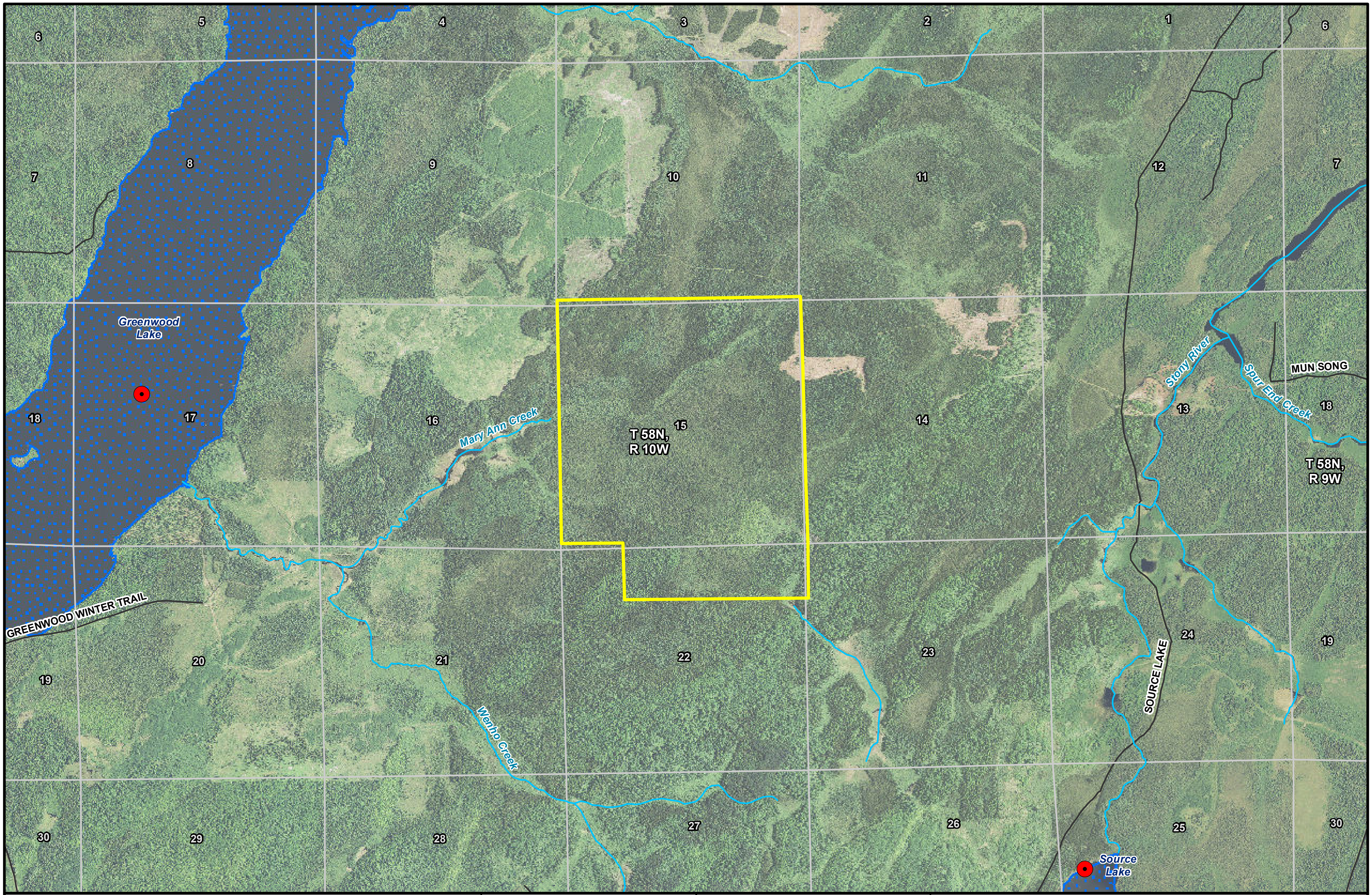

Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
Section Label
Road

0 0.175 0.35 0.7 Miles

Figure 4.3.2-4
Surface Water
Tract 3 - Wolf Lands 2
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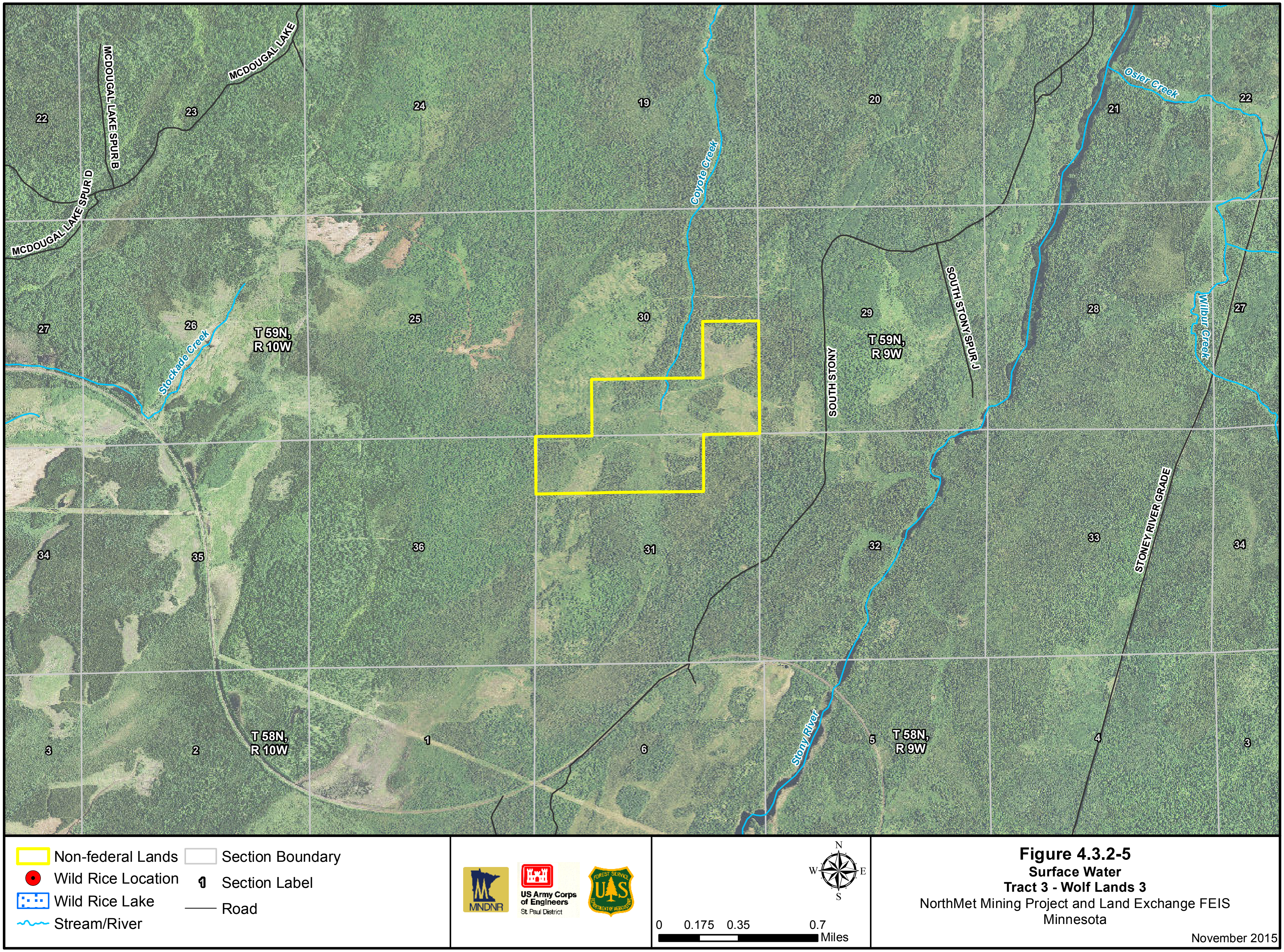

Figure 4.3.2-5
Surface Water
Tract 3 - Wolf Lands 3
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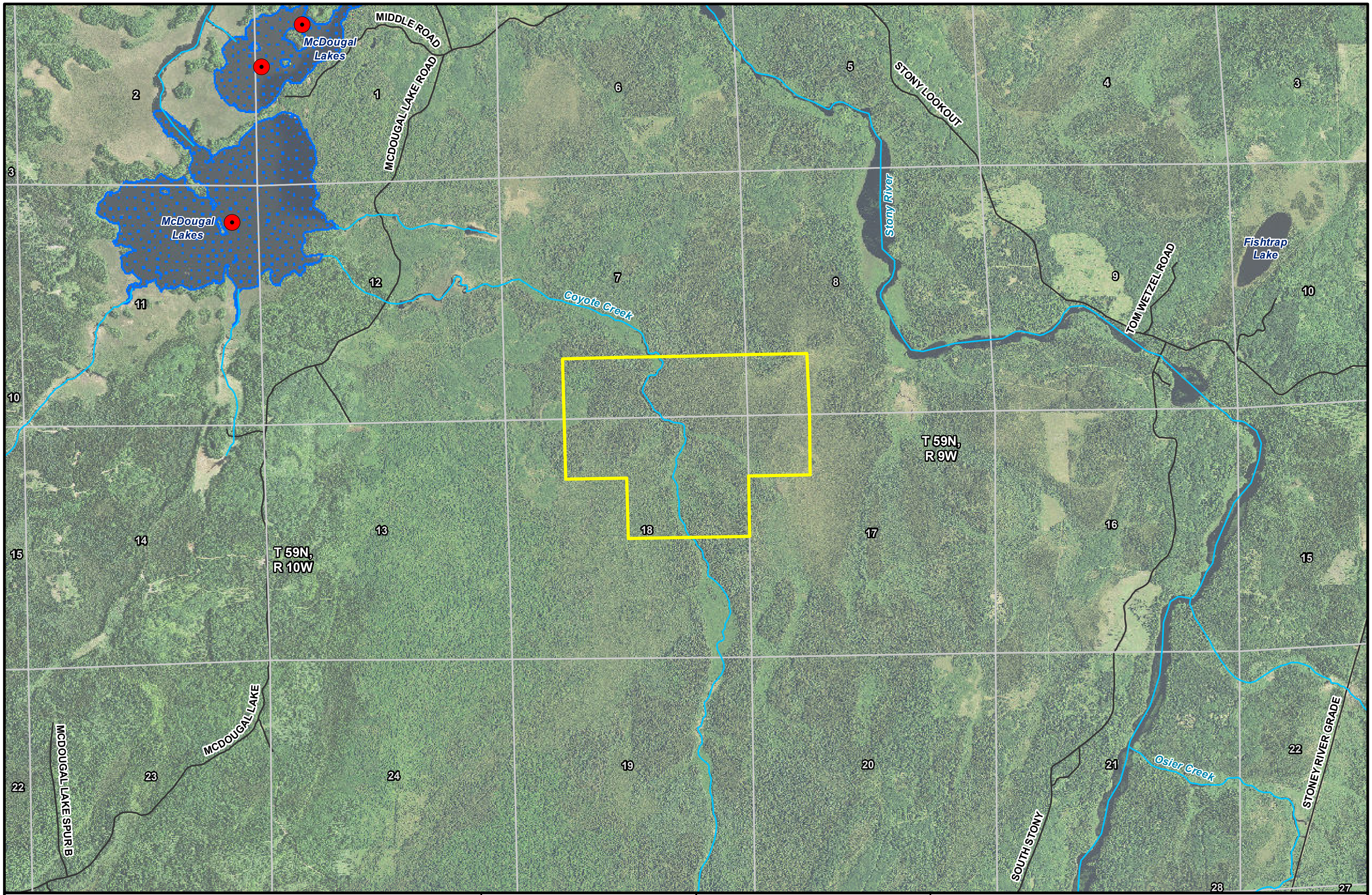

Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
1 Section Label
Road

MNDNR
US Army Corps of Engineers St Paul District

0 0.175 0.35 0.7 Miles

Figure 4.3.2-6
Surface Water
Tract 3 - Wolf Lands 4
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Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
1 Section Label
Road

MNDNR | US Army Corps of Engineers St. Paul District | Forest Service U.S. Department of Agriculture

N S E W

0 0.25 0.5 1 Miles

Figure 4.3.2-7
Surface Water
Tract 4 - Hunting Club Lands
NorthMet Mining Project and Land Exchange FEIS
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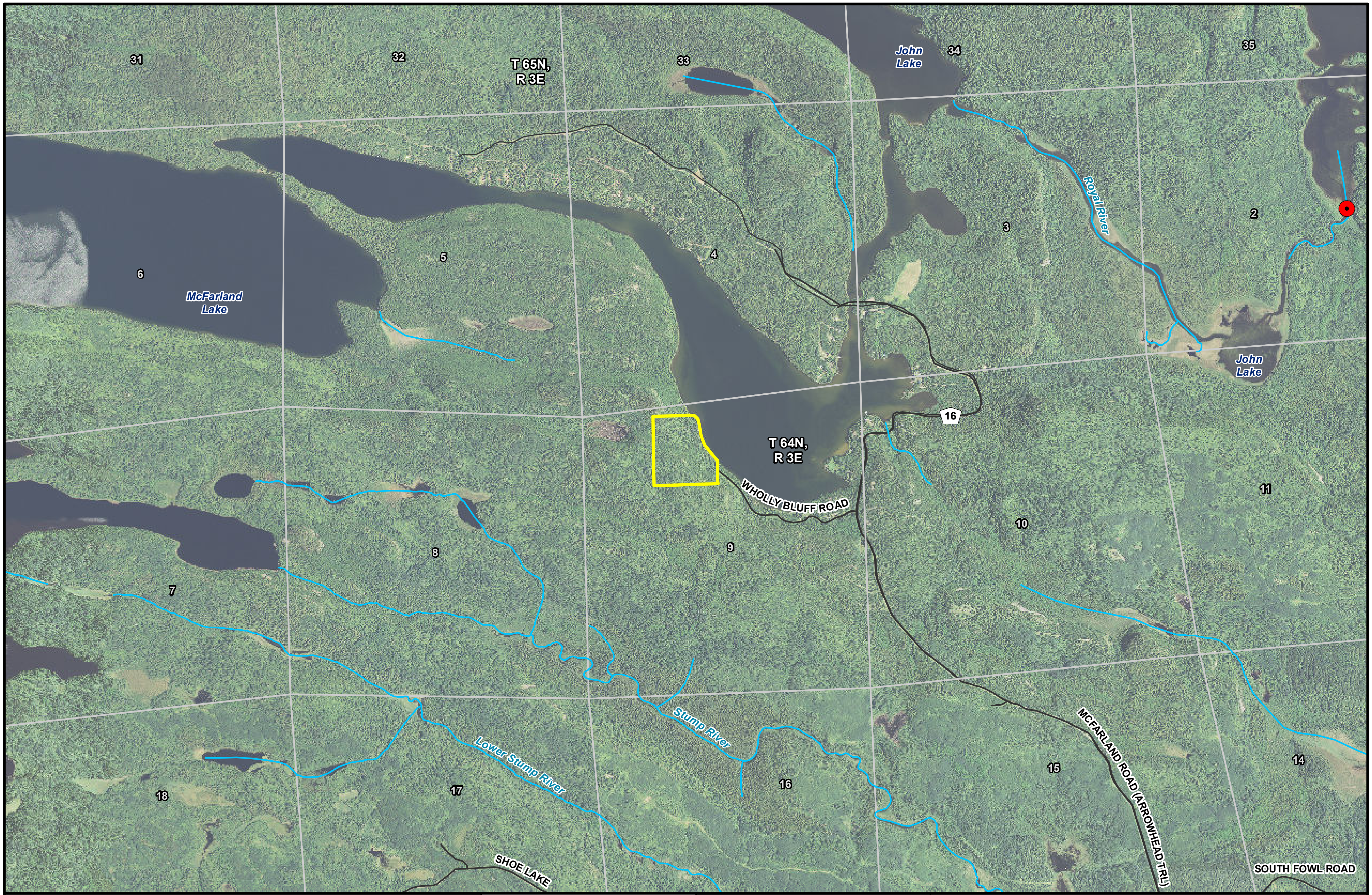

Non-federal Lands
Wild Rice Location
Wild Rice Lake
Stream/River
Section Boundary
1 Section Label
Road

MNDNR
US Army Corps of Engineers
St Paul District

N W E S

0 0.15 0.3 0.6 Miles

Figure 4.3.2-8
Surface Water
Tract 5 - McFarland Lake Lands
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4.3.3 Wetlands

4.3.3.1 Federal Lands

The federal lands, both the Land Exchange Proposed Action and Land Exchange Alternative B boundaries, are located in the Partridge River Watershed, about 3 miles south of the Laurentian Divide (see Figures 4.3.3-1 and 4.2.2-1). As previously stated, the Partridge River is located in the East St. Louis River Watershed, which discharges into Lake Superior. Much of the federal lands consist of wetlands and the Land Exchange Proposed Action boundary includes a portion of the One Hundred Mile Swamp. The One Hundred Mile Swamp (see Figure 4.3.3-1) is a large wetland of approximately 3,028 acres that was aerially surveyed by the MDNR as part of a larger study (MDNR 1997); however, no delineated boundary exists for the One Hundred Mile Swamp. The following sections provide baseline information on the Land Exchange Proposed Action and Land Exchange Alternative B boundaries.

4.3.3.1.1 Land Exchange Proposed Action

Wetland Delineation and Classification

Wetland characterization, mapping, and surveys for the federal lands were conducted between 2004 and 2010. The wetland delineation and classification is the same as described in Section 4.2.3.1.1. The federal lands within the Land Exchange Proposed Action encompass 6,495.4 acres (see Figure 4.3.3-1).

Wetland delineations of the federal lands surrounding the Mine Site were subsequently conducted in August 2004, June 2005, and July 2006. Between 2007 and 2010, additional wetlands within the federal lands adjacent to the Mine Site were identified from aerial photographic interpretation and field studies. In August 2008, additional upland and wetland habitat surveys were conducted on the areas outside the Mine Site on the adjoining federal lands. Initially, potential wetland locations were determined by reviewing CIR aerial photographs, USGS topographic maps, and wetland maps previously prepared. Aerial photographs and field maps were then used in the field to verify cover types. Upon completion of field studies, cover types were mapped as habitat polygons. Polygons were digitized using GIS and overlaid onto habitat maps created from aerial photographs. These maps and the associated GIS database were used to determine the approximate acreage of each wetland type.

During the field surveys, data was collected related to the overall functions and values of the wetlands within the federal lands associated with the Mine Site (see Section 4.2.3.1.3) and of representative wetlands within the federal lands adjacent to the Mine Site. Wetland functions and values were rated using the guidelines in the MnRAM, Versions 3.0-3.2.

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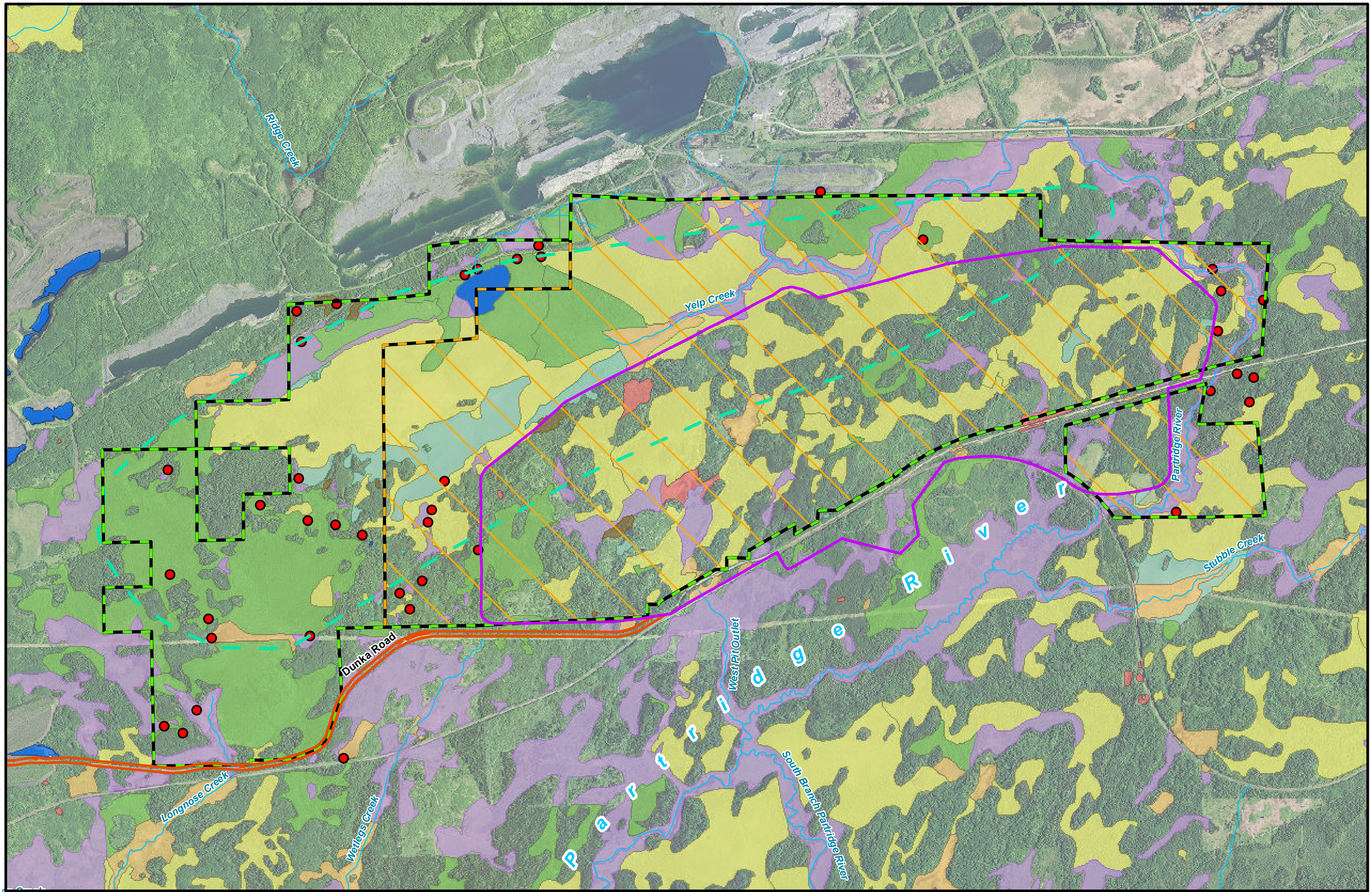

- Mine Site
- Federal Lands
- Alternative B: Smaller Federal Parcel
- Transportation and Utility Corridor
- Stream/River
- One Hundred Mile Swamp (Approximate Boundary)
- Wetland Assessment Site

Eggers & Reed Wetland Types

- Coniferous Bog
- Coniferous Swamp
- Deep Marsh & Shallow Marsh
- Hardwood Swamp
- Open Bog
- Sedge Meadow & Wet Meadow
- Shrub Swamps (Alder Thicket & Shrub-Carr)
- Shallow, Open Water & Lake

MNDNR

US Army Corps of Engineers
St. Paul District

N
W E
S

0 0.25 0.5 1
Miles

Figure 4.3.3-1
Wetland Community Types Federal Lands and Alternative B: Smaller Federal Parcel
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Hydrology, Wetland Vegetation, and Community Types

The hydrology, wetland vegetation, and community types of the federal lands within the Land Exchange Proposed Action include those elements within the Mine Site boundary (see Section 4.2.3.1.2), as well as the adjoining federal lands to the northwest. The hydrology, wetland vegetation, and community types are discussed below.

Bogs in the federal lands consist of leatherleaf and bog Labrador-tea, with scattered speckled alder, swamp birch, tamarack, and, in some areas, cattail and sedges. Sphagnum moss was observed to cover 80 to 90 percent of the bogs. Other species encountered during the field work include: black spruce, tamarack, blueberry, small fruited bog cranberry, willows, purple pitcher plant, marsh cinquefoil, cottongrass, round sundew, starflower, bunchberry, and Solomon's seal (AECOM 2011a).

Shrub swamp communities on the adjoining federal lands surrounding the Mine Site were observed to consist of a dense cover of speckled alder. These wetlands typically include sapling balsam fir, jack pine, black spruce, willow, and the occasional American mountain-ash. Dominant low shrubs include bog Labrador-tea, leatherleaf, lowbush blueberry, prickly rose, raspberry, and red-osier dogwood. Mountain maple saplings were also present during the field work in a few wetlands. Herbaceous layer species include club and sphagnum mosses, woolly sedge, bluejoint, horsetail, wood fern, bunchberry, bluebead lily, starflower, and creeping snowberry (AECOM 2011a).

The forested swamp communities (coniferous swamps and hardwood swamps) for the federal lands surrounding the Mine Site are also dominated by black spruce and northern white cedar, with scattered tamarack. Deciduous and mixed forest wetlands are uncommon; aspen is the dominant deciduous species found in these forests. Much of One Hundred Mile Swamp consists of mature (80-plus years) black spruce and northern white cedar. Bog Labrador-tea, leatherleaf, and blueberry are prevalent, as is spruce regeneration. In some areas with dense stands of spruce, few shrubs were seen during field surveys, but sphagnum and club mosses often covered nearly 100 percent of the ground. More open stands may have an understory comprised of shrubs and scattered sapling white cedar, tamarack, and black spruce, along with speckled alder and willow. Common species include bluebead lily, Solomon's seal, horsetail, starflower, and creeping snowberry. Some areas also have cottongrass and bog laurel. An area in the southern portion of One Hundred Mile Swamp has a large number of purple pitcher plants. Forest and shrub cover typically range from 40 to 70 percent, while moss and other understory vegetation cover from 60 to 90 percent of the ground (AECOM 2011a).

There were several ponds/inland fresh meadow (emergent) wetlands identified on the federal lands surrounding the Mine Site that were created by logging activities, road construction, or beaver dams, or were natural depressions or associated with the Partridge River. These wetlands were often dominated by bluejoint, sedges, and cattails. Water depths were several feet in deeper areas. Spruce and other trees associated with the wetland were often killed when flooded as a result of the rising water level. Willows, tamarack, and speckled alder were often found along the border of these wetlands, but comprised less than 20 percent of the cover. Wild iris is common in some inland fresh meadow wetlands, as was horsetail, burreed, spikerush, and woolly sedge (AECOM 2011a).

The wetland assessment identified 200 wetlands covering 4,164.4 acres (64 percent) within the 6,495.4 acre federal lands boundary (see Figure 4.3.3-1). Table 4.3.3-1 below summarizes the wetland areas within the federal lands represented by each Eggers and Reed (1997; 2014) wetland community type. A large portion of the wetlands within the federal lands are located in the floodplains of Yelp Creek and the Partridge River or one of their associated tributaries. The most common wetland types within the federal lands are coniferous bogs (approximately 47 percent), coniferous swamps (31 percent), and shrub swamps (approximately 13 percent), which includes alder thickets and shrub-carrs.

Other wetland community types present within the federal lands include open bog, shallow marsh, hardwood swamp, open water, and sedge/wet meadows. Section 4.2.3.1.2 provides a discussion on the hydrology, wetland vegetation, and community types of the federal lands.

Table 4.3.3-1 Wetland Acreage by Wetland Community Type for the Federal Lands within the Land Exchange Proposed Action and within the Land Exchange Alternative B

	Land Exchange Proposed Action		Land Exchange Alternative B	
Eggers and Reed Class[1]	**Acres**	**%**	**Acres**	**%**
Coniferous bog	1,961.4	47	1,677.0	59
Coniferous swamp	1,287.8	31	476.1	17
Deep marsh	0.0	0	0.0	0
Hardwood swamp	21.1	<1	13.7	<1
Open bog	209.5	5	175.0	6
Open water (includes shallow, open water, and lakes)	30.8	1	8.6	<1
Sedge/wet meadow	35.7	1	34.9	1
Shallow marsh	97.0	2	80.9	3
Shrub swamp (includes alder thicket and shrub-carr)	521.1	13	394.7	14
Total	4,164.4	100	2,860.9	100

Note:
1 Eggers and Reed 1997; 2014.

Wetland Functional Assessment

The Land Exchange Proposed Action federal lands include the Mine Site area as well as the adjoining federal lands to the northwest. The wetland function and values assessment for the Mine Site is described in 4.2.3.1.3 and wetlands function and values for the federal lands surrounding the Mine Site are provided below.

During the surveys conducted for the federal lands surrounding the Mine Site, the primary wetland functions rated by MnRAM 3.2 were evaluated based on a review of the following: 1) wetland soil, hydrology, and vegetation; 2) outlet characteristics; 3) watershed and adjacent upland land uses and conditions; 4) erosion and sedimentation; and 5) human disturbances (AECOM 2011a). The Eggers and Reed (1997; 2014) classification system was used to classify wetland communities for the wetland function and value evaluation. Landscape factors were typically evaluated on a larger scale. Sixty-three questions given in MnRAM 3.2 were addressed for the August 2008 field surveys, and all factors were evaluated for each wetland surveyed. Based on this assessment methodology, wetlands were rated high, medium, or low.

The wetland functions that were typically most applicable to the federal lands include the following:

- Maintenance of characteristic hydrologic regime;
- Maintenance of wetland water quality;
- Vegetative diversity/integrity;
- Maintenance of characteristic wildlife habitat structure;
- Downstream water quality;
- Groundwater interaction; and
- Aesthetics/recreation/education/cultural.

During 2008, 40 wetlands, or portions of wetlands, were evaluated for their functions and values at representative wetland locations within the federal lands outside the Mine Site boundary (see Figure 4.2.3-2 and Table 4.3.3-2); nearly all wetlands were rated with a high value (approximately 93 percent) for wetland functions based on minimal or no current disturbance. Only a small subset (approximately 7 percent) of the wetlands was disturbed wetlands (AECOM 2011d). Vegetation diversity/integrity was high for 93 percent of the wetlands because they have been minimally altered by recent anthropogenic factors and had a relatively constant supply of water. Wetland vegetation around the Mine Site needed no active management and provided quality habitat for fish and wildlife. The overall rating was based on the highest rated community for vegetation diversity and integrity, rather than the average or weighted value for community vegetation diversity and integrity. MnRAM 3.2 guidance states that this is the appropriate measure for assessing wetland quality for regulatory purposes (AECOM 2011a).

Wildlife habitat was rated high for most wetlands on the basis of natural wildlife corridors and upland communities relatively untouched by recent human disturbances or effects. Wildlife habitat was rated lower in areas where there were few plant communities (AECOM 2011d).

Fish habitat was rated as not applicable for most wetlands, primarily because they did not have enough standing water throughout the year to support fish. Other characteristics associated with the rating include isolated wetlands that are not permanently flooded, or forested wetlands where the water table was below the surface for all or part of the year (AECOM 2011d).

Amphibian habitat was rated high for most wetlands, primarily because they stayed inundated long enough in most years to allow amphibians to successfully reproduce. Amphibian habitat was rated not applicable for some wetlands if conditions needed to support amphibian reproduction did not occur at the site. Forested wetlands with little or no standing water during the mating season would likely not support amphibians (AECOM 2011d).

Aesthetic, recreational, educational, and cultural values were rated medium. All wetlands were aesthetically pleasing and could be used for recreation, education, and cultural purposes. However, road access to the federal lands surrounding the Mine Site is only available via a private mining road and is not easily accessible to the general public (AECOM 2011d). Access to the federal lands is discussed in Section 4.3.1.

Table 4.3.3-2 Wetland Functions and Values Assessment for the Federal Lands Surrounding the Mine Site, 2008

	Functional Value Ratings (%)								
Wetland Functions and Value Rating	**Vegetation Diversity/ Integrity**	**Hydrology**	**Flood Attenuation**	**Downstream Water Quality**	**Wetland Water Quality**	**Wildlife Habitat**	**Fish Habitat**	**Amphibian Habitat**	**Aesthetics/ Education/ Cultural**
High	93	98	2	95	93	93	38	55	0
Moderate	7	2	98	5	7	7	2	7	100
Low	0	0	0	0	0	0	0	5	0
Not Available or Applicable	0	0	0	0	0	60	60	33	0
Total	100	100	100	100	100	160	100	100	100

Source: AECOM 2011a.

Floodplains

Floodplains are lowland areas adjacent to lakes, wetlands, and rivers that are prone to being inundated by water during a flood. Floodplains carry and store water and help to attenuate water flows. Floodplains also provide important habitat for fish and wildlife; filter sediments, nutrients, and pollutants from the water; and are important for public uses, such as fishing and hunting.

There are several definitions people use to estimate the limits of a floodplain. These include an ecological definition, a zoning or regulatory definition, and a hydrologic definition based upon the frequency of flood inundation. Ecologically defined floodplains are considered and described as wetlands for the effects analysis. Federal EO 11988, Section 2(a)(1), states that the "[d]etermination [of a floodplain] shall be made according to a Department of Housing and Urban Development (HUD) floodplain map or a more detailed map of an area, if available. If such maps are not available, the agency shall make a determination of the location of the floodplain based on the best available information."

A Flood Insurance Rate Map (FIRM) developed by the Federal Emergency Management Agency (FEMA) for most of St. Louis County estimates the floodplain areas of inundation. The areas identified on the FIRM are considered "mapped floodplains." The mapped floodplains can be the result of a detailed hydrologic investigation associated with a 100-year (1 percent chance) return frequency flood elevation or an approximation based upon topography of floodplains. Wetlands were not generally mapped as floodplains by FEMA because they had relatively less development pressure with less need for regulation and establishment of insurance rates. Smaller streams with a contributing drainage area of less than 1 square mile were not prioritized by FEMA for mapping. In addition, some areas adjacent to lakes were not mapped because the land use was managed by shoreland ordinances.

The Land Exchange Proposed Action federal lands are within a portion of St. Louis County that is unmapped by FEMA. Therefore, there is no FEMA estimate of the areas of inundation and there are no FEMA-mapped floodplains on the federal lands. However, a hydrologic model (XP-SWMM) was developed as part of the hydrologic analysis needed for the design of the NorthMet Project Proposed Action. The area of inundation associated with the 500-year (or 0.2 percent chance) floodplain of the Partridge River was estimated as part of this analysis. This estimate of the floodplain area in the federal lands was used for the effects analysis.

Floodplain importance was determined by measuring the number of acres of floodplain per acre of parcel as an index to the relative importance of floodplains on the parcels. The unmapped floodplain area on the federal lands associated with the Partridge River and Yelp Creek, estimated using the XP-SWMM, was estimated to total 1,889.4 acres of floodplain (500-year floodplain) (see Figure 4.3.3-2). The ratio of the number of acres of floodplain per acre of parcel for the federal lands is 0.3. The proposed mining activity associated with the NorthMet Project Proposed Action would be managed by the MDNR Permit to Mine to manage the flood damage potential for upstream and downstream property owners.

Frontage of Waterways

Lakes, streams, and rivers/creeks and their associated riparian habitat provide important habitat for fish and wildlife and provide for additional recreational and social functions and values for humans. Lake, stream, and river/creek frontage and associated habitat are not typically evaluated during a wetland assessment, and were not considered during the wetland assessment field studies conducted for the NorthMet Project Proposed Action. However, the linear distance of lake and river/stream frontage for the federal lands was determined using GIS, and the length of frontage per acre of parcel was calculated as an index of the relative importance of frontage on the parcels.

Mud Lake, the dominant lake feature on the federal lands, is located within the One Hundred Mile Swamp and is 30.5 acres in size. Mud Lake was determined to have a frontage of approximately 4,550 ft. The length of lake frontage per acre of federal lands is 0.7 ft.

