6.0 CUMULATIVE EFFECTS

6.1 INTRODUCTION

Both NEPA and MEPA require an assessment of potential cumulative effects. The CEQ defines cumulative effects as:

> ...the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other action. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 CFR § 1508.7)

The MEQB's regulations in *Minnesota Rules,* part 4410.0200, subparts 11 and 11a, mirror the CEQ cumulative effects definition. In addition to the regulations, this analysis follows the guidance in the 1997 CEQ guidance presented in *Considering Cumulative Effects under the National Environmental Policy Act* and the USEPA's NEPA review guidance *Consideration of Cumulative Impacts in EPA Review of NEPA Documents* (CEQ 1997 and USEPA 1999, respectively).

This section presents the resource-specific cumulative effects analysis of the NorthMet Project Proposed Action and Land Exchange Proposed Action that may result when combined with effects from other activities (e.g., projects and/or actions). Each resource has specific spatial (geographic) or temporal (time) boundaries, which are called Cumulative Effects Assessment Areas (CEAAs). The cumulative projects and/or actions applied to this analysis are those past, present, and reasonably foreseeable activities within the various resource-specific CEAAs that, when combined with the NorthMet Project Proposed Action and Land Exchange Proposed Action, may cause cumulative effects as measured by the evaluation criteria and defined by NEPA and MEPA. In addition to additive effects, cumulative effects may be further magnified by synergisms or cross-interactions in the environment.

This chapter is divided into two major subsections: Section 6.2 describes the cumulative effects of the NorthMet Project Proposed Action and Section 6.3 describes the cumulative effects of the Land Exchange Proposed Action.

Two basic factors are used to quantify how a proposed project and/or action may cause cumulative effects. The first summarizes existing environmental conditions, which are the result of actions that have taken place in the past or are subject to present activities. It is not possible, however, to catalogue all past human actions to quantify how the natural environment has been affected by anthropogenic activities. Chapter 4 describes the baseline conditions for the NorthMet Project area and Land Exchange parcels, which may include contributions from past and present activities. Intensive land uses, such as towns, cities, roads, hunting, fishing and trapping, mines, forest practices, farming, and damming of rivers and creation of reservoirs have all had an influence on the natural environment of the region, which has resulted in present day conditions. In addition, natural trends in the environment would be affected into the future by currently permitted and approved land uses and projects. The direct and indirect effects of the NorthMet Proposed Action and Land Exchange Proposed Action are discussed in Chapter 5.

The second factor in determining how the NorthMet Project Proposed Action would, in combination with other reasonably foreseeable actions as defined in Section 6.1.1.1 below, cumulatively affect resources in the future. The method and set of assumptions for identifying which projects, actions, and activities that could contribute to cumulative effects are described below in Section 6.1.1.1. In addition to the identified cumulative projects, actions, and activities, the USFS identified six projects which are land exchanges and/or land acquisition projects that are reasonably foreseeable to be considered in the cumulative effects assessment for the Land Exchange Proposed Action (see Sections 6.1.2 and 6.3).

Throughout this section, we refer to *Past, Present,* and *Reasonably Foreseeable Future Actions* when describing potential cumulative effects. The past and present actions are described in detail in Chapter 4, Affected Environment.

6.1.1 NorthMet Project Proposed Action

6.1.1.1 Cumulative Effects Analysis Approach

Potential cumulative effects for the NorthMet Project Proposed Action have been assessed at the resource level. The spatial and temporal extents of the CEAAs depend on several resource-specific factors. For example, given that noise effects decrease in direct proportion to the distance between the source and sensitive receptors, the geographic extent is necessarily limited. Conversely, air effects can extend many miles from the source and are conversely much broader. For the purposes of the cumulative effects assessment, the timing or scheduling of specific cumulative actions is also important to the context of the assessment given the overlapping and possibly synergistic effects they may have on some resources, such as sediment loading to waterbodies or dust and particle emissions to visual resources.

For all resources, future temporal boundaries are the expected service life of the mining activities, including closure and post-closure restoration. The spatial and temporal boundaries for each resource are defined within the respective resources' sections of this analysis.

Resource-specific spatial and temporal boundaries are used to identify past, present, and reasonably foreseeable future projects/actions that would likely affect the same environmental resources as the NorthMet Project Proposed Action. MEQB, CEQ, and USEPA guidance allow for a fairly broad interpretation of "reasonably foreseeable" to accommodate project-specific conditions, but indicate that actions that would be considered "speculative" should be excluded. For the purposes of this assessment, "reasonably foreseeable" actions are defined as those actions that are included in approved planning documents and have approved funding, are permitted, or have a currently active federal or state permit or site plan application under review. The discussion of potential cumulative effects assumes the successful implementation of the best management practices and mitigation measures discussed throughout this FEIS, as well as compliance with all applicable federal, state, and local regulations and permit requirements.

In addition to other cumulative effects that may be identified through the analysis, Section 6.2 also addresses the following cumulative effects topics, identified in the Final SDD (MDNR 2005):

- Hoyt Lakes area projects and air concentrations in Class II areas;
- Class I areas PM_{10} increment;
- Ecosystem acidification resulting from deposition of air pollutants;
- Mercury deposition and bioaccumulation in fish;
- Visibility impairment;
- Loss of threatened and endangered plant species;
- Loss of wetlands;
- Loss or fragmentation of wildlife habitat;
- Streamflow and lake level changes;
- Water quality changes;
- Economic effects; and
- Social effects.

These topics are discussed under their respective resource sections in Section 6.2 below.

6.1.1.2 Past, Present, and Reasonably Foreseeable Actions and Projects

For the purposes of this analysis, the NorthMet Project Proposed Action may contribute to cumulative effects when considered along with 47 other actions and projects in the region. These projects and/or actions are shown on Table 6.1-1 and Figure 6.1.1-1, and are further described in Section 6.1.1.2.1. Air Resources and Wilderness and other Special Designation Areas have unique extents of consideration and the specific actions considered are identified under those resource sections. Existing conditions that may be related to past or present actions on specific environmental resources are fully described in their respective sections in Chapter 4 and the direct and indirect impacts of the NorthMet Proposed Action are described in Chapter 5. Section 6.1.1.2.1 provides a brief description of the cumulative actions considered in this assessment. Some actions unique to a particular resource are discussed under those resources.

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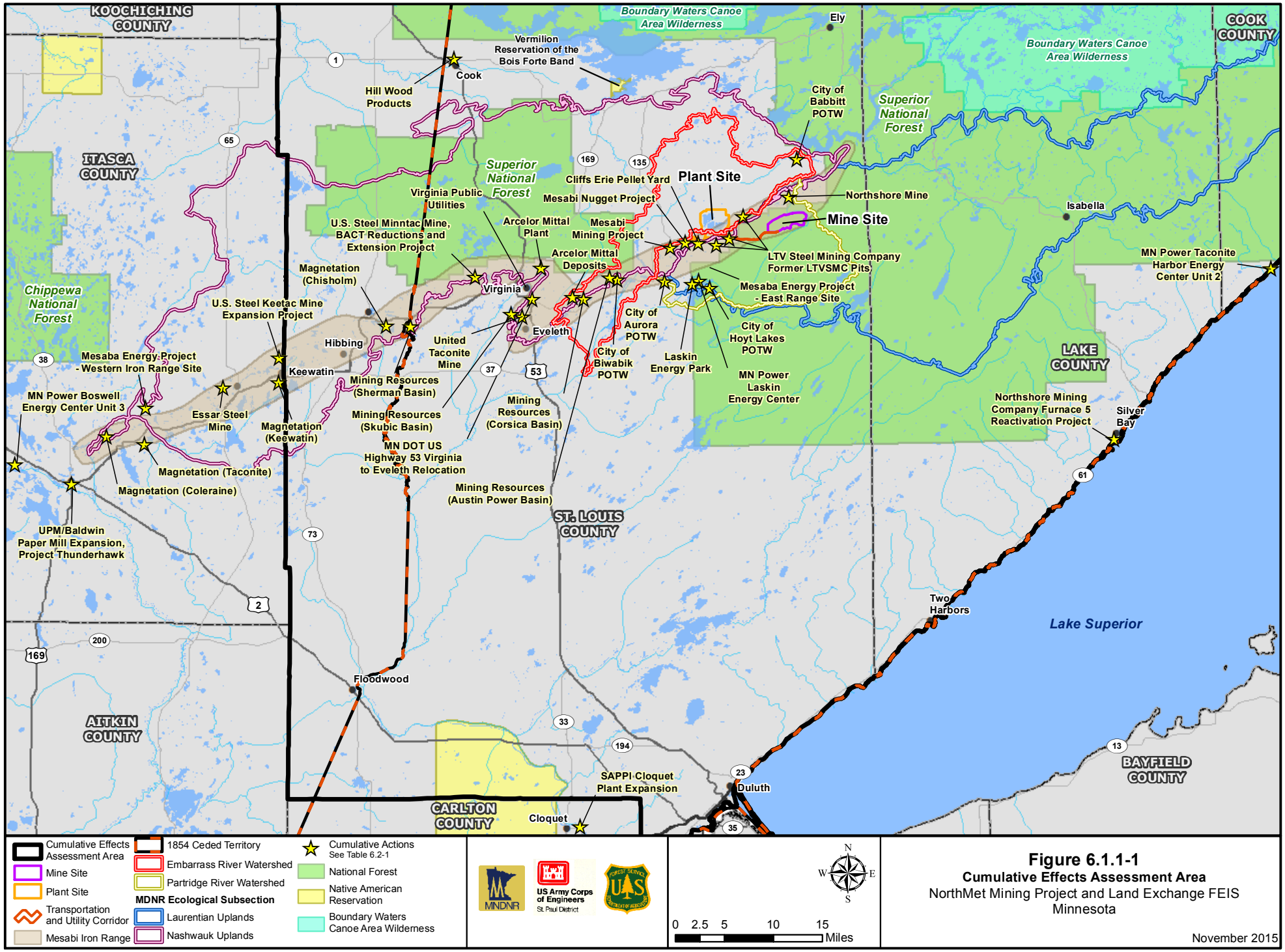

Figure 6.1.1-1
Cumulative Effects Assessment Area
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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Table 6.1.1-1 Projects and Actions Considered and Affected Resources in the Cumulative Effects Assessment

	Activity	Status	Approx. Distance from NorthMet Project Area[1] (Miles)	Affected Environment
1	ArcelorMittal Deposits (Laurentian and East Reserve Deposits)	Present	18	Land Use, Water Aquatic Species, Wetlands, Vegetation, Wildlife, Cultural, Socioeconomics, Recreation and Visual Resources
2	ArcelorMittal Deposit Push Back Project	Reasonably Foreseeable	18	Wetlands, Vegetation, Wildlife, Cultural, Socioeconomics, Recreation and Visual Resources
3	ArcelorMittal Plant and Modifications	Reasonably Foreseeable	18	Air Quality
4	City of Aurora POTW	Present	6	Water, Aquatic Species
5	City of Babbitt POTW	Present	10	Water, Aquatic Species
6	City of Biwabik POTW	Present	10	Water, Aquatic Species
7	City of Hoyt Lakes POTW	Present	7	Water, Aquatic Species
8	Cliffs Erie Pellet Yard	Present	<1	Vegetation, Wildlife, Air Quality
9	Essar Steel Mine	Present	55	Vegetation, Wildlife, Air Quality
10	Hill Wood Products	Present	50	Air Quality
11	Hill Wood Products Major Modification Amendment	Reasonably Foreseeable	50	Air Quality
12	Laskin Energy Park	Reasonably Foreseeable	5	Wetlands
13	LTV Steel Mining Company Former LTVSMC Pits	Present	<1	Water, Wetlands, Vegetation, Wildlife, Aquatic Species, Air Quality, Cultural, Socioeconomics, Wilderness
14	Magnetation Keewatin	Present	55	Vegetation, Wildlife
15	Magnetation Taconite	Present	61	Vegetation, Wildlife
16	Magnetation Chisholm	Present	41	Vegetation, Wildlife
	Magnetation Coleraine	Reasonably Foreseeable	63	Vegetation, Wildlife
17	MDOT US Highway 53 Virginia to Eveleth Relocation	Reasonably Foreseeable	23	Vegetation, Wildlife, Cultural
18	Mesaba Energy Project – Western Iron Range Site[2]	Reasonably Foreseeable	55	Cultural, Air Quality
19	Mesabi Nugget Project (formerly Mesabi Nugget Phase I)	Present	<1	Water, Wetlands, Vegetation, Wildlife, Aquatic Species, Air Quality, Noise, Socioeconomics, Cultural, Wilderness
20	Mesabi Mining Project (formerly Mesabi Nugget Phase II)[3]	Reasonably Foreseeable	2	Land Use, Water, Vegetation, Wetlands, Wildlife, Aquatic Species, Air Quality, Noise, Cultural, Socioeconomics, Recreation and Visual Resources, Wilderness
21	Mining Resources - Austin Powder Basin near Biwabik	Reasonably Foreseeable	10	Wetlands, Cultural, Socioeconomics
22	Mining Resources - Corsica Basin near McKinley	Reasonably Foreseeable	15	Wetlands, Cultural, Socioeconomics

	Activity	Status	Approx. Distance from NorthMet Project Area[1] (Miles)	Affected Environment
23	Mining Resources - Skubic Basin (SW of Virginia)	Reasonably Foreseeable	23	Cultural, Socioeconomics
24	Mining Resources Sherman Basin (SE of Chisholm)	Reasonably Foreseeable	41	Vegetation, Wildlife, Cultural, Socioeconomics
25	Minnesota Power Boswell Energy Center Unit 3[(4)]		85	Air Quality
26	Minnesota Power Laskin Energy Center[5]	Present	5	Water, Wetlands, Air Quality, Wilderness
27	Minnesota Power Taconite Harbor Energy Center Unit 2, Emission control modifications	Reasonably Foreseeable	48	Air Quality, Wilderness
28	Northshore Mining Company: Furnace 5 Reactivation Project	Present	39	Air Quality, Wilderness
29	Northshore Mine	Present	7	Water, Wetlands, Vegetation, Wildlife, Aquatic Species, Air Quality, Cultural, Socioeconomics, Wilderness
30	Northshore Mine Ultimate Pit Progression Project	Reasonably Foreseeable	7	Vegetation, Wildlife, Cultural, Socioeconomics, Recreation and Visual Resources, Wilderness
31	Northshore Mine Closure	Reasonably Foreseeable	7	Land Use, Water, Aquatic Species, Wetlands
32	Northshore Mine BART Reductions	Reasonably Foreseeable	7	Air Quality
33	Sappi Cloquet Plant Expansion	Reasonably Foreseeable	73	Air Quality
34	St Louis County Public Works Bridge replacements	Reasonably Foreseeable	Within the Embarrass and Partridge River watersheds	Wetlands ,Vegetation, Wildlife,
35	U.S. Steel Keetac Mine	Present	45	Land Use, Vegetation, Wildlife, Socioeconomics, Recreation and Visual Resources
36	U.S. Steel Keetac Mine Expansion Project (Keewatin)[6]	Reasonably Foreseeable	45	Air Quality, Vegetation, Wildlife
37	U.S. Steel Minntac Mine	Present	25	Vegetation, Wildlife, Air Quality, Cultural, Socioeconomics, Wilderness
38	U.S. Steel Minntac BACT Reductions	Reasonably Foreseeable	25	Air Quality
39	U.S. Steel Minntac Mine Extension Project	Reasonably Foreseeable	25	Land Use, Wildlife, Vegetation, Cultural, Aquatic Species, Air Quality, Socioeconomics, Recreation and Visual Resources, Wilderness
40	United Taconite Mine	Present	27	Air Quality
41	United Taconite Mine Modifications	Present		Vegetation, Wildlife, Air Quality
42	United Taconite Mine Expansions	Reasonably Foreseeable	27	Vegetation, Wildlife, Air Quality, Socioeconomics

	Activity	Status	Approx. Distance from NorthMet Project Area[1] (Miles)	Affected Environment
43	United Taconite Green Production Project	Reasonably Foreseeable	27	Air Quality
44	United Taconite Bart Reductions	Reasonably Foreseeable	27	Air Quality
45	UPM/Blandin Paper Mill Expansion, Project Thunderhawk[6]	Reasonably Foreseeable	80	Air Quality
46	Virginia Public Utilities	Present	24	Air Quality
47	Community growth and development	Present and Reasonably Foreseeable	Regional, no specific locations	Vegetation, Wildlife, Cultural
48	Forestry practices on public and private lands	Past, Present, and Reasonably Foreseeable	Regional, no specific locations	Vegetation, Wildlife, Cultural

Notes:
[1] At closest point to NorthMet Project area.
[2] The State of Minnesota has issued permits for the West Range site. However, the United States Department of Energy has not issued a ROD for this EIS. See below for more information. Given this, the East Range site is included as a reasonably foreseeable project for this cumulative effects assessment.
[3] This project was included in the cumulative effects analysis in the SDEIS. While the applications are still active, the likelihood of them occurring has diminished. Class II modeling for the Plant Site was already completed when the MPCA recommended that the Mesabi Mining project not be included; therefore, the modeling results reported can be considered conservative.
[4] Note that this project was not built.
[5] Class II modeling for the SDEIS included this facility as burning coal. Natural gas is now the primary fuel; therefore, the modeling performed for the SDEIS was conservative.
[6] This project was included in the cumulative effects analysis in the SDEIS. While the application are still active, the likelihood of the project occurring has diminished.

Table 6.1.1-2 summarizes the CEAA spatial areas that were utilized by each resource area for the projects identified above.

Table 6.1.1-2 Summary of the Spatial Areas Used for the Cumulative Effects Analysis of the NorthMet Project Proposed Action

Resource Area	Spatial Area Assessed
Land Use, Recreation and Visual Resources, Wilderness	The portion of the Mesabi Iron Range encompassed by St. Louis County.
Water Resources, Wetlands[1], Aquatics[2]	Partridge River and Embarrass River watersheds.
Vegetation, Wildlife	The portion of the Mesabi Iron Range located within the Nashwauk Uplands and Laurentian Uplands ecological subsections.
Air Quality	Areas with sources that generally are located within the Arrowhead region and outside the boundaries of the NorthMet Plant Site and Mine Site, the Mesabi Nugget Ambient Air Boundary, Cliffs Erie Pellet Yard, and the Northshore Mine.
Noise and Vibration	An approximate 0.5-mile radius of the Mine Site and Plant Site; no past, present, or reasonably foreseeable actions located within a 0.5-mile radius of the Mine Site and Plant Site that would interact in such a way as to have cumulative effects on identified receptors.
Hazardous Materials, Geotechnical Stability	The topic areas were not assessed for cumulative effects because they would not interact with any other past, present, or reasonably foreseeable actions in such a way as to cause cumulative effects.
Cultural Resources	The portion of the 1854 Ceded Territory that is within the Mesabi Iron Range.
Socioeconomics	The Mesabi Iron Range within St. Louis, Lake, and Cook counties.

Notes:
[1] A qualitative assessment for wetlands was also performed and the spatial area was the St. Louis River below the ordinary high water mark from its confluence with the Embarrass River to Lake Superior.
[2] A qualitative assessment for aquatics was also performed and the spatial area was the St. Louis River, as the Partridge River and Embarrass River are tributaries to the St. Louis River, which flows through the Fond du Lac Indian Reservation and empties into Lake Superior near Duluth.

6.1.1.2.1 Brief Description of Cumulative Actions Considered

ArcelorMittal Mines (Laurentian and East Reserve Deposits, Push-Back Project, and Plant)

ArcelorMittal operates two separate taconite deposits, the Laurentian and the East Reserve. These deposits are approximately 2 miles apart between Gilbert and Biwabik, in St. Louis County, Minnesota. Both are located approximately 18 miles from the NorthMet Project area.