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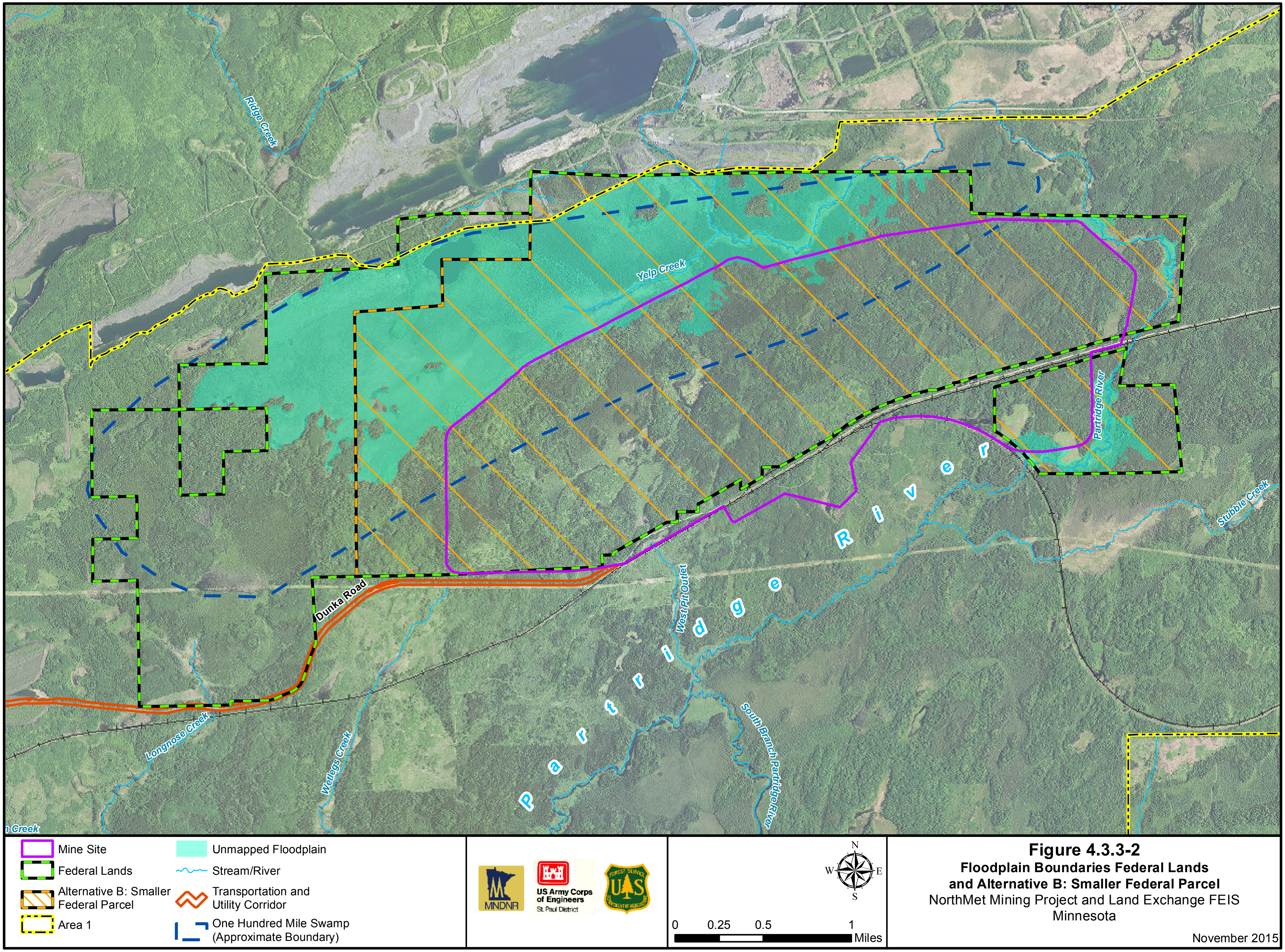

Figure 4.3.3-2
Floodplain Boundaries Federal Lands and Alternative B: Smaller Federal Parcel
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Yelp Creek flows out of the One Hundred Mile Swamp, while Yelp Creek and the Partridge River flow through portions of the federal lands. Collectively, the creek and river are 5.3 miles in length. Since both sides of the river provide riparian habitat, the length of the river on the federal lands was doubled to determine the importance of river frontage. It was determined that there were 55,968.0 linear ft of creek/river frontage on the federal lands. The length of creek/river frontage per acre of federal lands is 8.6 ft.

4.3.3.1.2 Land Exchange Alternative B

Wetland Delineation and Classification

Land Exchange Alternative B is a reduced area of the Land Exchange Proposed Action federal lands boundary, and the wetland delineation and classification is the same as described in Section 4.3.3.1.1. The Land Exchange Alternative B is 4,752.6 acres (see Figure 4.3.3-1).

Hydrology, Wetland Vegetation, and Community Types

The hydrology, wetland vegetation, and community types of the smaller federal parcel are a subset of the Land Exchange Proposed Action federal lands, and the hydrology, wetland vegetation, and community types are the same as described above in Section 4.3.3.1.1. The wetland assessment identified 143 wetlands covering 2,860.9 acres (60 percent) within the 4,752.6 acre smaller federal parcel boundary (see Figure 4.3.3-1). Table 4.3.3-1, above, summarizes the wetland areas within the Land Exchange Alternative B parcel represented by each Eggers and Reed (1997; 2014) wetland community type. A large portion of the wetlands within the Alternative B: Smaller Federal Parcel is located in the floodplains of Yelp Creek and the Partridge River or one of their associated tributaries. The most common wetland types within the Land Exchange Alternative B include coniferous bogs (approximately 59 percent), coniferous swamps (17 percent), and shrub swamps (approximately 14 percent), which includes alder thickets and shrub-carrs.

Other wetland community types present within the Land Exchange Alternative B include open bog, hardwood swamps, shallow marsh, and sedge/wet meadows. The sedge/wet meadows may receive some portion of its hydrology from groundwater. The shallow marsh community generally results from artificial impoundment by beaver dams, roads, and railroads and is primarily dependent on surface waters for hydrology.

Wetland Functional Assessment

Land Exchange Alternative B is a subset of the Land Exchange Proposed Action federal lands, and the wetland function and values assessment is the same as described in Section 4.3.3.1.1.

Floodplains

The Land Exchange Alternative B federal lands are within a portion of St. Louis County that is unmapped by FEMA. Therefore, there is no FEMA estimate of the areas of inundation and there are no FEMA-mapped floodplains on the federal lands. However, a hydrologic model (XP-SWMM) was developed as part of the hydrologic analysis needed for the design of the NorthMet Project Proposed Action. The area of inundation associated with the 500-year (or 0.2 percent chance) floodplain of the Partridge River was estimated as part of this analysis. This estimate of the floodplain area in the federal lands was used for the effects analysis. The unmapped floodplain area on the federal lands associated with the Partridge River and Yelp Creek, estimated using the XP-SWMM, was estimated to total 1,412.9 acres of floodplain (500-year floodplain) (see Figure 4.3.3-2). The ratio of the number of acres of floodplain per acre of parcel for the Land Exchange Alternative B is 0.3.

Frontage of Waterways

A portion of Mud Lake, 8.9 acres, is located within the Land Exchange Alternative B. The portion of Mud Lake was determined to have a frontage of approximately 1,200 ft. The length of lake frontage per acre of the Land Exchange Alternative B is 0.3 ft.

As with the Land Exchange Proposed Action, Yelp Creek flows out of the One Hundred Mile Swamp, while Yelp Creek and the Partridge River flow through portions of the Land Exchange Alternative B. Collectively, the creek and river are 5.3 miles in length in the Land Exchange Alternative B, corresponding to 55,968.0 linear ft of creek/river frontage (counting both sides of the water feature). The length of creek/river frontage per acre of the Land Exchange Alternative B is 11.8 ft.

4.3.3.2 Non-federal Lands

4.3.3.2.1 Non-federal Lands

The Land Exchange Proposed Action must comply with two EOs that are related to wetlands and floodplains. EO 11990 was signed by President Jimmy Carter on May 24, 1977 “in order to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modifications of wetlands….” This order applies to land exchanges such that, as much as practicable, the exchange does not result in the loss of wetland resources. EO 11988 was signed by President Jimmy Carter on May 24, 1977 “in order to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative…” This order applies to land exchanges such that, as much as practicable, the exchange does not result in an increase in the flood damage potential.

The USFS policy is that the following three conditions satisfy the requirements of EOs 11990 and 11988 (FSH 5409.13 § 33.43c):

1. The value of the wetlands or floodplains for properties received and conveyed is equal (balancing test) and the land exchange is in the public interest.
2. Reservations or restrictions are retained on the unbalanced portion of the wetlands and floodplains on the federal lands when the land exchange is in the public interest but does not meet the balancing test.
3. The federal property is removed from the exchange proposal when the conditions described in the preceding paragraphs 1 or 2 cannot be met.

The USFS is also required, by both EOs 11990 and 11988, to reference in a conveyance those uses that are restricted under identified federal, state, or local wetland and floodplain regulations. In Minnesota, the CWA (USACE/EPA/MPCA), Protected Waters Permit Program (MDNR), and the WCA regulate certain activities in wetlands. Floodplain management ordinances are administered at the local (county) level.

In addition to the evaluating wetlands in accordance with these EOs (acres for acres of wetland and no increase in flood hazards), analysis for the Land Exchange Proposed Action includes information on wetland community types as well as the ecological floodplain. Furthermore, the analysis evaluates the net change of shoreline frontage along rivers, streams, and lakes. Although such analysis is not required by EO 11990, it is consistent with the USFS's strategic goal to sustain and enhance outdoor recreation opportunities and with the management direction to protect water resources.

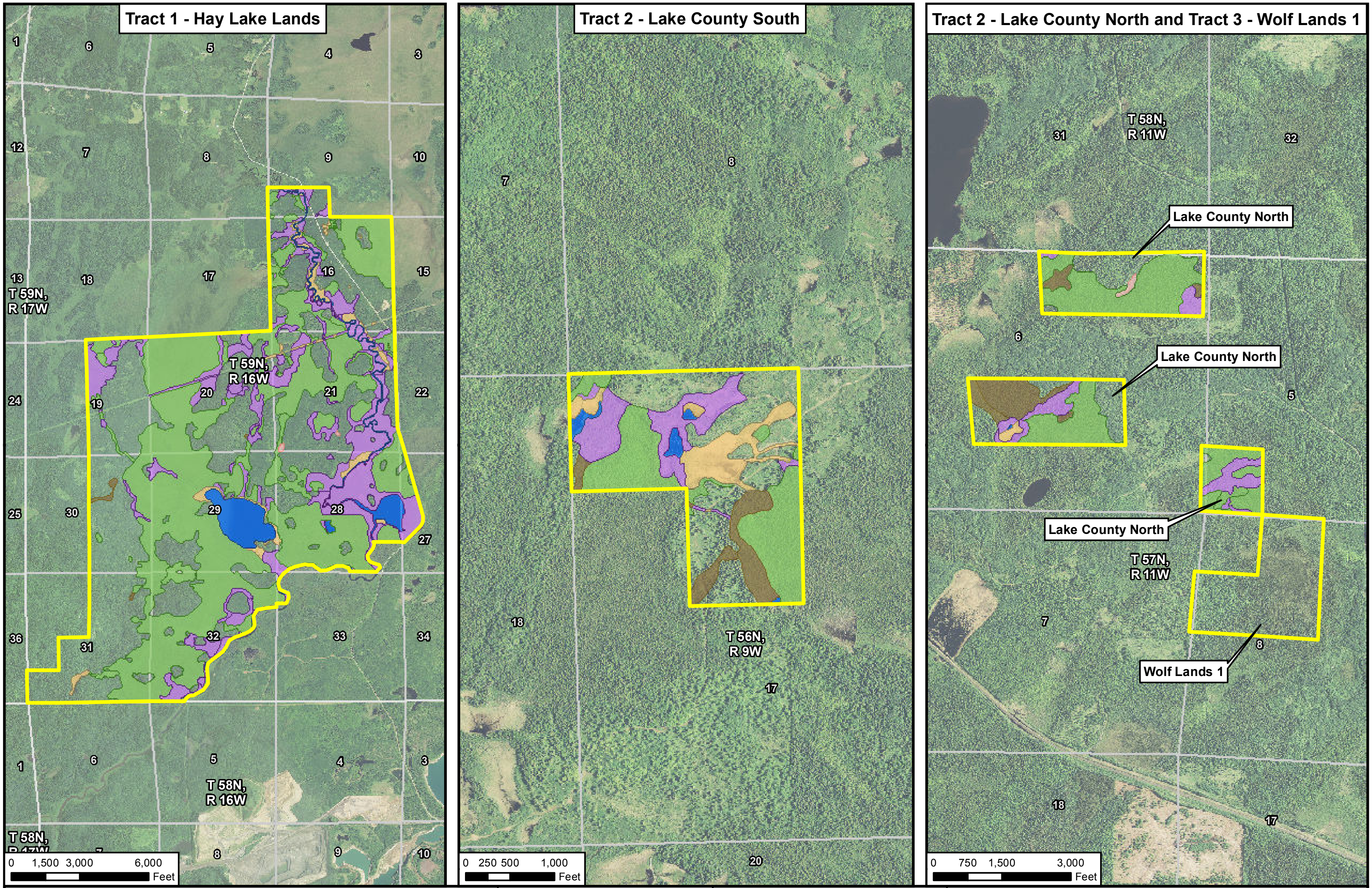
Wetland Delineation and Classification

Wetland boundaries and community types for the non-federal lands were identified from aerial photographic interpretation and field studies; no federal or state delineation protocols were used, as it was primarily a habitat assessment (AECOM 2011b; AECOM 2011c). Infrared and true color aerial photographs and topographic maps of the parcels were reviewed to identify areas that could have wetlands based on vegetative characteristics and topography. In addition, wetlands identified by the NWI were overlaid onto aerial photographs to assist in wetland identification. Field studies were conducted subsequent to the initial desktop study in June 2009 for the Hay Lake Lands and McFarland Lands (AECOM 2011b) and in November 2010 for the Hunting Club Lands, Lake County Lands, and Wolf Lands (AECOM 2011c); this was done to better delineate wetland boundaries on the parcels using the same methods as used for the federal lands surrounding the Mine Site. Mapping information from the field work was then used to modify the NWI wetland types and boundaries.

Wetland surveys were conducted along transects located on primary roads (parcel access and logging) and secondary access routes (skid trails, stream corridors, wetlands, other natural corridors) in order to maximize the amount of area covered during the survey period. Additional surveys were conducted off of the primary and secondary access routes in an effort to better determine wetland boundaries and types (AECOM 2011b; 2011c).

The boundaries of wetlands were determined based on aerial photograph interpretation and NWI mapping, with some refining of wetland boundaries during field studies. Wetland boundaries were determined in the field based on hydrologic and vegetative characteristics and were more accurate where survey routes crossed or were near wetland boundaries. Approximate wetland boundaries and wetland types based on habitat mapping are shown on Figures 4.3.3-3 and 4.3.3-4. Surveys covered nearly all portions of the parcels, although not all wetlands were field surveyed (AECOM 2011b; AECOM 2011c).

During the field surveys in June 2009 and November 2010, data were collected using the guidelines in MnRAM 3.2 (BWSR 2009) related to the functions and values of representative wetlands within the tracts (AECOM 2011b; AECOM 2011c). The primary wetland functions were evaluated based on a review of the: 1) wetland soil, hydrology, and vegetation; 2) outlet characteristics; 3) watershed and adjacent upland land uses and conditions; 4) erosion and sedimentation; and 5) human disturbances. The Eggers and Reed (1997; 2014) classification system was used to classify wetland communities for the wetland function and value evaluation. Landscape factors were typically evaluated on a larger scale. For instance, soil and vegetation conditions within the watershed were usually similar for large groups of wetlands. The anthropogenic factors were also typically similar across broad areas. Based on the responses to questions addressed by MnRAM 3.2 and the assessment of special features, a function value of high, medium, or low was given for each primary function (AECOM 2011b; AECOM 2011c). See below for more information on MnRAM scoring for the non-federal lands.



Non-federal Lands
Section Boundary
1 Section Label

Eggers & Reed Wetland Types

- Shrub Swamps (Alder Thicket & Shrub-Carr)
- Coniferous Swamp
- Hardwood Swamp
- Open Bog
- Shallow, Open Water & Lake
- Shallow Marsh & Deep Marsh

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Figure 4.3.3-3
Wetland Community Types
Tract 1, Tract 2, and Tract 3
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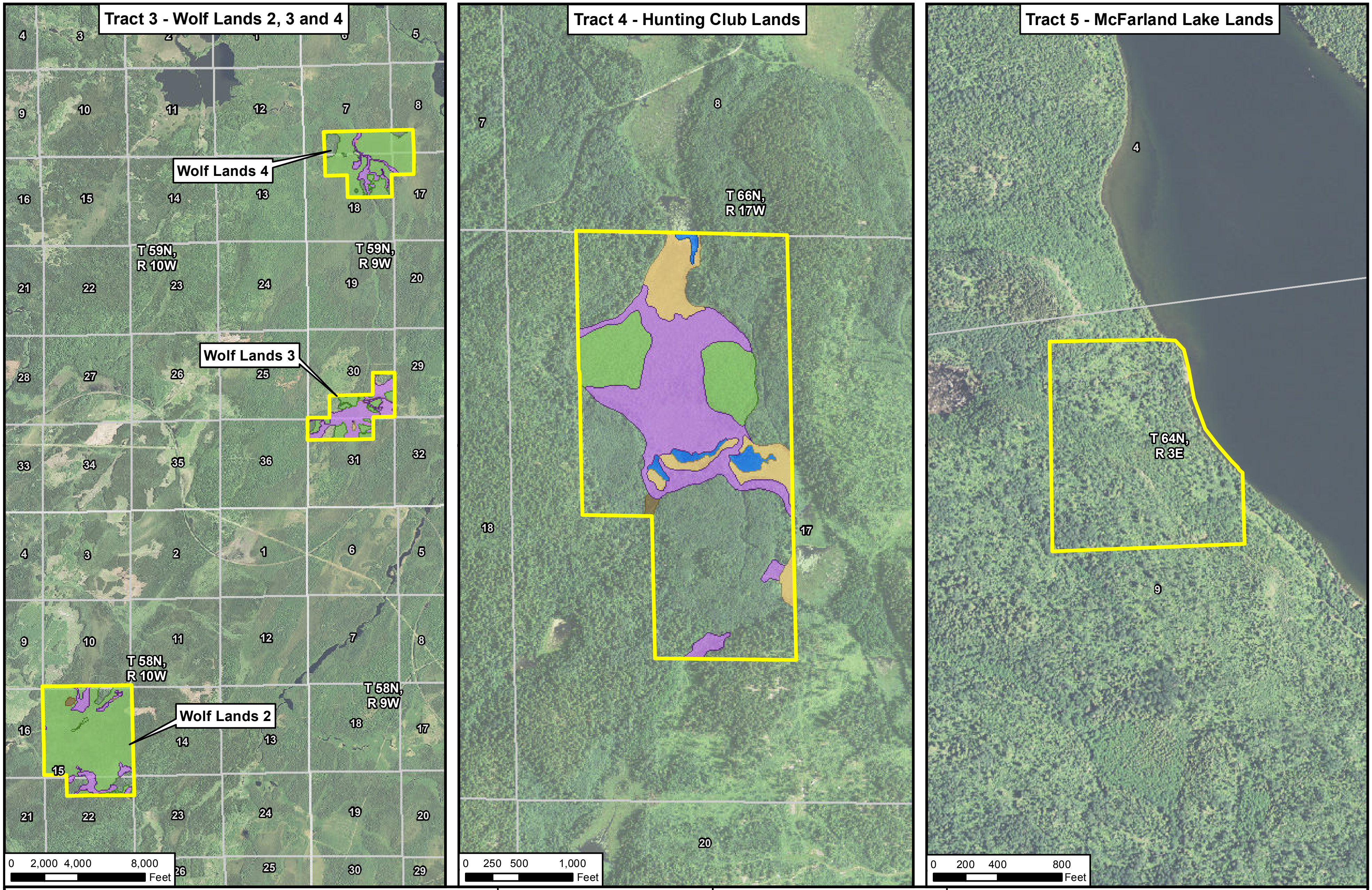

Non-federal Lands

Section Boundary

Section Label

Eggers & Reed Wetland Types

- Shrub Swamps (Alder Thicket & Shrub-Carr)
- Coniferous Swamp
- Hardwood Swamp
- Open Bog
- Shallow, Open Water & Lake
- Shallow Marsh & Deep Marsh

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Figure 4.3.3-4

Wetland Community Types

Tract 3, Tract 4, and Tract 5

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Hydrology, Wetland Vegetation, and Community Types

Habitat and wetland community types within the five tracts were found to be consistent with habitats in much of the Mesabi Iron Range and northeastern Minnesota, including coniferous, deciduous, and mixed coniferous and deciduous forests, and a variety of wetland habitats. Generally, the parcels consisted of a mosaic of slightly elevated upland areas surrounded by wetland areas.

The surveys identified that the majority of the tracts' total area consists of wetlands (66 percent; 4,669.9 acres). Individual tracts with a higher percentage of upland areas include the Hunting Club parcel (60 percent upland), Hay Lake (41 percent upland), and McFarland Lake (100 percent upland) (see Table 4.3.3-3). The most common wetland types within the five non-federal tracts are coniferous swamps (approximately 69 percent) and shrub swamps (approximately 23 percent), which includes both alder thickets and shrub-carr wetlands. Wetland types based on Eggers and Reed (1997; 2014) classification system for the non-federal lands are presented in Table 4.3.3-4 below (AECOM 2011b; AECOM 2011c).

Table 4.3.3-3 Total Wetland and Upland Acreage for the Non-federal Lands

Tract	Wetland Acres [1]	Upland Acres [1]	Total Acres [1]	% of Wetlands	% of Upland
Tract 1 – Hay Lake	2,930.8	1,995.6	4,926.4	59	41
Tract 2 – Lake County					
Lake County North	209.3	55.9	265.2	79	21
Lake County South	73.6	43.4	117.0	63	37
Tract 3 – Wolf Lands					
Wolf Lands 1	90.4	35.4	125.8	72	28
Wolf Lands 2	706.2	61.5	767.7	92	8
Wolf Lands 3	233.2	44.3	277.5	84	16
Wolf Lands 4	362.8	41.9	404.7	90	10
Tract 4 - Hunting Club	63.6	96.5	160.1	40	60
Tract 5 – McFarland Lake	0.0	30.8	30.8	0	100
Total	4,669.9	2,405.3	7,075.2	66	34

Note:
[1] Total acres may be more or less than presented due to rounding.

Table 4.3.3-4 Total Wetland Acreage by Wetland Type for the Non-federal Lands

	Total Non-federal Lands	
Eggers and Reed Class[1]	Acres	%
Coniferous swamp[2]	3,242.4	69
Hardwood swamp[3]	58.0	1
Open bog	7.1	<1
Open water (includes shallow, open water, and lakes)	182.5	4
Shallow marsh[4]	117.5	3
Shrub swamp (includes alder thicket and shrub-carr)	1,062.4	23
Total	4,669.9	100

Notes:
[1] Eggers and Reed 1997; 2014.
[2] Field data for coniferous bogs and coniferous swamps was combined.
[3] Coniferous tree species may be present within some hardwood swamps.
[4] Shallow marsh areas may contain deep marshes.

Wetlands Functional Assessment

Wetland functions and values for the non-federal lands were determined during the June 2009 and November 2010 field surveys. Wetland functions and values were evaluated at 64 sites within the five non-federal tracts (AECOM 2011b; AECOM 2011c; AECOM 2011d). The wetlands on the five non-federal lands share characteristics similar to those found on the federal lands. All wetlands on the non-federal lands were rated high for most wetland functions and values.

During the field surveys, data were collected related to the functions and values of representative wetland locations. A few survey locations were for individual wetlands, while for larger wetland complexes several locations were surveyed. An attempt was made to survey a variety of wetland types across the entire parcel (AECOM 2011b; AECOM 2011c). Survey locations for the wetland functions and values assessment are shown on Figures 4.3.3-3 through 4.3.3-4.

Table 4.3.3-5 summarizes the functional value ratings for the 64 wetlands that were evaluated for primary wetland functions rated by MnRAM 3.2. Wetlands were rated high for nearly all wetland functional values. Vegetation diversity/integrity was rated high for all wetlands. The overall rating for vegetation diversity/integrity was based on the highest rated community for vegetation diversity and integrity, rather than the average or weighted value for community vegetation diversity and integrity. MnRAM 3.2 guidance states that this is the appropriate measure for assessing wetland quality for regulatory purposes.

According to MnRAM scores (AECOM 2011b; AECOM 2011c), the following ratings were determined:

- Wetland hydrology and water quality were rated high for all wetlands, and high for all wetlands except three for downstream water quality. Most wetlands on Tracts 1 and 5 provide moderate to high flood attenuation value and most wetlands on Tracts 2, 3, and 4 provide moderate flood attenuation value, with two wetlands rated high for this function.
- Wildlife habitat was rated high for all but one wetland, as natural wildlife corridors and upland communities are relatively untouched by recent human disturbances or effects. There are no barriers to wildlife movement. Wildlife habitat was rated moderate in an area where there are few plant communities and large amounts of water.
- Fish habitat was rated high for wetlands that provide fish habitat. Fish habitat was rated as not applicable for some wetlands where the wetland does not have enough standing water throughout the year to support fish. Some other characteristics that might limit wetland value for fish would include isolated wetlands that are not permanently flooded, or forested wetlands where the water table is below the surface for all or part of the year.
- Amphibian habitat was rated high for most wetlands. This indicated that the wetland stays inundated long enough in most years to allow amphibians to successfully reproduce. Amphibian habitat was rated medium for some wetlands if ideal conditions needed to support amphibian reproduction do not occur at the parcels. Forested wetlands with little or no standing water or not enough woody vegetation during the mating season would likely not support amphibians. Wetlands with predatory fish may also not support amphibians. Other wetlands were rated not applicable for amphibian habitat, indicating that the parcel is not inundated long enough in most years to support successful breeding.

- Aesthetic, recreational, educational, and cultural values were rated medium for all but one wetland. All wetlands are aesthetically pleasing, and could be used for recreation, education, and cultural purposes. However, access by the general public access is limited to overland by foot or on snowmobile/all-terrain vehicle from Pike River Road or from USFS roads. A few wetlands have human influences on the viewshed due to close proximity to Pike River Road; however, due to their remote locations, most of the wetlands have little human influence on the viewshed.

Table 4.3.3-5 Wetland Functional Value Assessment for the Non-federal Lands

Wetland Functions and Value Rating	Functional Value Ratings (%)								
	Vegetation Diversity/ Integrity	Hydrology	Flood Attenuation	Downstream Water Quality	Wetland Water Quality	Wildlife Habitat	Fish Habitat	Amphibian Habitat	Aesthetics/ Education/ Cultural
High	100	100	8	97	100	98	55	69	2
Moderate	0	0	92	3	0	2	0	9	98
Low	0	0	0	0	0	0	0	6	0
Not Available or Applicable	0	0	0	0	0	0	45	16	0
Total	100	100	100	100	100	100	100	100	100

Sources: AECOM 2011b; AECOM 2011c.

4.3.3.2.2 Tract 1 – Hay Lake Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 1 is moderately hilly and consists primarily of second- or third-growth deciduous and coniferous forest uplands and emergent, shrub swamp, and forested wetlands. This parcel is adjacent to the Superior National Forest (AECOM 2011b). The wetland assessment identified 2,930.8 acres of wetlands within Tract 1 (approximately 59 percent of the land area) (see Figure 4.3.3-3 and Table 4.3.3-6). The most common wetland types within Tract 1 are coniferous swamps (approximately 67 percent) and shrub swamps (approximately 24 percent), which includes both alder thickets and shrub-carr wetlands.

Table 4.3.3-6 Total Wetland Acreage by Wetland Type for Tract 1

Eggers and Reed Class[1]	Total Hay Lake Acres	Total Hay Lake %
Coniferous swamp[2]	1,953.9	67
Hardwood swamp[3]	8.0	<1
Open bog	2.1	<1
Open water (includes shallow, open water, and lakes)	176.6	6
Shallow marsh[4]	84.1	3
Shrub swamp (includes alder thicket and shrub-carr)	706.1	24
Total	2,930.8	100

Notes:
1 Eggers and Reed 1997; 2014.
2 Field data for coniferous bogs and coniferous swamps was combined.
3 Coniferous tree species may be present within some hardwood swamps.
4 Shallow marsh areas may contain deep marshes.

Wetlands on Tract 1 consist primarily of early successional coniferous swamps, shrub wetlands, and open water wetlands. Hay Lake, Rice Lake, an unnamed lake, and the Pike River are the dominant water features. Large bogs dominate much of the east-central portion of Tract 1. Several wetlands were created or enlarged due to impoundment of streams by beaver dams. Raised water levels resulted in stands of dead and dying spruce along portions of the Pike River (AECOM 2011b).

Bogs within Tract 1 are dominated by leatherleaf and bog Labrador-tea, with scattered young speckled alder, bog birch, tamarack, and in some areas, narrow-leaved cattail and sedges. Sphagnum and club moss often cover 80 to 90 percent of the bog. Scattered (less than 5 percent) black spruce (some dead) and immature tamarack are found in the tree layer. Lowbush blueberry, small-fruited bog cranberry, bog rosemary, and small willows are also common. Other species encountered include cottongrass, wild iris, wild raspberry, bunchberry, and northern bog orchid (AECOM 2011b).

Emergent wetlands are primarily limited to disturbed areas on Tract 1, floodplains associated with the Pike River, wetlands associated with abandoned logging roads, transmission line ROWs, and beaver ponds. These emergent wetlands are often dominated by Canada bluejoint grass, various sedge species, and narrow-leaved cattail (70 to 80 percent cover) and generally are characterized by water depths of 1 ft or greater. Spruce, tamarack, and northern white cedar associated with these wetlands are often killed when flooded due to the rising water level behind beaver dams. Willows, tamarack, red-osier dogwood, and speckled alder are often found along the border of these wetlands, but comprised less than 30 percent of the total cover. Wild iris is encountered in some wetlands, as is horsetail, bur reed, spikerush, water arum, broad-leaved arrowhead, and woolly sedge (AECOM 2011b).

Shrub swamp wetlands usually consist of a dense (60 to 90 percent) cover of speckled alder, meadowsweet, and bog birch, with alder often 6 ft or taller in height. Some of the wetlands have scattered black spruce, tamarack, and willow saplings, but tree cover does not exceed 25 percent. Dominant low shrubs are bog Labrador-tea, leatherleaf, lowbush blueberry, prickly rose, wild raspberry, and red-osier dogwood. Mountain maple saplings are also present in a few wetlands. Herbaceous layer species include club and sphagnum mosses, woolly sedge, Canada bluejoint grass, horsetail, bunchberry, and clintonia (AECOM 2011b).

Forested wetlands (coniferous and hardwood swamps) are dominated by black spruce and tamarack, with some scattered northern white cedar, red pine, and black ash also present. Coniferous wetland forests are the most common habitat type on the parcel; deciduous and mixed forest wetlands are uncommon. In some areas with dense stands of spruce, few shrubs are seen, but sphagnum and club mosses often cover nearly 100 percent of the ground. Some open stands have an understory comprised of shrubs and scattered sapling northern white cedar, tamarack, and black spruce, along with speckled alder and willow. Mountain maple is also encountered among tree species on Tract 1, primarily in deciduous and mixed forests. Common species encountered in the shrub layer include specked alder, leatherleaf, bog Labrador-tea, lowbush blueberry, and bog birch. Species found near the ground include clintonia, bracken fern, horsetail, bunchberry, wild raspberry, cottongrass, wild sarsaparilla, wild strawberry, and false lily-of-the-valley. Forest and shrub cover typically range from 30 to 60 percent, while moss and other understory vegetation cover ranges from 50 to 90 percent (AECOM 2011b).

Wetland Functional Assessment

Table 4.3.3-7 summarizes the 30 wetland functional value ratings that were obtained for Tract 1 for the primary wetland functions rated by MnRAM 3.2. Tract 1 wetlands were rated high for nearly all wetland functional values with the exception of flood attenuation and aesthetic, recreational, educational, and cultural values.

Table 4.3.3-7 Wetland Functional Value Assessment for Tract 1

Wetland Functions and Value Rating	Functional Value Ratings (%)								
	Vegetation Diversity/ Integrity	Hydrology	Flood Attenuation	Downstream Water Quality	Wetland Water Quality	Wildlife Habitat	Fish Habitat	Amphibian Habitat	Aesthetics/ Education/ Cultural
High	100	100	13	93	100	97	53	87	0
Moderate	0	0	87	7	0	3	0	3	100
Low	0	0	0	0	0	0	0	10	0
Not Available or Applicable	0	0	0	0	0	0	47	0	0
Total	100	100	100	100	100	100	100	100	100

Source: AECOM 2011b.

Floodplains

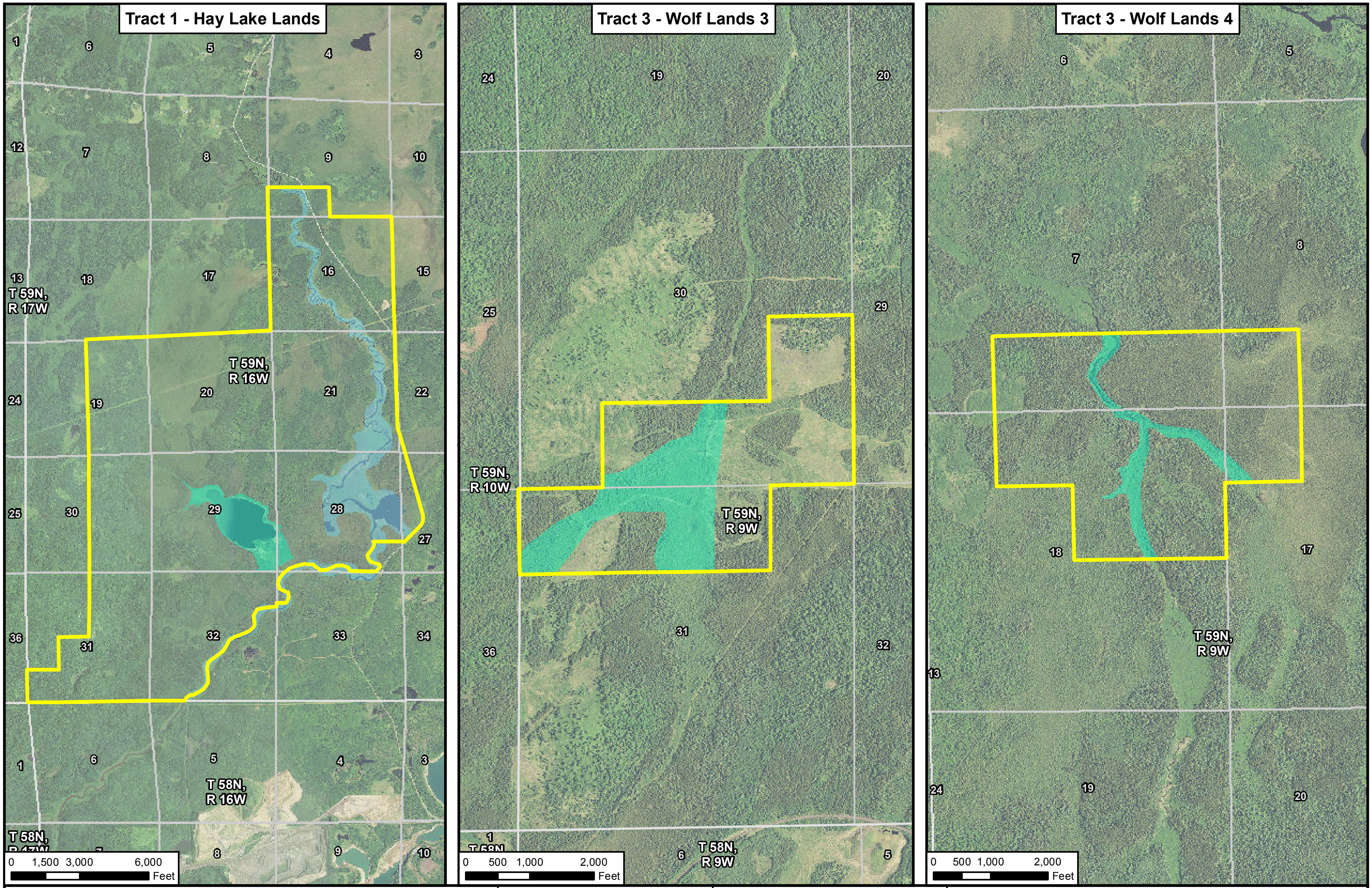
Non-federal and non-state-owned lands mapped as floodplains are regulated by a county floodplain overlay zoning district. In St. Louis County, the mapped floodplains are regulated by the County Floodplain Ordinance. The only non-federal parcel with a mapped floodplain identified in the existing effective FEMA FIRM is located in St. Louis County for Tract 1 along the Pike River. The mapped floodplain was not part of a detailed study area along the Pike River and the area of floodplain has been estimated on the FIRM. Tract 1 also has unmapped floodplains associated with Hay Lake itself (Figure 4.3.3-5) (AECOM 2011d). The mapped floodplain has been estimated to be approximately 376.2 acres, while the unmapped area including and near Hay Lake has been estimated to be approximately 175.0 acres. The total floodplain associated with Tract 1 is approximately 551.2 acres. The ratio of the number of acres of floodplain per acre of parcel for Tract 1 is 0.11.