The Laurentian Deposit has been operating since the early 1990s and is 2 miles southwest of the East Reserve Deposit. East Reserve Pit #1 began operations in 2008. A second pit, East Reserve Pit #2, has been permitted and stripping/site development has begun.

Ore from the East Reserve #1 Pit is being blended with, and intended to gradually replace, ore from the Laurentian Deposit. It is used to make steel, primarily for the automobile industry and the transportation sector.

ArcelorMittal plans to amend the Permit to Mine with a pushback project that would extend the limits of East Pits 1 and 2, which are referred to as push-back areas, to the south, allowing for economical mining/increased ore reserve. Specifically, there are two elements to the proposed push-back project: extending the permitted mining area by 103 acres and extending the permitted plant site by 11 acres to construct a new construction equipment pole area. The push-backs would not result in additional mining roads, production rates, plant emission rates, or dewatering rates.

The taconite facility is capable of producing up to approximately 3.2 million long tons of finished pellets per year. There are three main areas where emissions are released: the mine, the tailings basin, and the pellet plant. Emissions from the mine are fugitive emissions, which are primarily particulate matter, and are created from blasting, coarse ore loading and unloading, overburden loading and unloading, and haul truck traffic on unpaved roads. Emissions from the tailings basin are fugitive emissions, which are primarily particulate matter, and are created by tailings basin dike construction, truck traffic on unpaved roads, and wind erosion of exposed tailings beaches. Emissions from the pellet plant consist of point source emissions from crushing, concentrating, and agglomerating operations, which primarily create particulate matter emissions. The indurating furnace emits particulate matter, SO_2, NO_X, CO, and other pollutants such as HAPs. HAPs emissions tend to be metals and products of combustion. Fugitive emissions from the pellet plant are from pellet loadout and wind erosion of fine particles from the pellet storage piles and are particulate matter. The facility uses a variety of bag houses and wet scrubbers to control emissions from the point sources located in the pellet plant. Water and chemical dust suppressants are applied to haul roads and other fugitive sources to reduce particulate emissions when weather permits.

City of Aurora Publicly Owned Treatment Works

To support its POTW, the City of Aurora withdraws water from the St. James Pit, which is a former natural ore pit within the Embarrass River Watershed. The facility discharges treated wastewater into Silver Creek, which, in turn, drains into the St. Louis River.

City of Babbitt Publicly Owned Treatment Works

The City of Babbitt uses several wells, some of which are in the Dunka River Watershed, for its municipal water supply. The City POTW discharges treated wastewater effluent to the Embarrass River. Because some of the discharged water originates in the Dunka River Watershed and is transferred to the Embarrass River, the treatment work is assumed to increase the flow in the Embarrass River and decrease flow in the Dunka River.

City of Biwabik Publicly Owned Treatment Works

The City of Biwabik withdraws water from the flooded Canton Mine Pit for its municipal water supply and discharges treated wastewater to a tributary of Embarrass Lake.

City of Hoyt Lakes Publicly Owned Treatment Works

The City of Hoyt Lakes withdraws water from Colby Lake for municipal water supply and discharges treated wastewater to the Whitewater Reservoir. Most of this water returns to the Partridge River Watershed during droughts, when it is pumped from the Whitewater Reservoir to maintain water levels in Colby Lake or seeps into the Lower Partridge River through a dike.

Cliffs Erie Pellet Yard

Under Amendment 005 to Emission Permit No, 13700009, Cliffs Erie LLC would provide commercial taconite pellet shipping and storage for pellets produced on the Mesabi Iron Range utilizing the Cliffs Erie (formerly LTV Steel Mining Company) site in Hoyt Lakes. These facilities include a pellet yard at Hoyt Lakes, shipping docks at Taconite Harbor, and

interconnected railroads. Modifications to the existing facilities are required to accommodate commercial pellet shipping operations.

Essar Steel Mine

Essar is permitted and has begun constructing a new taconite mine and processing plant near Nashwauk, Minnesota, in Itasca County. The project would produce 6.5 million metric tonnes per year (mtpy) of high-flux pellets, or 7.0 million mtpy of low-flux taconite pellets. Essar estimates that, once operational, the modifications would operate at full capacity for up to 15 years. The project is located approximately 55 miles southwest of the NorthMet Project area. Essar has stated that it intends to complete construction and begin operation in 2016.

Hill Wood Products (Hill Wood Products and Major Modifications Amendment)

Hill Wood Products is a sawmill and lumber-processing facility. The facility purchases birch log rough-cut wood to produce various wood products including wood pallets, wood biscuits, and flooring. The facility sources include:

- Two boilers and dryer combustion sources. The boilers and dryer burn wood waste. The dryer dries wood waste for processing in the hammermills for use as a fuel both on and off site. The dryer has an electrified filter bed and cyclone for emissions control. The boilers provide steam for a lumber kiln.
- Particulate emission sources such as debarking, skragging, sawing, trimming, molding, sanding, hammermills, and storage silos. Some units are vented internally without controls, some internally with controls, and some externally with controls.
- Miscellaneous sources such as a small extruder for surface coating, an emergency fire pump, and an emergency generator.

Non-permitted equipment was documented by MPCA staff during a site inspection in August 2007, which led to the signing of a Stipulation Agreement on October 13, 2008. A major permit amendment was issued in 2010 to incorporate 17 emission units, 2 fugitive sources, and 1 baghouse and to delete 21 removed emission units, 1 baghouse, and 1 stack vent from the permit.

Laskin Energy Park

The Laskin Energy Park is proposed 220-acre industrial park that is located in the Partridge River Watershed and south of the Minnesota Power Laskin Energy Center. It is located adjacent to Colby Lake and Whitewater Lake, near the City of Hoyt Lakes.

LTV Steel Mining Company Former LTVSMC Pits

LTVSMC mined and processed taconite from the 1950s to 2001, when it went bankrupt. Cliffs Erie LLC (a subsidiary of Cliffs Natural Resources, Inc. [both names for this company are used in this document, depending on the specific context of the citation]) acquired a port of the former LTVSMC lands and is currently managing legacy issues through voluntary actions (e.g., VIC agreements), NPDES/SDS permits, and a Consent Decree with the MPCA. Mesabi Nugget LLC (a joint venture of Steel Dynamics and Kobe Steel) and Mesabi Mining LLC, a subsidiary of Steel Dynamics, own the remainder of the former LTVSMC lands. The former LTVSMC processing plant and tailings facility now owned by Cliffs Erie is proposed for use by the

NorthMet Project Proposed Action. The former LTVSMC mine pits are now owned by Mesabi Nugget, Mesabi Mining, and Cliffs Erie and are located to the west, south, and east of the NorthMet Project area. Ownership and the current hydrologic status of each of these pits is described below.

Mesabi Nugget

Pit 1: Because of Mesabi Nugget, this pit has seasonal (September to March) discharges of approximately 4,000 gpm (9.0 cfs) to Second Creek; no discharges occur from April to August. The proposed Mesabi Mining Project would result in the partial dewatering of this pit to a currently unspecified water at an unspecified rate.

Mesabi Mining

- Pit 2WX: The pit is currently in the process of filling. Within a few years, this pit may overflow to an unnamed creek that discharges to the Partridge River just below Colby Lake.
- Pit 6: This pit currently releases water to Second Creek via the surficial aquifer. There is no surface water discharge.
- Pit 9S: This pit is currently stable (with likely groundwater discharge off-site and/or to Pit 6).
- Pit 9N: This pit is currently stable (with a likely groundwater connection to Pit 1).

Cliffs Erie

- Pit 2/2E: This pit is stabilized with no direct discharge. There is likely groundwater flow from this pit to Pit 2W.
- Pit 2W: This pit discharges intermittently to Second Creek at a current rate of approximately 350 gpm (0.8 cfs)
- Pit 3: This pit currently discharges to Wyman Creek at approximately 400 gpm (0.9 cfs). Cliffs Erie is currently considering the feasibility of pumping from this pit to Pit 2W, which ultimately discharges to Second Creek, as part of its NPDES/SDS permit reissuance process.
- Pit 5SW: This pit overflows via "dispersed" discharge, at an estimated rate of less than 350 gpm (0.8 cfs) to Wyman Creek. PolyMet has an option agreement to purchase this pit; however, Pit 5SW is not part of the NorthMet Project Proposed Action.
- Pit 5NW: This pit has an overflow discharge of approximately 539 gpm (1.2 cfs) to Spring Mine Creek, a tributary of the Embarrass River. PolyMet has an option agreement to purchase this pit; however, Pit 5NW is not part of the NorthMet Project Proposed Action.

Magnetation (Keewatin, Taconite, Chisolm, Coleraine)

Magnetation is currently permitted and operating (or co-operating) scram mining operations near Keewatin, Taconite, and Chisholm. Scram mining is a mining process that produces natural iron ore, natural iron ore concentrates, or taconite ore from previously developed stockpiles, tailing basins, underground mine workings, or open pits and that involves no more than 80 acres of land not previously affected by mining, or more than 80 acres of land not previously affected by mining if the operator can demonstrate that impacts would be substantially the same as other scram operations. "Land not previously affected by mining" means land upon which mine wastes

have not been deposited and land from which materials have not been removed in connection with the production or extraction of metallic minerals (*Minnesota Statutes* 93.46, Subd.10). Magnetation has received a permit for a new operation near Coleraine. Magnetation has an EAW underway for dewatering the Canisteo pit in order to explore potential future scram mining.

Minnesota Department of Transportation US Highway 53 Virginia to Eveleth Relocation

This highway project is needed to allow United Taconite to continue its permitted mining operations near Eveleth, St. Louis County, Minnesota. United Taconite has authority to continue its mining operations, including an area that crosses the current location of Highway 53. The Minnesota Department of Transportation (MDOT) has proposed a new route (Preferred Alternative E-2), analyzed in a Draft EIS released in December 2014 (MDOT 2014). No other details are available at this time regarding the timing and exact scope of this road construction project. The proposed road construction is planned for 2017.

Mesaba Energy Project – Western Iron Range Site

Excelsior Energy has received permits to develop the Mesaba Energy Project, a natural gas fueled electric power-generating station. The project would be designed, constructed, and operated in two phases, each phase generally producing 600 megawatts. Excelsior's preferred site is the Western Iron Range site near Taconite, Minnesota, about 55 miles from the NorthMet Project area. Pit 2/2E, Pit 2W, and Pit 3 of the LTVSMC mine (see above) could be drawn down as part of the Mesaba Energy Project. An FEIS was prepared in 2009 by the USDOE and MDC.

On March 12, 2010, the Minnesota Public Utilities Commission (PUC) granted Excelsior Energy's Mesaba Energy Project a Large Electric Power Generating Plant Site Permit, a High Voltage Transmission Line Route Permit, and a Pipeline Route Permit (together, "the Site and Route Permits"), for construction of an Integrated Coal Gasification Combined Cycle electric power-generating station. On May 31, 2012, Excelsior Energy requested that the PUC confirm that the Site and Route Permits issued in 2010 were valid for a construction of a gas-fired plant at the same site, and that no additional environmental review was required. On September 19, 2012, the PUC issued an Order finding the Site and Route Permits valid and requiring additional filings prior to construction of the natural gas-fueled facility. At the time of this FEIS, the project has not yet been constructed.

Mesabi Nugget (Formerly Mesabi Nugget Phase I)

The Mesabi Nugget facility, located within approximately 2 miles of the NorthMet Project area, is currently producing iron nuggets from iron ore concentrate. The concentrate is mixed, dried, and fed into a rotary hearth furnace and reduced to a metallic iron and slag material. Water is appropriate from Pit 1 and/or Pit 2WX for contact and non-contact cooling and air pollution control equipment. Treated wastewater is discharged into Pit 1, which, in turn, is discharged on a seasonal basis (September through March) into Second Creek.

Mesabi Mining Project (Formerly Mesabi Nugget Phase II)

The Mesabi Mining Project area is located approximately 2 miles from the NorthMet Project area, and is currently under a Closure Plan. This facility would involve the reactivation of a taconite mine and construction of a taconite concentration facility near Hoyt Lakes. Under the most recent proposal, Pits 2WX and 6 would be dewatered to access the iron ore and tailings

would be disposed into Pit 1. Most of the concentrate generated at the Mesabi Mining Project facility would be used in the Mesabi Nugget facility, and the remainder would be shipped by rail to other facilities for processing. This project is currently on indefinite hold by the applicant, but was considered as reasonably foreseeable for this assessment.

Mining Resources (Austin Powder Basin, Corsica Basin, Skubic Basin, and Sherman Basin)

Mining Resources is a scram operation that received their original Permit to Mine in November 2011. Mining Resources is currently operating in the Duncan, Niles, Douglas, Dunwoody Tailings Basin just south of Chisholm, Minnesota (Section 35, Township 58N, Range 20 West). Proposed scram projects to extend the mine life of this operation include expansion into the Sherman Tailings Basin located approximately 1 mile east of the current facility, as well as expansion in to further afield basins, called "backhauls," which refers to the plan to load tailings into trucks returning from the Mesabi Nugget facility. Mesabi Nugget currently runs Mining Resources' concentrate through the pelletization process. Backhaul basins included in the current permit amendment application are the Austin Powder Basin located near Biwabik, the Corsica Basin located near McKinley, and Skubic Basin located southwest of Virginia.

Minnesota Power Boswell Energy Center Unit 3

In 2006, Minnesota Power submitted an emission reduction proposal, the Boswell 3 Environmental Improvement Plan, pursuant to *Minnesota Statutes* 216B.682 and 216B.6851. The proposal was designed to remove existing air pollution control equipment on Unit 3 of the Boswell station, and replace the equipment to control mercury, NO_x, SO_2, and particulate matter emissions. The project would result in considerable reductions in key pollutant emissions from the Boswell electric power generating station. Emissions of SO_2 would be reduced by 90 percent and NO_x would be reduced by 81 percent from Unit 3. Emissions of mercury would be reduced by more than 90 percent from Unit 3.

In 2007, the MPCA issued a major permit amendment (003) to the facility's total facility operating permit. This amendment allowed for a project to be conducted to comply with USEPA's Regional Haze Rule, CAIR, Minnesota's Mercury Reduction Act, and USEPA's Clean Air Mercury Rule. The amendment authorized the installation of new air quality control equipment, including wet flue gas desulfurization, low NO_x burners, selective catalytic reduction, baghouse filter, and a carbon injection system.

Minnesota Power Laskin Energy Center

The Minnesota Power Laskin Energy Center is a former natural gas power plant on Colby Lake between Aurora and Holt Lakes, about 5 miles from the NorthMet Project area. The facility was permitted in 2014 for conversion from coal to natural gas combustion. For the purposes of this cumulative effects analysis, it was assumed that the plant would be gas-fired. The project also included installation of low-NOx burners. The facility withdraws cooling water from Colby Lake and discharges it into the downstream portion of the lake. The plant produces more than 110 megawatts of power. The project also includes retrofits similar to Minnesota Power Taconite Harbor Energy Center Unit 2 described below. Work on these retrofits began in 2006.

Minnesota Power Taconite Harbor Energy Center Unit 2, Emission Control Modifications

In 2009, Minnesota Power was permitted for implementing emission control modifications to Unit 2 of its Taconite Harbor Center in Schroeder, Cook County, Minnesota. This facility is located approximately 48 miles east of the NorthMet Project area. The company installed a custom-designed control system that injects sorbents into the combustion process to control SO_2, NO_x, and mercury. Minnesota Power anticipates the system would cut NO_x emissions by more than 60 percent and SO_2 emissions by 65 percent.

The project also included similar retrofits at Minnesota Power's Laskin Energy Center in Hoyt Lakes. Work on these retrofits began in 2006.

Northshore Mining Company: Furnace 5 Reactivation Project

The Reserve Mining Company opened the facility in Babbitt, St. Louis County, Minnesota, in the 1950s and operated it until 1986, when the facility closed. Cyprus Minerals acquired and reopened the facility in 1989 and operated it until 1994, when Cliffs Natural Resources, Inc. acquired it. The Northshore Mining Company is a wholly-owned subsidiary of Cliffs Natural Resources, Inc.

In the early 2000s, the Northshore Mining Company reactivated Furnace 5, a pelletizing furnace at its taconite processing facility near Silver Bay on Lake Superior, Minnesota, about 39 miles to the southeast of the proposed NorthMet Mine Site and about 46 miles from the proposed NorthMet Plant Site.

The reactivated equipment included two crushing units and nine ore concentrator sections, as well as the construction of a concentrate handling system and an expansion of the facility's WWTP.

Northshore Mine (Mine, Ultimate Pit Progression, Closure and BART Reductions)

The Northshore Mine (also known as the Peter Mitchell Mine) is an open-pit taconite mine near Babbitt, St. Louis County, Minnesota, that opened in 1951, about 4 miles northwest and northeast from the NorthMet Plant Site and about 1 mile north of the NorthMet Mine Site. One of the mine areas currently discharges to the Partridge River. Northshore Mining Company has recognized at least another 60 years of minable reserves at current production rates. Conceptual post-closure plans for the Northshore Mine pit allow for the pit to flood due to groundwater inflow and runoff. Predicted ultimate outflow from the pit would be from the northeast end of the pit, to the Dunka River in the Rainy River Watershed. No water from mine dewatering would be anticipated to be flowing to the Partridge River post-closure (MDNR 2011p).

The mine is operated by Northshore Mining Company, Inc. the ore and processes it into pellets at Silver Bay, which ships it to steel producing blast furnaces throughout the country.

Northshore Mining Company is proposing a 108-acre progression of the Ultimate Pit Limit within its Permit to Mine at its Northshore Mine to access additional economic taconite ore, consistent with the company's long-term development plan for the mine. MDNR was the RGU for environmental review of Northshore's proposed progression project (the EAW process was completed in April 2015). The company is now in the process of seeking permit amendments that would address the progression.

Sappi Cloquet Plant Expansion

Sappi Cloquet LLC is an existing pulp and paper mill that uses the Kraft process to make pulp from wood chips. The pulp is bleached and made into coated paper. Currently, the mill operates four boilers, including a chemical recovery boiler to provide heating and process steam and to generate electricity.

Other sources of air emissions, besides the boilers, include the sources in the chemical recovery system. The bleach plant sources include the chlorine dioxide plant and a bleach line. These sources are primarily sources of chlorine dioxide and chloroform emissions; the bleaching system is also a source of CO and VOC emissions. Some of the particulate emissions, besides the boilers and chemical recovery sources, include fugitive sources such as woodpiles and roadways.

Sappi controls odor-causing non-condensable gases by collecting them in three different systems: a Low-Volume/High Concentration system, a High-Volume/Low Concentration system, and a steam Stripper Off-Gas system. The non-condensable gases are currently burned in the Incinerator-Quencher scrubber, with Power Boiler #7 or #9 used as backup.

The latest permit amendment, 014, issued on March 13, 2012, authorizes Sappi to modify the pulp mill to manufacture chemical cellulose pulp, also known as dissolving pulp. The project emissions increases are quite small, but include a projected increase in ozone emissions, which is subject to PSD requirements at any increase greater than zero.

This project replaces a previously planned plant expansion ("Project Hercules"), which was authorized through permit amendment 011, issued on October 28, 2009. Most of the facility changes permitted through that permit action will be "unpermitted" through this permit action.

St. Louis County Public Works Bridge Replacement

St. Louis County Public Works will be conducting eight bridge replacements in the Partridge River and Embarrass River watersheds over the next 10 years. Bridge replacements generally directly impact 10,000 ft^2 of wetlands or less, so the maximum direct wetland impact from the bridge projects would be 1.8 acres.