Frontage of Waterways

Within Tract 1, Hay Lake, 96.2 acres, has a frontage of 9,894.4 ft. Rice Lake, 29.5 acres, has a frontage of 4,829.6 ft. An unnamed lake between Hay Lake and Rice Lake is 3.9 acres in area and has a frontage of approximately 1,700 ft.

The Pike River flows from the southern boundary to the northern boundary of Tract 1 and is 8.1 miles in length. Riparian habitat is found on both sides of the river for 5.7 miles, and on only one side for 2.4 miles where the river formed the boundary of the parcel. The linear distance of river frontage for Tract 1 is approximately 72,864 linear ft (AECOM 2011d).

The length of lake and river frontage per acre on Tract 1 was calculated to be 3.5 ft per acre and 15.3 ft per acre, respectively.



Non-federal Lands

Section Boundary

1 Section Label

Mapped Floodplain

Unmapped Floodplain

MNDNR

US Army Corps of Engineers St. Paul District

N W E S

Figure 4.3.3-5

Floodplain Boundaries

Tract 1 and Tract 3

NorthMet Mining Project and Land Exchange FEIS

Minnesota

November 2015

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4.3.3.2.3 Tract 2 – Lake County Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 2 consists of 381.9 acres located in Lake County and is comprised of two parcels. Tract 2 identified 282.9 acres of wetlands (74 percent of Tract 2) (see Figure 4.3.3-3 and Table 4.3.3-8). The most common wetland types within Tract 2 are coniferous swamps (approximately 59 percent); shrub swamps (approximately 18 percent), which includes both alder thickets and shrub-carr wetlands; and hardwood swamps, which includes some coniferous swamps (approximately 16 percent). The two parcels (Lake County North and Lake County South) are nearly level and consist predominantly of second- and third-growth mixed deciduous and coniferous forest uplands and bog, emergent, shrub, and forested wetlands. Much of the Lake County South parcel has been recently logged (AECOM 2011c; AECOM 2011d).

Lake County North

The Lake County North parcel consists of 265.0 acres, of which 209.3 acres are identified as wetlands (approximately 79 percent) (see Figure 4.3.3-3 and Table 4.3.3-8). The most common wetland types within the Lake County North parcel are coniferous swamps (approximately 65 percent); shrub swamps (approximately 17 percent), which includes alder thickets and shrub-carr wetlands; and hardwood swamps, which includes some coniferous swamps (approximately 17 percent).

Table 4.3.3-8 Total Wetland Acreage by Wetland Type for Tract 2

	Lake County North		Lake County South		Total Lake County	
Eggers and Reed Class[1]	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Coniferous swamp[2]	135.0	65	32.4	44	167.4	59
Hardwood swamp[3]	34.7	17	9.9	13	44.6	16
Open bog	1.8	1	0.0	0	1.8	1
Open water (includes shallow, open water, and lakes)	0.2	<1	2.5	3	2.7	1
Shallow marsh[4]	2.5	1	12.3	17	14.8	5
Shrub swamp (includes alder thicket and shrub-carr)	35.1	17	16.5	22	51.6	18
Total	209.3	100	73.6	100	282.9	100

Notes:
1 Eggers and Reed 1997; 2014.
2 Field data for coniferous bogs and coniferous swamps was combined.
3 Coniferous tree species may be present within some hardwood swamps.
4 Shallow marsh areas may contain deep marshes.

The Lake County North parcel has moderate topography, with the terrain generally sloping toward the southwest toward Pine Lake. This parcel consists of two smaller subparcels to the north and a single, small subparcel to the south that is adjacent to the Wolf Lands 1 parcel (see Figure 4.3.3-3). The subparcels are comprised of mostly wetland habitat, except for an area of upland habitat in the northern portion of the northern subparcel and in portions of the southern subparcel. Portions of the subparcels have recently been logged. Wetland habitat consists mostly of immature coniferous forest, with lesser amounts of mature mixed forest and shrubland (AECOM 2011c).

The Lake County North parcel encompasses several wetland types, including forested wetlands comprised of coniferous swamps and hardwood swamps, shrub swamps, and open bog/palustrine emergent wetlands, open water, and shallow marshes (collectively, emergent wetlands). Forested wetlands are comprised primarily of sapling northern white cedar and black spruce with lesser amounts of tamarack, although several drainages also contain black ash. Northern white cedar is predominant in the more southerly portions of the northern two subparcels, while black spruce is more common in the northern and northwestern portion of these two subparcels. Shrub wetland habitat is associated with several drainages, a beaver pond, a bog area, and recently logged areas, while emergent wetland habitat is found near the beaver pond and in recently logged areas. Shrub wetlands within the Lake County North parcel are dominated by speckled alder. Vegetation in the emergent wetlands consists of various sedge species and Canada bluejoint grass, with scattered black spruce, northern white cedar, tamarack, and speckled alder (AECOM 2011c).

Canopy cover in forested wetlands ranges from 50 to 80 percent and most canopy trees are 6 to 10 inches dbh. The midstory consists of balsam fir and black spruce (approximately 40 percent cover), while speckled alder, leatherleaf, and bog Labrador-tea are found in the shrub layer (40 percent cover) and club moss and sphagnum moss cover most of the ground (AECOM 2011c).

In general, the southern subparcel consists of forested wetland stands of immature black spruce and northern white cedar with northern white cedar to 20 inches dbh and black spruce to 14 inches dbh. Canopy cover is 50 percent, while the midstory cover is 60 percent and comprised of sapling balsam fir. The nearly continuous ground cover is dominated by sphagnum moss and club moss. Another immature forested wetland in the northern subparcel includes black ash trees to 16 inches dbh (AECOM 2011c).

Shrub and emergent wetland habitats are also found on the subparcels. Shrub wetland habitat is associated with several drainages, a beaver pond, a bog area, and recently logged areas, while emergent wetland habitat is found near the beaver pond and in recently logged areas. Shrub wetlands are dominated by speckled alder (to 80 percent cover). Two wetlands are classified as shrub wetlands because speckled alder covered 70 percent of the area, but the wetlands also have open bog characteristics since bog Labrador-tea also covers 70 to 80 percent of the wetlands, and sphagnum moss covers most of the ground. Scattered sapling black spruce, northern white cedar, and red-osier dogwood are also found in these wetlands. Vegetation in the emergent wetlands consists of various sedge species and Canada bluejoint (40 percent cover), with scattered black spruce, northern white cedar, tamarack, and speckled alder (AECOM 2011c).

Lake County South

The Lake County South parcel consists of 116.9 acres, of which 73.6 acres are identified as wetlands (approximately 63 percent) (see Figure 4.3.3-3 and Table 4.3.3-8). The most common wetland types within the Lake County South parcel are coniferous swamps (approximately 44 percent); shrub swamps (approximately 22 percent), which includes both alder thickets and shrub-carr wetlands; shallow marshes (approximately 17 percent); and hardwood swamps (approximately 13 percent).

Lake County South is relatively flat in the northwestern section, rises in elevation to the northeast, and then falls in elevation to the southeast. Water flows from west to east. At the time of the survey, a series of beaver dams and ponds dominated the landscape, as did areas that had been recently logged. Although shrubland dominates upland habitats, several habitat types comprise wetland habitats within this parcel (AECOM 2011c).

Forested wetlands dominate the western and southeastern portions of the parcel and are comprised of black spruce and northern white cedar. However, tamarack is found in some forest stands and black ash is an important component of several drainages. The overstory cover is about 50 to 70 percent, while the midstory coverage of balsam fir and black spruce is about 20 percent. Speckled alder, leatherleaf, bog Labrador-tea, and red-osier dogwood are common shrubs (to 80 percent cover), while sphagnum moss covers most of the ground. Forests in the northwestern section contain a dense mix of northern white cedar and black spruce with scattered black ash in the canopy (50 percent cover), and black spruce, northern white cedar, balsam fir, and speckled alder in the midstory and shrub layer (80 percent cover). Five beaver ponds were found on the parcel creating wetlands, which are comprised of open water with scattered dead spruce. These open-water wetlands are surrounded by emergent wetlands dominated by various sedge species, narrow-leaved cattail, woolgrass, and Canada bluejoint grass, or by dense stands of speckled alder in more shallow areas (AECOM 2011c).

Wetland Functional Assessment

Table 4.3.3-9 summarizes the 13 wetland functional value ratings (8 Lake County North and 5 Lake County South) that were obtained for Tract 2 for the primary wetland functions rated by MnRAM 3.2. Tract 2 wetlands were rated high for nearly all wetland functional values with the exception of flood attenuation and aesthetic, recreational, educational, and cultural values.

Table 4.3.3-9 Wetland Functional Value Assessment for Tract 2

Wetland Functions and Value Rating	Functional Value Ratings (%)								
	Vegetation Diversity/ Integrity	Hydrology	Flood Attenuation	Downstream Water Quality	Wetland Water Quality	Wildlife Habitat	Fish Habitat	Amphibian Habitat	Aesthetics/ Education/ Cultural
Lake County North									
High	100	100	0	100	100	100	63	63	0
Moderate	0	0	100	0	0	0	0	0	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	37	37	0
Total	100	100	100	100	100	100	100	100	100
Lake County South									
High	100	100	0	100	100	100	60	60	20
Moderate	0	0	100	0	0	0	0	0	80
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	40	40	0
Total	100	100	100	100	100	100	100	100	100

Source: AECOM 2011c.

Floodplains

Lake County has an older Flood Hazard Boundary Map developed by the HUD to estimate the areas of frequent inundation. FEMA rescinded the map in 1985 and it is not considered to be an effective FEMA FIRM map; therefore, it is not used as part of the management of flood-prone areas. Lake County does not have a floodplain overlay ordinance; therefore, there are no "regulatory floodplains" within Lake County. While the floodplains identified using the older map are not considered to be the effective FEMA FIRM maps of flood-prone areas, they can offer an approximation of floodplains within the county for the effects analysis.

Mapped floodplain identification for the effects analysis of non-federal lands in Lake County was done using this older, rescinded map and it was determined that Tract 2 has no mapped or unmapped floodplains.

Frontage of Waterways

Tract 2 does not include any streams, rivers, creeks, or lakes.

4.3.3.2.4 Tract 3 – Wolf Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 3 consists of a total of 1,575.8 acres located in Lake County and is comprised of four individual parcels. A total of 1,392.6 acres (88 percent) of wetlands were identified within Tract 3 (see Figures 4.3.3-3 and 4.3.3-4, and Table 4.3.3-10). The most common wetland types within the Wolf Lands are coniferous swamps (approximately 79 percent) and shrub swamps (approximately 20 percent), which includes alder thickets and shrub-carr wetlands. The four parcels are nearly level and consist predominantly of second- and third-growth mixed deciduous and coniferous forested uplands and bog, emergent, shrub, and forested wetlands. Much of the area of the parcels comprising the Wolf Lands has been recently logged (AECOM 2011c; AECOM 2011d).

Table 4.3.3-10 Total Wetland Acreage by Wetland Type for Tract 3

Eggers and Reed Class[1]	Wolf Lands 1		Wolf Lands 2		Wolf Lands 3		Wolf Lands 4		Total Wolf Lands	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Coniferous swamp[2]	75.4	84	627.4	89	82.6	35	320.3	88	1,105.7	79
Hardwood swamp[3]	0.0	0	5.0	1	0.0	0	0.0	0	5.0	<1
Open bog	3.0	3	0.0	0	0.0	0	0.2	<1	3.2	<1
Open water (includes shallow, open water, and lakes)	0.0	0	0.4	<1	0.0	0	0.0	0	0.4	<1
Shallow marsh[4]	0.0	0	0.4	<1	5.2	2	0.0	0	5.6	<1
Shrub swamp (includes alder thicket and shrub-carr)	12.0	13	73.0	10	145.4	63	42.3	12	272.7	20
Total	90.4	100	706.2	100	233.2	100	362.8	100	1,392.6	100

Notes:
1 Eggers and Reed 1997; 2014.
2 Field data for coniferous bogs and coniferous swamps was combined.
3 Coniferous tree species may be present within some hardwood swamps.
4 Shallow marsh areas may contain deep marshes.

Wolf Lands 1

The Wolf Lands 1 parcel consists of 122.8 acres, of which 90.4 acres are mapped as wetlands (approximately 72 percent) (see Figure 4.3.3-3 and Table 4.3.3-10). The most common wetland types within this parcel are coniferous swamps (approximately 84 percent) and shrub swamps (approximately 13 percent), which includes alder thickets and shrub-carr wetlands.

Most of the upland habitat consists of mature mixed forest, while most wetland habitats consist of coniferous forest. The parcel is relatively flat but slopes gently downward toward the southwest. The Wolf Lands 1 parcel is adjacent to Lake County North (AECOM 2011c). The eastern half of the parcel is wetland, while upland comprises most of the western portion of the parcel. Pine Lake is about 0.5 mile northwest of the parcel (AECOM 2011c).

Immature forested wetland communities on the parcel are comprised primarily of black spruce, with scattered northern white cedar and tamarack. More mature forested wetlands have characteristics of more open bogs, as tree cover is sparse at about 30 percent, while 80 percent of the area is covered by bog Labrador-tea and leatherleaf, and sphagnum moss covers most of the ground. In more immature forests, tree cover ranges from 60 to 80 percent, with a canopy dominated by 6 to 10 inches dbh black spruce, with tamarack and northern white cedar also present. The midstory consists of balsam fir and black spruce (about 40 percent cover), while speckled alder, leatherleaf, bog Labrador-tea, and red-osier dogwood dominate the shrub layer (40 percent cover) and club moss and sphagnum moss cover most of the ground (AECOM 2011c).

Wolf Lands 2

The Wolf Lands 2 parcel consists of 767.9 acres, of which 706.2 acres are mapped as wetlands (approximately 92 percent) (see Figure 4.3.3-4 and Table 4.3.3-10). The most common wetland types within Wolf Lands 2 are coniferous swamps (approximately 89 percent) and shrub swamps (approximately 10 percent), which includes both alder thickets and shrub-carr wetlands.

The Wolf Lands 2 parcel, which slopes toward the southwest, can generally be characterized by gently undulating terrain. Overland water flows to the southwest and to Mary Ann Creek, Wenho Creek, and Greenwood Lake. The Wolf Lands 2 parcel consists primarily of forested wetlands comprised of black spruce and northern white cedar, with a black ash component in a few drainages; shrubland comprised of speckled alder is also common on the parcel. Most upland habitat consists of mixed forest. Several drainages are dominated by speckled alder, while emergent wetland habitat is associated with beaver ponds. Black spruce is the dominant tree in wetlands in the northern and eastern portions of the parcel, while northern white cedar is more prevalent in other portions of the parcel (AECOM 2011c).

Forested wetlands are of three types: black spruce dominant, a mix of black spruce and northern white cedar, or northern white cedar dominant. Canopy trees range from four to eight inches dbh, with total canopy cover from 70 to 80 percent. The midstory consists of sapling black spruce, northern white cedar, and balsam fir. Midstory cover is patchy, ranging from 10 to 40 percent. Bog Labrador-tea comprises 10 to 30 percent of the low shrub cover, while sphagnum moss often covers more than 80 percent of the ground. In areas with a dense canopy, the midstory and ground cover are poorly developed (AECOM 2011c).

Several drainages are dominated by shrub swamp vegetation. These parcels generally have a sparse overstory, with approximately 20 percent aerial cover of black spruce, northern white cedar, and tamarack. Speckled alder and sapling trees usually cover 60 percent or more of the midstory, while low shrub cover consists of bog Labrador-tea (40 to 60 percent cover) (AECOM 2011c).

Beaver dams and ponds were found in the southeastern portion of the parcel during the field survey. Typically, open water is adjacent to the dams, with emergent wetland surrounding the open water and shrub wetlands upstream of the dams (AECOM 2011c).

Wolf Lands 3

The Wolf Lands 3 parcel consists of 277.4 acres, of which about 233.2 acres are mapped as wetlands (approximately 84 percent) (see Figure 4.3.3-4 and Table 4.3.3-10). The most common wetland types within the Wolf Lands 3 parcel are shrub swamps (approximately 63 percent), which includes alder thickets and shrub-carr wetlands, and second most common are coniferous swamps (approximately 35 percent).

The Wolf Lands 3 parcel is relatively flat. Coyote Creek begins its flow north within the parcel. Uplands consist of mostly shrubland and deciduous forest, while wetlands are dominated by shrub wetland and coniferous forested wetland habitats (AECOM 2011c). About half of the parcel had been recently logged. Logged wetlands are dominated by grasses, forbs, and low-growing shrubs, including red-osier dogwood and speckled alder. In the unlogged areas, forested wetlands are comprised primarily of black spruce. In the northern portion of the parcel, black spruce is co-dominant with tamarack; in the rest of the parcel, tamarack is present in the canopy but in much lower quantity (AECOM 2011c).

In shrub swamp wetlands, speckled alder covers from 20 to 80 percent of the area. In some areas, bog Labrador-tea covers 80 to 90 percent of the ground, especially in areas with a dense cover of speckled alder. In areas with a lower density of speckled alder, grasses, forbs, and ferns are the dominant vegetation, but due to snow cover at the time of survey, it was not possible to determine percent ground cover or species composition. Scattered sapling black spruce and paper birch are also seen on logged wetlands. Woody debris from the recent logging operations is abundant in logged areas (AECOM 2011c).

In the unlogged areas, wetland forests are comprised of black spruce. In the northern part of the parcel, the black spruce is co-dominant with tamarack; in the rest of the parcel, tamarack is present in the canopy but in much lower amounts. Total canopy cover ranges from 60 to 80 percent, with canopy trees ranging from 4 to 10 inches dbh. The midstory consists of balsam fir and black spruce (20 to 30 percent cover), while the shrub layer is dominated by bog Labrador-tea (80 percent), over a ground layer of nearly continuous (80 percent cover or more) sphagnum moss with scattered grasses and forbs (AECOM 2011c).

Coyote Creek is bordered by an emergent sedge meadow wetland complex comprised of sedges, narrow-leaved cattail, and Canada bluejoint (collectively about 90 percent cover). There is also scattered sapling tamarack and northern white cedar, as well as scattered patches of speckled alder and bog Labrador-tea. The emergent wetland is bordered by dense (80 percent cover) speckled alder. Water depth in the emergent and shrub wetlands is approximately 18 to 24 inches (AECOM 2011c).

Logging roads on the parcel have become emergent wetland habitat dominated by narrow-leaved cattail, woolgrass, Canada bluejoint, scattered sedges, and speckled alder. Herbaceous vegetation covers about 70 to 80 percent of the wetland area, while alder shrubs cover approximately 10 percent of the wetlands (AECOM 2011c).

Wolf Lands 4

The Wolf Lands 4 parcel consists of 404.7 acres of which 362.8 acres are mapped as wetlands (approximately 90 percent) (see Figure 4.3.3-4 and Table 4.3.3-10). The most common wetland types within the Wolf Lands 4 parcel are coniferous swamps (approximately 88 percent) and shrub swamps (approximately 12 percent).

Coyote Creek bisects the parcel, while the Stony River is about 2,000 ft northwest of the parcel. Timber harvests recently occurred along the western border of the parcel. Upland habitats consist primarily of mature deciduous forest, while forested and shrub wetland community types dominate wetland habitats (AECOM 2011c).

Wetland types include coniferous forest, shrub wetlands, and emergent. Black spruce forests are the most prevalent community type in the northern half of the parcel, while northern white cedar is more prevalent in the southern half of the parcel. Emergent wetland communities that include various species of sedge, Canada bluejoint grass, and shrub wetlands comprised primarily of speckled alder are found in floodplains that border Coyote Creek. Shrub wetlands also occur in two drainages to Coyote Creek in the southeastern portion of the parcel and in a drainage to the Stony River in the northeastern portion of the parcel (AECOM 2011c).

Coniferous wetlands composed of black spruce and black spruce/northern white cedar are dominated by trees ranging from four to eight inches dbh, with a patchy canopy cover of about 50 percent. Scattered tamaracks are also found in these wetlands. The low shrub layer is nearly continuous (80 to 90 percent cover), and is comprised of leatherleaf, bog Labrador-tea, and other vegetation. Sphagnum and club mosses cover most of the ground. Other forests have a more developed midstory, with 60 percent cover by black spruce, northern white cedar, tamarack, and speckled alder, and a similarly dense shrub layer, with 60 to 70 percent cover by leatherleaf and bog Labrador-tea (AECOM 2011c).

Shrub wetlands are dominated by speckled alder (60 to 80 percent cover), with scattered black spruce, tamarack, and northern white cedar in the overstory. Leatherleaf and bog Labrador-tea cover about 40 to 50 percent of the shrub layer (AECOM 2011c).

Wetland Functional Assessment

Table 4.3.3-11 summarizes the 18 wetland functional value ratings (three for Wolf Lands 1, six for Wolf Lands 2, six for Wolf Lands 3, and three for Wolf Lands 4) that were obtained for Tract 3 for the primary wetland functions rated by MnRAM 3.2. Tract 3 wetlands were rated high for nearly all wetland functional values with the exception of flood attenuation on Wolf Lands 2, 3, and 4; amphibian habitat on Wolf Lands 3; and aesthetic, recreational, educational, and cultural values for all four sub-parcels.

Table 4.3.3-11 Wetland Functional Value Assessment for Tract 3

Wetland Functions and Value Rating	Functional Value Ratings (%)								
	Vegetation Diversity/ Integrity	Hydrology	Flood Attenuation	Downstream Water Quality	Wetland Water Quality	Wildlife Habitat	Fish Habitat	Amphibian Habitat	Aesthetics/ Education/ Cultural
Wolf Lands 1									
High	100	100	100	100	100	100	67	67	0
Moderate	0	0	0	0	0	0	0	0	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	33	33	0
Total	100	100	100	100	100	100	100	100	100
Wolf Lands 2									
High	100	100	20	100	100	100	33	33	0
Moderate	0	0	80	0	0	0	0	0	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	67	67	0
Total	100	100	100	100	100	100	100	100	100
Wolf Lands 3									
High	100	100	0	100	100	100	50	33	0
Moderate	0	0	100	0	0	0	0	33	100
Low	0	0	0	0	0	0	0	17	0
Not Available or Applicable	0	0	0	0	0	0	50	17	0
Total	100	100	100	100	100	100	100	100	100
Wolf Lands 4									
High	100	100	0	100	100	100	33	100	0
Moderate	0	0	100	0	0	0	0	0	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	67	0	0
Total	100	100	100	100	100	100	100	100	100

Source: AECOM 2011c.

Floodplains

As previously indicated, there are no mapped floodplains in Lake County; therefore, there are no mapped floodplains on the Wolf Lands tracts. However, the extent of unmapped floodplains along Coyote Creek for Tract 3 was estimated to be 112.2 acres, based upon topography (see Figure 4.3.3-5). Wolf Lands 3 was estimated to have 32.8 acres of floodplains and Wolf Lands 4 was estimated to have 79.4 acres. The ratio of the number of acres of floodplain per acre of parcel is 0.1 and 0.2, respectively (AECOM 2011d).

Frontage of Waterways

Coyote Creek begins in Wolf Lands 3, flows north into Wolf Lands 4, and continues north of Wolf Lands 4. The creek is 0.1 mile in length in Wolf Lands 3, and 0.9 miles in length in Wolf Lands 4. Riparian habitat is found on both sides of the river. The linear distance of river frontage for Wolf Lands 3 and Wolf Lands 4 is 1,056.0 and 9,504 linear ft, respectively. The length of river frontage per acre on Wolf Lands 3 and Wolf Lands 4 was calculated to be 3.8 and 23.5 ft, respectively.

4.3.3.2.5 Tract 4 – Hunting Club Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 4 consists of 160.2 acres, of which 63.6 acres are mapped as wetland (approximately 40 percent) (see Figure 4.3.3-4 and Table 4.3.3-12). The most common wetland types within Tract 4 are shrub swamps (approximately 50 percent), which includes alder thickets and shrub-carr wetlands; coniferous swamps (approximately 24 percent); and shallow marshes (approximately 20 percent). The parcel is nearly level and consists predominantly of second- and third-growth deciduous and mixed deciduous and coniferous forested uplands and emergent, shrub, and forested wetlands (AECOM 2011c).

Table 4.3.3-12 Total Wetland Acreage by Wetland Type for Tract 4

	Total Hunting Club	
Eggers and Reed Class[1]	**Acres**	**%**
Coniferous swamp[2]	15.4	24
Hardwood swamp[3]	0.4	1
Open bog	0.0	0
Open water (includes shallow, open water, and lakes)	2.8	5
Shallow marsh[4]	13.0	20
Shrub swamp (includes alder thicket and shrub-carr)	32.0	50
Total	63.6	100

Notes:
1 Eggers and Reed 1997; 2014.
2 Field data for coniferous bogs and coniferous swamps was combined.
3 Coniferous tree species may be present within some hardwood swamps.
4 Shallow marsh areas may contain deep marshes.

A wetland complex bisects the parcel and drains to the north and then northeast. From this low area, the land slopes upward to the east and west. Several beaver dams were found during field surveys along the creek on or near the parcel. The parcel consists primarily of wetland shrublands, with lesser amounts of emergent and shrub wetlands and upland deciduous forests (AECOM 2011c).

Beaver ponds and dams are the dominant wetland features on the parcel. Open water habitat is typical near the dams. Emergent vegetation, consisting of Canada bluejoint grass, narrow-leaved cattail, and various sedge species, are found in water from 12 to 24 inches deep, while speckled alder shrub wetlands are located near ponds at water depths from 6 to 18 inches. A large black spruce forest is located in the middle of the parcel. Overstory cover is about 60 percent, with most of the cover resulting from black spruce, with scattered tamarack occasionally present. The midstory consists of speckled alder (50 percent cover), while leatherleaf and bog Labrador-tea (80 percent cover) and sphagnum moss (about 80 percent cover) are found below the speckled alder (AECOM 2011c).

Wetland Functional Assessment

Table 4.3.3-13 summarizes the three wetland functional value ratings that were obtained for Tract 4 for the primary wetland functions rated by MnRAM 3.2. Tract 4 wetlands were rated high for nearly all wetland functional values with the exception of flood attenuation, amphibian habitat, and aesthetic, recreational, educational, and cultural values.

Table 4.3.3-13 Wetland Functional Value Assessment for Tract 4

Wetland Functions and Value Rating	Functional Value Ratings (%)								
	Vegetation Diversity/ Integrity	Hydrology	Flood Attenuation	Downstream Water Quality	Wetland Water Quality	Wildlife Habitat	Fish Habitat	Amphibian Habitat	Aesthetics/ Education/ Cultural
High	100	100	0	100	100	100	100	33	0
Moderate	0	0	100	0	0	0	0	33	100
Low	0	0	0	0	0	0	0	0	0
Not Available or Applicable	0	0	0	0	0	0	0	33	0
Total	100	100	100	100	100	100	100	99	100

Source: AECOM 2011c.

Floodplains

Tract 4 is located within St. Louis County, where there are no mapped floodplains identified on the county's FIRM. There were no unmapped floodplains associated with Tract 4.

Frontage of Waterways

Tract 4 does not include any streams, rivers, creeks, or lakes.

4.3.3.2.6 Tract 5 – McFarland Lake Lands

Hydrology, Wetland Vegetation, and Community Types

Tract 5 is a single parcel of 30.8 acres. The entire parcel is mapped as upland. The parcel is approximately 3 miles west of the U.S.-Canada border. This parcel is mostly on a hill slope and consists of second- and third-growth deciduous and coniferous forested uplands. There are no wetlands located on Tract 5. This parcel is surrounded by the Superior National Forest. McFarland Lake borders Tract 5 and provides lake habitat (AECOM 2011b).

Wetland Functional Assessment

No wetlands are associated with Tract 5; therefore, there are no functional assessment values.

Floodplains

Cook County has an older Flood Hazard Boundary Map developed by the HUD to estimate the areas of frequent inundation. FEMA rescinded the map in 1985 and it is not considered to be an effective FEMA FIRM map; therefore, it is not used as part of the management of flood-prone areas. Cook County does not have a floodplain overlay ordinance; therefore, there are no "regulatory floodplains" within Cook County. While the floodplains identified using the older map are not considered to be the effective FEMA FIRM maps of flood-prone areas, they can offer an approximation of floodplains within the county for the effects analysis.

Mapped floodplain identification for the effects analysis of non-federal lands in Cook County was done using this older, rescinded map and it was determined that Tract 5 has no mapped or unmapped floodplains.

Frontage of Waterways

Tract 5 borders McFarland Lake. The parcel has a lake frontage of approximately 990 ft along McFarland Lake. The length of lake frontage per acre on Tract 5 was calculated to be 32.1 ft.

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4.3.4 Vegetation

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list. A BE has been prepared that contains further information about RFSS. The BE is included in Appendix D.

4.3.4.1 Federal Lands

The federal lands include a large tract of mostly forested land, up to 6,495.4 acres in size. The tract is located in the west-central part of the Superior National Forest (PolyMet 2015a).

4.3.4.1.1 Land Exchange Proposed Action

Cover Types

Cover types consist of several categories of classification, including MDNR GAP land cover types, specific plant community survey results, MBS Sites of Biodiversity Significance, SNAs, USFS Management Areas, USFS ELTs, USFS MIH types, and USFS landscape ecosystems.

Habitat Types

The federal land cover types are similar to the Mine Site described in Section 4.2.4.2.1 (see Figure 4.2.4-1). Specific acreages for MDNR GAP land cover types on the federal lands are presented in Table 4.3.4-1 below. In the past, portions of the federal lands have been logged to varying degrees, depending on the management area allocation. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-1 Federal Lands Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	2,978.6	46
Upland coniferous forest[2]	1,618.9	25
Upland deciduous forest[3]	1,091.8	17
Shrubland	645.6	10
Disturbed	63.8	1
Aquatic environments	60.1	1
Upland conifer-deciduous mixed forest[4]	20.9	<1
Lowland deciduous forest[5]	9.5	<1
Cropland/grassland	6.2	<1
Total	**6,495.4**	**100**

Source: MDNR 2006b.

Notes:
[1] Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
[2] Includes pine and spruce/fir forest cover types.
[3] Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
[4] Includes all mixed coniferous-deciduous forest cover types.
[5] Includes black ash forest cover types.

Plant Community Surveys

Wetlands are dominated by immature black spruce and northern white cedar, with scattered tamarack (*Larix laricina*) and aspen (AECOM 2011d). There are several areas of open water, including Mud Lake, the Partridge River, Yelp Creek, and scattered small ponds. Bogs are dominated by leatherleaf (*Chamaedaphne calyculata*) and bog-Labrador tea (*Ledum groenlandicum*). Uplands are dominated by immature mixed pine-hardwood forests, including jack pine, black spruce, trembling aspen (*Populus tremuloides*), paper/white birch (*Betula papyrifera*), and balsam fir. Grassland/shrubland habitat is uncommon and is primarily associated with the transmission line ROW in the western portion and recent logging in the southeastern portion of the federal lands. Disturbed areas are associated with roads and landings, waste rock storage areas immediately north of the federal lands, and a rail route along the southern portion of the federal lands.

The majority of forest stand trees on the federal lands are characterized as immature, or 12 inches dbh or less, which corresponds to trees from 10 to 60 years in age (AECOM 2011d). For both coniferous and deciduous trees, the largest ones are approximately 18 to 20 inches dbh, but a 24-inch dbh red pine was found on the federal lands. Much of the One Hundred Mile Swamp north and west of the Mine Site consists of mature (80-plus years in age) black spruce and northern white cedar.

Of the wetlands that are located on the federal lands, the majority are determined to have high overall quality due to minimal or no current disturbance (AECOM 2011a). Of the wetlands that are located on the Mine Site, the majority (92 percent) is rated as having a high overall wetland quality and 8 percent are of moderate overall wetland quality. Wetlands on the federal lands are rated high for nearly all wetland functions, based on the MnRAM 3.2 criteria (AECOM 2011d). Vegetation diversity and integrity are rated moderate to high for all wetlands because recent human contact and alteration are minimal and the wetlands have a relatively constant supply of water. See Section 4.3.3 for a more detailed discussion on wetlands.

Minnesota Biological Survey

The majority (6,142.7 acres) of the federal lands consist of MBS Sites of High Biodiversity Significance, including the One Hundred Mile Swamp site (53 percent of federal lands) and the Upper Partridge River site (41 percent of federal lands). The Upper Dunka Peatlands site (less than 1 percent of federal lands) is a Site of Moderate Biodiversity Significance and is also located on the federal lands (see Figure 4.2.4-1) (MDNR 2008a). These sites are located in the Laurentian Uplands subsection.

Three vegetation communities, white pine-red pine forest (FDn43a; less than 1 percent of federal lands), black spruce-Jack pine woodlands (FDn32c; 17 percent of federal lands), and rich black spruce swamps (FPn62a; 5 percent of federal lands) have been characterized by the MBS as "imperiled," "imperiled/vulnerable," and "vulnerable" native plant communities, respectively (MDNR 2008b). Black ash-conifer swamps (WFn64a), black spruce bogs (APn80a), graminoid bogs (APn90b1), poor tamarack-black spruce swamps (APn81b), and white cedar swamps (FPn63a) are ranked as "apparently secure" in Minnesota based on abundance, distribution, trends, and threats. Aspen-birch forests: balsam fir subtype (FDn43b1), alder swamps (FPn73a), poor black spruce swamps (APn81a), rich tamarack-alder swamps (FPn82a), willow-dogwood shrub swamps (WMn82a), and low shrub poor fens (APn91a) are all considered "widespread and secure."

Scientific and Natural Areas

Similar to the Mine Site, there are no lands designated or nominated for designation as SNAs on the federal lands (MDNR 2006c; MDNR, Pers. Comm., February 14, 2012).