U.S. Steel Keetac Mine and Mine Expansion Project (Keewatin)

U.S. Steel is permitted to restart an idled production line and expand contiguous sections at the Keetac Mine and taconite processing facility near Keewatin, Itasca County, Minnesota, about 45 miles from the NorthMet Project area, on the boundary between St. Louis and Itasca counties. The project would increase iron pellet production from 6 million to 9.6 million tpy.

The project involved preparation of a joint State-Federal EIS; the State ROD was issued in December 2010. The expanded facility is scheduled to begin full operations between 2013 and 2015. U.S. Steel has announced that this project is currently on indefinite hold. Media reports in September 2014 stated that U.S. Steel had cancelled these projects (Minneapolis/St. Paul Business Journal 2014). These projects, however, were included in the cumulative effects air quality assessment for the NorthMet Project Proposed Action SDEIS, so they have been included in this analysis, and until a final decision by the federal agency (USACE) is made, this project is considered reasonably foreseeable for the purposes of this assessment. This change would reduce overall air emissions in the cumulative effects analysis area for air resources.

U.S. Steel Minntac Mine, Best Available Control Technology Reductions (Mountain Iron) and Minntac Mine Extension Project

The U.S. Steel Minntac Mine Project included three components for the cumulative effects analysis: the active mine, BACT reductions, and the proposed Minntac Mine Extension Project.

The BACT reductions project implemented technological modifications to reduce air emissions from the existing facility. In 2008, the MPCA issued a draft permit to U.S. Steel establishing BACT limits for VOCs, CO, and fluorides at the company's Minntac facility in Mountain Iron, Minnesota. The permit addresses potential effects on visibility from NO_x emissions and establishes a procedure to set a BACT limit for NO_x. The draft permits set interim NO_x limits and requires the ongoing testing of control technologies for NO_x, with a goal to reduce emissions more than 70 percent compared to the initial permit limit.

U.S. Steel is also proposing to extend its open pit facilities by 483 permitted acres at the Minntac Mine in Mountain Iron, St. Louis County, Minnesota. The project is expected to extend mine life and taconite production to 2031.

The Minntac Mine is a taconite mine and pelletizing operation about 25 miles from the NorthMet Project area. The Minntac plant consists of a series of crushers and screens, a concentrator, an agglomerator, and auxiliary facilities. Taconite produced from the extension would continue to be processed at the existing Minntac facility at the current levels of production.

MDNR issued a ROD on April 11, 2013, stating that the project would not cause significant environmental effects and that an EIS was not required (MDNR 2013f).

United Taconite Mine

This is a taconite mine near Eveleth, St. Louis County, Minnesota that began operations in 1965 and has an annual capacity of approximately 5.2 million gross tons of taconite pellets. It is located about 27 miles west of the NorthMet Project area. The United Taconite mine has six permitted mine pit dewatering discharges, all of which discharge to the St. Louis River Basin. United Taconite make-up water comes from the St. Louis River.

At the mine site, crushed ore is unloaded in a covered building. The ore is then transferred by a covered conveyor to the fine crusher building where it is immediately crushed at the third stage crusher or sent to the coarse ore surge pile. The coarse ore surge pile is used to store ore between train shipments or during times when the crusher is down.

Ore is returned from the coarse ore surge pile and fed into one of the 5 third-stage crushers. Particulate emissions from the third-stage crusher are controlled by wet scrubbers. The oversize material is conveyed to 1 of 8 fourth-stage crushers. Each fourth-stage crusher has a dedicated wet scrubber to control particulate emissions. Undersize material is transferred to the fine ore storage building. Oversize material is recirculated to the fourth-stage crushers.

Five concentrator lines receive ore from the fine ore surge building. Particulate emissions from the transfer of fine ore to the concentrator lines are controlled using wet scrubbers. Here ore is ground and magnetic separators remove the magnetite ore from the tailings. Low-magnetic coarse tailing are transported by truck for use as construction material for the tailings basin sidewalls. Fine tailings are pumped in slurry form to the tailings basin. Processes performed in the concentrator are wet operations. Concentrate is piped as a slurry to the pelletizing plant. The slurry is dewatered with filters and additives are introduced. Green pellets are produced in

balling drums and conveyed to one of two travelling grate kilns. Grate feed, grate discharge, kiln induration, and kiln cooler emissions are controlled with wet scrubbers.

Fired pellets are conveyed to pellet storage silos. Pellets are then loaded into rail cars and transported from the facility. Particulate emissions from the pellets are controlled with wet scrubbers and dust suppressants. Intermediate products and byproducts, including but not limited to rocks, tailings, and concentrate, are also sold by the United Taconite.

United Taconite Mine Modifications

The MPCA issued a major air permit amendment in 2002 for the installation and operation of the replacement pellet reclaim screening system. Furthermore, the MPCA issued a major permit amendment in 2010 for the installation of air pollution control equipment, implementation of an energy reduction project, and conversion of fuel type. The MPCA is currently working on a major amendment that would authorize the replacement of particulate controls and modification of scrubber solids wasting requirements.

United Taconite Mine Expansion

United Taconite has an original Department of the Army (DA) Permit for the Basin 3 tailings pond from the original permit issued in 1982. The original permit authorized discharge and fill material into 2,200 acres of wetlands as part of construction of three tailings basins. Construction of Basin 3 has not occurred to date. When United Taconite is ready to develop the Basin 3 tailings basin, they would need to apply for a Wetland Conservation Act (WCA) permit for the disturbance of approximately 1,200 acres of wetlands.

United Taconite Green Production Project

This project involves fuel changes and improvements to the concentrator and the Line 1 pellet plant to increase pellet production and was a PSD minor project. Because it was a PSD minor project, specific considerations for BACT/MACT were not required. However, the Line 1 pellet plant has an existing wet scrubber to control particulate and SO_2 emissions. Emission estimates are taken from the Technical Support Document for Permit No. 13700113-005 authorizing the project on August 19, 2010.

UPM/Blandin Paper Mill Expansion, Project Thunderhawk

This project would include the installation of a complete new paper manufacturing line, efficiency improvements to a second paper manufacturing line, shutdown of another existing paper machine and related infrastructure, additional pulping capacity, a new water intake structure, energy infrastructure improvements, a new paper warehousing facility, and WWTF modifications. Paper production would increase by an estimated 314,000 tons per year. The MPCA issued a permit action that incorporated a major amendment application (for Project Thunderhawk) dated August 23, 2005, for a modification that will increase paper production. Note that this project was not built.

Virginia Public Utilities

The City of Virginia Department of Public Utilities provides steam and electricity to businesses and residents of the local Virginia area. The department has the potential to operate any combination of four boilers using coal and/or natural gas and/or wood as fuel. Boiler 7 (EU001)

and Boiler 9 (EU003) can burn only coal, and Boiler 10 (EU004) is a natural gas fired boiler. Boiler 11 (EU006) is a wood-fired boiler to be used for district heating and electric generation. There is an additional boiler, Boiler 8, located at the facility but it is physically disconnected from the utility system. Pollution control equipment consists of wet scrubbers, baghouses, and/or electrostatic precipitators in combination with good combustion practices.

Community Growth and Development

Where community growth and development are assessed, they are based on historical and projected population and economic trends derived from state census data and regional land use plans as described in the appropriate resource sections.

Forestry Practices on Public and Private Lands

Where forestry practices are assessed, they are based on historical and projected trends derived from state databases and regional forestry plans as described in the appropriate resource sections.

6.1.1.2.2 Speculative Actions

Other projects in the early stages of development by mining companies are considered to be speculative by the Co-lead Agencies. While these projects have been identified to provide an indication of regional development interest, these actions have not been mapped or considered in the cumulative analysis.

Twin Metals

Twin Metals Minnesota Antofagasta PLC has begun looking at the feasibility of creating an underground copper-nickel-PGE mine near Ely, Lake County, Minnesota. This venture is known as the Twin Metals Project. At this time, a permit application has not been submitted for activities that would require state and federal permits, including a DA permit pursuant to Section 404 of the CWA. This project would likely require preparation of a joint State-Federal EIS. Preliminary data collection and maps to support environmental review and permitting is underway by the company.

Essar Steel

The Essar Steel Nashwauk, Itasca County, Minnesota, facility was permitted in 2007 and is under construction, and a plant expansion of its taconite operations is permitted and under construction. The construction of a legacy scram processing facility is being considered. Scram operations produce natural iron ore or iron ore concentrates from previously developed stockpiles, basins, underground workings, or open pits. The legacy scram facility is exempt from state environmental review, but requires state permitting.

Rio Tinto (Kennecott Exploration)

Rio Tinto is currently performing exploration drilling of a non-ferrous (copper-nickel) deposit near Tamarack, Aitkin County, Minnesota, about 45 miles west of Duluth, St. Louis County, Minnesota. The project may require preparation of a joint State-Federal EIS. Preliminary data collection to support environmental review and permitting is currently underway by the company (Rio Tinto 2010).

Teck

Teck is considering operations to mine the Mesaba deposit near Babbitt, St. Louis County, Minnesota, approximately 3 miles east of the NorthMet Mine Site, for non-ferrous metals (copper-nickel). The current phase is exploration and drilling. The project may require a joint State-Federal EIS. Preliminary data collection to support environmental review and permitting is underway.

North Star Blue Scope Steel

North Star Blue Scope Steel is considering a direct reduced iron (DRI) plant to process iron ore concentrate purchased from others into DRI-grade pellets. A site for the plant has not been selected. The project may require preparation of a joint State-Federal EIS.

ArcelorMittal

The ArcelorMittal facility is an operating iron taconite plant in Virginia, St. Louis County, Minnesota. The company is considering an expansion by initiating mining operations in a central pit, thereby connecting two existing pits. The project may require preparation of a joint State-Federal EIS and reissuance of NPDES permits for the mine and plant sites. The Town of McKinley is located between the two pits.

Cardero Resource Group (Two Projects)

Cardero Resource Group has initiated exploration activities for non-ferrous deposits (titanium) for its Longnose and Titac properties. Although both properties are located near Aurora, St. Louis County, Minnesota, they are separated by approximately 25 miles. The two are considered separate mines and each project may require preparation of a joint State-Federal EIS.

Cooperative Mineral Resources

Cooperative Mineral Resources is a subsidiary of Crow Wing Power located near Emily, Crow Wing County, Minnesota. The project is located 50 miles south and west of the Iron Range area and is proposed as a non-ferrous mine with an interest in manganese extraction from deposits 200 to 400 ft bgs. The project proposer has conducted small-scale pilot testing of extraction technology at the site. Based on results of the pilot-testing, the company does not intend to proceed with the project at this time. If the project were to move ahead, it would require preparation of a State EIS, and may require preparation of a joint State-Federal EIS.

Encampment Minerals

Encampment Minerals, Inc. is currently exploring the Serpentine copper-nickel deposit. This project would require a State EIS.

Magnetation

Magnetation has considered a similar scram mining operation near Calumet, Minnesota, but has not submitted permit applications for this facility and does not plan to pursue this project at this time.

6.1.2 Land Exchange Proposed Action

6.1.2.1 Cumulative Effects Analysis Approach and Baseline Conditions

Potential cumulative effects for the Land Exchange Proposed Action have been assessed at the resource level. The spatial and temporal extents of the CEAAs depend on several resource-specific factors. As discussed in the NorthMet Project Proposed Action cumulative effects introduction, some resources would not be directly affected by the action of a land exchange. These topics include noise, cultural/historic resources, geotechnical stability, wilderness and other special designation areas, and hazardous materials. The cumulative effects analysis for these topics, including the indirect effects of mining operations following any land exchange, are identified in their respective headings under Section 6.2, NorthMet Project Proposed Action.

The resource discussions in Chapter 4 provide the baseline conditions of the natural and human environment affected by past and present actions. Future actions—also called reasonably foreseeable projects—are those activities that could combine with the Land Exchange Proposed Action to potentially cause cumulative effects. The focus of this analysis is on those future activities when placed against baseline conditions that include the effects of past and present activities.

Land exchanges are property purchase and transfer transactions, whereas land acquisitions are only property purchases. The land exchange and property acquisition actions described in this section are designed to consolidate and enhance the functional boundaries of the Superior National Forest. The effects measure the net increase or decrease of each specific resource that would result from the Land Exchange Proposed Action and other cumulative actions in context of the entire Superior National Forest system.

In addition to the Land Exchange Proposed Action, two alternatives have been carried forward: Land Exchange Alternative B and the Land Exchange No Action Alternative. A description of these alternatives is presented in Chapter 3.

6.1.2.2 Cumulative Forest Service Land Actions

Because past land exchange and land acquisition actions through 2011 have been incorporated into the existing Superior National Forest boundaries and the subsequent area and resource calculations, it is assumed that the aggregate effect of these past land exchange actions has been absorbed into and are represented in the current Superior National Forest baseline data. Based on this assumption, the Land Exchange Proposed Action and other current and foreseeable land exchange and land acquisition actions are evaluated as cumulative actions.

The USFS identified the following six current and reasonably foreseeable land exchange and land acquisition (Figure 6.1.2-1) actions that would be cumulative to the Land Exchange Proposed Action:

- Cook County Land Exchange;
- Crane Lake Land Exchange;
- Fall Lake Land Acquisition;
- Gunflint Land Acquisition;

- School Trust Land Exchange and Land Acquisition; and
- Wolf Island Phase 2 Land Acquisition.

A brief description of each of the current and reasonable foreseeable land exchange and land acquisition actions is presented below.

6.1.2.2.1 Cook County Land Exchange

The USFS proposes to exchange up to 1,620 acres for 1,911 acres of Cook County lands within the BWCAW to assist in meeting the goals and objectives of the BWCAW elements of the Forest Plan. The federal lands consist of 14 parcels located throughout Cook County and would be conveyed to Cook County to allow for sustainable development. The lands the USFS would receive would consolidate National Forest System land within the BWCAW.

6.1.2.2.2 Crane Lake Land Exchange

In 2014, this project exchanged 352 acres of federal land located within and adjacent to the Town of Crane Lake for 265 acres of private land in the general vicinity of Crane Lake and the BWCAW. The federal lands were adjacent to the Town of Crane Lake in T67N, R17W, Sections 23 and 26. The non-federal lands acquired included three separate parcels in the general vicinity of Crane Lake and some distance south of the town.

The USFS's purpose was to acquire and consolidate land adjoining the BWCAW, the Vermillion River, and other existing National Forest System lands. The Town of Crane Lake's purpose was to acquire land that would better allow for sustainable municipal development and management of municipal facilities by the Town of Crane Lake.

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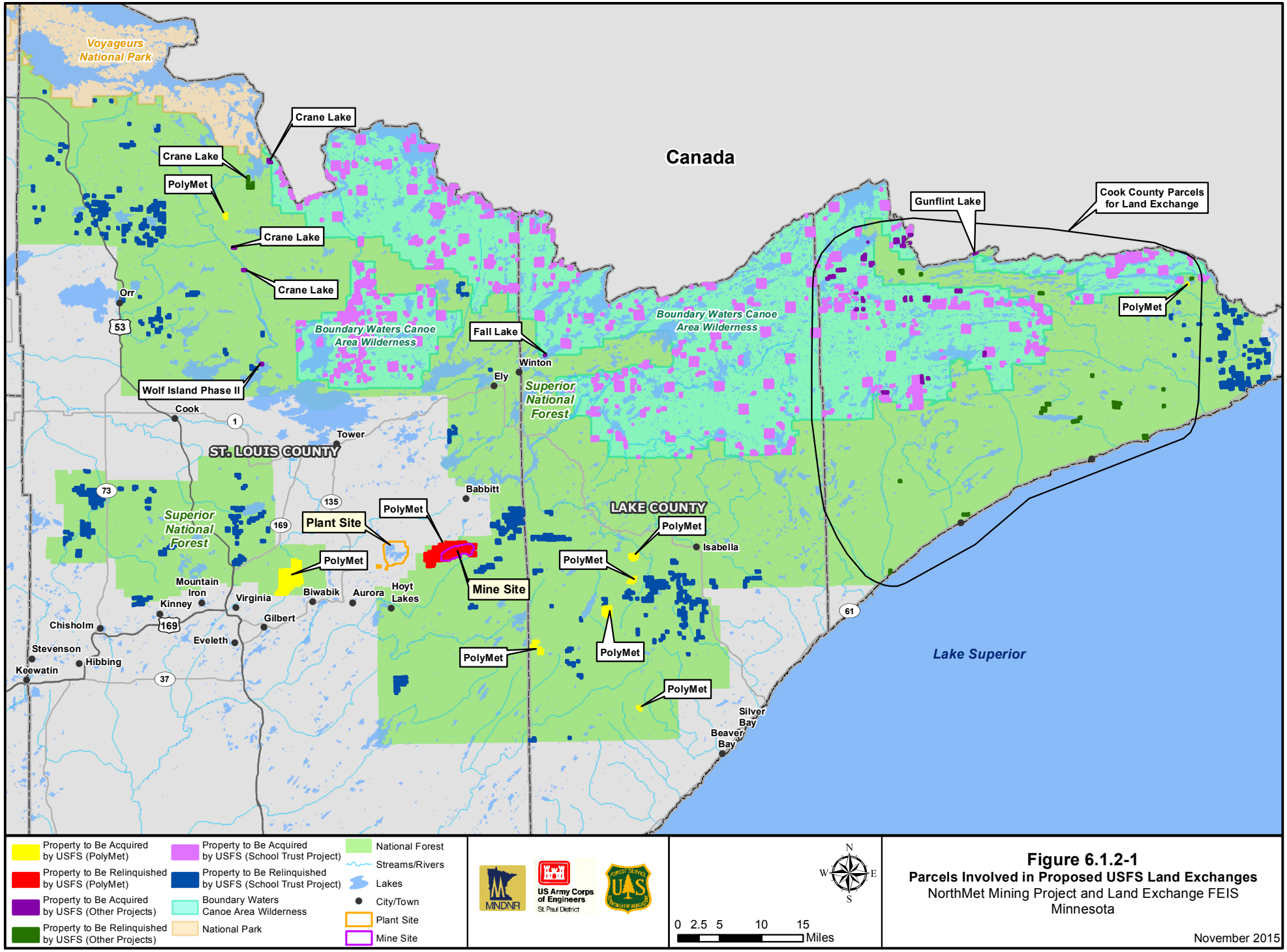

Figure 6.1.2-1
Parcels Involved in Proposed USFS Land Exchanges
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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6.1.2.2.3 Fall Lake Land Acquisition

In 2014, the Forest Service purchased two properties totaling approximately 27 acres from The Trust for Public Land. The two properties included Duvall (11 acres of Fall Lake) and Laur (17 acres on Fall Lake). The properties are located on the shores of Fall Lake, across from the Fall Lake boat landing/campground and within 0.5 mile of the Fall Lake entry to the BWCAW.

6.1.2.2.4 Gunflint Land Acquisition

The Conservation Fund purchased this 32-acre property in 2014 and is holding title until the USFS receives the funds to acquire the lands in order to consolidate them into the Superior National Forest. The request for funds to purchase these properties was included in the USFS's Land and Water Conservation Fund request with the potential to receive funds as early as 2016.

The property is located in Cook County along Gunflint and Little Gunflint Lakes at the US-Canadian border along the "Voyageurs Route." The acquisition would protect 5,465 ft of shoreline along Gunflint Lake and Little Gunflint Lake.

6.1.2.2.5 School Trust Land Exchange and Land Acquisition

The State of Minnesota and the USFS are working together on a mutually beneficial strategy to transfer ownership of approximately 86,000 acres of currently designated school trust lands, located within the BWCAW, to federal ownership as part of a combined purchase and land exchange. The USFS would exchange federal lands outside the BWCAW for one-third of the school trust parcels within the BWCAW. The USFS would purchase the remaining two-thirds of the school trust lands within the BWCAW.