Culturally Important Plants

Natural resources culturally important to the Bands are discussed in Section 4.2.9.3.3.

Management Areas

The USFS manages its forests by assigning various management area allocations. The federal lands are currently managed under the General Forest – Longer Rotation Management Area (95 percent) and the General Forest Management Area (5 percent) (see Table 4.3.4-2) (USFS 2011j). Section 4.3.1 describes the management areas in detail.

Table 4.3.4-2 Management Areas for the Federal Lands

Category	Federal Lands Acres	Federal Lands Percent
General Forest	355.3	5
General Forest – Longer Rotation	6,140.1	95
Potential/Candidate Research Natural Areas	0.0	0
Riparian Areas	0.0	0

Source: USFS 2011j.

Ecological Land Types

USFS ELT data for the federal lands are not fully developed, but provide data for over half of the parcel. The federal lands contain five different categories of ELTs, including Lowland Loamy

Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), Upland Deep Loamy Dry Coarse (ELT 13), and Upland Shallow Loamy Dry (ELT 16). Almost all of the federal lands are included within the Big-Bird Lake Moraine LTA, with the small remaining portion included in the Mesabi Range LTA.

Management Indicator Habitats

As mentioned previously, the USFS also tracks MIH types. The most abundant MIH type on the federal lands is lowland black spruce-tamarack forest (MIH 9; 3,060.2 acres), but upland forest (MIH 1; 1,330.0 acres) and upland conifer forest (MIH 5; 1,252.4 acres) is also present (see Table 4.3.4-3) (USFS 2010b). Aquatic habitats (MIH 14) are not tracked on the federal lands, though several open water features occur on the federal lands (see Figure 4.2.4-4). Though not considered MIH types, the federal lands contain 492.3 acres of lowland shrub habitat and 185.5 acres of lowland emergent wetlands, as well. The remaining acres present on the federal lands have no corresponding MIH classification.

The USFS Forest Stand data also contain information about forest stand ages. The majority of the federal lands consist of mature (3,854.2 acres) forest stands, with smaller amounts of immature (1,539.2 acres) stands and young (271.1 acres) stands (USFS 2011i). Additionally, the USFS tracks large (greater than 300 acres) contiguous patches of mature upland forest (MIH 13) on the Superior National Forest. There are currently no patches of mature upland forest over 300 acres on the federal lands (USFS 2012c). However, since smaller patches will grow over time into larger contiguous patches, the USFS predicts that in 2020, there would be two patches (707.8 acres and 322.1 acres) over 300 acres on the federal lands (USFS 2012d).

Table 4.3.4-3 MIH Types and Age Classes (Acres) for the Federal and Non-federal Lands

MIH Type	Total of Federal Lands[1]	Total of Non-federal Lands[2]	Tract 1 – Hay Lake	Tract 2 – Lake County North	Tract 2 – Lake County South	Tract 3 – Wolf 1	Tract 3 – Wolf 2	Tract 3 – Wolf 3	Tract 3 – Wolf 4	Tract 4 - Hunting Club	Tract 5 - McFarland Lake
MIH 1	1,330.0	2,694.5	2,366.0	49.1	2.1	43.8	56.8	40.9	20.4	89.3	26.1
MIH 5	1,252.4	79.9	54.2	1.1	0.0	0.0	7.9	0.0	0.0	12.7	4.0
MIH 9	3,060.2	3,308.5	1,817.6	193.7	46.2	72.2	626.6	186.2	348.9	17.1	0.0
MIH 14	0.0	226.7	206.2	0.5	3.3	0.0	0.5	0.9	4.3	10.3	0.7
Lowland Shrub	492.3	332.2	113.3	20.6	6.4	9.7	76.0	48.6	31.0	26.6	0.0
Lowland Emergent	185.5	385.7	365.0	0.0	15.6	0.0	0.0	0.9	0.0	4.2	0.0
Upland Grass	0.0	43.3	0.0	0.0	43.3	0.0	0.0	0.0	0.0	0.0	0.0
Age Class											
Young	271.1	778.2	533.8	24.4	43.3	2.2	7.6	130.4	9.5	27.0	0.0
Immature	1,539.2	3,539.7	3,259.8	74.6	0.8	76.1	68.7	21.8	5.4	32.5	0.0
Mature	3,854.2	1,824.6	460.2	144.9	47.6	37.8	615.1	74.9	354.3	59.7	30.1

Sources: USFS 2010b; USFS 2011i.

Note:
[1] Determined based on: AECOM 2011c; AECOM 2011b; USFS 2010b; USFS 2011i.

Landscape Ecosystems

In order for the USFS to sustainably and ecologically manage National Forest System lands, it must consider areas based on historical and current ecosystem functions. The USFS tracks and manages the Superior National Forest and other National Forest System lands on several levels, but to maintain a broader ecosystem view it uses a landscape ecosystem basis. A landscape ecosystem is an area that shares similar habitat composition, structure, and functions and occurs naturally on the landscape (USFS 2004a). The federal lands are located within three landscape ecosystem types, including Jack Pine-Black Spruce, Lowland Conifer, and Mesic Red and White Pine (see Table 4.3.4-4).

The Jack Pine-Black Spruce landscape ecosystem occupies 3,000.1 acres of the federal lands (represents less than 0.01 percent of Jack Pine-Black Spruce landscape ecosystem). It is dominated by both jack pine and black spruce, but aspen and paper birch are also occasionally present (USFS 2004a). Typically, jack pine dominates areas after fire disturbances and black spruce dominates areas after wind disturbances.

The Lowland Conifer landscape ecosystem occupies 3,460.3 acres of the federal lands (represents 0.01 percent of Lowland Conifer landscape ecosystem). It is dominated by one or all three species of black spruce, tamarack, and northern white cedar (USFS 2004a). Typically, black spruce occupies acidic organic soils, northern white cedar occupies neutral sites, and tamarack occupies areas between both types. Fire disturbances are more frequent than wind disturbances.

The Mesic Red and White Pine landscape ecosystem occupies less than one acre of the federal lands (represents less than 0.01 percent of Mesic Red and White Pine landscape ecosystem). It is dominated by mixed stands of red pine, white pine, aspen, paper birch, northern white cedar, white spruce, and balsam fir (USFS 2004a). Severe fire disturbances typically result in aspen/birch stands with red and white pine also present. Succession generally reduces the aspen/birch component, which leaves pines as the dominant species. White spruce and balsam fir typically regenerate in the understory.

Table 4.3.4-4 Landscape Ecosystem Types (Acres) on Federal and Non-federal Lands[1, 2]

Landscape Ecosystem Type	Total of Federal Lands	Total of Non-Federal Lands	Tract 1 – Hay Lake	Tract 2 – Lake County North	Tract 2 – Lake County South	Tract 3 - Wolf 1	Tract 3 – Wolf 2	Tract 3 – Wolf 3	Tract 3 - Wolf 4	Tract 4 - Hunting Club	Tract 5 - McFarland Lake
Dry-Mesic Red and White Pine	0.0	682.9	589.2	0.0	0.0	0.0	0.0	0.0	0.0	93.7	0.0
Mesic Red and White Pine	0.1	558.8	528.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.8
Jack Pine-Black Spruce	3,000.1	983.5	983.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lowland Conifer	3,460.3	4,455.0	2,835.3	227.6	80.2	84.3	653.2	217.7	356.7	0.0	0.0
Mesic Birch-Aspen-Spruce-Fir	0.0	302.1	0.9	37.4	0.0	41.5	114.7	59.7	47.9	0.0	0.0
Lowland Hardwood	0.0	66.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.5	0.0
Sugar Maple	0.0	36.7	0.0	0.0	36.7	0.0	0.0	0.0	0.0	0.0	0.0

Source: USFS 2011g.

Notes:
[1] Total acres may be more or less than presented elsewhere due to rounding or GIS layers used.
[2] Data may not have complete coverage of parcels.

<u>Invasive Non-native Plants</u>

The federal lands have the same invasive non-native species as the Mine Site since they occupy the same area. Section 4.2.4.2.2 provides a list of invasive non-native species likely located on the federal lands.

<u>Threatened and Endangered Plant Species</u>

Endangered, Threatened, and Special Concern Plant Species

No federally listed threatened and endangered plant species are known to occur on the federal lands. The federal lands contain the same state-listed ETSC plant species as the Mine Site, with the exception of *Botrychium campestre*, which is located south of the federal lands on the Mine Site; an additional species, *Pyrola minor*, is found north of the Mine Site on the federal lands. Section 4.2.4.2.3 provides a list and discussion of the ETSC species on the federal lands.

Ten state-listed ETSC plant species are known to occur on the federal lands. Based on a review of the MDNR NHIS and field investigations (AECOM 2009b; Barr 2007i; Johnson-Groh 2004; Pomroy and Barnes 2004; Walton 2004), one state endangered species, and nine state species of special concern have been identified on the federal lands (see Table 4.3.4-5 and Figure 4.2.4-3). Some colonies of species listed for the Mine Site may be located outside of the federal lands but within the Mine Site. As a result, numbers of individuals may be smaller than the Mine Site.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Table 4.3.4-5 Endangered, Threatened, and Special Concern Plant Species Identified on the Federal Lands [5]

Common Name	Scientific Name	State Status[1]	No. of Populations[2]	No. of Individuals[2,3]	Habitat and Location
Pale moonwort[4]	*Botrychium pallidum*	SC	1	2	Full to shady exposure, edge of alder thicket, along Dunka Road.
Ternate, or St. Lawrence, grapefern[4]	*Botrychium rugulosum* (*ternatum*)	SC	1	4	Early successional habitats, fields, open woods, forests, and along Dunka Road.
Least grapefern[4]	*Botrychium simplex*	SC	3	905	Full to shady exposure, edge of alder thicket, forest roads, along Dunka Road.
Floating marsh marigold[4]	*Caltha natans*	E	1	29	Shallow water in ditches and streams, alder swamps, shallow marshes, beaver ponds, and Partridge River mudflat.
Neat spikerush[4]	*Eleocharis nitida*	SC	1	~486 ft^2	Full exposure, moist ditches along Dunka Road, wet area between railroad grades, and railroad ditch.
Bog rush[4]	*Juncus stygius* var. *americanus*	SC	1	Unknown	Open-patterned peatlands, rich and poor fens, northern spruce bog within the One Hundred Mile swamp.
Club-spur orchid	*Platanthera clavellata*	SC	1	Unknown	Black spruce and/or tamarack swamps, northern spruce bog within the One Hundred Mile swamp.
Small shinleaf[4]	*Pyrola minor*	SC	1	10	Rich black spruce swamps, cedar swamps, on Sphagnum hummocks in forested peatlands within the One Hundred Mile swamp.
Lapland buttercup	*Ranunculus lapponicus*	SC	1	~919 ft^2	On and adjacent to Sphagnum hummocks in black spruce stands, up to 60 percent shaded with alder also dominant.
Torrey's manna-grass	*Torreyochloa pallida*	SC	1	~25 ft^2	In muddy soil along shore and in water within shallow channels, beaver ponds, shallow marshes, along Partridge River.

Sources: AECOM 2009b; Barr 2007i; Johnson-Groh 2004; MDNR 2005; MDNR 2011k; MDNR 2014d; Pomroy and Barnes 2004; Walton 2004.

Notes:
[1] E - Endangered, T - Threatened, SC - Species of Special Concern.
[2] Note that the number of populations may differ from those given in the NHIS data because of populations found during other surveys.
[3] Where the number of individuals could not be determined without damaging the population, then patch size was used as a representative abundance measure.
[4] These species are also RFSS as tracked by the USFS.
[5] Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of August 5, 2014. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

Species Life Histories

The species life histories are provided in Section 4.2.4.2.3 for all species except the additional one listed below.

Small shinleaf (*Pyrola minor*) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. The species was first reported in Lake County in 1914 near the North Kawishiwi River. It has since only been documented in Cook, St. Louis, Lake (Bell Museum of Natural History 2011), and Carlton counties (NatureServe 2014b). *P. minor* is a circumpolar species occurring across Canada and the western United States in boreal and alpine habitats (MDNR 2011k). It usually occurs in conifer swamps, including black spruce and northern white cedar swamps, and black spruce-balsam fir woodlands. Small shinleaf can also be found along moist ecotones between wetlands and uplands or between streams and slopes. It is a perennial evergreen forb species that is rhizomatous and flowers in mid-July. It may be semi-tolerant to disturbance, since healthy populations exist along well-traveled portage routes and at sites that have experienced timber harvesting around 20 years prior (MDNR 2011k). Threats to *P. minor* include climate change, since it is a circumpolar species, and competition from non-native species.

Regional Foresters Sensitive Species

Seven state-listed ETSC plant species that occur on the federal lands (*Botrychium pallidum*, *Botrychium rugulosum*, *Botrychium simplex*, *Caltha natans*, *Eleocharis nitida*, *Juncus stygius*, and *Pyrola minor*) are also RFSS plants. A species description for *Pyrola minor* is provided above, and for the other six ETSC species in Section 4.2.4.2.3. The other RFSS plants that are likely located on the federal lands using MIH types and suitable habitat as indicators are discussed in Section 4.2.4.2.3.

4.3.4.1.2 Land Exchange Alternative B

Cover Types

A smaller portion of the federal lands (up to 4,752.6 acres) would be exchanged into private ownership under this alternative.

Habitat Types

The Alternative B: Smaller Federal Parcel contains similar MDNR GAP land cover types as the federal lands, but smaller acreages of them, with lowland coniferous forest making up the majority of the parcel and cropland/grassland occupying the least amount (see Table 4.3.4-6). The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-6 Alternative B: Smaller Federal Parcel Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	2,064.8	43
Upland coniferous forest[3]	1,366.1	29
Upland deciduous forest[4]	804.7	17
Shrubland	436.9	9
Disturbed	29.1	1
Aquatic environments	26.3	1
Upland conifer-deciduous mixed forest[5]	17.8	<1
Lowland deciduous forest[2]	4.7	<1
Cropland/grassland	2.2	<1
Total	**4,752.6**	**100**

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.

Minnesota Biological Survey

Lands as part of the Alternative B: Smaller Federal Parcel would be mostly classified as MBS Sites of High Biodiversity Significance, including the Upper Partridge River (56 percent of Alternative B: Smaller Federal Parcel lands) and the One Hundred Mile Swamp (40 percent of Alternative B: Smaller Federal Parcel lands) (see Figure 4.2.4-1) (MDNR 2008a). Less than 1 percent of Alternative B: Smaller Federal Parcel would contain the Upper Dunka Peatlands MBS Site of Moderate Biodiversity Significance. These sites are located in the Laurentian Uplands subsection.

The Alternative B: Smaller Federal Parcel would also contain “imperiled,” “imperiled/vulnerable,” and “vulnerable” native plant communities, including white pine-red pine forests (FDn43a; less than 1 percent), rich black spruce swamp (FPn62a; 6 percent), and black spruce-Jack pine woodlands (FDn32c; 23 percent), respectively (MDNR 2008b). Black ash-conifer swamps (WFn64a), black spruce bogs (APn80a), graminoid bogs (APn90b1), poor tamarack-black spruce swamps (APn81b), and white cedar swamps (FPn63a) are ranked as “apparently secure” and are located in the Alternative B: Smaller Federal Parcel lands. Aspen-birch forests: balsam fir subtype (FDn43b1), alder swamps (FPn73a), poor black spruce swamps (APn81a), rich tamarack-alder swamps (FPn82a), willow-dogwood shrub swamps (WMn82a), and low shrub poor fens (APn91a) are all considered “widespread and secure” and are also on the Alternative B: Smaller Federal Parcel.

Scientific and Natural Areas

There are no SNAs located on or near the Alternative B: Smaller Federal Parcel lands.

Culturally Important Plants

Similar to the federal lands, natural resources culturally important to the Bands are discussed in Section 4.2.9.3.3.

Management Areas

The Alternative B: Smaller Federal Parcel lands are currently managed under the General Forest – Longer Rotation Management Area (93 percent) and the General Forest Management Area (7 percent; see Table 4.3.4-7) (USFS 2011j). Section 4.3.1 describes the management areas in detail.

Table 4.3.4-7 Management Areas for the Land Exchange Alternative B Lands

Category	Land Exchange Alternative B Lands	
	Acres	Percent
General Forest	355.3	7
General Forest – Longer Rotation	4,397.3	93
Potential/Candidate Research Natural Areas	0.0	0
Riparian Areas	0.0	0

Source: USFS 2011j.

Ecological Land Types

The Alternative B: Smaller Federal Parcel lands contain the same five categories of ELTs as the federal lands. Section 4.3.4.1.1 provides a discussion of these ELT types.

Management Indicator Habitats

The Alternative B: Smaller Federal Parcel consists mostly of lowland black spruce-tamarack forest (MIH 9; 2,078.7 acres), with lesser amounts of upland conifer forest (MIH 5; 1,138.8 acres) and upland forest (MIH 1; 954.2 acres) (see Table 4.3.4-8 and Figure 4.2.4-4) (USFS 2010b). Aquatic habitats (MIH 14) are not tracked on the Alternative B: Smaller Federal Parcel lands, though several open water features are present. Though not considered an MIH type, the smaller federal parcel contains 385.4 acres of lowland shrub habitat and 115.4 acres of lowland emergent habitat, as well. The remaining acres present on the federal lands have no corresponding MIH classification.

The Alternative B: Smaller Federal Parcel consists of mostly mature (2,574.7 acres) forest stands, with smaller amounts of immature (1,325.9 acres) stands and young (271.1 acres) stands (see Table 4.3.4-8). There are currently no patches of mature upland forest over 300 acres on the Alternative B: Smaller Federal lands (USFS 2012c). However, since smaller patches will grow over time into larger contiguous patches, the USFS predicts that in 2020, there would be one patch (707.8 acres) over 300 acres on the Alternative B: Smaller Federal lands (USFS 2012d).

Table 4.3.4-8 MIH Types and Age Classes (Acres) for the Land Exchange Alternative B Lands

MIH Type	Total of Land Exchange Alternative B Parcel Lands
MIH 1	954.2
MIH 5	1,138.8
MIH 9	2,078.7
MIH 14	0.0
Lowland Shrub	385.4
Lowland Emergent	115.4
Upland Grass	0.0
Age Class	
Young	271.1
Immature	1,325.9
Mature	2,574.7

Sources: USFS 2010b; USFS 2011i.

Landscape Ecosystems

The Alternative B: Smaller Federal Parcel lands are located within two landscape ecosystem types. The Jack Pine-Black Spruce landscape ecosystem occupies 2,395.1 acres of the smaller federal parcel lands (represents less than 0.01 percent of Jack Pine-Black Spruce landscape ecosystem), while the Lowland Conifer landscape ecosystem occupies 2,349.1 acres (represents less than 0.01 percent of Lowland Conifer landscape ecosystem) (see Table 4.3.4-9).

Table 4.3.4-9 Landscape Ecosystem Types (Acres) on the Land Exchange Alternative B Lands and Tract 1 Lands[1]

Landscape Ecosystem Type	Alternative B: Smaller Federal Parcel Lands[2]	Tract 1 – Hay Lake
Dry-Mesic Red and White Pine	0.0	589.2
Mesic Red and White Pine	0.0	528.0
Jack Pine-Black Spruce	2,395.1	983.5
Lowland Conifer	2,349.1	2,835.3
Mesic Birch-Aspen-Spruce-Fir	0.0	0.9
Lowland Hardwood	0.0	0.0
Sugar Maple	0.0	0.0

Source: USFS 2011g.

Notes:
1 Total acres may be more or less than presented elsewhere due to rounding or GIS layers used.
2 Data may not have complete coverage of parcel.

Invasive Non-native Plants

The Alternative B: Smaller Federal Parcel lands contain similar invasive non-native species as those that are part of the Land Exchange Proposed Action, since they occupy a smaller portion of the federal lands.

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

The Alternative B: Smaller Federal Parcel contains the same threatened and endangered species as the federal lands since it occupies the same general area, and the ETSC species located on the federal lands are also located within the boundary of the smaller federal parcel. Section 4.3.4.1.1 provides the list of species that occur on the Alternative B: Smaller Federal Parcel lands.

Regional Foresters Sensitive Species

The RFSS plants located on the smaller federal parcel are the same as those located on the federal lands and Mine Site. Sections 4.2.4.2.3 and 4.3.4.1.1 provide a list and discussion of these species.

4.3.4.2 Non-federal Lands

4.3.4.2.1 Cover Types

The non-federal lands portion of the Land Exchange Proposed Action includes five different private tracts of land that total up to 7,075.0 acres. These lands, which include forest and wetland habitat, are located throughout the Superior National Forest in St. Louis, Lake, and Cook counties.

4.3.4.2.2 Habitat Types

The MDNR GAP land cover types of the combined non-federal lands consist of mostly lowland coniferous forests, shrublands, and upland deciduous forests (see Table 4.3.4-10).

Table 4.3.4-10 Non-federal Lands Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	2,920.5	41
Shrubland	1,845.0	26
Upland deciduous forest[4]	1,232.9	17
Upland coniferous forest[3]	699.4	10
Aquatic environments	266.6	4
Upland conifer-deciduous mixed forest[5]	50.4	1
Cropland/grassland	31.7	<1
Lowland deciduous forest[2]	28.6	<1
Disturbed	0.0	0
Total	**7,075.0[(6)]**	**99[(7)]**

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.
7 Percent totals less than 100 percent due to rounding.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Management Indicator Habitats

MIH types and age classes were determined and mapped for the non-federal lands using several data sources, including field survey maps, aerial maps, surrounding federal MIH data, topographic maps, and USFS review. This analysis limited the MIH types to those mentioned above in Section 4.2.4.2.3, due to risk of misidentification of further subcategories of forests. Lowland shrub habitat, while not an MIH type, was also considered due to its importance to several wildlife species such as moose (USFS, Pers. Comm., October 26, 2011). Additionally, lowland emergent wetlands and upland grass types were included. The non-federal lands are dominated by lowland black spruce-tamarack forest (MIH 9; 3,308.5 acres) and upland forest (MIH 1; 2,694.5 acres), with lesser amounts of aquatic habitats (MIH 14; 226.7 acres) and upland conifer forest (MIH 5; 79.9 acres) (see Table 4.3.4-3). Though not considered MIH types, the non-federal lands also contain 385.7 acres of lowland emergent wetlands, 332.2 acres of lowland shrub habitat, and 43.3 acres of upland grassland.

Of forested plant communities on the non-federal lands, immature forest stands (3,539.7 acres) are most abundant, with lesser amounts of mature (1,824.6 acres) and young (778.2 acres) forest types.

Landscape Ecosystems

The non-federal lands are located within seven landscape ecosystem types, including Jack Pine-Black Spruce, Lowland Conifer, Mesic Red and White Pine, Dry-Mesic Red and White Pine, Lowland Hardwood, Mesic Birch-Aspen-Spruce-Fir, and Sugar Maple (see Table 4.3.4-4). All landscape ecosystem types on each tract represent less than 0.01 percent of that landscape ecosystem type within the Northern Superior Uplands Section.

4.3.4.2.3 Invasive Non-native Plants

The non-federal lands contain similar invasive non-native species as the federal lands, although there are also different species. The subsections on each tract below provide more detailed discussions of these species.

4.3.4.2.4 Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

The non-federal lands contain three state-listed ETSC plant species according to the MDNR NHIS, including *Woodsia scopulina*, *Saxifraga paniculata*, and *Carex ormostachya*. The former two of these species are located on Tract 5, and the latter species is located on Tract 1. Additional information about these three species is presented in the discussion of Tracts 1 and 5 below. Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Regional Foresters Sensitive Species

The non-federal lands are located outside the current boundaries of the Superior National Forest; however, following the Land Exchange Proposed Action, some or all of the non-federal lands could become National Forest System lands. The USFS currently manages 58 vascular and non-vascular plant species that are listed as RFSSs in the Superior National Forest (see Table 4.2.4-5). Detailed RFSS plant surveys have not been conducted on the private non-federal lands, but information from other field surveys and habitat preferences (MIH types) for each species is used to determine potential habitat or occurrences of RFSS plant species on the non-federal lands.

Saxifraga paniculata is located on the non-federal lands and it is also an RFSS plant. The non-federal lands consist of mostly lowland black spruce-tamarack forests (MIH 9), which means there is generally more habitat available for the 13 RFSS species listed under that category to occur on the non-federal lands, if suitable habitat exists for them (see Table 4.2.4-5). One of these species is *Pyrola minor*, which is a state-listed ETSC plant species that occurs on the federal lands. The non-federal lands also contain a large portion of upland forest (MIH 1), which means there are many acres for the 17 RFSS species listed under that category to occur on the non-federal lands as well. Three of these species are state-listed ETSC species on the federal lands and include *Botrychium pallidum*, *Botrychium rugulosum*, and *Botrychium simplex*. *Botrychium lanceolatum* is also known to occur near the southwest corner of the Tract 1 lands, and is associated with MIH 1. There is a smaller amount of aquatic habitat (MIH 14) available on the non-federal lands, so there is less available habitat for the eight RFSS species listed under that category. One of these species is *Caltha natans*, which is a state-listed ETSC plant species and occurs on the federal lands. There is very little upland conifer forest habitat (MIH 5) available, meaning there are likely fewer occurrences of some species in the MIH 5 category. There are also 385.7 acres of lowland emergent wetland habitat on the non-federal lands, so the five RFSS plant species listed under this category may occur on the non-federal lands as well. This includes *Eleocharis nitida* and *Juncus stygius*, which are both state-listed ETSC plant species that occur on the federal lands.

4.3.4.2.5 Tract 1 – Hay Lake Lands

The largest non-federal tract is Tract 1, which is 4,926.3 acres in size. It is located in the Laurentian Ranger District (USFS 2011n). The parcel has moderate topographic relief and slopes toward the east-northeast, in the direction of the Pike River (AECOM 2011b).

Cover Types

Tract 1 is located in the Nashwauk Uplands subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). See Section 4.2.4.1 for a description of the Nashwauk Uplands subsection.

Habitat Types

The primary MDNR GAP land cover types for Tract 1 include shrublands and lowland conifer forests (see Table 4.3.4-11). There are fewer acres of cropland/grassland and lowland deciduous forests. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-11 Tract 1 – Hay Lake Lands Cover Types

Cover Types	Total Acres	Percent of Area
Shrubland	1,664.6	34
Lowland coniferous forest[1]	1,524.2	31
Upland deciduous forest[4]	999.9	20
Upland coniferous forest[3]	437.3	9
Aquatic environments	251.1	5
Cropland/grassland	31.7	1
Lowland deciduous forest[2]	17.4	<1
Disturbed	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**4,926.3[(6)]**	**100**

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.

Plant Community Surveys

Much of Tract 1 (59 percent) is wetlands (AECOM 2011b). All of the 33 wetlands evaluated are rated high for wetland functions and values, according to MnRAM 3.2 (AECOM 2009b; AECOM 2011b). Most of the wetland habitats consist of scrub-shrub habitat dominated by speckled alder (*Alnus incana* ssp. *rugosa*), beaked hazel (*Corylus cornuta*), willows (*Salix* spp.), and bog birch (*Betula pumila*); pole and immature size coniferous forests dominated by black spruce, northern white cedar, and tamarack; and emergent/bog wetlands dominated by sedges (*Carex* spp.), cattail (*Typha* spp.), bog-Labrador tea, and leatherleaf (AECOM 2011b). There are several open water features on the parcel as well, including Hay Lake, Little Rice Lake, and the Pike River. See Section 4.3.3 for a more detailed description of wetland habitat types present.

Uplands consist of pole and immature deciduous forests, dominated by trembling aspen and paper birch, with midstories of sapling mountain maple (*Acer spicatum*), trembling aspen, paper birch, balsam fir, and black spruce. Shrub species include beaked hazel, with scattered speckled alder, twining honeysuckle (*Lonicera dioica*), and prickly rose (*Rosa acicularis*) (AECOM 2011b). The ground cover includes sedges, wild strawberry (*Fragaria virginiana*), bunchberry (*Cornus canadensis*), wild raspberry (*Rubus* spp.), horsetail (*Equisetum* spp.), clintonia (*Clintonia borealis*), twinflower (*Linnaea borealis*), large-leaved aster (*Aster macrophyllus*), rose twisted stalk (*Streptopus roseus*), skunk currant (*Ribes glandulosum*), spotted coralroot (*Corallorhiza maculata*), wood anemone (*Anemone quinquefolia*), tall buttercup (*Ranunculus acris*), bracken fern (*Pteridium aquilinum*), and interrupted fern (*Osmunda claytoniana*) (AECOM 2011b).

Disturbed areas and grasslands are primarily associated with abandoned logging roads, landings, and powerline ROWs and are dominated by forbs and grasses, including cow parsnip (*Heracleum lanatum*), white clover (*Trifolium repens*), ox-eye daisy (*Leucanthemum vulgare*), tall buttercup, common sow thistle (*Sonchus arvensis* ssp. *uliginosus*), orange hawkweed

(*Hieracium aurantiacum*), American vetch (*Vicia americana*), wild strawberry, wild raspberry, and common tansy (AECOM 2011b).

Almost all forest stands on Tract 1 consist of trees that are 8 to 11 inches dbh, having been harvested in relatively recent years (AECOM 2011b). Upland deciduous trees range up to 16 inches dbh, while upland coniferous trees range up to 10 inches dbh. Upland forest stands in the northern, central, and southwestern portions of the parcel are pole to immature, while upland stands in the western portion of the parcel are sapling to young pole. The majority of the trees on the parcel are estimated to be 60 years or younger (AECOM 2011b).

Minnesota Biological Survey

There are no lands designated as MBS Sites of Biodiversity Significance on Tract 1 (see Figure 4.3.4-1); however, the entire parcel is located within the preliminary Pike Range and Peatlands MBS Site of Outstanding Biodiversity Significance and could potentially be the only site ranked as Outstanding in the Nashwauk Uplands subsection upon final designation by the MDNR (MDNR, Pers. Comm., February 14, 2012; MDNR *In progress*). The preliminary site is approximately 26,000 acres in size, approximately half of which is owned or managed by the Superior National Forest. On a larger landscape level, this site is one of the largest and most contiguous high-quality areas within the subsection or LTA scale. The Pike Mountain cRNA and Loka Lake cRNA abut Tract 1 and are included within this preliminary MBS site.

Native plant community designations are not available for Tract 1. However, native plant communities of the preliminary Pike Range and Peatlands MBS site are generally of high quality and include representative examples of almost all communities known to exist in the subsection (MDNR, Pers. Comm., April 9, 2012; MDNR n.d.).

Scientific and Natural Areas

There are no lands designated as SNAs on Tract 1; however, state, federal, and private land near the southwest corner of the parcel has been identified as a “potential” SNA site (MDNR, Pers. Comm., February 14, 2012). The federal lands bordering the southwest corner of the parcel are designated as the Pike Mountain cRNA, and this designation could be extended onto Tract 1 due to high-quality mature hardwood forest stands, rare cliff and rock outcrop features, and low human disturbance.

Culturally Important Plants

Wild rice has been observed on Tract 1, including on Hay Lake, Little Rice Lake, and the Pike River (Barr 2011a; 2012a; 2013l). Small populations of wild rice have been found on Hay Lake with less than 10 percent coverage, while Little Rice Lake has several locations with greater than 75 percent coverage of wild rice and continuous growth throughout the lake. Wild rice was also found along the Pike River flowing north into Little Rice Lake. The survey performed in 2012 found lower densities of wild rice beds. Hay Lake, Rice Lake, and the Pike River all had density factor ratings of 1. The decreases in density in Rice Lake and the Pike River were consistent with a decrease in wild rice bed density across all areas surveyed in 2012. Section 4.2.2 provides further discussion of wild rice on the Tract 1 lands.

As with the federal lands, natural resources culturally important to the Bands are discussed in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 1 contains six categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), Upland Deep Loamy Over Sandy Dry (ELT 11), Upland Shallow Loamy Dry (ELT 16), and Upland Extremely Shallow Loamy Droughty (ELT 18). The majority of Tract 1 is included within the Pike-Sandy River Sand Plain LTA and the remainder is within the Mesabi Range LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on the Tract 1 lands (see Figure 4.3.4-1) (USFS 2010b). Though not considered MIHs, Tract 1 also contains 365.0 acres of lowland emergent wetlands and 113.3 acres of lowland shrub habitat.

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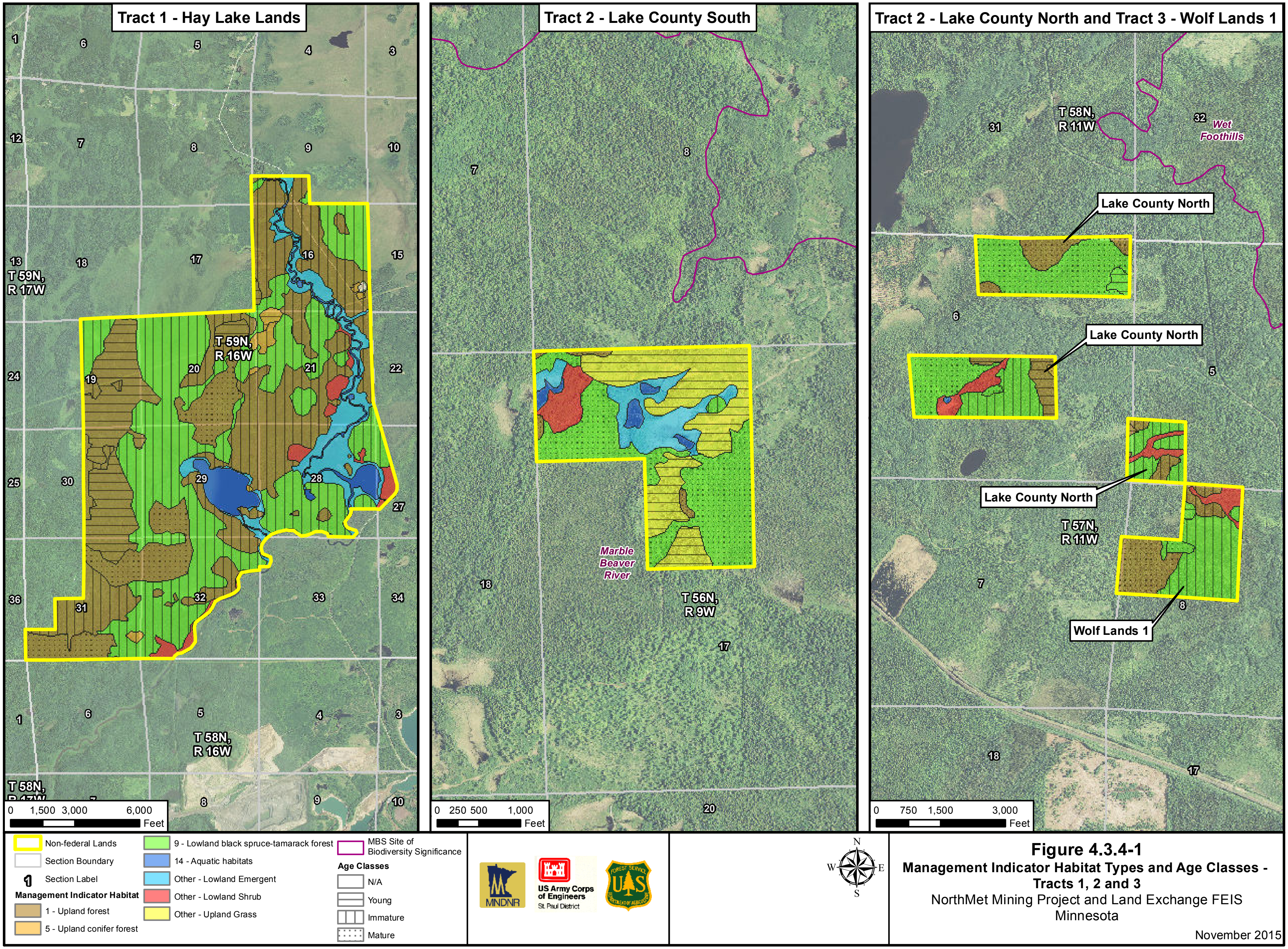

Figure 4.3.4-1
Management Indicator Habitat Types and Age Classes - Tracts 1, 2 and 3
NorthMet Mining Project and Land Exchange FEIS
Minnesota

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Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 1.

The Lowland Conifer landscape ecosystem occupies 2,835.3 acres of Tract 1. The Jack Pine-Black Spruce landscape ecosystem occupies 983.5 acres of Tract 1. The Mesic Red and White Pine landscape ecosystem occupies 528.0 acres of Tract 1. See the previous federal lands section above (see Section 4.3.4.1.1) for a description of these landscape ecosystem types.

The Dry-Mesic Red and White Pine landscape ecosystem occupies 589.2 acres of Tract 1. It comprises the following species: aspen, paper birch, red pine, white pine, jack pine, balsam fir, black spruce, white spruce, bigtooth aspen, and red maple (USFS 2004a). On drier sites, jack pine, red pine, and black spruce dominate, while the other species dominate on mesic sites. Succession after fire disturbances is similar to the Mesic Red and White Pine landscape ecosystem described above.

The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies less than 1 acre of Tract 1. It is dominated by mixed stands of aspen, paper birch, balsam fir, and white spruce, though northern white cedar, bigtooth aspen, and red maple are sometimes also present (USFS 2004a). Fire disturbances usually result in aspen/birch-dominated stand regeneration, while wind disturbances usually result in balsam fir and white spruce forests. The climax tree stage consists of a multi-aged white spruce and balsam fir forest with components of paper birch and northern white cedar.

Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, Tract 1 contains two known occurrences of common tansy (USFS 2010a). Common tansy can spread vegetatively or reproductively via tufted seeds that are dispersed by wind or water (MDNR 2011b). It is widespread and common along roadsides or abandoned farmyards in northern Minnesota. Common tansy was observed during field investigations along trails near recently installed gates and disturbed earthen berms. Additionally, AECOM (2011b) identified common tansy, orange hawkweed, common sow thistle, and ox-eye daisy within disturbed logging roads, landings, and power line rights-of-way. Orange hawkweed primarily spreads vegetatively through runners, rhizomes, and root buds, but can also spread reproductively (MDNR 2011b). It colonizes newly disturbed sites and early successional habitats quickly. Ox-eye daisy spreads vegetatively and reproductively, but often cannot invade intact grasslands (MDNR 2011b). It can, however, invade newly disturbed areas quickly. Common sow thistle spreads vegetatively and through wind-borne seeds or root cuttings. It colonizes fields, woodlands, and roadsides, but generally is not a threat to intact native plant communities (MDNR 2011b).

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

No federally listed ETSC plant species are known to occur on the Tract 1 lands according to field investigations (AECOM 2011b). Based on a review of the MDNR NHIS (MDNR 2014d), one state-listed species of special concern has been identified on Tract 1 (see Table 4.3.4-12 and Figure 4.3.4-3). Necklace sedge (*Carex ormostachya*) is not tracked by the USFS as an RFSS. No other state-listed species are known to occur on Tract 1.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

Table 4.3.4-12 Endangered, Threatened, and Special Concern Plant Species Identified on the Tract 1 Lands [3]

Common Name	Scientific Name	State Status[1]	No. of Populations	No. of Individuals[2]	Habitat and Location
Necklace sedge	*Carex ormostachya*	SC	1	>20	Dry/mesic shallow soils on rock outcrop in red oak-dominated forest

Sources: MDNR 2014d.

Notes:
1 E - Endangered, T - Threatened, SC - Species of Special Concern.
2 Where the number of individuals cannot be determined without damaging the population, then patch size is used as a representative abundance measure.
3 Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of August 5, 2014. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

Species Life Histories

The following summary provides a description of the life history, state-wide distribution, and sensitivity to disturbance for the species of special concern found on Tract 1.

Necklace sedge (*Carex ormostachya*) is listed as a species of special concern in Minnesota and is globally ranked as apparently secure; it is not listed as an RFSS in the Superior National Forest. The species was first documented in Cook County, Minnesota in 1938, and has since been reported across northern Minnesota (Bell Museum of Natural History 2014). *C. ormostachya* reaches the southwest corner of its range in Minnesota (NatureServe 2014b). It typically occurs in moist to dry deciduous, evergreen, or mixed forests, often in sandy gravel or disturbed soils (eFlora 2014). *C. ormostachya* is a perennial herbaceous species that flowers and fruits in spring to summer.

Regional Foresters Sensitive Species

There is more upland forest (MIH 1) and lowland black spruce-tamarack forest (MIH 9) habitat available than any other type, so the RFSS plants associated with these types would be most likely to occur on Tract 1. *Botrychium lanceolatum* is known to occur near the southwest corner of the Tract 1 lands, and is associated with MIH 1. There is a moderate amount of aquatic habitat (MIH 14) and a smaller amount of upland conifer forest (MIH 5), so RFSS plants associated with these would be less likely to occur.

4.3.4.2.6 Tract 2 – Lake County Lands

Tract 2 is 381.9 acres in size and includes several subparcels ranging in size from 44 to 117 acres on the Laurentian Ranger District southeast of Seven Beaver Lake that are mostly surrounded by the Superior National Forest (USFS 2011n). Tract 2 is divided into north (Lake County North) and south (Lake County South) parcels, with the north parcel being the larger of the two. Lake

County North consists of three subparcels, which are made up of mostly wetland habitats; the majority of Lake County South lands consists of wetland habitats as well (AECOM 2011c).

Lake County North

Cover Types

The Tract 2 is located in the Laurentian Mixed Forest Province ecoregion. Lake County North is located in the Laurentian Uplands subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). Section 4.2.4.1 provides a description of the Laurentian Uplands subsection.

Habitat Types

The primary MDNR GAP land cover type on the Tract 2 – Lake County North lands is lowland coniferous forest (see Table 4.3.4-13). It contains very few acres of aquatic environments or lowland deciduous forests. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-13 Tract 2 – Lake County North Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	133.0	50
Upland conifer-deciduous mixed forest[5]	34.0	13
Upland deciduous forest[4]	34.0	13
Upland coniferous forest[3]	32.8	12
Shrubland	28.1	11
Aquatic environments	1.8	1
Lowland deciduous forest[2]	1.4	1
Cropland/grassland	0.0	0
Disturbed	0.0	0
Total	**265.1[(6)]**	**101[(7)]**

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.
7 Percent totals are greater than 100 percent due to rounding.

Plant Community Surveys

The primary cover types are pole coniferous forest on the wetlands and mature and pole deciduous forests on the uplands (AECOM 2011c). Wetlands are dominated by northern white cedar, black spruce, and tamarack; balsam fir is a common understory species. Lake County North also contains scrub-shrub habitats that are dominated by speckled alder and contain emergent wetlands that consist of sedges and Canada bluejoint (*Calamagrostis canadensis*). Lake County North has several open bog areas, a beaver pond, and drainages as well. See Section 4.3.3 for a more detailed description of wetland habitat types present.

Upland habitats are dominated by immature paper birch and black spruce, but recently logged areas support sapling paper birch stands or shrub habitats. The midstory is comprised of balsam fir, black spruce, and beaked hazel. Areas that have been recently logged are dominated by sapling paper birch with scattered sapling trembling aspen and pole paper birch. Beaked hazel forms a patchy shrub layer, with several grasses and forbs in the ground layer (AECOM 2011c). Older forests near logged areas contain large amounts of downed woody debris, and have a midstory dominated by dense stands of balsam fir, black spruce, and northern white cedar.

Lake County North wetland canopy trees range from 6 to 10 inches dbh, but northern white cedar up to 20 inches dbh and black spruce up to 14 inches dbh are found on the subparcels (AECOM 2011c). The north parcel also contains an immature forested wetland containing black ash (*Fraxinus nigra*) trees up to 16 inches dbh.

Minnesota Biological Survey

There are no MBS Sites of Biodiversity Significance located on the Lake County North subparcels (see Figure 4.3.4-1) (MDNR 2008a). However, Lake County North is located on the potential Seven Beavers MBS Site, which has not yet been finalized by the MDNR but is ranked as having Moderate to High Biodiversity Significance (MDNR 2007a).

Native plant community rankings for Lake County North are not available.

Scientific and Natural Areas

There are no lands designated as SNAs on Tract 2 – Lake County North.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

The Lake County North parcel contains five categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), Upland Deep Loamy Dry Course (ELT 13), and Upland Deep Medium Loamy Dry (ELT 14). All three subparcels of the Lake County North parcel are included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 2 (see Figure 4.3.4-1) (USFS 2010b). Though not considered an MIH, the Lake County North parcel also contains 20.6 acres of lowland shrub habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 2.

The Lowland Conifer landscape ecosystem occupies 227.6 acres of Lake County North. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 37.4 acres of the Lake County North lands. See the federal or non-federal lands sections above for a description of these landscape ecosystem types.

Lake County South

Cover Types

The Lake County South parcel is located in the North Shore Highlands subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). Most of the vegetative cover types in the North Shore Highlands subsection grow in thin, rocky red and brown glacial till (MDNR 2011g). Upper Precambrian bedrock is often exposed at the surface. The most common soils are loams and sandy loams, which support forest communities of white pine, red pine, jack pine, balsam fir, white spruce, and aspen-birch.

Habitat Types

The primary MDNR GAP land cover types on Tract 2 – Lake County South are lowland coniferous forest and upland coniferous forest (see Table 4.3.4-14). There are fewer acres of aquatic environments. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-14 Tract 2 – Lake County South Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	53.1	45
Upland coniferous forest[3]	38.8	33
Shrubland	10.8	9
Upland deciduous forest[4]	10.1	9
Aquatic environments	4.0	3
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland deciduous forest[2]	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**116.8**[(6)]	**99**[(7)]

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.
7 Percent totals are less than 100 percent due to rounding.

Plant Community Surveys

The primary cover types on Tract 2 – Lake County South are similar to Tract 2 – Lake County North, with wetlands dominated by pole coniferous forest and upland areas dominated by immature paper birch, black spruce, jack pine, eastern white pine, and northern white cedar. There are five beaver ponds, surrounded by emergent wetland species, including sedges, narrow-leaved cattail (*Typha angustifolia*), woolgrass (*Scirpus cyperinus*), and Canada bluejoint (AECOM 2011c). Please see Section 4.3.3 for a more detailed description of wetland habitat types present.

Most upland areas on Tract 2 – Lake County South have been recently clear-cut, except the southwest portion of the parcel. This area has been partially thinned, leaving areas where immature paper birch, black spruce, jack pine, eastern white pine, and northern white cedar trees remain ranging from 12 to 24 inches dbh (AECOM 2011c). The midstory includes balsam fir and beaked hazel. Grasses and forbs dominate the ground layer.

Minnesota Biological Survey

The entire 116.9 acres of the Tract 2 – Lake County South parcel are located within the Marble Beaver River MBS Site of High Biodiversity Significance (see Figure 4.3.4-1) (MDNR 2008a). This site is located within the North Shore Highlands subsection.

Native plant communities have been identified for the Lake County South parcel. It contains one vegetation community, sugar maple (*Acer saccharum*) forest (MHn45c; 8 percent of parcel), which has been characterized as "vulnerable" in the state (MDNR 2008b). Black ash-conifer swamps (WFn64a; less than 1 percent of parcel) and lowland white cedar forests (WFn53a; 29 percent of parcel) are also present on the parcel and are ranked as "apparently secure" in Minnesota based on abundance, distribution, trends, and threats (MDNR 2008b).

Scientific and Natural Areas

There are no lands designated as SNAs on Tract 2 – Lake County South.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 2 – Lake County South contains two categories of ELTs, including Lowland Loamy Wet (ELT 2), and Upland Deep Medium Loamy Dry (ELT 14). The entire Lake County South parcel is included in the Tettegouche Till Plain LTA.

<u>Management Indicator Habitats</u>

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 2 lands (see Figure 4.3.4-1) (USFS 2010b). Though not considered MIHs, the Tract 2 – Lake County South parcel also contains 43.3 acres of upland grassland, 15.6 acres of lowland emergent wetland, and 6.4 acres of lowland shrub habitat.

<u>Landscape Ecosystems</u>

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 2 lands.

The Lowland Conifer landscape ecosystem occupies 80.2 acres of Tract 2 – Lake County South. See the federal or non-federal lands sections above for a description of this landscape ecosystem type.

The Sugar Maple landscape ecosystem occupies 36.7 acres of Tract 2 – Lake County South. It generally is located in a band within 15 miles of Lake Superior and is dominated by sugar maple with yellow birch, although northern white cedar, basswood, red maple, and northern red oak may also be present (USFS 2004a). Fire and wind disturbances are very infrequent, leaving individual tree mortality as the principal disturbance.

Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on the Tract 2 lands (USFS 2010a). Field studies indicate that one area of Tract 2 – Lake County North and several areas in the Tract 2 – Lake County South parcel contain occurrences of thistles and ox-eye daisy in a recently clear-cut habitat (AECOM 2011c).

Threatened and Endangered Plant Species

<u>Endangered, Threatened, and Special Concern Plant Species</u>

Based on a review of the MDNR NHIS and field investigations, no federally or state-listed ETSC plant species are known to occur on the Tract 2 lands.

<u>Regional Foresters Sensitive Species</u>

There is more lowland black spruce-tamarack forest (MIH 9) and upland forest (MIH 1) habitat available than any other type, so the RFSS plants associated with these types would be most likely to occur on the Tract 2 lands. There is a very small amount of upland conifer forest (MIH 5) or aquatic habitat (MIH 14) so RFSS plants associated with these would be less likely to occur.

4.3.4.2.7 Tract 3 – Wolf Lands

Tract 3 is 1,575.8 acres in size and is located on the Laurentian and Tofte Ranger Districts. Tract 3 includes four separate parcels ranging in size from 126 to 768 acres, referred to here as Tract 3 – Wolf Lands 1 through 4, which would complement Superior National Forest ownership by reducing federal exterior boundaries and eliminating several private ownership patterns (USFS 2011n). Tract 3 lands are located east to southeast of the federal lands and Tract 3 – Wolf Lands 1 is adjacent to Tract 2 – Lake County North.

Cover Types

Tract 3 lands are located in the Laurentian Uplands subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). Section 4.2.4.1 provides a description of the Laurentian Uplands subsection.

Tract 3 – Wolf Lands 1

Habitat Types

The primary MDNR GAP land cover type on the Tract 3 – Wolf Lands 1 parcel is lowland coniferous forest (see Table 4.3.4-15). It has fewer acres of shrubland and mixed upland forests. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-15 Tract 3 – Wolf Lands 1 Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	74.8	59
Upland deciduous forest[4]	27.2	22
Upland coniferous forest[3]	13.3	11
Shrubland	6.9	5
Upland conifer-deciduous mixed forest[5]	3.7	3
Aquatic environments	0.0	0
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland deciduous forest[2]	0.0	0
Total	**125.9[(6)]**	**100**

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.

Plant Community Surveys

The primary cover types on Tract 3 – Wolf Lands 1 are pole coniferous forest on the wetlands, and immature mixed forest on the uplands (AECOM 2011c). The wetlands contain equal amounts of open, bog-like communities of sapling black spruce, northern white cedar, and tamarack, and denser pole forests of these same species, in addition to balsam fir. Please see Section 4.3.3 for a more detailed description of wetland habitat types present. Uplands are dominated by deciduous and coniferous immature forest with paper birch, trembling aspen, and balsam fir. Shrub species include beaked hazel and red-osier dogwood (*Cornus stolonifera*) (AECOM 2011c).

The majority of the Tract 3 – Wolf Lands 1 consists of wetland pole coniferous trees from 6 to 10 inches dbh, while the mature mixed forest trees on uplands are 12 inches dbh or greater (AECOM 2011c).

Minnesota Biological Survey

There are no designated MBS Sites of Biodiversity Significance located on the Tract 3 –Wolf Lands 1 parcel (see Figure 4.3.4-1) (MDNR 2008a). However, Tract 3 – Wolf Lands 1 is located on a potential MBS Site of Moderate to High Biodiversity Significance that has not yet been finalized by the MDNR (MDNR 2007a).

Native plant community rankings for Tract 3 are not available.

Scientific and Natural Areas

There are no SNAs located on the Tract 3 parcels.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 3 – Wolf Lands 1 contains three categories of ELTs, including Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), and Upland Deep Medium Loamy Dry (ELT 14). The entire Tract 3 – Wolf Lands 1 parcel is included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 3 lands (see Figure 4.3.4-1) (USFS 2010b). Though not considered an MIH, the Tract 3 – Wolf Lands 1 parcel also contains 9.7 acres of lowland shrub habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 3 lands.

The Lowland Conifer landscape ecosystem occupies 84.3 acres of the Tract 3 – Wolf Lands 1 parcel. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 41.5 acres of the Tract 3 – Wolf Lands 1 parcel. See the federal or non-federal lands sections above for a description of these landscape ecosystem types.

Tract 3 – Wolf Lands 2

Habitat Types

The primary MDNR GAP land cover type on the Tract 3 – Wolf Lands 2 parcel is lowland coniferous forest (see Table 4.3.4-16). The least abundant cover types include lowland deciduous forest and mixed upland forests. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-16 Tract 3 – Wolf Lands 2 Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	586.2	76
Upland coniferous forest[3]	86.5	11
Shrubland	54.0	7
Upland deciduous forest[4]	29.9	4
Lowland deciduous forest[2]	5.8	1
Upland conifer-deciduous mixed forest[5]	5.5	1
Aquatic environments	0.0	0
Cropland/grassland	0.0	0
Disturbed	0.0	0
Total	**767.9**	**100**

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.

Plant Community Surveys

Tract 3 – Wolf Lands 2 consists of mostly wetland habitats dominated by either pole black spruce, northern white cedar, or a mix of the two (AECOM 2011c). Midstory cover types in these forests consist of sapling black spruce, northern white cedar, or balsam fir. Scrub-shrub habitats of speckled alder dominate drainage areas. Some bogs, emergent wetlands, and beaver ponds exist on the parcel. Section 4.3.3 presents a more detailed description of wetland habitat types present.

Upland habitats consist of pole or immature mixed coniferous-deciduous forest types, including paper birch, trembling aspen, and black spruce, with a midstory of balsam fir and shrub layer of beaked hazel (AECOM 2011c).

The majority of Tract 3 – Wolf Lands 2 consists of wetland coniferous forests with canopy trees ranging from 4 to 8 inches dbh. An upland area in the northern portion of the parcel was logged in the past, and so the canopy cover in this area consists of immature coniferous and deciduous trees ranging from 5 to 12 inches dbh (AECOM 2011c).

Minnesota Biological Survey

The entire 767.9 acres of the Tract 3 – Wolf Lands 2 parcel is located within the East Greenwood MBS Site of Moderate Biodiversity Significance (see Figure 4.3.4-2) (MDNR 2007a; MDNR 2008a). This site is located in the Laurentian Uplands subsection. Sites of Moderate Biodiversity Significance are sites that contain occurrences of rare species and/or moderately disturbed native plant communities or landscapes that have a strong potential for recovery.

Native plant community rankings for Tract 3 are not available.

Scientific and Natural Areas

There are no SNAs located on the Tract 3 parcels.

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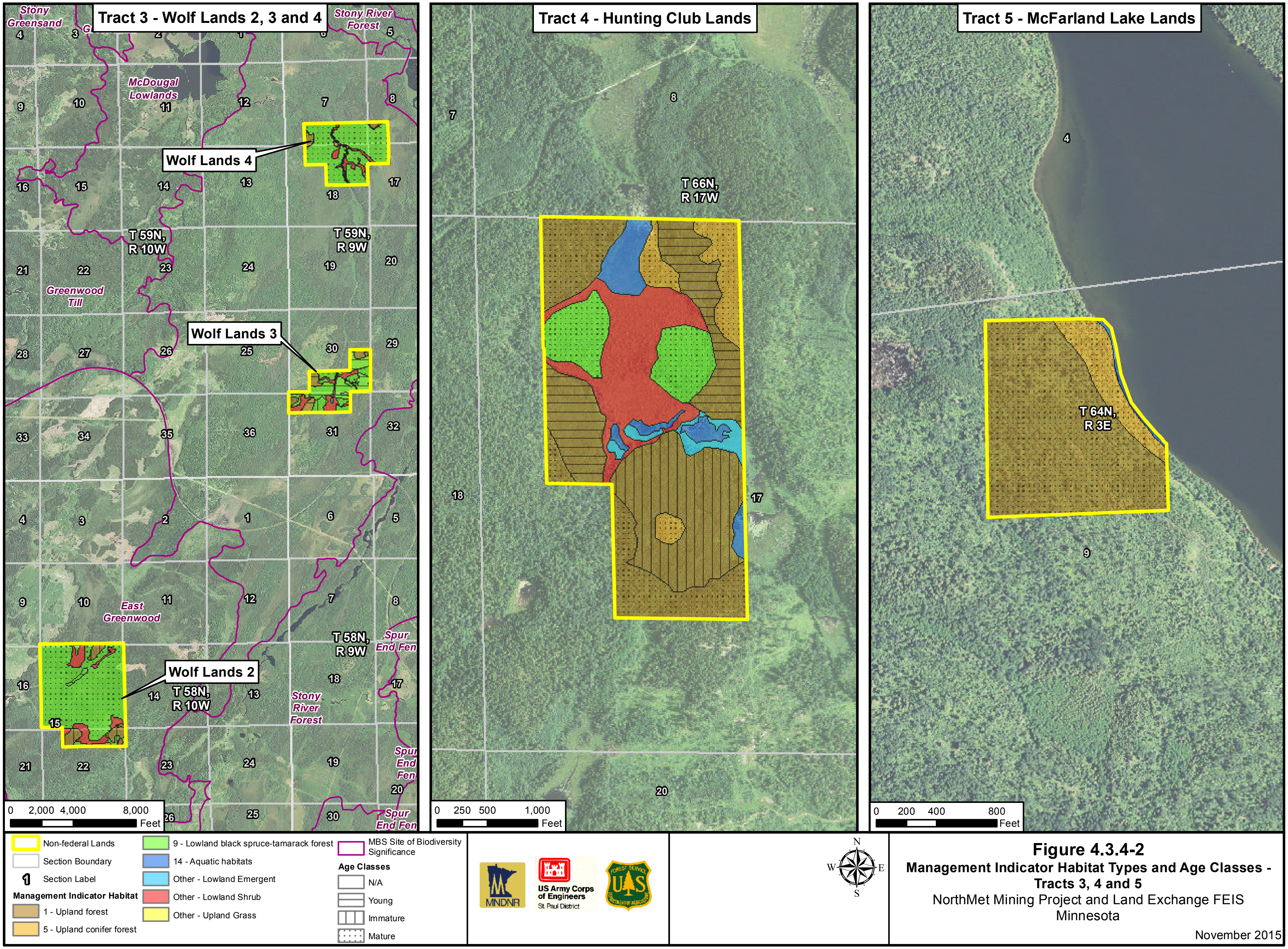

Figure 4.3.4-2

Management Indicator Habitat Types and Age Classes - Tracts 3, 4 and 5

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Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 3 – Wolf Lands 2 contains four categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Upland Deep Loamy Dry Course (ELT 13), and Upland Deep Medium Loamy Dry (ELT 14). The entire Wolf Lands 2 parcel is included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 3 lands (see Figure 4.3.4-2) (USFS 2010b). Though not considered an MIH, the Tract 3 – Wolf Lands 2 parcel also contains 76 acres of lowland shrub habitat. The Tract 3 – Wolf Lands 2 parcel contains one patch of mature forest over 300 acres (598.2 acres), which is an important habitat type. However, this is different from the USFS Patch layer discussed in Section 4.3.4.1.1.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 3 lands.

The Lowland Conifer landscape ecosystem occupies 653.2 acres of the Tract 3 – Wolf Lands 2 parcel. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 114.7 acres of the Tract 3 – Wolf Lands 2 parcel. Previous federal or non-federal land sections present descriptions of these landscape ecosystem types.

Tract 3 – Wolf Lands 3

Habitat Types

The primary MDNR GAP land cover type on the Tract 3 – Wolf Lands 3 parcel is lowland coniferous forest (see Table 4.3.4-17). The upland deciduous forest and mixed upland forest types are least represented. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-17 Tract 3 – Wolf Lands 3 Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	183.8	66
Upland coniferous forest[3]	46.4	17
Shrubland	31.7	11
Upland deciduous forest[4]	12.4	4
Upland conifer-deciduous mixed forest[5]	3.1	1
Aquatic environments	0.0	0
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland deciduous forest[2]	0.0	0
Total	**277.4**	**99[(6)]**

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Percent totals less than 100 percent due to rounding.

Plant Community Surveys

The Tract 3 – Wolf Lands 3 parcel also consists of mostly wetland habitats (AECOM 2011c). Coyote Creek runs through the parcel and is bordered by sedge meadow wetlands, consisting of sedges, narrow-leaved cattail, and Canada bluejoint. Roughly half of the parcel has been recently logged. Logged wetlands are dominated by grasses, forbs, and shrubs, including red-osier dogwood and speckled alder. Unlogged wetlands consist of pole black spruce, with tamarack and balsam fir also present. Please see Section 4.3.3 for a more detailed description of wetland habitat types.

Upland areas within the parcel have been recently logged and most of these areas have few remaining trees. Logged uplands are dominated by grasses, forbs, and beaked hazel, but some areas still support paper birch and scattered balsam fir. The upland habitat bordering the parcel consists of young and mature paper birch with scattered black spruce and northern white cedar over an understory of balsam fir (AECOM 2011c).

Tract 3 – Wolf Lands 3 consists of pole coniferous trees in wetlands and sapling or mature mixed forest trees on uplands, which range from 0 to 4 inches dbh or 12 inches dbh or greater, respectively (AECOM 2011c). Unlogged wetland forests on the Tract 3 – Wolf Lands 3 parcel range from 4 to 10 inches dbh. Logged upland areas still support paper birches that are up to 16 inches dbh.

Minnesota Biological Survey

There are no designated MBS Sites of Biodiversity Significance located on the Tract 3 – Wolf Lands 3 parcel (see Figure 4.3.4-2) (MDNR 2008a). However, Tract 3 – Wolf Lands 3 is located on a potential MBS Site of Moderate to High Biodiversity Significance that has not yet been finalized by the MDNR (MDNR 2007a).

Native plant community rankings for Tract 3 are not available.

Scientific and Natural Areas

There are no SNAs located on the Tract 3 parcels.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 3 – Wolf Lands 3 contains three categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), and Lowland Organic Acid to Neutral (ELT 6). The entire Tract 3 – Wolf Lands 3 parcel is included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 3 lands (see Figure 4.3.4-2) (USFS 2010b). Though not considered MIHs, the Tract 3 – Wolf Lands 3 parcel also contains 48.6 acres of lowland shrub habitat and less than an acre of lowland emergent habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 3 lands.

The Lowland Conifer landscape ecosystem occupies 217.7 acres of the Tract 3 – Wolf Lands 3 parcel. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 59.7 acres of the Tract 3 – Wolf Lands 3 parcel. Please see previous federal or non-federal lands sections above for a description of these landscape ecosystem types.

Tract 3 – Wolf Lands 4

Habitat Types

The primary MDNR GAP land cover type on the Tract 3 – Wolf Lands 4 parcel is lowland coniferous forest (see Table 4.3.4-18). The shrubland and mixed upland forest cover types are least represented. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-18 Tract 3 – Wolf Lands 4 Cover Types

Cover Types	Total Acres	Percent of Area
Lowland coniferous forest[1]	356.5	88
Upland coniferous forest[3]	32.0	8
Upland deciduous forest[4]	8.2	2
Upland conifer-deciduous mixed forest[5]	4.1	1
Shrubland	3.9	1
Aquatic environments	0.0	0
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland deciduous forest[2]	0.0	0
Total	**404.7**	**100**

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.

Plant Community Surveys

The Tract 3 – Wolf Lands 4 parcel consists of approximately 90 percent wetland habitats (AECOM 2011c). Coyote Creek bisects the parcel and is bordered on either side by emergent wetland habitats similar to Tract 3 – Wolf Lands 3. Wetlands are dominated by pole black spruce in the northern half of the parcel and pole northern white cedar in the southern half. Scrub-shrub wetlands consist of speckled alder, leatherleaf, and bog-Labrador tea. See Section 4.3.3 for a more detailed description of wetland habitat types present.

Upland habitats consist of immature paper birch and black spruce, with balsam fir, beaked hazel, and raspberry also present. In areas that have been logged recently, sapling trembling aspen and paper birch are common over a shrub layer of beaked hazel, raspberry, and bog Labrador-tea (AECOM 2011c).

The majority of the black spruce/northern white cedar wetlands are dominated by trees ranging from 4 to 8 inches dbh (AECOM 2011c). Upland mature coniferous and deciduous trees range up to 18 inches dbh, although a 30-inch-dbh jack pine and several red pines up to 24 inches dbh have been found.

Minnesota Biological Survey

There are no designated MBS Sites of Biodiversity Significance located on the Tract 3 – Wolf Lands 4 parcel (see Figure 4.3.4-2) (MDNR 2008a). However, Tract 3 – Wolf Lands 4 is located on a potential MBS Site of Moderate to High Biodiversity Significance that has not yet been finalized by the MDNR (MDNR 2007a).

Native plant community rankings for Tract 3 are not available.

Scientific and Natural Areas

There are no SNAs located on the Tract 3 parcels.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 3 – Wolf Lands 4 contains four categories of ELTs, including Lowland Loamy Moist (ELT 1), Lowland Loamy Wet (ELT 2), Lowland Organic Acid to Neutral (ELT 6), and Upland Deep Medium Loamy Dry (ELT 14). The entire Tract 3 – Wolf Lands 4 parcel is included in the Greenwood Lake Till Plain LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 3 lands (see Figure 4.3.4-2) (USFS 2010b). Though not considered an MIH, the Tract 3 – Wolf Lands 4 parcel also contains 31.0 acres of lowland shrub habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 3 lands.

The Lowland Conifer landscape ecosystem occupies 356.7 acres of the Tract 3 – Wolf Lands 4 parcel. The Mesic Birch-Aspen-Spruce-Fir landscape ecosystem occupies 47.9 acres of the Tract 3 – Wolf Lands 4 parcel. Please see previous federal or non-federal lands sections above for a description of these landscape ecosystem types.

Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on any of the Tract 3 parcels (USFS 2010a). Field studies indicate that one area of Tract 3 – Wolf Lands 3 contains an occurrence of thistles and ox-eye daisy in a recently clear-cut habitat (AECOM 2011c).

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS and field investigations, no federally or state-listed ETSC plant species are known to occur on the Tract 3 – Wolf Lands.

Regional Foresters Sensitive Species

There is more lowland black spruce-tamarack forest (MIH 9) and upland forest (MIH 1) habitat available than any other type, so the RFSS plants associated with these types would be most likely to occur on the Tract 3 lands. There is a very small amount of upland conifer forest (MIH 5) or aquatic habitats (MIH 14) so RFSS plants associated with these would be less likely to occur.

4.3.4.2.8 Tract 4 – Hunting Club Lands

Tract 4 is 160.2 acres in size, located on the LaCroix Ranger District, 5 miles southwest of Crane Lake. Tract 4 is surrounded by the Superior National Forest, St. Louis County lands, and privately owned lands (USFS 2011n).

Cover Types

Tract 4 is located in the Laurentian Mixed Forest Province Ecoregion and in the Border Lakes subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). Most of the vegetative cover types in this subsection grow in thin, acid, cobbly to gravelly glacial materials over Precambrian bedrock (MDNR 2011g). Lakes and rocky ridges dominate this type of landscape. Soils vary from coarse-loamy to coarse texture, and support forest communities of aspen-birch, aspen-birch-conifer, and, on dry sites, jack pine barrens. Many such communities within this subsection are fire-dependent.

Habitat Types

The primary MDNR GAP land cover type on Tract 4 is upland deciduous forest (see Table 4.3.4-19). The upland conifer forest and lowland deciduous forest types are least represented. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-19 Tract 4 – Hunting Club Lands Cover Types

Cover Types	Total Acres	Percent of Area
Upland deciduous forest[4]	84.6	53
Shrubland	45.0	28
Aquatic environments	9.6	6
Lowland coniferous forest[1]	8.9	6
Upland coniferous forest[3]	8.2	5
Lowland deciduous forest[2]	4.0	2
Cropland/grassland	0.0	0
Disturbed	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**160.3[(6)]**	**100**

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.
6 Total acres may be more or less than presented due to rounding.

Plant Community Surveys

The primary cover types on Tract 4 are pole and mature deciduous forests on the uplands and scrub-shrub and emergent wetlands (AECOM 2011c). An unnamed creek bisects the parcel, and beaver ponds and dams are common wetland features. Emergent vegetation surrounding open water consists of Canada bluejoint, narrow-leaved cattail, and sedges, while speckled alder dominates scrub-shrub wetlands. Pole black spruce and scattered tamarack dominate the wetlands on the interior of the parcel. Please see Section 4.3.3 for a more detailed description of wetland habitat types present.

Upland habitats in the northwestern, northeastern, and southern portions of the parcel are dominated by mature white pine, red pine, paper birch, and trembling aspen, with balsam fir and beaked hazel also present, though some areas consist of sapling and immature trees. The upland habitats in the eastern and southern portions of the parcel consist of patches of sapling and pole trembling aspen, with beaked hazel, black spruce, and balsam fir. An "island" of immature white pine, trembling aspen, and black spruce exists within this patch of sapling trembling aspen (AECOM 2011c).

The Tract 4 uplands are dominated by mostly deciduous sapling trees from 0 to 4 inches dbh, but mature white pines up to 24 inches dbh, and paper birch and trembling aspen up to 12 inches dbh occupy a large area as well (AECOM 2011c). Other upland areas on the parcel contain trembling aspen and white pine up to 16 inches dbh, and black spruce up to 12 inches dbh. Wetlands are dominated by immature coniferous forest trees ranging from 5 to 12 inches dbh.

Minnesota Biological Survey

There are no lands designated as MBS Sites of Biodiversity Significance on Tract 4 (see Figure 4.3.4-2) (MDNR 2008a).

Native plant community rankings are not available for Tract 4.

Scientific and Natural Areas

There are no lands designated as SNAs on Tract 4.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 4 contains seven different categories of ELTs, including Lowland Clayey Moist (ELT 3), Lowland Clayey Wet (ELT 4), Lowland Organic Acid to Neutral (ELT 6), Upland Deep Clayey Dry (ELT 10), Upland Shallow Loamy Dry (ELT 16), Upland Very Shallow Loamy Droughty (ELT 17), and Upland Extremely Shallow Loamy Droughty (ELT 18). The entire Tract 4 is included in the Johnson Lake Bedrock Complex LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 4 (see Figure 4.3.4-2) (USFS 2010b). Though not considered MIHs, Tract 4 also contains 26.6 acres of lowland shrub habitat and 4.2 acres of lowland emergent habitat.

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 4.

The Dry-Mesic Red and White Pine landscape ecosystem occupies 93.7 acres of Tract 4. Please see previous federal or non-federal lands sections above for a description of this landscape ecosystem type.