6.1.2.2.6 Wolf Island Phase 2 Land Acquisition (Domine Phase 2)

The Forest Service purchased this 27.54-acre property from The Trust for Public Land in 2013. This parcel represents the northern portion of Wolf Island in the northern arm of Lake Vermilion, 1 mile from the head of the Vermillion River. The USFS acquired the southern portion of Wolf Island in 2010. Acquisition of the remainder of Wolf Island resulted in public ownership of the entire 60-acre island and approximately 10,500 ft of lakeshore on Lake Vermilion. The island provides riparian habitat for sensitive species, including bald eagles and other resident and migratory birds such as osprey, loons, and blue herons.

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6.2 CUMULATIVE EFFECTS BY RESOURCE FOR THE NORTHMET PROJECT PROPOSED ACTION

This section considers cumulative effects by resource area. Only the direct and indirect effects of the NorthMet Project Proposed Action described in Chapter 5 of the FEIS are considered to potentially cause cumulative effects for the purposes of this analysis. For each of the resources analyzed in this chapter, the specific methodologies used to approach the cumulative analysis, as well as the spatial and temporal boundaries that limit the analysis, are described.

6.2.1 Land Use

The NorthMet Project Proposed Action would affect approximately 6,498 acres of land near Hoyt Lakes and Babbitt, in St. Louis County, Minnesota. This area includes public lands in the Superior National Forest, as well as private lands within the municipal boundaries of Hoyt Lakes and Babbitt.

6.2.1.1 Approach

The cumulative actions were evaluated against existing land use plans and ordinances. These include the St. Louis County Comprehensive Land Use Plan, provisions of the 1854 Treaty with the Chippewa of Lake Superior as they may affect or be affected by land use, and local (municipal) land use plans and zoning ordinances.

6.2.1.2 Cumulative Effects Assessment Area

6.2.1.2.1 Spatial

The CEAA for land use includes effects associated with the NorthMet Project Proposed Action combined with other industrial (including mining) or public works projects located within the portion of the Mesabi Iron Range encompassed by St. Louis County (see Figure 6.1.1-1). While changes in land use patterns do not necessarily depend on such projects, historical census data indicate changes in population in St. Louis County have been historically linked to such projects, especially mines. As discussed in Section 4.2.10, the iron deposits associated with the Mesabi Iron Range have been mined on an industrial scale for more than 100 years.

Recreation and natural areas (such as the BWCAW, Voyageurs National Park, and Superior National Forest) are also important economic and land use resources; however, the spatial extent of these designated lands is largely fixed (i.e., they have designated federal boundaries). Changes in use of these resources are due to evolving socioeconomic preferences, such as preferred type and amount of recreational activity.

6.2.1.2.2 Temporal

This evaluation focuses on existing and reasonably foreseeable land use patterns within the CEAA. Because mining and public resource management have been historically the primary drivers defining regional development and land use within the CEAA for over 100 years, existing conditions are considered indicative and representative of historical mining and resource management activities.

6.2.1.3 Contributing Past, Present, and Reasonably Foreseeable Actions

As noted previously, it is not possible to identify all past activities that may contribute to a cumulative effect. Similarly, all present activities would continue to affect the environment. The impacts of these combined activities are described in Chapter 4, Affected Environment. While not a new project, the Northshore Mine is anticipated to close in 2070.

The foreseeable future actions included in this analysis are discussed in Section 6.1.1.2. Activities specifically associated with potential cumulative effects on land use include permitted mines and other projects in the portions of the Mesabi Iron Range in St. Louis County where future activities are likely to be different from current activities. These projects include:

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits);
- Mesabi Mining Project;
- Northshore Closure;
- U.S. Steel Keetac Mine (Keewatin); and
- U.S. Steel Minntac Mine, Extension Project.

6.2.1.4 Cumulative Effects Assessment

The cumulative actions described in Section 6.2.1.3 are largely existing, expanded, or reconfigured mines operating on private land. These activities total approximately 2,650 acres, including more than 2,000 acres at the Keetac mine alone (MDNR and USACE 2010). While much of this land has not previously been mined, all of the cumulative actions are found within the Mesabi Iron Range. Expanded mining in this area does not necessarily reflect a change in land use and is consistent with land use regulations (St. Louis County 2011).

Together, the five projects included in the cumulative assessment would generate new jobs (Section 6.2.10). As with the NorthMet Project Proposed Action, this could increase housing demand in the region although a majority of this increased demand could be absorbed by the substantial available housing stock in St. Louis County (see Section 5.2.10.2.4). Any new housing would need to be consistent with the St. Louis County Land Use Ordinance 27 (Comprehensive Plan Land Use).

Post-closure, the Northshore Mine pit lake is estimated to be approximately 2,800 acres at an elevation of 1,500 ft amsl. Mitigation for changes to the watershed includes in-pit aquatic habitat development and upland enhancements. Public access to the reclaimed pit lake would be provided (Barr 2010e).

The sources for data regarding cumulative actions include MDNR and USACE 2007, USDOE and MDC 2007, and MDNR and USACE 2010.

6.2.2 Water Resources

The FSDD identified several resources with the potential to be cumulatively affected, including water resources, which would be subjected to a cumulative effects analysis using guidance from the CEQ (CEQ 1997). The FSDD identified hydrology and water quality as elements with the potential for cumulative effects. The analysis within this FEIS also identified the potential for cumulative effects on surface water hydrology and water quality. Neither the FSDD nor this FEIS identified potential cumulative effects on surficial groundwater. The NorthMet Project Proposed Action would supplant the existing seepage from the existing LTVSMC Tailings Basin and extend the duration of these effects, but these effects are localized and already incorporated in the groundwater quality models the results of which are in Section 5.2.2. The existing LTVSMC Tailings Basin is not considered a part of the cumulative effects because the NorthMet Project Proposed Action would replace these effects; therefore, they cannot be considered in addition to the NorthMet Project Proposed Action. Although the NorthMet Project Proposed Action would affect groundwater levels, this effect would be very limited geographically and temporally (e.g., groundwater levels would begin to restore once pit dewatering ceases) and not subject to any off-site cumulative effects. The effects of mine pit dewatering are considered in terms of effects on surface water flows. Therefore, the scope of this cumulative effects assessment focuses on the effects of past, present, and reasonably foreseeable future activities on surface water hydrology and quality.

6.2.2.1 Cumulative Effects Assessment Areas

In accordance with the CEQ guidance, a cumulative effects assessment should define the spatial and temporal scope of its analysis. These are described below.

6.2.2.1.1 Spatial

The FSDD identified the Partridge River and the Embarrass River as the geographic scope for the hydrology and water quality analyses. The analysis in this FEIS supports this study area. The St. Louis River was considered for inclusion in the cumulative effects assessment, but was not included in the assessment of project-specific impacts for the reasons described below. The cumulative effects actions with the potential to affect flow within the Partridge River and Colby Lake include the Northshore Mine, Laskin Energy City of Hoyt Lakes, Mesabi Mining, and Mesabi Nugget. In the Embarrass River, the projects include ArcelorMittal Deposits (Laurentian and East Reserve Deposits), City of Aurora POTW, City of Babbitt POTW, and the City of Biwabik POTW.

As concluded in Section 5.2.2, the NorthMet Project Proposed Action, which includes augmentation to Embarrass River tributaries, is predicted to only result in minor changes to hydrology within the Partridge River and Embarrass River. Most of the actions considered in this cumulative effects analysis (see Table 6.1.1-1) with the potential to cumulatively affect hydrology within the Partridge River and Embarrass River exist and their hydrologic effects are already incorporated into the impact assessment water modeling for the NorthMet Project Proposed Action.

The water quality modeling for the NorthMet Project Proposed Action already takes into consideration low flow conditions, and even during low flows, it is not predicted to result in any

direct exceedances of water quality evaluation criteria, although achieving this would require indefinite water treatment and WWTF and WWTP maintenance. Other reasonably foreseeable actions may also increase metal and other solute loadings downstream, but it is assumed that these other actions would also be required to meet federal and state water quality requirements, including nondegradation. Therefore, the potential for exceedances of water quality evaluation criteria as a result of cumulative effects from the NorthMet Project Proposed Action and other reasonably foreseeable actions is considered unlikely.

Although not expected to result in any direct exceedances of water quality evaluation criteria, the NorthMet Project Proposed Action, in combination with other reasonably foreseeable actions, would increase metal and other solute loadings to the Partridge River and Embarrass River, and further downstream in the St. Louis River. These loadings would, however, be diluted as the solutes are transported downstream (i.e., average annual flow in the St. Louis River at the confluence with the Embarrass River is approximately four times more than in the Partridge and Embarrass rivers alone). Further, the MPCA will review the NorthMet Project Proposed Action for consistency with the State's non-degradation requirements prior to any permitting, as it would also do at the time of permitting for any other reasonably foreseeable actions.

Finally, sulfate and mercury loadings, two key constituents of concern, are predicted to decrease overall as a result of the NorthMet Project Proposed Action. Although sulfate loadings are predicted to increase slightly in the Partridge River Watershed (less than 1 percent) as a result of the NorthMet Project Proposed Action, this is offset by a large decrease in the Embarrass River Watershed (greater than 40 percent at PM-13), resulting in a significant net decrease in overall sulfate loadings to the St. Louis River as a result of the NorthMet Project Proposed Action. Similarly, mercury loadings are predicted to increase slightly in the Embarrass River Watershed (0.1 percent) as a result of the NorthMet Project Proposed Action, but this is offset by a larger decrease (1 percent) in the Partridge River Watershed, resulting in a net decrease in overall mercury loadings to the St. Louis River as a result of the NorthMet Project Proposed Action.