The Lowland Hardwood landscape ecosystem occupies 66.5 acres of Tract 4. It is dominated by black ash and/or balsam poplar, although elm, green ash, paper birch, aspen, yellow birch, balsam fir, northern white cedar, and white spruce may also be present (USFS 2004a). This landscape ecosystem typically occurs on sites that are seasonally wet or wet year-round. Stand replacement disturbances are infrequent, resulting in a multi-aged stand of black ash and balsam poplar.

Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on Tract 4 (USFS 2010a).

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

Based on a review of the MDNR NHIS and field investigations, no federally or state-listed ETSC plant species are known to occur on Tract 4.

Regional Foresters Sensitive Species

There is more upland forest (MIH 1) habitat available than any other type, so the RFSS plants associated with this type would be most likely to occur on Tract 4. There is a similar smaller amount of upland conifer forest (MIH 5), lowland black spruce-tamarack forest (MIH 9), and aquatic habitats (MIH 14), so RFSS plants associated with these would be less likely to occur.

4.3.4.2.9 Tract 5 – McFarland Lake Lands

Tract 5 is 30.8 acres in size on the Gunflint Ranger District in northeastern Cook County. The tract adds to Superior National Forest ownership and includes lakefront property on McFarland Lake, which is an entry point to the BWCAW. The parcel reaches an approximate maximum elevation of 1,762 ft amsl and the topography slopes steeply to the east toward its eastern border of McFarland Lake (NTS 2010b).

Cover Types

Tract 5 is located in the Border Lakes subsection of the Laurentian Mixed Forest Province ecoregion (MDNR 2006a). See Tract 4 above for a description of the Border Lakes subsection.

Habitat Types

The primary MDNR GAP land cover type on Tract 5 is upland deciduous forest (see Table 4.3.4-20). The remaining cover types on the parcel are upland conifer forest and aquatic environments. The MDNR GAP land cover types below may not fully represent the extent of mixed forest types, since the cover type level below is fairly specific, so there may be more mixed forest types than indicated.

Table 4.3.4-20 Tract 5 – McFarland Lake Lands Cover Types

Cover Types	Total Acres	Percent of Area
Upland deciduous forest[4]	26.6	86
Upland coniferous forest[3]	4.0	13
Aquatic environments	0.2	1
Cropland/grassland	0.0	0
Disturbed	0.0	0
Lowland coniferous forest[1]	0.0	0
Lowland deciduous forest[2]	0.0	0
Shrubland	0.0	0
Upland conifer-deciduous mixed forest[5]	0.0	0
Total	**30.8**	**100**

Source: MDNR 2006b.

Notes:
1 Includes lowland black spruce, lowland northern white cedar, and tamarack forest cover types.
2 Includes black ash forest cover types.
3 Includes pine and spruce/fir forest cover types.
4 Includes aspen/aspen-white birch, maple/basswood, and oak forest cover types.
5 Includes all mixed coniferous-deciduous forest cover types.

Plant Community Surveys

Tract 5 consists of upland habitats, dominated by pole and mature deciduous and coniferous forests (AECOM 2009b; AECOM 2011b). The parcel is located on McFarland Lake, and a narrow band of horsetail and white cedar was observed along the shoreline (AECOM 2011b). Section 4.3.3 presents a more detailed description of wetland habitat types present.

Upland forest types on the hill slope of the parcel consist of trembling aspen, paper birch, mountain maple, northern white cedar, black spruce, and balsam fir. Mountain maple and northern white cedar are common on the lower hill slopes, while red pine and trembling aspen are more prevalent at the top of the hill slope. The shrub layer includes smooth sumac (*Rhus glabra*) and beaked hazel, while the ground layer includes forbs such as bunchberry, twining honeysuckle, clintonia, large-leaved aster, twinflower, false lily-of-the-valley (*Maianthemum canadense*), ox-eye daisy, thimbleberry (*Rubus parviflorus*), wild raspberry, wild strawberry, bog rosemary (*Andromeda glaucophylla*), bog cranberry (*Vaccinium oxycoccus*), wild sarsaparilla (*Aralia nudicaulis*), bracken fern and other ferns, and club moss (*Lycopodium* spp.) (AECOM 2011b). Some recent logging has occurred along the hill slope of the western boundary of the parcel. Steep rocky cliffs about 150 ft in height exist toward this western boundary (AECOM 2011b). Enchanter's nightshade (*Circaea quadrisulcata*) and wild columbine (*Aquilegia canadensis*) have been observed on the rocky cliffs.

Upland forests on the parcel contain trembling aspen, red pine, and eastern white pine up to 18 inches dbh, balsam fir up to 16 inches dbh, and paper birch up to 12 inches dbh (AECOM 2011b). Wetland forests along McFarland Lake contain northern white cedar up to 24 inches dbh.

Minnesota Biological Survey

There are no lands designated as MBS Sites of Biodiversity Significance on the Tract 5 lands (see Figure 4.3.4-2) (MDNR 2008a).

Native plant community rankings are not available for the Tract 5 lands.

Scientific and Natural Areas

There are no lands designated as SNAs on the Tract 5 lands.

Culturally Important Plants

A discussion of natural resources culturally important to the Bands is presented in Section 4.2.9.3.3.

Management Areas

The non-federal lands currently do not have any management area designations, as they are not managed by the federal government. Section 4.3.1 describes the management areas in detail.

Ecological Land Types

Tract 5 contains four different categories of ELTs, including Lowland Loamy Wet (ELT 2), Upland Deep Medium Loamy Dry (ELT 14), Upland Shallow Loamy Dry (ELT 16), and Upland Extremely Shallow Loamy Droughty (ELT 18), though categories are not available for the entire parcel. All of Tract 5 is included in the Rove Slate Bedrock Complex LTA.

Management Indicator Habitats

Table 4.3.4-3 provides a summary of the MIH types and age classes present on Tract 5 (see Figure 4.3.4-2) (USFS 2010b).

Landscape Ecosystems

Table 4.3.4-4 provides a summary of the landscape ecosystem types present on Tract 5.

The Mesic Red and White Pine landscape ecosystem occupies 30.8 acres of the Tract 5. See the federal or non-federal lands sections above for a description of these landscape ecosystem types.

Invasive Non-native Plants

According to the Superior National Forest invasive plant geodatabase, there are no known occurrences of invasive species on the Tract 5 lands (USFS 2010a).

Threatened and Endangered Plant Species

Endangered, Threatened, and Special Concern Plant Species

No federally listed ETSC plant species are known to occur on Tract 5. Based on a review of the MDNR NHIS, one state-listed threatened species and one species of special concern have been identified on Tract 5 (see Table 4.3.4-21 and Figure 4.3.4-3). Encrusted saxifrage is also tracked by the USFS as an RFSS. No other state-listed species are known to occur on Tract 5.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list.

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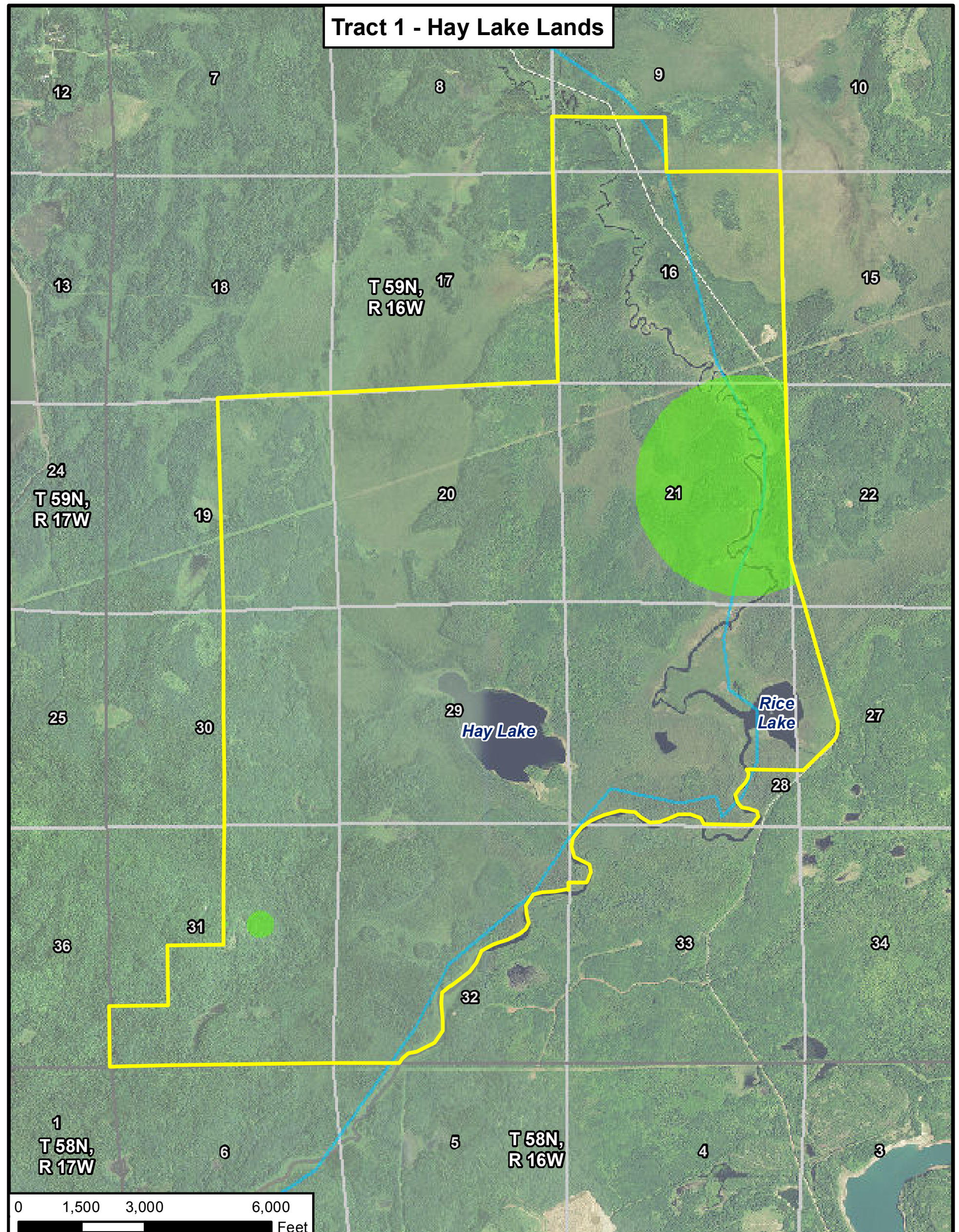

Non-federal Lands

Endangered, Threatened and Special Concern Vegetation Species

1 - Section Number

MNDNR US Army Corps of Engineers St. Paul District

N W E S

Figure 4.3.4-3

ETSC Vegetation - Tracts 1 and 5

NorthMet Mining Project and Land Exchange FEIS

Minnesota

November 2015

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Table 4.3.4-21 Endangered, Threatened, and Special Concern Plant Species Identified on the Tract 5 Lands [4]

Common Name	Scientific Name	State Status[1]	No. of Populations	No. of Individuals[2]	Habitat and Location
Encrusted saxifrage[3]	*Saxifraga paniculata* (=*aizoon*)	SC	1	1000+	Shaded rock crevices and mossy ledges of north-facing sedimentary rock cliffs.
Rocky Mountain woodsia	*Woodsia scopulina*	T	1	2+	Cool, moist moss-covered chutes of north-facing sedimentary rock cliffs.

Sources: MDNR 2014d; MDNR 2011k.

Notes:
1 E - Endangered, T - Threatened, SC - Species of Special Concern.
2 Where the number of individuals cannot be determined without damaging the population, then patch size is used as a representative abundance measure.
3 These species are also RFSS as tracked by the USFS.
4 Data included here were provided by the Division of Ecological Resources, MDNR, and were current as of August 5, 2014. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

Species Life Histories

The following summary provides descriptions of the life histories, state-wide distributions, and sensitivity to disturbance for each of the two threatened species found on Tract 5.

Encrusted saxifrage (*Saxifraga paniculata*) (synonyms: *Saxifraga aizoon* var. *neogaea*, white mountain saxifrage) is listed as a species of special concern in Minnesota and as an RFSS in the Superior National Forest. The species was first documented in Cook County, Minnesota in 1932, and has since only been reported in Cook and Lake counties (Bell Museum of Natural History 2011).

S. paniculata is an arctic-alpine species that reaches the southern end of its range in Minnesota (MDNR 2011k). It typically occurs in rock crevices and on ledges of shaded north-facing cliffs with bedrock of diabase, gabbro/diorite, basalt, or Rove Formation rocks. *S. paniculata* is a perennial herb species that flowers from early June to July and bears fruit from late July through August, though it can also spread vegetatively via stolons. There is very little suitable cliff habitat for *S. paniculata* in Minnesota, and threats to the species could include climate change, changes in the biotic community, and recreational exploration of vulnerable cliff faces.

Rocky Mountain woodsia (*Woodsia scopulina*) (Synonyms: *Woodsia scopulina* ssp. *laurentiana*) is listed as a threatened species in Minnesota; it is not listed as an RFSS in the Superior National Forest. The species was first documented in Cook County, Minnesota in 1929 amidst slate rocks, and has since only been reported in Cook County (Bell Museum of Natural History 2011). Though it is common in the Rocky Mountains, it is limited primarily to cool, moist north-facing cliffs of the Rove Slate Formation in northeast Minnesota (MDNR 2011k). *W. scopulina* is a perennial fern that grows in small clumps, and produces spores from summer to fall (eFlora 2011). There is very little suitable cliff habitat for *W. scopulina* in Minnesota, as it requires diabase and slate bedrock and east-west oriented valleys. Threats to the species could include climate change, introduction of non-native species, erosion events, forest management activities that alter the biotic community, or recreational exploration of vulnerable cliff faces.

Regional Foresters Sensitive Species

Based on a review of the MDNR NHIS, *Saxifraga paniculata* is located on Tract 5, and it is also an RFSS plant. There is more upland forest (MIH 1) habitat available than any other type, so the RFSS plants associated with this type would be most likely to occur on the Tract 5 lands. There is a smaller amount of upland conifer forest (MIH 5) and aquatic habitats (MIH 14) so RFSS plants associated with these would be less likely to occur. There is no lowland black spruce-tamarack forest (MIH 9) available, and so RFSS plants associated with this habitat would likely not exist. The cliff habitat present on Tract 5 is important to the 12 RFSS plants that utilize exposed rock habitats in the Superior National Forest (see Table 4.2.4-5), including *Saxifraga paniculata*, as there is very little suitable cliff microhabitat for these species in Minnesota. *Woodsia scopulina* also utilizes this habitat type.

4.3.5 Wildlife

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). This FEIS considers any new listings, or changes in the previous listings, associated with the updated list. A BA that provides further information on federally listed species, and a BE that contains further information about RFSS have been prepared. The BA and BE are included in Appendix D.

4.3.5.1 Federal Lands

4.3.5.1.1 Land Exchange Proposed Action

The federal land portion of the Land Exchange Proposed Action is similar to the Mine Site previously discussed, but extends further north and west and excludes the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.5.1 provides further discussion of the existing conditions on the Mine Site and associated federal lands.

The acres of key habitat present on the federal lands, along with the associated SGCN (and RFSS), are included in Table 4.3.5-1 below (see Figure 4.2.4-4).

Table 4.3.5-1 Key Habitat, Cover Types, and Associated Species for the Federal Lands under the Land Exchange Proposed Action and Land Exchange Alternative B

Key Habitat Type, Cover Types, and Management Indicator Habitats	**Associated Wildlife Species**[1]	**Land Exchange Proposed Action (Acres)**	**Land Exchange Alternative B (Acres)**
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Rock vole, *northern goshawk*, veery, whip-poor-will, eastern wood-pewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, boreal chickadee, *boreal owl*, wood thrush, black-backed woodpecker, *bald eagle,* black-throated blue warbler, *bay-breasted warbler, great gray owl, three-toed woodpecker*	5,719.7	4,258.1
2. Open Ground, Bare Soils: disturbed/ developed (no MIH)	Laurentian tiger beetle	63.8	29.1
3. Grassland and Brushland, Early Successional Forest (no MIH)	Franklin's ground squirrel, American badger, Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, bobolink, tawny crescent	651.8	439.1
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, northern rough-winged swallow, semipalmated sandpiper, American golden-plover, greater yellowlegs, buff-breasted sandpiper, eastern red-backed salamander, common snapping turtle, bog copper, *taiga alpine*	60.1	26.3

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Land Exchange Proposed Action (Acres)	Land Exchange Alternative B (Acres)
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[(3)]), *Canada lynx*[2] (1-4), rose-breasted grosbeak (1, 3), Macoun's arctic (1, 3), least flycatcher (1, 3), *Connecticut warbler* (1, 3), *olive-sided flycatcher (1, 4)*, *grizzled skipper* (2, 3), *Nabokov's blue* (2, 4), wood turtle[2] (1, 3, 4)	NA	NA
Total		6,495.4	4,752.6

Source: MDNR 2006b.

Notes:
[1] Plain text indicates SGCN species; italicized text indicates RFSS; plain text indicates SGCN species identified as likely to be present at the Mine Site or Plant Site but not targeted in surveys.
[2] Canada lynx, gray wolf, bald eagle, and wood turtle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
[3] Numbers refer to the Key Habitat Types (1-4) where those species may occur or are known to occur.

4.3.5.1.2 Land Exchange Alternative B

As shown on Table 4.3.5-1, each of the key habitat types and MIH categories that are found on the federal lands of the Land Exchange Proposed Action are also found on the smaller federal parcel of the Land Exchange Alternative B. Acreages of each habitat category are correspondingly reduced for the Land Exchange Alternative B.

4.3.5.2 Non-federal Lands

4.3.5.2.1 Tract 1 – Hay Lake Lands

Federally and State-listed Species and Species of Special Concern

Tract 1 is not located in an LAU but is located in designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). The Tract 1 parcel is located in Wolf Zone 2 and the Minnesota Northeast Wolf Zone. Radio-collared wolves have been recorded in the vicinity and evidence of wolves was observed during 2009 wildlife surveys (AECOM 2009b). Moose sign, including droppings, tracks, and browsing evidence, were observed on the Tract 1 lands in speckled alder and shrub wetlands (AECOM 2011b). Trumpeter swans, state-listed as species of special concern, were identified on the Tract 1 lands during wildlife surveys (AECOM 2011b) and habitat for the Laurentian tiger beetle, state-listed as a species of special concern, is present at the former sand and gravel pit on the parcel. An active northern goshawk territory is present on Tract 1, and is currently being monitored by the MDNR. Though northern goshawks were not seen or heard during 2011 field surveys (AECOM 2011b), NHIS records indicate one chick was observed on a new nest in 2013. There was a probable nesting attempt in 2014, as a nest was being incubated at one time but failed to produce chicks (USFS, Pers. Comm., August 21, 2015). Bats were recorded at several echolocation survey sites on or near the Tract 1 lands, but the species of the bats recorded was not determined (AECOM 2011b). Both NHIS records and surveys of the parcel failed to identify individuals or signs of the remaining federally and state-listed species and species of special concern, including wood turtle, horned grebe, Wilson's phalarope, common tern, boreal owl, American white pelican, marbled godwit, yellow rail, smoky shrew, eastern heather vole, least weasel, and mountain lion (AECOM 2011b).

Species of Greatest Conservation Need

As discussed in Section 4.2.5.1.2, the potential presence of SGCN can be correlated to the presence of their corresponding habitat. Table 4.3.5-2 below lists the SGCN (and RFSS) by the key habitat types and cover types present in the Nashwauk Uplands ecological subsection.

Tract 1 is located in the Nashwauk Uplands ecological subsection. The species found in this subsection are listed in Table 4.3.5-2 below.

Table 4.3.5-2 Key Habitat and Cover Types of Species of Greatest Conservation Need and Regional Forester Sensitive Species for Tract 1 in the Nashwauk Ecological Subsection

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Tract 1 (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	*Northern goshawk*, veery, whip-poor-will, eastern wood-pewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, boreal chickadee, wood thrush, black-backed woodpecker, *bald eagle, great gray owl, three-toed woodpecker*	2,978.8
2. Open Ground, Bare Soils: disturbed/developed (no MIH)		0.0
3. Grassland and Brushland, Early Successional Forest (no MIH)	Franklin's ground squirrel, American badger, Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, red-headed woodpecker, bobolink, tawny crescent	1,696.3
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, red-necked grebe, northern rough-winged swallow, dunlin, semipalmated sandpiper, short-billed dowitcher, American golden-plover, Virginia rail, greater yellowlegs, buff-breasted sandpiper, eastern red-backed salamander, common snapping turtle, bog copper, *taiga alpine, ebony boghaunter*	251.1
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[3]), Canada lynx[2] (1-4), *eastern pipistrelle* (1,3), rose-breasted grosbeak(1,3), least flycatcher (1,3), *olive-sided flycatcher* (1,4), *Connecticut warbler* (1,3), peregrine falcon(1-3), Macoun's arctic (1,3), *Nabokov's blue* (2,4), *grizzled skipper* (2,3), *Quebec emerald* (3,4)	NA
Total[4]		4,926.2

Source: MDNR 2006b.

Notes:
1 Plain text indicates SGCN species, italicized text indicates RFSS.
2 Canada lynx, gray wolf, bald eagle, and wood turtle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
3 Numbers refer to the Key Habitat Types (1-4) where those species may occur or are known to occur.
4 Total acres may be more or less than presented due to rounding.

Regional Forester Sensitive Species

RFSS that are also state-listed or species of special concern are discussed above. With the possible exception of RFSS bat species, no other RFSS were observed during surveys of Tract 1 (AECOM 2011b). Potential Superior National Forest RFSS and their habitat on Tract 1 are listed on Table 4.3.5-2.

Other Wildlife Species

Other wildlife species, including species of concern to the Bands, were observed during surveys of Tract 1. Species observed, or their sign, include black bear, white-tailed deer, red fox, river otter, beaver, marten, red squirrel, snowshoe hare, ruffed grouse, American woodcock, common loon, hooded merganser, ring-necked duck, red-tailed hawk, broad-winged hawk, barred owl, great horned owl, pileated woodpecker, several passerine bird species, snapping turtle, and painted turtle (AECOM 2011b).

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

4.3.5.2.2 Tract 2 – Lake County Lands

Federally and State-listed Species and Species of Special Concern

Tract 2 is split into two parcels, Lake County Lands North and Lake County Lands South. Lake County North is located in LAU 16 and Lake County South is located in LAU 22. Both are in designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). While no lynx or their sign have been observed on the Tract 2 parcels, denning habitat may be present. Areas of blowdown or logging slash where there is both vertical and horizontal cover may be used by lynx for denning sites (Moen 2009). Moose sign, including droppings, tracks, and browsing evidence, were observed on the Lake County South parcel in speckled alder and shrub wetlands (AECOM 2011c).

Both Tract 2 parcels are located in federal Wolf Zone 2 and the Minnesota Northeast Wolf Zone. Wolf sign was observed on Lake County North during 2010 wildlife surveys (AECOM 2011c). Both NHIS records and surveys of the parcel failed to identify individuals or signs of the remaining federally and state-listed species or species of special concern (MDNR 2014d; AECOM 2011c).

Species of Greatest Conservation Need

The Lake County North parcel is located in the Laurentian Uplands ecological subsection and the Lake County South parcel is located in the North Shore Highlands ecological subsection. Table 4.3.5-3 below lists the SGCN (and RFSS) by the key habitat types and cover types present at Tract 2.

Table 4.3.5-3 Key Habitat and Cover Types of Species of Greatest Conservation Need and Regional Forester Sensitive Species for Tract 2 in the Laurentian Uplands and North Shore Highlands Ecological Subsections

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Tract 2 (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Rock vole, *northern goshawk*, veery, whip-poor-will, eastern wood-pewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, boreal chickadee, *boreal owl*, wood thrush, black-backed woodpecker, *bald eagle,* black-throated blue warbler, *bay-breasted warbler, great gray owl, three-toed woodpecker*	337.2
2. Open Ground, Bare Soils: disturbed/ developed (no MIH)	Laurentian tiger beetle	0.0
3. Grassland and Brushland, Early Successional Forest (no MIH)	Franklin's ground squirrel, American badger, Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, bobolink, red-headed woodpecker, tawny crescent	38.9
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, northern rough-winged swallow, dunlin, semipalmated sandpiper, short-billed dowitcher, American golden-plover, Virginia rail, greater yellowlegs, buff-breasted sandpiper, ruddy turnstone, white-rumped sandpiper, marsh wren, Hudsonian godwit, whimbrel, common tern, eastern red-backed salamander, common snapping turtle, Blanding's turtle, bog copper, *taiga alpine,* extra-striped snaketail, *ebony boghaunter*	5.8
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[(3)]), Canada lynx[2] (1-4), *eastern heather vole* (1,3), smoky shrew (1,3), *northern long-eared bat* (1,4), *eastern pipistrelle* (1,3,4), eastern spotted skunk (1,3), rose-breasted grosbeak (1,3), least flycatcher (1,3), *olive-sided flycatcher* (1,4), *Connecticut warbler* (1,3), peregrine falcon(1-3), *wood turtle*[2] (1,3,4), four-toed salamander (1,4), Macoun's arctic (1,3), *Nabokov's blue* (2,4), *grizzled skipper* (2,3), *Quebec emerald* (3,4)	NA
Total		381.9

Source: MDNR 2006b.

Notes:
1 Plain text indicates SGCN species, italicized text indicates RFSS.
2 Canada lynx, gray wolf, bald eagle, and wood turtle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
3 Numbers refer to the Key Habitat Types (1-4) where those species may occur or are known to occur.

Regional Forester Sensitive Species

RFSS that are also state-listed or species of special concern are discussed above. No other RFSS were observed during surveys of Tract 2. Potential Superior National Forest RFSS and their habitat on Tract 2 are listed on Table 4.3.5-3.

Other Wildlife Species

Other wildlife species, including species of concern to the Bands, were observed during surveys of Tract 2. Species observed, or their sign, include white-tailed deer, beaver, snowshoe hare, marten, mink, red squirrel, raven, ruffed grouse, pileated woodpecker, and several passerine bird species (AECOM 2011c).

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

4.3.5.2.3 Tract 3 – Wolf Lands

Federally and State-listed Species and Species of Special Concern

Tract 3 is split into four parcels, Wolf Lands 1, 2, 3, and 4. Wolf Lands 1 is located in LAU 16 and Wolf Lands 2 through 4 are located in LAU 22. All are within designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). While no lynx or their sign have been observed on the Tract 3 parcels, denning habitat may be present. Areas of blowdown or logging slash where there is both vertical and horizontal cover may be used by lynx for denning sites (Moen 2009). Moose sign, including droppings, tracks, and browsing evidence, were observed on the Wolf Lands 3 and 4 parcels in speckled alder and shrub wetlands (AECOM 2011c).

All Tract 3 parcels are located in federal Wolf Zone 2 and the Minnesota Northeast Wolf Zone. Wolf sign was observed on Wolf Lands 3 and 4 during 2010 wildlife surveys (AECOM 2011c). Both NHIS records and surveys of the parcel failed to identify individuals or signs of the remaining federally and state-listed species or species of special concern (MDNR 2014d; AECOM 2011c).

Species of Greatest Conservation Need

The Wolf Lands parcels are located in the Laurentian Uplands ecological subsection. The species of greatest conservation need and habitat that may be found in this subsection are listed on Table 4.3.5-4.

Table 4.3.5-4 Key Habitat and Cover Types of Species of Greatest Conservation Need and Regional Forester Sensitive Species for Tract 3 in the Laurentian Uplands Ecological Subsection

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Tract 3 (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Rock vole, *northern goshawk*, veery, whip-poor-will, eastern wood-pewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, boreal chickadee, *boreal owl*, wood thrush, black-backed woodpecker, *bald eagle,* black-throated blue warbler, *bay-breasted warbler, great gray owl, three-toed woodpecker*	1,479.4
2. Open Ground, Bare Soils: disturbed/ developed (no MIH)	Laurentian tiger beetle	0.0
3. Grassland and Brushland, Early Successional Forest (no MIH)	Franklin's ground squirrel, American badger, Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, sharp-tailed grouse, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, bobolink, tawny crescent	96.5
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, northern rough-winged swallow, semipalmated sandpiper, American golden-plover, greater yellowlegs, buff-breasted sandpiper, eastern red-backed salamander, common snapping turtle, bog copper, *taiga alpine, ebony boghaunter*	0.0
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[(3)]), Canada lynx[2] (1-4), *eastern heather vole* (1,3), smoky shrew (1,3), *eastern pipistrelle* (1,3,4), rose-breasted grosbeak (1,3), least flycatcher (1,3), *olive-sided flycatcher* (1,4), *Connecticut warbler* (1,3), Macoun's arctic (1,3), *Nabokov's blue* (2,4), *grizzled skipper* (2,3), *Quebec emerald* (3,4)	NA
Total[4]		1,575.9

Source: MDNR 2006b.

Notes:
1 Plain text indicates SGCN species, italicized text indicates RFSS.
2 Canada lynx, gray wolf, and bald eagle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
3 Numbers refer to the Key Habitat Types (1-4) where those species may occur or are known to occur.
4 Total acres may be more or less than presented due to rounding.

Regional Forester Sensitive Species

RFSS that are also state-listed or species of special concern are discussed above. No other RFSS were observed during surveys of Tract 3. Potential Superior National Forest RFSS and their habitat on Tract 3 are listed on Table 4.3.5-4.

Other Wildlife Species

Other wildlife species, including species of concern to the Bands, were observed during surveys of Tract 3. Species observed, or their sign, include white-tailed deer, red fox, marten, snowshoe hare, beaver, red squirrel, ruffed grouse, pileated woodpecker, and several passerine bird species (AECOM 2011c).

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

4.3.5.2.4 Tract 4 – Hunting Club Lands

Federally and State-listed Species and Species of Special Concern

Tract 4 is located in LAU 4 and is located in designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). The Tract 4 parcel is located in federal Wolf Zone 2 and the Minnesota Northeast Wolf Zone. Both NHIS records and surveys of the parcel failed to identify individuals or signs of federally and state-listed species or species of special concern (MDNR 2014d; AECOM 2011c).

Species of Greatest Conservation Need

Tract 4 is located in the Border Lakes ecological subsection. Table 4.3.5-5 lists the species of greatest conservation need and habitat that may be found in this subsection.

Table 4.3.5-5 Key Habitat and Cover Types of Species of Greatest Conservation Need and Regional Forester Sensitive Species for Tracts 4 and 5 in the Border Lakes Ecological Subsection

Key Habitat Type, Cover Types, and Management Indicator Habitats	Associated Wildlife Species[1]	Tract 4 (Acres)	Tract 5 (Acres)
1. Mature Upland Forest, Continuous Upland/Lowland Forest: aspen forest/aspen-birch forest, jack pine forest, mixed pine-hardwood forest (MIHs 1-13)	Rock vole, *northern goshawk*, veery, whip-poor-will, eastern wood-pewee, yellow-bellied sapsucker, ovenbird, Canada warbler, spruce grouse, Cape May warbler, winter wren, boreal chickadee, *boreal owl*, wood thrush, black-backed woodpecker, *bald eagle,* black-throated blue warbler, *bay-breasted warbler, great gray owl, three-toed woodpecker*	105.7	30.6
2. Open Ground, Bare Soils: disturbed/ developed (no MIH)	Laurentian tiger beetle	0.0	0.0
3. Grassland and Brushland, Early Successional Forest (no MIH)	Le Conte's sparrow, eastern meadowlark, brown thrasher, white-throated sparrow, golden-winged warbler, American woodcock, northern harrier, sedge wren, common nighthawk, black-billed cuckoo, bobolink, tawny crescent	45.0	0.0
4. Aquatic Environments: rivers, lakes, ponds, wetlands, etc. (MIH 14)	American black duck, American bittern, swamp sparrow, common loon, northern rough-winged swallow, semipalmated sandpiper, American golden-plover, greater yellowlegs, buff-breasted sandpiper, ruddy turnstone, white-rumped sandpiper, black tern, red-necked grebe, eastern red-backed salamander, common snapping turtle, *taiga alpine, ebony boghaunter*	9.6	0.2
5. Multiple Habitats (MIHs 1-14)	Gray wolf[2] (1-4[(3)]), Canada lynx[2] (1-4), *eastern heather vole* (1,3), smoky shrew (1,3), *eastern pipistrelle* (1,3), rose-breasted grosbeak (1,3), least flycatcher (1,3), *olive-sided flycatcher* (1,4), *Connecticut warbler* (1,3), rusty blackbird (1,4), Macoun's arctic (1,3), *Nabokov's blue* (2,4), *grizzled skipper* (2,3), *Quebec emerald* (3,4)	NA	NA
Total[4]		160.3	30.8

Source: MDNR 2006b.

Notes:
[1] Plain text indicates SGCN species, italicized text indicates RFSS.
[2] Canada lynx, gray wolf, and bald eagle are or have recently been listed as ETSC species as discussed in detail in the ETSC species section.
[3] Numbers refer to the Key Habitat Types (1-4) where those species may occur or are known to occur.
[4] Total acres may be more or less than presented due to rounding.

Regional Forester Sensitive Species

RFSS that are also state-listed or species of special concern are discussed above. No other RFSS were observed during surveys of Tract 4 (AECOM 2011c). Potential Superior National Forest RFSS and their habitat on Tract 4 are listed on Tables 4.3.5-5.

Other Wildlife Species

Other wildlife species, including species of concern to the Bands, were observed during surveys of Tract 4. Species observed, or their sign, include white-tailed deer, red fox, marten, snowshoe hare, beaver, red squirrel, pileated woodpecker, and several passerine bird species (AECOM 2011c).

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

4.3.5.2.5 Tract 5 – McFarland Lake Lands

Federally and State-listed Species and Species of Special Concern

Tract 5 is located in LAU 42 and is located in designated lynx critical habitat. No Canada lynx or their sign have been observed on the non-federal lands during surveys (AECOM 2011b; AECOM 2011c). Though bats were observed on the parcel, the species of bats were not determined and may potentially include eastern pipistrelle and/or northern long-eared bat (AECOM 2011b). The Tract 5 parcel is located in federal Wolf Zone 2 and the Minnesota Northeast Wolf Zone. Wolf sign was observed on the parcel in October 2011. Both NHIS records and surveys of the parcel failed to identify individuals or signs of the remaining federally and state-listed species or species of special concern (MDNR 2014d; AECOM 2011c).

Species of Greatest Conservation Need

Like Tract 4, Tract 5 is located in the Border Lakes ecological subsection. Table 4.3.5-5 provides a list of species of greatest conservation need and habitat that may be found in this subsection.

Regional Forester Sensitive Species

RFSS that are also state-listed or species of special concern are discussed above. With the possible exception of RFSS bat species, no other RFSS were observed during surveys of Tract 5 (AECOM 2011b). Potential Superior National Forest RFSS and their habitat on Tract 5 are listed on Table 4.3.5-5.

Other Wildlife Species

Other wildlife species, including species of concern to the Bands, were observed during surveys of Tract 5. Species observed, or their sign, include black bear, white-tailed deer, red fox, beaver, red squirrel, raven, ruffed grouse, common loon, hooded merganser, broad-winged hawk, barred owl, pileated woodpecker, and several passerine bird species (AECOM 2011b).

Sections 4.2.5, 4.2.9, 5.2.5, and 5.2.9 discuss species of importance to the Bands.

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4.3.6 Aquatic Species

This section discusses aquatic resources located on the non-federal parcels considered for acquisition by the USFS through the Land Exchange Proposed Action. The federal lands are discussed in Section 4.2.6.1 along with the Mine Site. The Alternative B: Smaller Federal Parcel contains similar surface waters, but smaller acreages or linear distances than the federal lands.

Some of the non-federal lands contain streams, creeks, rivers, and lakes. Tract 1 contains three lakes and one river, comprising approximately 90,000 linear ft of shoreline and approximately 129 acres of surface area. Tract 3 – Wolf Lands 3 and Wolf Lands 4 contain Coyote Creek, with approximately 12 linear ft of river frontage per acre. Tract 5 includes 506 ft of McFarland Lake frontage. Tract 2 and Tract 4 do not contain surface water features.

There are no SGCN, state, federal, or RFSS species known to occur at or in the immediate vicinity of the non-federal lands. According to available data, however, there are several SGCN or RFSS that are associated with the Superior National Forest or various ecoregions on which the non-federal lands are located.

Rulemaking was conducted with the intent to update the list of ETSC species (*Minnesota Rules*, parts 6134.0100 to 6134.0400), with new listings becoming effective on August 19, 2013 (MDNR 2013h). The FEIS considers any new listings, or changes in the previous listings, associated with the updated list. The FEIS also considers any federal listing changes. A BE has been prepared that contains further information about RFSS species. The BE is included in Appendix D.

4.3.6.1 Federal Lands

4.3.6.1.1 Land Exchange Proposed Action

The existing conditions found within the federal lands area are discussed in Section 4.2.6.1.

4.3.6.1.2 Land Exchange Alternative B

The existing conditions found within the Alternative B area are discussed in Section 4.2.6.1. However, site-specific information is presented below.

<u>Surface Water Features</u>

A portion of Mud Lake, covering 8.9 acres with approximately 1,200 ft of lake frontage, is located within the Alternative B lands. The length of lake frontage per acre of this alternative boundary is 0.3 ft.

As with the federal lands within the Land Exchange Proposed Action, Yelp Creek and the Partridge River, which originates at the Northshore Mine, flow out of the One Hundred Mile Swamp and through portions of the smaller federal parcel within the Land Exchange Alternative B. Collectively, the creek and river are 5.3 miles in length in the Alternative B, corresponding to 55,968 linear ft of creek/river frontage (counting both shores). The combined Yelp Creek and Partridge River frontage per acre of the smaller federal parcel within the Land Exchange Alternative B is 11.8 ft (see Table 4.3.6-1).

The MIH represented within the boundaries of the Alternative B: Smaller Federal Parcel includes 8.9 acres for Mud Lake and 55,968 linear ft for the combined Yelp Creek and Partridge River.

Table 4.3.6-1 Alternative B Surface Water Characteristics

Surface Water	Size on Parcel	Approximate Shoreline Frontage (ft)	MIH	Frontage Index (ft/acre)
Mud Lake	8.9 acres	1,200.0	8.9 acres	0.3
Yelp Creek	1.1 miles	*	*	*
Partridge River	4.2 miles	55,968.0	55,968.0 linear ft	11.8

Source: Adapted from AECOM 2011d.

* Combined with Partridge River.

4.3.6.2 Non-federal Lands

4.3.6.2.1 Tract 1 – Hay Lake Lands

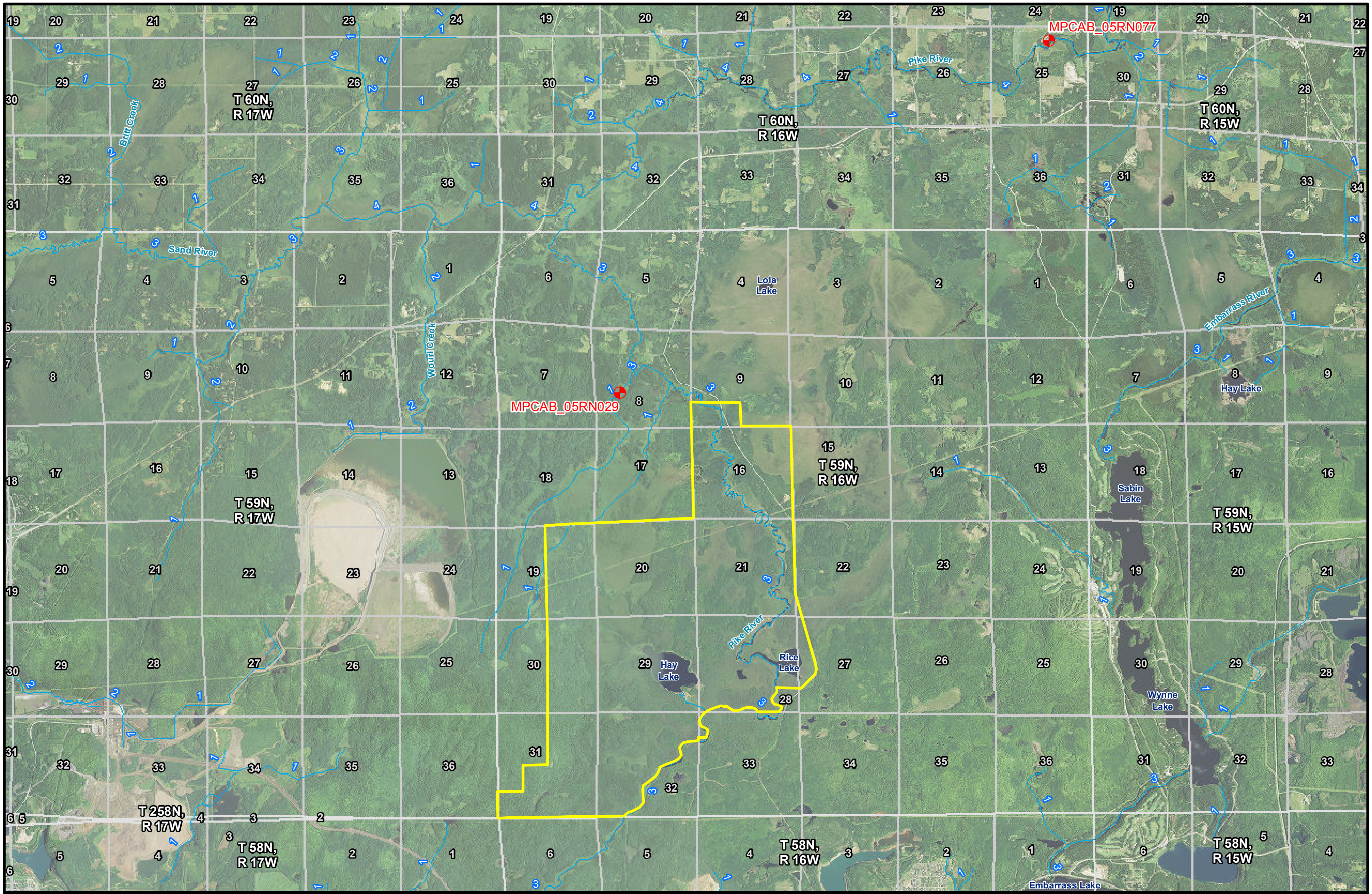
Surface Water Features

Surface water features on Tract 1 include three lakes and one river. Aerial photograph review of the three lakes associated with the parcel indicates a mix of deep water and shallow, submergent/emergent vegetation habitats in the open water portions of the lakes, which provide fish and macroinvertebrate habitats.

The Pike River, which flows north through the tract, is classified as a third-order stream (see Figure 4.3.6-1) within Tract 1 and includes approximately 376.2 acres of mapped floodplain. The heavily vegetated riparian habitats and associated floodplains adjacent to the river's edge likely provide important fish and macroinvertebrate habitats. Tract 1 also has unmapped floodplains associated with Hay Lake itself, which has been estimated to be approximately 175.0 acres.

The USFS MIH categories within Tract 1 include 129.6 acres of lakes, 16,424 linear ft of lake shoreline, and 72,864 linear ft of river shoreline (see Table 4.3.6-2).

Riparian habitats, which surround all surface water features on the parcel, include shrub-carr, coniferous swamp, sedge meadow, alder thicket, shallow open water, and deep marsh wetlands (AECOM 2011d). Aerial photograph review indicates a wide riparian buffer and minimal disturbance along each surface water feature. All wetlands adjacent to the surface water features scored high for fish habitat according to the MnRAM 3.2 rating (AECOM 2011d).



Non-federal Lands	Section Boundary
Monitoring Station	Section Label
Stream / River	Stream Order Number

US Army Corps of Engineers St. Paul District

N W E S

0 0.5 1 2 Miles

Figure 4.3.6-1

Monitoring Sample Site Locations

Tract 1 - Hay Lake Lands

NorthMet Mining Project and Land Exchange FEIS

Minnesota

November 2015

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Table 4.3.6-2 Tract 1 Surface Water Characteristics

Surface Water	Surface Area (acres)	Approximate Shoreline Frontage (linear ft)	MIH
Hay Lake	96.2	9,894.4	96.2 acres
Rice Lake	29.5	4,829.6	29.5 acres
Unnamed lake	3.9	1,700	3.9 acres
Pike River	na	72,864[1]	72,864 linear ft
Total	129.6	89,288	

Source: Adapted from AECOM 2011d.

Notes:
na = Not available
1 Includes riparian distance on both sides of river except along property boundary to the southeast where only the west side of the river is included.

Aquatic Biota Studies

No aquatic biota studies were performed within the surface water features associated with Tract 1; however, studies were completed by the MPCA (MPCA 2011c) for two locations downstream from the parcel's northern boundary (see Figure 4.3.6-1). Aquatic biota sampling station MPCAB_05RN029 is located in a first-order section of an unnamed tributary to the Pike River approximately 1 river mile downstream from Tract 1's northern boundary. The sampling station MPCAB_05RN077 is located approximately 12 river miles downstream of the parcel's northern boundary in a fourth-order section of the Pike River. These aquatic biota sampling stations recorded predominant stream substrate and fish assemblages at both locations and benthic macroinvertebrate assemblages at station MPCAB_05RN029, as summarized in Table 4.3.6-3 and 4.3.6-4.

Table 4.3.6-3 Fish Species Collected at the MPCA Sampling Sites in the Vicinity of the Tract 1 Parcel

Scientific Name	Common Name	Tolerance Designation[1]	Site: MPCAB_ 05RN029 (individuals recorded)	Site: MPCAB_ 05RN077 (individuals recorded)
Catostomus commersonii	White sucker	Tolerant	9	1
Notemigonus crysoleucas	Golden shiner	Tolerant		3
Notropis hudsonius	Spottail shiner	Intermediate		6
Etheostoma nigrum	Johnny darter	Intermediate		19
Lota lota	Burbot	Intermediate		12
Ambloplites rupestris	Rock bass	Intermediate		1
Esox lucius	Northern pike	Intermediate		2
Culaea inconstans	Brook stickleback	Intermediate	8	
Umbra limi	Central mudminnow	Tolerant	7	43
Phoxinus neogaeus	Finescale dace	Intermediate	1	
Semotilus atromaculatus	Creek chub	Tolerant	3	2
Study year			2005	2009
Species observed			5	9
# intolerant species			0	0

Scientific Name	Common Name	Tolerance Designation[1]	Site MPCAB_ 05RN029 (individuals recorded)	MPCAB_ 05RN077 (individuals recorded)
Total abundance			28	89
Index of Biological Integrity (IBI)[2]			25	60
Predominant Substrate			sand	sand

Source: MPCA 2011c.

Notes:
[1] Adapted from NCDENR 2006, Ohio EPA 1989, and Hubbs and Lagler 2007. Tolerance values indicate qualitative tolerances of physical and chemical disturbances.
[2] IBI is the sum of study specific metrics where 0 represents the worst fish assemblage conditions and 100 represents the best fish assemblage conditions (USEPA 2011a).
-- = no designation assigned.

Table 4.3.6-4 Benthic Macroinvertebrate Attributes for Aquatic Biota Sampling Site MPCAB_05RN029

Benthic Macroinvertebrate Attributes[1]	MPCAB_ 05RN029
EPT (mayfly, stonefly, caddisfly) Taxa	1
Ephemeroptera (mayfly) Taxa	1
Hilsenhoff's Biotic Index (HBI)	5.7
Intolerant Families	2
Percent Pollution Tolerant	3
Percent Chironomidae (midges)	69.5
Percent Diptera (true flies)	71.3
Percent Dominant Taxa	69.5
Percent Dominant Two Taxa	91.1
Percent Filterers	0.9
Percent Gatherers	92.3
Percent Hydropsychidae (net- spinning caddisflies)	0
Percent Scraper	0
Plecoptera (stonefly) Families	0
Total Families	11
Trichoptera (caddisfly) Families	0

Source: MPCA 2011c.

The majority of fish species found at the two sample sites were designated pollution-tolerant and intermediate species (Table 4.2.6-3). The IBI score of 25 at sample location MPCAB_05RN029 was at the low end of the scale, indicating below-average fish communities existed. This is likely a function of the sampling location, as less diverse fish habitat may exist at headwater stream locations (Barbour et al. 1999).

The MPCAB_05RN077 fourth-order stream sampling site results did not identify any intolerant fish species; however, with increasing stream order, fish diversity increases (Barbour et al. 1999) but is variable, as exhibited by the abundance values of 28 and 89 fish, respectively, in the first- and fourth-order study site locations. The IBI score of 60 at this fourth-order sampling location indicates above-average fish communities and habitat exist. The dominant sand substrates, as opposed to silt substrate, and apparent wide riparian shoreline characteristics at these two sampling sites would also indicate quality fish habitat exists at the sampling sites.

The third-order sections of the Pike River within Tract 1 likely display some similar fish habitats and communities compared to the two study locations.

Macroinvertebrate assemblages exhibited low Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa and were dominated by midges and true flies at the headwater sampling location referenced above for fish assemblages. The attributes collected for macroinvertebrates at this sampling site suggest diverse macroinvertebrate habitats were not present, which may be attributed to the headwater characteristics and substrate of the sampling site. The macroinvertebrate habitat available for the third-order segments of the Pike River within the Tract 1 parcel likely exhibit more diverse and high-quality habitats than the headwater macroinvertebrate sampling location.

Special Status Fish and Macroinvertebrates

No SGCN, state, federal, or RFSS species are known to occur within or in the immediate vicinity of Tract 1. Of the species listed as potentially occurring in the Nashwauk Uplands ecoregion or Superior National Forest (see Table 4.3.6-5), the northern brook lamprey and creek heelsplitter are the most likely species to occur at this parcel.

Suitable habitat for northern brook lamprey is likely to exist within Tract 1; however, the nearest known occurrence of this species is more than 19 miles from Tract 1.

Suitable habitat likely exists for the creek heelsplitter in the third-order segments of the Pike River within Tract 1, as the substrate likely contains adequate sand substrate and flow to provide habitat for this freshwater mussel species. Additionally, this species has been documented 0.5 mile upstream of the Sand and Pike rivers confluence, where the Pike River becomes a fourth-order stream (see Figure 4.3.6-2).

Table 4.3.6-5 SGCN and RFSS Species Identified within Portions of the Nashwauk Uplands Ecoregion or Superior National Forest

Scientific Name	Common Name	Nashwauk Uplands Ecoregion SGCN	RFSS
Insects			
Chilostigma itascae	Headwaters chilostigman caddisfly		X
Somatochlora brevicincta	Quebec emerald		X
Williamsonia flechen	Ebony boghaunter		X
Fish			
Acipenser fulvescens	Lake sturgeon		X
Coregonus nipigon	Nipigon cisco		X
Coregonus zenithicus	Shortjaw cisco		X
Ichthyomyzon fossor	Brook lamprey	X	X
Mussels			
Lasmigona compressa	Creek heelsplitter	X	X
Ligumia recta	Black sandshell	X	X

Sources: MDNR 2006d; FEIS Appendix D.

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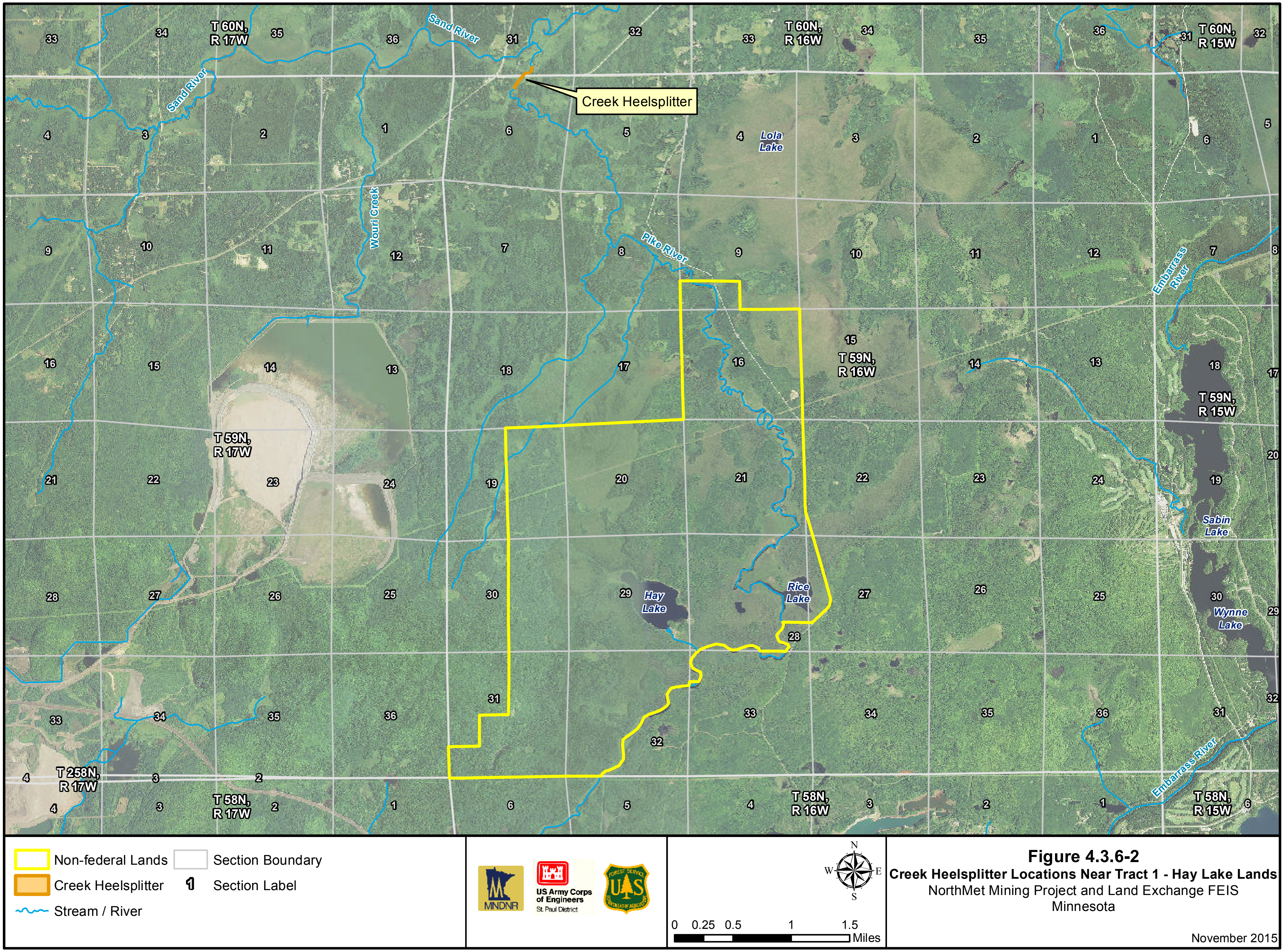

Figure 4.3.6-2
Creek Heelsplitter Locations Near Tract 1 - Hay Lake Lands
NorthMet Mining Project and Land Exchange FEIS
Minnesota

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4.3.6.2.2 Tract 2 - Lake County Lands

No lakes or waterbodies are known to exist within Tract 2 (AECOM 2011d); therefore, no fish or macroinvertebrate habitats are present.

4.3.6.2.3 Tract 3 - Wolf Lands

Surface Water Features

Coyote Creek is the only surface water feature within the Wolf Lands 3 and 4. Wolf Lands 1 and 2 do not have surface water features. Coyote Creek is a headwater stream that begins in Wolf Lands 3 where it flows north for 0.1 mile within the parcel boundary and includes approximately 32.8 acres of unmapped floodplain. Coyote Creek continues north and flows for 0.9 mile within Wolf Lands 4 before continuing further north, and includes approximately 79.4 acres of unmapped floodplain. The heavily vegetated riparian habitats and associated floodplains adjacent to the river's edge likely provide important fish and macroinvertebrate habitats. Coyote Creek flows through two of the three lakes in the McDougal Lakes chain and becomes a third-order stream (see Figure 4.3.6-3) at its confluence with the Stony River approximately 4 river miles downstream from the northern boundary of Wolf Lands 4. Wolf Lands 3 and 4 contain a combined 16.1 ft of river frontage per acre. Aerial photograph review indicates a wide riparian vegetative buffer with minimal human disturbance where emergent sedge-meadow wetlands are adjacent to the creek within the Wolf Lands 3 parcel, and both emergent and scrub-shrub wetlands are adjacent to the creek within the Wolf Lands 4 parcel (AECOM 2011c). The riparian vegetative buffer adjacent to the creek segments offers shade, structure, and erosion control.

Much of the emergent wetlands adjacent to Coyote Creek within the Wolf Lands 3 parcel exhibited 18 to 24 inches of standing water (AECOM 2011c), which could provide high-quality headwater stream fish and macroinvertebrate habitats because wetlands provide nutrient-rich environments that would be accessible to fish and macroinvertebrates at the documented water depth. Additionally, these wetlands likely provide potential spawning habitat for some warmwater fish species that require headwater wetland habitats for spawning.

The USFS MIH categories within the combined Wolf Lands parcels 3 and 4 boundaries include approximately 10,560 linear ft of creek shoreline.

Aquatic Biota Studies

No fish or macroinvertebrate studies have been completed along Coyote Creek within the two parcels; however, two MPCA aquatic biota studies (MPCAB_05RN024 and MPCAB_05RN074) were completed within the third- and fourth-order stretches of the Stony River, approximately 2 river miles and 4 river miles, respectively, downstream of the Coyote Creek and Stony River confluence, as indicated in Figure 4.3.6-3 (6 and 8 miles downstream of northern boundary of parcel Wolf Lands 4) (MPCA 2011c). Results from the two sampling events are summarized below in Table 4.3.6–6 and Table 4.3.6-7. The fish communities for both sampling sites appeared diverse and abundance was high. IBI scores for each site were high, indicating good to excellent fish habitat was likely present. Although high-quality fish habitat likely exists at the Coyote Creek stream locations within Wolf Lands 3 and 4, some, but not all, of the fish species observed at the Stony River sampling locations are likely present, as fish community diversity is likely less in headwater stream habitats.

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Non-federal Lands
Section Boundary
Monitoring Station
Section Label
Stream / River
Stream Order Number

MNDNR
US Army Corps of Engineers St. Paul District
Forest Service U.S. Department of Agriculture

N W E S

0 0.25 0.5 1 1.5 Miles

Figure 4.3.6-3
Monitoring Sample Site Locations
Tract 3 - Wolf Lands
NorthMet Mining Project and Land Exchange FEIS
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A qualitative assessment of the benthic macroinvertebrate data presented in Table 4.3.6-7 indicates a diverse community with attributes indicating little human disturbance or sedimentation at the Stony Creek sampling sites. The Coyote Creek headwater stretches of stream likely exhibit more siltation due to slower moving water typically observed in headwater streams in the region and, therefore, likely offer less diverse habitats for benthic macroinvertebrates compared to the two sampling sites summarized below.

Table 4.3.6-6 Fish Species Collected at Two Sites in the Vicinity of the Wolf Lands Parcels within the Stony River

			Site	
Scientific Name	**Common Name**	**Tolerance Designation[1]**	**MPCAB_ 05RN024 (number recorded)**	**MPCAB_ 05RN074 (number recorded)**
Catostomus commersonii	White sucker	Tolerant	21	4
Luxilus cornutus	Common shiner	Intermediate		23
Notemigonus crysoleucas	Golden shiner	Tolerant	2	84
Notropis hudsonius	Spottail shiner	Intermediate	19	11
Notropis heterolepis	Blacknose shiner	Intolerant	1	123
Notropis volucellus	Mimic shiner	Intolerant	6	29
Etheostoma nigrum	Johnny darter	Intermediate	8	2
Perca flavescens	Yellow perch	Intermediate	31	93
Sander vitreus	Walleye	Intermediate		2
Percina caprodes	Logperch	Intermediate	4	3
Lota lota	Burbot	Intermediate	85	3
Ambloplites rupestris	Rock bass	Intermediate		2
Esox lucius	Northern pike	Intermediate		12
Umbra limi	Central mudminnow	Tolerant	1	
Pimephales promales	Fathead minnow	Tolerant	6	
Rhinichthys cataractae	Longnose dace	Intolerant	177	
Noturus gyrinus	Tadpole madtom	Intermediate	7	7
Cottus bairdii	Mottled sculpin	Intolerant	19	
Study year			2005	2005
Species observed			14	14
# intolerant species			4	2
Total Abundance			387	398
Index of Biological Integrity (IBI)[2]			86	77
Predominant Substrate			rubble/cobble	na

Source: MPCA 2011c.

Notes:
1 Adapted from NCDENR 2006, Ohio EPA 1989, and Hubbs and Lagler 2007. Tolerance values indicate qualitative tolerances of physical and chemical disturbances.
2 IBI is the sum of study specific metrics where 0 represents the worst fish assemblage conditions and 100 represents the best fish assemblage conditions (USEPA 2011b).
na = Not available
-- = no designation assigned.

Table 4.3.6-7 Benthic Macroinvertebrate Attributes for Aquatic Biota Sampling Sites within the Stony River

Benthic Macroinvertebrate Attributes[1]	MPCAB_ 05RN024	MPCAB_ 05RN074
EPT (mayfly, stonefly, caddisfly) Taxa	11	11
Ephemeroptera (mayfly) Taxa	5	5
Hilsenhoff's Biotic Index (HBI)	5.9	5.2
Intolerant Families	4	1
% Pollution Tolerant	10.3	26.1
% Chironomidae (midges)	55.5	17.2
% Diptera (true flies)	58.7	17.5
% Dominant Taxa	55.5	18.8
% Dominant Two Taxa	63.7	36
% Filterers	11.7	17.8
% Gatherers	75.4	50.2
% Hydropsychidae (net- spinning caddisflies)	1.4	11.9
% Scraper	5	25.4
Plecoptera (stonefly) Families	0	0
Total Families	23	27
Trichoptera (caddisfly) Families	6	6

Source: MPCA 2011c.

Special Status Fish and Macroinvertebrates

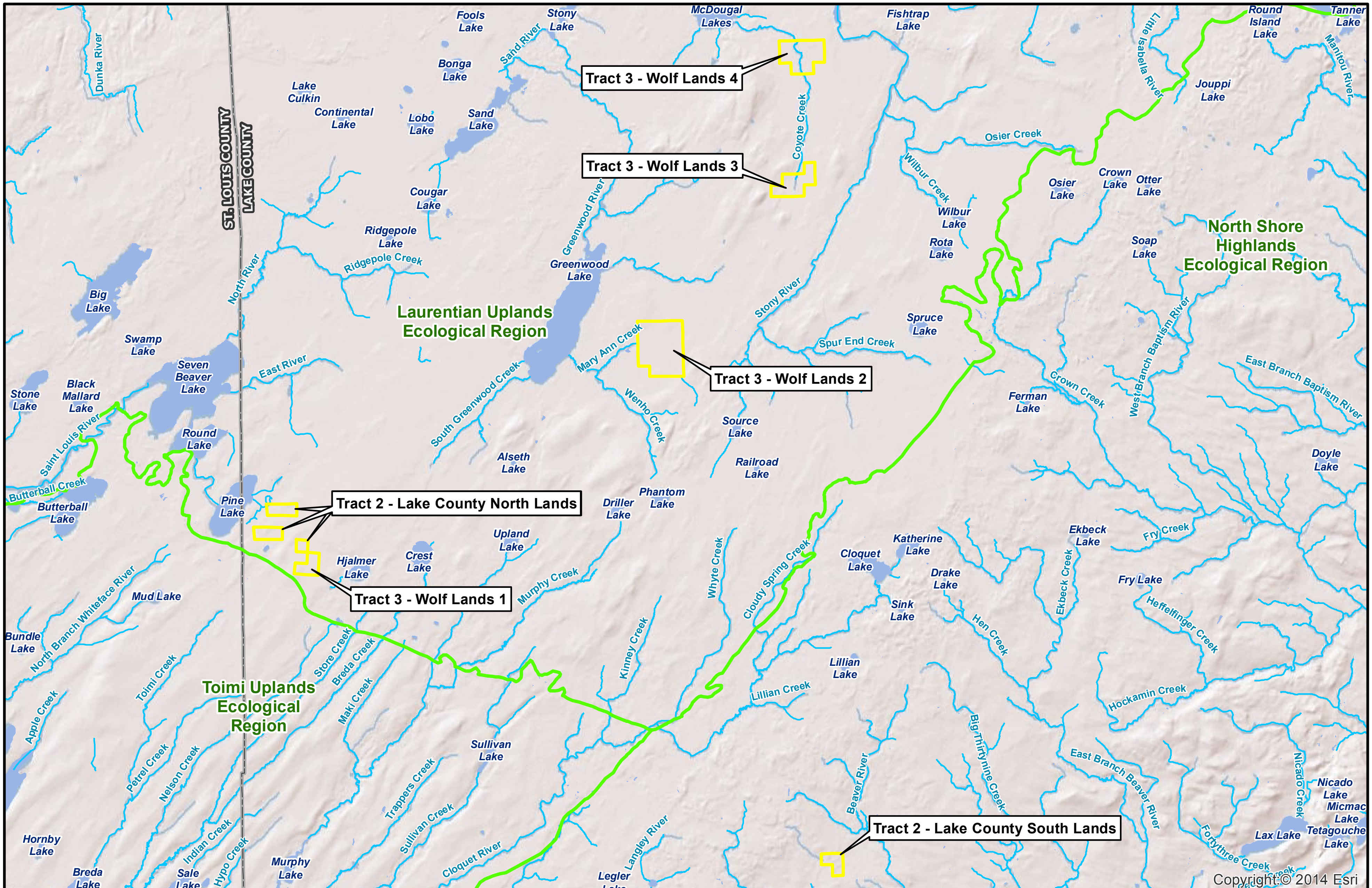
No SGCN, state, federal, or RFSS species are known to occur at or in the immediate vicinity of Tract 3. Of the species listed to potentially occur in the Laurentian Uplands ecoregion (see Figure 4.3.6-4) or Superior National Forest (see Table 4.3.6-8), the northern brook lamprey and creek heelsplitter are the most likely species to occur within Tract 3.

Suitable habitat for northern brook lamprey is likely to exist in Tract 3, although the nearest known occurrence of this species is more than 52 miles from the Wolf Lands parcels.

The creek heelsplitter has historically been found near the east and west confluence of the northernmost lake in the chain of McDougal Lakes and the Stony River in the third-order stretch of the Stony River (see Figure 4.3.6-5). The aquatic species habitat in the stretches of Coyote Creek within Wolf Lands 3 and 4 is unknown, but likely would display first-order headwater stream characteristics; it is unknown if the necessary aquatic species habitat for the creek heelsplitter is present on the parcels. However, the presence of the creek heelsplitter within the parcel boundary is possible but not likely, since Coyote Creek is a first-order stream.

Habitats for the other special status species described in Table 4.3.6-8 likely do not exist within the parcel boundary.

No invasive fish or macroinvertebrate species are known to exist on Tract 3.



Non-federal Lands

Ecological Regions

Stream / River

Lake / Pond

MNDNR

US Army Corps of Engineers St. Paul District

N W E S

0 1 2 4 Miles

Figure 4.3.6-4

Ecological Regions

Tract 2 - Lake County and Tract 3 - Wolf Lands

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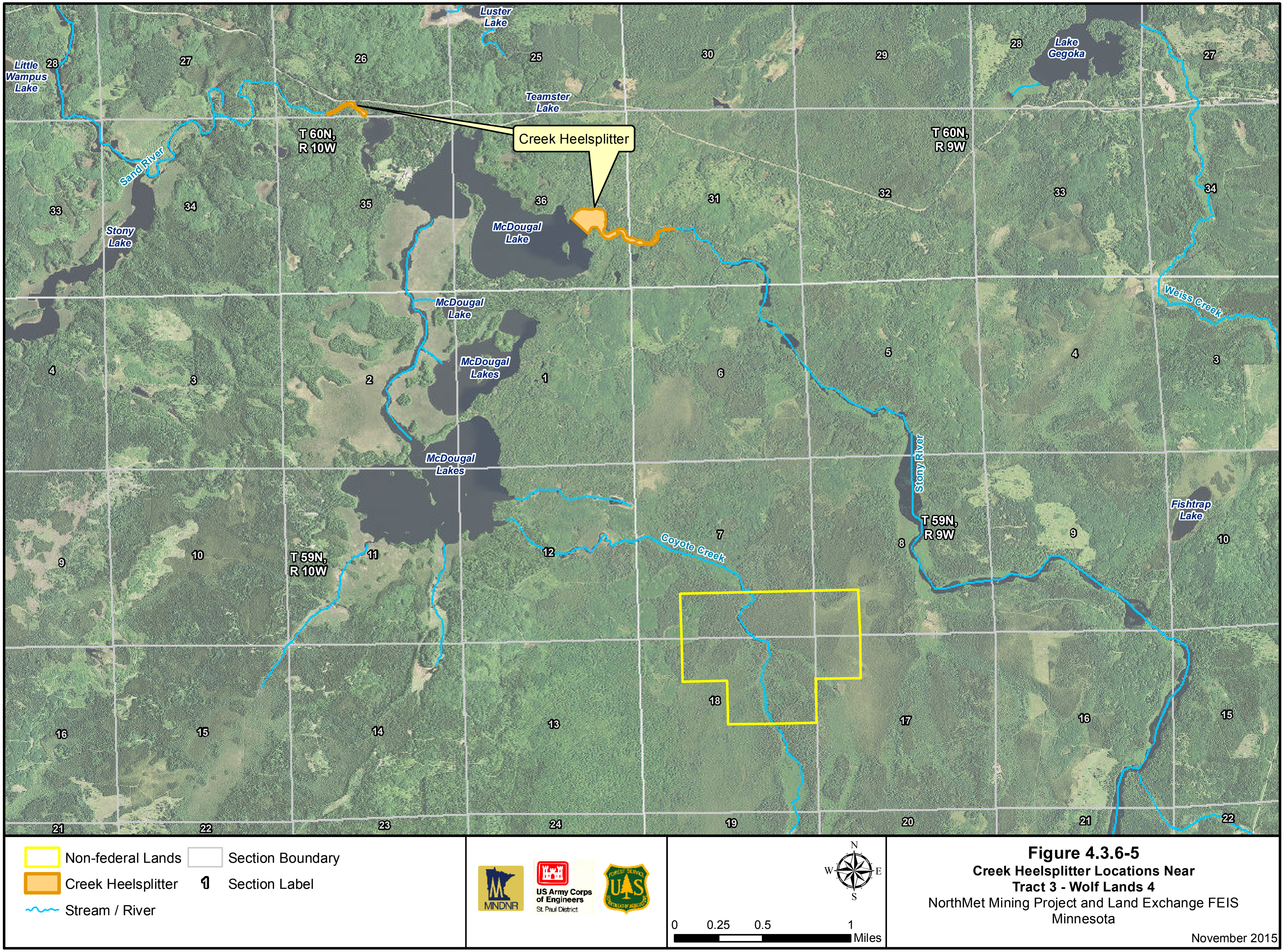

Figure 4.3.6-5
Creek Heelsplitter Locations Near
Tract 3 - Wolf Lands 4
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Table 4.3.6-8 SGCN and RFSS Species Identified within Portions of the Laurentian Uplands Ecoregion or Superior National Forest

Scientific Name	Common Name	Laurentian Uplands Ecoregion SGCN	RFSS
Insects			
Chilostigma itascae	Headwaters chilostigman caddisfly		X
Somatochlora brevicincta	Quebec emerald		X
Williamsonia flechen	Ebony boghaunter		X
Fish			
Acipenser fulvescens	Lake sturgeon		X
Coregonus nipigon	Nipigon cisco		X
Coregonus zenithicus	Shortjaw cisco		X
Ichthyomyzon fossor	Brook lamprey		X
Mussels			
Lasmigona compressa	Creek heelsplitter	X	X
Ligumia recta	Black sandshell	X	X

Source: MDNR 2006d; FEIS Appendix D.

4.3.6.2.4 Tract 4 - Hunting Club Lands

Surface Water Features

No lakes or waterbodies are known to exist within Tract 4 (AECOM 2011d); therefore, no fish or macroinvertebrate habitats exist.

4.3.6.2.5 Tract 5 - McFarland Lake Lands

Surface Water Features

The only surface water feature within Tract 5 is the 990 ft of shoreline associated with McFarland Lake along the eastern parcel boundary. McFarland Lake is classified as an oligotrophic lake (MPCA 2011c) with a surface area of 384 acres and a maximum depth of 49 ft (MDNR 2011c). Aerial photograph review indicates minimal shoreline disturbance and a wide riparian vegetative buffer along the entire parcel boundary with McFarland Lake.

The USFS MIH represented in Tract 5 (MIH 14, Aquatic Habitats) would include 990 linear ft of lake shoreline.

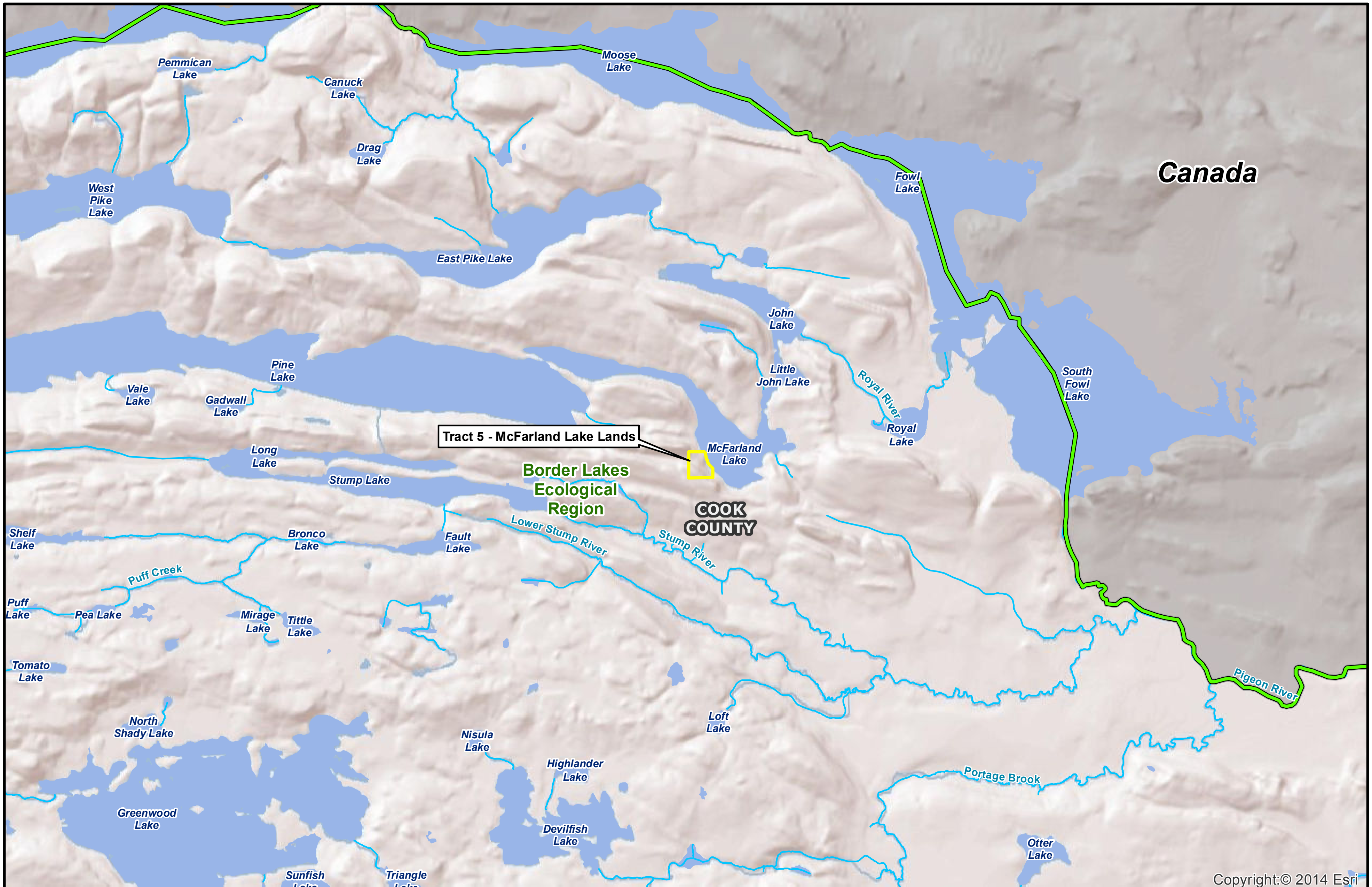
Aquatic Biota Studies

MDNR conducted a fishery assessment within McFarland Lake in 2003 and reported several game fish species including lake whitefish, northern pike, smallmouth bass, walleye, and yellow perch (MDNR 2011c). Tulibee and white sucker were also recorded. These species are typical for large and deep lakes within the region.

Special Status Fish and Macroinvertebrates

No special status fish or macroinvertebrates are known to exist within Tract 5. A summary of the SGCN and RFSS species is provided in Table 4.3.6-9. The spoonhead sculpin, lake chub, and longear sunfish are known to occur within the Border Lakes ecoregion and could occur at Tract 5 (see Figure 4.3.6-6). These species are described below. Due to limiting habitat requirements and limited distribution, the remaining species listed in Table 4.6.3-9 likely are not present in McFarland Lake.

The invasive species, spiny water flea (*Bythotrephes longimanus*), has been documented in McFarland Lake. The spiny water flea is a species of zooplankton native to Europe and Asia that competes for food sources with other zooplankton species and fish.



Non-federal Lands
Ecological Regions
Stream / River
Lake / Pond

MNDNR
US Army Corps of Engineers St. Paul District

N W E S
0 0.25 0.5 1 1.5 Miles

Figure 4.3.6-6
Ecological Regions
Tract 5 - McFarland Lake Lands
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Table 4.3.6-9 SGCN Species for the Border Lakes Ecoregion and the USFS RFSS Species List

Scientific Name	Common Name	Border Lakes Ecoregion SGCN	RFSS
Insects			
Chilostigma itascae	Headwaters chilostigman caddisfly		X
Somatochlora brevicincta	Quebec emerald		X
Williamsonia flechen	Ebony boghaunter		X
Fish			
Acipenser fulvescens	Lake sturgeon	X	X
Coregonus nipigon	Nipigon cisco	X	X
Coregonus zenithicus	Shortjaw cisco	X	X
Cottus ricei	Spoonhead sculpin	X	
Couesius plumbeus	Lake chub	X	
Ichthyomyzon fossor	Brook lamprey	X	X
Lepomis megalotis	Longear sunfish	X	
Mussels			
Lasmigona compressa	Creek heelsplitter	X	X
Ligumia recta	Black sandshell	X	X

Sources: MDNR 2006d; FEIS Appendix D.

Spoonhead Sculpin

The spoonhead sculpin is a bottom dwelling fish that inhabits rocky areas of swift creeks and rivers; however, this species can also be found in lakes. They primarily feed on planktonic crustaceans and aquatic insect larvae and are native to Minnesota (Froese and Pauly 2011). Little is known about the habitat and macroinvertebrates in McFarland Lake. Although the habitat characteristics for McFarland Lake are not completely known, it is possible the spoonhead sculpin species exists in McFarland Lake.

Lake Chub

Lake chubs have a secure distribution in Lake Superior, but have shown declining distribution in Minnesota inland lakes. Their preferred habitat includes shallow areas of deep lakes, especially near river mouths (Stasiak 2006). Habitat for lake chub may exist in McFarland Lake.

Longear Sunfish

The longear sunfish is found in lake and stream habitats, which include high-quality waters with shallow (less than 3 ft) shorelines exhibiting firm, detritus rich substrates and extensive submerged vegetation. Only 37 Minnesota lakes and streams have confirmed populations of this fish species (Porterfield and Ceas 2008). Habitat for longear sunfish may exist in portions of McFarland Lake.

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4.3.7 Air Quality

Regional air quality, including for the federal and non-federal lands, is discussed in Section 4.2.7. The federal lands of the Land Exchange Proposed Action are similar to the Mine Site previously discussed, but exclude the privately owned land bordering Dunka Road to the south of the Mine Site. The non-federal parcels are all privately owned and there are currently no activities on these parcels that affect ambient air quality.

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4.3.8 Noise and Vibration

4.3.8.1 Federal Lands

The topography and land cover of the federal lands in the Land Exchange Proposed Action and the Land Exchange Alternative B are similar to that of the Mine Site, as previously discussed, but extend further north and west (mostly wetlands) and exclude the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.8.2 provides a discussion of the existing noise and vibration conditions on the federal lands.

4.3.8.2 Non-federal Lands

The non-federal lands in the Land Exchange Proposed Action consist of up to five tracts totaling 7,075.0 acres that are located within the Superior National Forest proclamation boundary, a sparsely populated rural region in northeast Minnesota. The tracts are predominantly forest and wetland habitat. Tracts 1, 2, and 3 are 13 to 27 miles from the federal lands, while Tracts 4 and 5 are 46 and 91 miles from the federal lands, respectively (see Table 4.3.8-1 and Figure 4.3.8-1).

Table 4.3.8-1 Approximate Distances and Direction of Non-federal Lands to Federal Lands and the Plant Site

Tract	Approximate Distance to Federal Lands (miles)	Approximate Distance to Plant Site (miles)	Direction from Federal Lands and Plant Site
Tract 1 – Hay Lake	15	10	West
Tract 2 – Lake County			
Lake County North	13	20	Southeast
Lake County South	27	34	Southeast
Tract 3 – Wolf Lands			
Wolf Lands 1	14	20	Southeast
Wolf Lands 2	18	26	Southeast
Wolf Lands 3	18	26	Southeast
Wolf Lands 4	18	26	East
Tract 4 – Hunting Club	46	43	Northwest
Tract 5 – McFarland Lake	91	100	Northeast

Review of the most-up-to-date aerial maps indicates that there are no noise-sensitive areas or receptors (e.g., residences, schools, campgrounds, or national wilderness areas) within the non-federal lands. However, people currently hunt within Tract 1 and Tract 4 due to the presence of wildlife. Wildlife species within each tract are described in Section 4.3.5. There are a few residential receptors outside the non-federal lands. Figure 4.3.8-1 shows the locations of the closest receptors to the non-federal lands.

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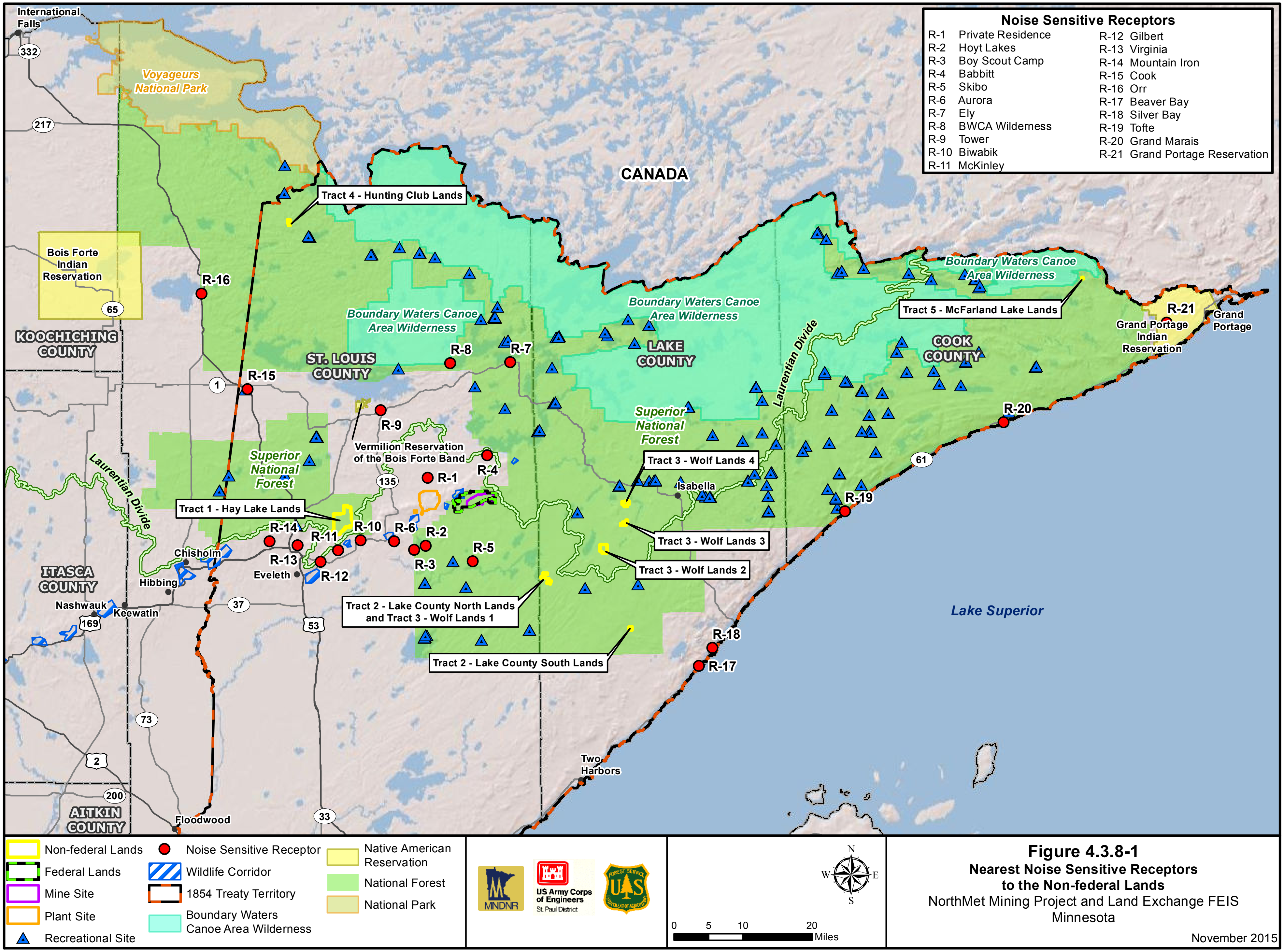

Figure 4.3.8-1
Nearest Noise Sensitive Receptors to the Non-federal Lands
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The non-federal lands would be managed consistent with the adjacent forest lands (see Section 4.3.1), and the USFS currently has no plans for operations on the non-federal lands. Since the non-federal lands are located in a forested and rural environment, the existing ambient L_{eq} at the five tracts has been assumed to be 5 dB lower than the levels shown in Table 4.2.8-2 for the Mine Site and Plant Site. This means that existing daytime and nighttime ambient L_{eq} for all non-federal lands are not expected to exceed 40 and 30 dB, respectively. The estimated L_{eq} for the statistical distribution was converted to other noise percentile metrics, such as L_{50} and L_{10}, using a USEPA calculation methodology (USEPA 1974). The calculation was based on an assumed standard deviation of 3 dB for the sound level statistical distribution. A summary of the estimated daytime and nighttime ambient L_{eq}, L_{50}, and L_{10} levels expected at the tracts is presented in Table 4.3.8-2.

Table 4.3.8-2 Summary of Estimated Existing Ambient Noise Levels at the Non-federal Lands

Ambient Noise Level Metric	Daytime (dBA)	Nighttime (dBA)
L_{eq}	40	30
L_{50}	39	29
L_{10}	42.8	32.8

Currently, no ground- or air-vibrating sources or activities (e.g., mine blasting or pile driving) exist within a 15-mile radius of the non-federal lands. The closest vibration-generating activities include operation of the coal and flux pulverizer and rotary hearth furnace at the Mesabi Phase I Plant in Hoyt Lakes (approximately 9 miles west of Tract 1, which is the closest non-federal tract) and blasting at the Northshore Mine (approximately 16 miles northwest of the closest tract [Tract 2]). Since ground and air vibration effects diminish with distance from the source, existing levels of vibration at the sensitive receptors are expected to be negligible.

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4.3.9 Cultural Resources

4.3.9.1 Federal Lands

4.3.9.1.1 Land Exchange Proposed Action

The federal lands within the Land Exchange Proposed Action area is similar to the Mine Site portion of the NorthMet Project area previously discussed, but extends further north and west and excludes the privately owned land bordering Dunka Road to the south of the Mine Site. The Land Exchange Proposed Action APE for both direct and indirect effects consists of the entire land exchange boundary (Figure 4.2.9-1). Section 4.2.9 provides further discussion of the existing conditions on the Mine Site and associated federal lands. Cultural resources identified within the Land Exchange Proposed Action area consisted of archaeological sites and properties and natural resources of religious and cultural significance to the Bands.

As a result of Phase I cultural resources surveys and consultation with the Bands and the SHPO concerning the results of identification efforts for properties of religious and cultural significance to the Bands, three cultural resources have been identified within the Land Exchange area: the BBLV Trail Segment, NorthMet Archaeological Site, and Knot Logging Camp. For detailed property descriptions and discussions of eligibilities, please see Section 4.2.9.

The investigations completed in the Land Exchange Proposed Action area have identified cultural resources as summarized in Table 4.3.9-1 below.

Table 4.3.9-1 Cultural Resources Identified in the Land Exchange Area

Resource ID	Resource Name	Resource Type	NRHP Determination by Co-lead Agencies	SHPO Concurrence with Co-lead Agencies' Findings
SL-HLC-069	BBLV Trail Segment[1]	Archaeological Site	Eligible	Concur
21SLpending	NorthMet Archaeological Site	Archaeological Site	Not Eligible	Concur
21SLmn	Knot Logging Camp	Archaeological Site	Not Eligible	Concur

Note:
[1] USFS designation BBLV Trail Segment #1 (USFS #01-569).

The 1854 Treaty resources located within the Land Exchange Proposed Action would be similar to the Mine Site portion of the NorthMet Project area previously discussed in Section 4.2.9. Section 4.2.9 provides further discussion of the existing conditions on the Mine Site and associated federal lands.

An analysis of whether any particular property associated with the Bands' exercise of their usufructuary rights may be considered a TCP is limited by lack of available information regarding Band members' traditional exercise of those rights. Determining how the Bands have traditionally conducted their usufructuary rights on or near the Land Exchange Proposed Action area would only be available through a detailed ethnographic study of individual Band members and their families. The cultural resources investigations included Band member interviews with

Bois Forte, Fond du Lac, and Grand Portage, although only Bois Forte's results were made available. The results of the interviews and the cultural resources investigation did not find any natural resources that would be considered a TCP or other traditional cultural place.

4.3.9.1.2 Land Exchange Alternative B

All of the cultural resources and 1854 Treaty resources identified and discussed in Section 4.3.9.1.1 are located within the Land Exchange Alternative B.

4.3.9.2 Non-federal Lands

There are no known cultural resources on the non-federal lands, except known 1854 Treaty resources consisting of wild rice beds within the Hay Lake lands. As discussed in Section 4.3.2, Hay Lake, Rice Lake, and the Pike River are the only waterbodies within the proposed non-federal land exchange tracts known to contain wild rice beds.

4.3.10 Socioeconomics

The Land Exchange Proposed Action study area for socioeconomics is the same as for the NorthMet Project Proposed Action: all of Cook, Lake, and St. Louis counties, as well as individual cities in St. Louis County (see Figure 4.2.10-1). This geography includes the federal and non-federal tracts. Socioeconomic data are not available, and thus are not reported, for the individual non-federal tracts and their parcels.

The federal lands are similar to that of the Mine Site previously discussed, but exclude the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.10.1 provides additional discussion of the existing conditions on the federal lands. The socioeconomic information in Section 4.2.10.1 broadly applies to the study area, which encompasses all of the non-federal parcels involved in the Land Exchange Proposed Action. The following provides additional information as it relates to the federal and non-federal parcels.

4.3.10.1 Economic Activity

There is no ongoing forestry activity on the federal lands and no evidence of recent past forestry activity. The non-federal parcels are all privately owned or otherwise have no official public access. There is some evidence of timber harvesting on Tracts 2, 3, and 4; this activity could generate income, employment, or revenue.

4.3.10.2 Recreation

Recreation in national forests can generate direct revenue to the USFS and the state in the form of entry fees and hunting and fishing license fees, as well as via indirect economic activity related to the multiplier effect of such activity (e.g., purchase of fishing tackle and bait).

In 2006 (the most recent year for which data are available), there were approximately 1,376,000 recreational visits to Superior National Forest (USFS 2012a). “Recreational,” as used in USFS 2010, is very broadly defined, and primarily distinguishes (and excludes) transient visitors such as commuters or for restroom visits. On average, visitors to the forest spent $643 per visiting party per day (i.e., the group participating in the visit, such as a family).

Currently, the federal lands are not easily accessible. The non-federal parcels are all privately owned or otherwise have no official public access, although evidence of recreational activity has been observed on some of these parcels. Such activity is discussed in Section 4.2.11.

4.3.10.3 Other Socioeconomic Characteristics

Currently, there is no demand for public safety services on the inaccessible federal lands and only limited demand on the non-federal lands. As described in Section 4.2.11, the non-federal parcels generally consist of undeveloped woodlands, wetlands, and other natural features. There is evidence of past extractive activity (quarrying and/or borrowing of sand and gravel) and ongoing private recreational hunting and fishing on Tract 1. Tract 5 was previously used by Wheaton College. In their current state, the non-federal parcels have minimal, if any, effect on public services and facilities.

Subsistence activity, as it relates to the federal lands, is described in Section 4.2.10.1.6. There is no available information that any of the non-federal tracts are being used for this purpose.

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4.3.11 Recreation and Visual Resources

4.3.11.1 Federal Lands

4.3.11.1.1 Land Exchange Proposed Action

Recreational Resources

The federal lands fall within the Semi-Primitive Motorized and Roaded Natural ROS designations, as shown in Table 4.3.11-1. These designations are defined in Section 4.2.11.1.1.

Table 4.3.11-1 Recreational Opportunity Spectrum Designations within the Land Exchange Proposed Action and Land Exchange Alternative B

Recreational Opportunity Spectrum Designation	Total Acreage
Land Exchange Proposed Action Federal Lands	
Semi-Primitive Motorized	5,528.4
Roaded Natural	967.0
Land Exchange Alternative B Federal Lands	
Semi-Primitive Motorized	4,276.5
Roaded Natural	476.1

Visual Resources

The visual resources surrounding the federal lands, visual receptors near the federal lands, and SIO designation of the federal lands are discussed in Section 4.2.11.1.2. SIO designations are also summarized in Table 4.3.11-2.

Table 4.3.11-2 Scenic Integrity Objective Designations for Lands under the Land Exchange Proposed Action and Land Exchange Alternative B

Scenic Integrity Objective Designation	Total Acreage
Land Exchange Proposed Action Federal Lands	
Low Scenic Integrity Objective	6,495.6
No Designation[1]	30.5
Land Exchange Alternative B Federal Lands	
Low Scenic Integrity Objective	4,743.7
No Designation[1]	8.9

Note:
[1] USFS does not designate SIO for bodies of water, such as Mud Lake, which is part of the federal lands. Only a portion of Mud Lake falls within the footprint of the Land Exchange Alternative B.

4.3.11.1.2 Land Exchange Alternative B

The recreational and visual conditions for the federal lands in Land Exchange Alternative B are similar to the federal lands in the Land Exchange Proposed Action. Acreage of ROS and SIO designations for the Land Exchange Alternative B are summarized in Tables 4.3.11-1 and 4.3.11-2.

4.3.11.2 Non-federal Lands

All of the non-federal lands are privately owned; those not already owned by PolyMet are under options to purchase by PolyMet. Thus, there are no current public recreation opportunities on any of the tracts. Observed and likely private recreational activity on the non-federal lands is described below, based on aerial photography, research, and field visits conducted in October 2011. For reference, ownership surrounding the non-federal lands is shown in Figures 4.3.1-2, 4.3.1-3, and 4.3.1-4.

4.3.11.2.1 Forest Service Recreation Designations

The ROS designations for areas surrounding the non-federal lands are summarized in Table 4.3.11-3. The Semi-Primitive Motorized and Roaded Natural ROS designations are defined in Section 4.2.11.1.1. The Semi-Primitive Non-Motorized designation is similar to the Semi-Primitive Motorized, except that motor vehicles are not permitted.

Table 4.3.11-3 Recreational Opportunity Spectrum Designations in the Vicinity of Non-federal Lands

Tract	Adjacent/Nearby ROS Designations
1 – Hay Lake Lands	Semi-Primitive Motorized, Semi-Primitive Non-Motorized, and Roaded Natural
2 – Lake County Lands	Semi-Primitive Non-Motorized (Lake County South); Semi-Primitive Motorized, and Semi-Primitive Non-Motorized (Lake County North)
3 – Wolf Lands	Semi-Primitive Motorized and Roaded Natural
4 – Hunting Club Lands	Semi-Primitive Motorized
5 – McFarland Lake Lands	Semi-Primitive Non-Motorized and Semi-Primitive Motorized

4.3.11.2.2 Regional Recreational Resources

The Superior National Forest, including the BWCAW, and Voyageurs National Park are important recreation areas in northeastern Minnesota. The Superior National Forest includes approximately 3 million acres and provides recreation opportunities for camping, boating, fishing, hiking, viewing scenery, off-highway vehicle riding, wilderness related recreation, snowmobiling, and cross country skiing. Located 20 miles to the north of the NorthMet Project area, the million-plus-acre BWCAW is protected as part of the National Wilderness Preservation System. Voyageurs National Park is located approximately 50 miles north of the NorthMet Project area (see Figure 1.1-1). In addition, there are year-round recreation opportunities at Giants Ridge (approximately 15 miles east of the Mine Site) that include downhill skiing, snowboarding, cross-country skiing, snowmobiling, mountain biking, hiking, and golf. There are also opportunities for biking, hiking, roller-blading on the Mesabi Trail which spans 70 miles across the Iron Range.

4.3.11.2.3 Forest Service Scenic Integrity Designations

The non-federal lands are all within the Superior National Forest proclamation boundary, and are surrounded by relatively flat terrain covered in forests and wetlands. Some of the tracts are located within a few miles of towns, mines, and active forestry activity. The Mine Site would not be visible from any of the non-federal tracts. SIO designations for portions of Superior National Forest surrounding the five tracts are summarized in Table 4.3.11-4. Definitions of the SIO designations are provided in Section 4.2.11.1.2.

Table 4.3.11-4 Scenic Integrity Objective Designations in the Vicinity of Non-federal Lands

Tract	Adjacent/Nearby SIO Designations
1 – Hay Lake Lands	High, Moderate, Low
2 – Lake County Lands	Moderate (Lake County South); Low, Moderate (Lake County North)
3 – Wolf Lands	Low (Wolf Lands 2, 4); Low, Moderate (Wolf Lands 1); Low, High (Wolf Lands 3)
4 – Hunting Club Lands	Moderate
5 – McFarland Lake Lands	High

4.3.11.2.4 Tract 1 – Hay Lake Lands

Recreation

Tract 1 exhibits evidence of recreational activity. Several trails cross the parcel, including trails that intersect with County Road 715; most of these trails are either bermed or gated and some have posted No Trespassing signs. Hay Lake and Rice Lake are accessible by canoe on the Pike River. Deer and evidence of bear were observed, as were two deer stands (others are believed to exist) (Lisson and Gawtry 2011). A sand and gravel pit in the northeastern portion of the parcel show evidence of use as a shooting range and/or hunting site. A boat landing and small parking area (not listed or mapped as a MDNR access point) are present near the southeastern corner of the parcel on Rice Lake.

Visual Resources

Tract 1 covers 4,926.3 acres that contain three lakes (see Figure 4.3.11-1). This tract is crossed by County Road (CR) 175 and CR 135 (both of which are known as Pike River Road) and the Pike River. Tract 1 can be viewed from Pike River Road and nearby Pike Mountain, as well as the waterways within the tract. Tract 1 is roughly 3 miles north-northwest of Biwabik; however, the flat terrain prevents the tract from being viewed from the town. The portions of Superior National Forest surrounding this parcel generally have Low SIO designations, with some Moderate designations near the northeastern and southwestern corners, and High designations to the north.

Figure 4.3.11-1 The Hay Lake Tract: Looking North along the Pike River

4.3.11.2.5 Tract 2 – Lake County Lands

Recreation

The Tract 2 parcels all have very limited access. There is no evidence of recreational activity or hunting on any of these parcels.

Visual Resources

Tract 2 consists of four individual parcels, referred to as Lake County North and Lake County South, totaling 381.9 acres. The three Lake County North parcels are located southeast of Pine Lake and approximately 13 miles southeast of the federal lands, and are not visible from Pine Lake Road, the nearest public road. The portions of Superior National Forest surrounding these parcels have Low and Moderate SIO designations (see Figure 4.3.11-2). The Lake County South parcel is approximately 27 miles southeast of the federal lands. Due to flat terrain and the remote nature of the southern site, it is not visible from public roads or other public areas. The portions of Superior National Forest surrounding this parcel have Moderate SIO designations.

Figure 4.3.11-2 Looking East from the Northwest Corner of Lake County North, Southern Sub-Parcel

4.3.11.2.6 Tract 3 – Wolf Lands

Recreation

The Tract 3 parcels all have very limited access. A rough forest road provides access to Wolf Lands 3, and a trail accesses Coyote Creek. No trails were observed on any of the other parcels during site visits, and there is no evidence of recreational activity or hunting on any of the Tract 3 lands.

Visual Resources

Tract 3 consists of four separate parcels totaling 1,575.8 acres, and consists of level land containing wetlands, bogs, and forests. Wolf Lands 1 is located southeast of Pine Lake and may be visible from Nelson Road. The portions of Superior National Forest surrounding this parcel have Low and Moderate SIO designations. Wolf Lands 2 is due east of Greenwood Lake and may be visible from a private road to the east of the property. The portions of Superior National Forest surrounding this parcel have Low SIO designations. Wolf Lands 3 has recently been logged and may be visible from Forest Route 393 (see Figure 4.3.11-3). The portions of Superior National Forest surrounding this parcel have Low SIO designations, with a corridor of High SIO land along the southeastern boundary. Wolf Lands 4 is visible from Forest Routes 103 and 393. The portions of Superior National Forest surrounding this parcel have Low SIO designations.

Figure 4.3.11-3 The Wolf Lands, Looking Northwest along Coyote Creek

4.3.11.2.7 Tract 4 – Hunting Club Lands

Recreation

Tract 4 is currently accessible via a private road. One trail passes close to the southern boundary of the site. There is no evidence of recreational activity or hunting on this parcel.

Visual Resources

Tract 4 is comprised of 160.2 acres and is approximately 50 miles northwest of the federal lands. It is level, remote, and surrounded by other forested lands (see Figure 4.3.11-4). There are no public roads leading into or directly around the parcel. Two small public roads are within 2 miles of the parcel but are screened from view by vegetation and terrain. The portions of Superior National Forest surrounding this parcel have Moderate SIO designations.

Figure 4.3.11-4 Wetland on the Hunting Club Lands Parcel

4.3.11.2.8 Tract 5 – McFarland Lake Lands

Recreation

Legal access to Tract 5 is limited to water access, although a private cart road exists at the edge of the property, as does a trail along the lake shore. There is no evidence of current recreational activity or hunting on this parcel; however, Tract 5 was previously owned by Wheaton College. A bunk house, fire pit, outhouse, and cistern (all unused and in disrepair) remain on site, indicating past use for recreational activities. All structures would be removed upon completion of the Land Exchange Proposed Action.

Visual Resources

Tract 5 encompasses 30.8 acres situated on the western shore of McFarland Lake (see Figure 4.3.11-5). The parcel is visible from the northern, eastern, southern, and portions of the western shore of McFarland Lake. County Road 74 and Woolys Bluff run along the southern and southeastern perimeter of McFarland Lake, but are substantially screened from viewing the parcel due to vegetation and flat terrain. A limited number of lakefront homes, private piers, and a public access point on the eastern shore of the lake have views of the McFarland Lake property. The portions of Superior National Forest surrounding this parcel have High SIO designations.

Figure 4.3.11-5 McFarland Lake from the McFarland Lake Tract

4.3.12 Wilderness and Other Special Designation Areas

4.3.12.1 Federal Lands

4.3.12.1.1 Land Exchange Proposed Action

The federal lands of the Land Exchange Proposed Action are similar to the Mine Site previously discussed, but exclude the privately owned land bordering Dunka Road to the south of the Mine Site. Section 4.2.12.1 provides a discussion of the existing conditions on the federal lands.

4.3.12.1.2 Land Exchange Alternative B

The federal lands included in the Land Exchange Alternative B are similar to the federal lands in the Land Exchange Proposed Action. Section 4.2.12.1 discusses the existing conditions on the federal lands.

4.3.12.2 Non-federal Lands

The non-federal lands comprise five tracts (groups of parcels) assembled by PolyMet for the purpose of the Land Exchange Proposed Action.

4.3.12.2.1 Tract 1 – Hay Lake Lands

Adjacent cRNAs include the Pike Mountain and Loka Lake cRNAs (southwest corner and northeast corner of the tract, respectively). Pike Mountain is a 709-acre research area located on top of the Mesabi Range, characterized by old growth northern hardwood communities (sugar maple and red oak), paper birch forest, and rock/talus communities. The Loka Lake cRNA is part of an extensive peatland dominated by stunted black spruce and tamarack with interspersed upland islands (USFS 2011h).

4.3.12.2.2 Tract 2 – Lake County Lands

There are no wilderness or other special designation areas in or adjacent to Tract 2.

4.3.12.2.3 Tract 3 – Wolf Lands

There are no wilderness or other special designation areas in or adjacent to Tract 3.

4.3.12.2.4 Tract 4 – Hunting Club Lands

There are no wilderness or other special designation areas in or adjacent to Tract 4.

4.3.12.2.5 Tract 5 – McFarland Lake Lands

This tract includes lakefront property on McFarland Lake, an entry point to the BWCAW. Access to the property is available by water from a landing off County Road 16 (Arrowhead Trail) approximately 10 miles north of Hovland, Minnesota. While near the BWCAW, this tract is located outside the BWCAW boundary. There are no other wilderness or other special-designation areas in or adjacent to Tract 5.

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4.3.13 Hazardous Materials

AOCs associated with contamination by hazardous materials from former activities and operations on the federal and non-federal lands are discussed in Section 4.3.1.

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4.3.14 Geotechnical Stability

The Land Exchange Proposed Action does not include the creation or modification of geotechnical features. As such, the current geotechnical conditions at lands proposed for exchange are not considered relevant to the EIS. The existing geotechnical conditions underlying the NorthMet Project Proposed Action stockpiles that would be located on federal lands proposed for exchange are discussed in Section 4.2.14.

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