Therefore, the NorthMet Project Proposed Action is not considered to have the potential for cumulative effects on hydrology and water quality in the St. Louis River. As a result, the CEAA for surface water is defined by the Partridge River and Embarrass River watersheds as shown on Figure 6.2.2-1.

Figure 6.2.2-1
Water Resources Cumulative Effects Assessment Areas, Projects, and Actions
NorthMet Mining Project and Land Exchange FEIS
Minnesota
November 2015

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6.2.2.1.2 Temporal

In terms of temporal scope, this assessment considered past and present and reasonably foreseeable effects on flow and water quality in the Partridge River and Embarrass River as reflected in existing baseline hydrologic and water quality conditions. Limited flow data are available back to 1942 for the Embarrass River and for the Partridge River. Limited water quality data are available dating back to the 1970s. In addition to the NorthMet Project Proposed Action, this assessment considered the activities identified below.

6.2.2.2 Contributing Past, Present, and Reasonably Foreseeable Actions

Existing and potential future actions, in combination with the NorthMet Project Proposed Action, which could cumulatively affect surface water hydrology and quality within the Partridge River and Embarrass River watersheds, include the following:

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits);
- City of Aurora POTW;
- City of Babbitt POTW;
- City of Biwabik POTW;
- City of Hoyt Lakes POTW;
- LTVSMC Pits (Cliffs Erie Pits);
- Mesabi Mining Project;
- Mesabi Nugget Project;
- Minnesota Power Laskin Energy Center;
- Northshore Mine; and
- Northshore Mine Closure.

6.2.2.3 Cumulative Effects on Hydrology

This section discusses cumulative effects on the hydrology within the Partridge River and Embarrass River watersheds.

6.2.2.3.1 Partridge River Watershed

There are several mines (active, closed, and proposed), the City of Hoyt Lakes POTW, 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 4.2.2-10). 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 (such as various mine pit dewatering discharges). The existing or predicted future hydrologic effects of these activities are briefly described below and summarized in Table 6.2.2-1. The average net hydrologic effect listed reflects the extent to which the listed activity impacts natural average annual flow in the Partridge River. For example,

flooded pit overflows (without artificial management) are assumed to generally reflect natural flow contributions.

Table 6.2.2-1 Cumulative Effects on Partridge River and Colby Lake Hydrology by Activity

Activity	Average Net Hydrologic Effect (cfs)	Location of Effects	Timing	Magnitude	Future Duration
Northshore Mine	+5.0	Upper Partridge River and Colby Lake	Intermittent	Varies	>50 years ongoing
Northshore Mine Closure	0.0	Upper Partridge River and Colby lake	NA	NA	Beginning in 2070
City of Hoyt Lakes POTW	-0.1	Colby Lake	Continuous	Relatively consistent	Long-term ongoing
LTVSMC Pits	+6.2	Wyman Creek, Upper and Lower Partridge River, Second Creek and Colby Lake	Varies	Varies	Long-term ongoing
NorthMet Project Proposed Action Mine Site WWTF	+0.65	Upper Partridge River and Colby Lake	Continuous	Relatively consistent	Long-term
Mesabi Nugget	+7.4	Second Creek and Lower Partridge River	October to March	Relatively consistent	Ongoing
Mesabi Mining Project	Unknown	Second Creek and Lower Partridge River	Unknown	Unknown	Unknown
Mesabi Mining Site Existing Conditions	0.0	Second Creek and Lower Partridge River	NA	NA	NA
Minnesota Power Laskin Energy Center	-4.2	Colby Lake	Continuous	Relatively consistent	Long-term ongoing
NorthMet Project Proposed Action Plant Site WWTP	±0.1	Second Creek and Lower Partridge River	Continuous	Relatively consistent	Long-term

Sources: PolyMet 2015i; MPCA 2012l; MPCA 2012m; MPCA 2013h; MPCA 2013j; MPCA 2013k; MPCA 2014d; MPCA 2014e; MPCA 2014f.

- Northshore Mine – This is an open pit taconite mine. The mine consists of three mining areas, only one of which (water appropriation permit Area 003) discharges to the Partridge River Watershed. There are several permitted discharges from Area 003, but only two mine pit discharges and a crusher discharge are active, with a collective maximum water appropriation-permitted discharge to the Partridge River of 29 cfs. Upper Partridge River flows are currently influenced by the timing and magnitude of Northshore Mine discharges from the Peter Mitchell Pit at SD-009 and SD-010, and would be influenced by the cessation of those discharges in approximately mine year 55.

Available records show an average annual discharge to the Partridge River ranging from 6.8 to 15.1 cfs, with a highest reported monthly discharge of 34 cfs (Barr 2008f). Since 2004, the average annual daily discharge from the Northshore Mine has been approximately 5.0 cfs, but this rate is quite variable, ranging from zero (mostly during the winter and summer droughts) to as high as approximately 20 cfs (MDNR et al. 2015a). The 5.0 cfs rate is used for cumulative hydrologic evaluations because it is the best representation of actual flows. For the direct impact assessment, a 2.6 cfs flow rate is used because it provides a better calibration for assessing water quality. The same flow rate is used for the cumulative water quality assessment (MDNR et al. 2015a).

- Northshore Mine Closure – Following closure in year 2070 of the Northshore Mine, its discharge to the Partridge River Watershed would cease as the pit is allowed to flood with water. After the pit lake is flooded, the pit would discharge towards the Dunka River into the Rainy River Watershed, effectively removing the pit discharge from the Partridge River Watershed (PolyMet 2015m).
- City of Hoyt Lakes POTW – The City of Hoyt Lakes is authorized to withdraw up to 2.3 cfs, but currently withdraws approximately 0.6 cfs of water from Colby Lake for municipal potable use, and discharges approximately 0.5 cfs of treated wastewater from its POTW to Whitewater Reservoir. Most of this water is returned to the Partridge River Watershed either via pumping during droughts to maintain water levels in Colby Lake or via seepage through its northwest dike to the Lower Partridge River. For purposes of this cumulative effects analysis, a consumptive loss of 0.1 cfs is assumed from the Partridge River Watershed.
- Mesabi Nugget, Pit 1 –This existing plant processes taconite concentrate into nuggets. It is not an active mine site. Wastewater from the plant is routed through a chemical precipitation unit and discharged into the west end of the Area 1 Pit. Water from the east end of the Area 1 Pit is then pumped to Outfall SD001 with ultimate discharge into Second Creek. This pit has seasonal (September to March) discharges to Second Creek that average approximately 7.4 cfs; no discharges occur from April to August.
- Mesabi Mining Project – This is a proposed project involving reactivation of a taconite mine and construction of a new taconite concentration facility. The iron ore concentrate would be used as feedstock for the Mesabi Nugget facility, with the remaining balance shipped by rail for use in other facilities. The project underwent some NEPA and MEPA review from 2009 to 2011, but that work is currently in suspension while the project is revaluated/redesigned. The water management strategy for this facility is still in the process of development, so the future hydrologic effects of this action are unknown.

- Mesabi Mining Site Existing Conditions:
  - Pit 2WX: The pit is currently in the process of filling. Within a few years, this pit may overflow to an unnamed creek that discharges to Colby Lake.
  - Pit 6: This pit currently releases water to Second Creek via the surficial aquifer. There is no surface water discharge.
  - Pit 9S: This pit is currently stable (with likely groundwater discharge off site and/or to Pit 6).
  - Pit 9N: This pit is currently stable (with groundwater connection to Pit 1 and the surficial aquifer).
- LTVSMC Pits (Cliffs Erie Pits) – These pits would influence the flow of the Upper Partridge River downstream of Wyman Creek's confluence with the Partridge River and the Lower Partridge River:
  - Pit 2/2E: This pit is stabilized with no direct discharge. There is likely groundwater flow from this pit to Pit 2W.
  - Pit 2W: This pit discharges intermittently to Second Creek at approximately 4.5 cfs.
  - Pit 3: This pit currently discharges to Wyman Creek, a tributary to the Upper Partridge River, at approximately 0.9 cfs.
  - Pit 5SW: This pit overflows to Wyman Creek via "dispersed" discharge, at an estimated rate of less than 0.8 cfs.
- Minnesota Power Laskin Energy Center – This is a natural gas power plant that withdraws cooling water from Colby Lake. It discharges once-through, non-contact cooling water to the downstream portion of Colby Lake, but has a 4.2 cfs evaporative loss of water to the atmosphere. No changes to its current mode of operation are anticipated for the foreseeable future.
- NorthMet Project Proposed Action – The NorthMet Project Proposed Action would also influence future Partridge River flows through: 1) WWTF discharges starting in mine year 52; 2) a watershed reduction; 3) pit inflows during operations and reclamation; and 4) groundwater flowpath contributions from stockpiles and pits during operations, reclamation, and closure. The WWTF would discharge continuously at rate of 0.65 cfs. Watershed area reductions resulting from the NorthMet Project Proposed Action for SW-001, SW-002, SW-003, SW-004, and SW-004a range from 0 to 2.1 percent during closure and long-term maintenance, which translates to a reduction of 0.39 cfs below current and future flows at SW-004a. Pit inflows would reduce Partridge River flows by less than 2 cfs. Changes to groundwater flows are considered negligible. There would be a decrease in flows during operations (about mine year 12) when the rate of pit inflows would be the greatest. There would be an increase in flows during closure for about a 3-year period when the WWTF would be discharging to the Partridge River.

The south discharge from the Tailings Basin into Second Creek would be managed within plus or minus 20 percent of flows, estimated to be 0.5 cfs, prior to the installation of the containment system. The expected flows from the WWTP that would augment these flows are predicted to range between 0.4 and 0.6 cfs.

Upper Partridge River

The P50 average annual modeled flows were assessed for the 200-year simulation in the Partridge River at SW-004a. The NorthMet Project Proposed Action would decrease flows by no more than 1.2 cfs and increase them by no more than 0.5 cfs Figure 6.2.2-2 shows P10, P50, and P90 average annual flow rates to capture the uncertainty in the hydrology. The decrease in flows would occur during operations.

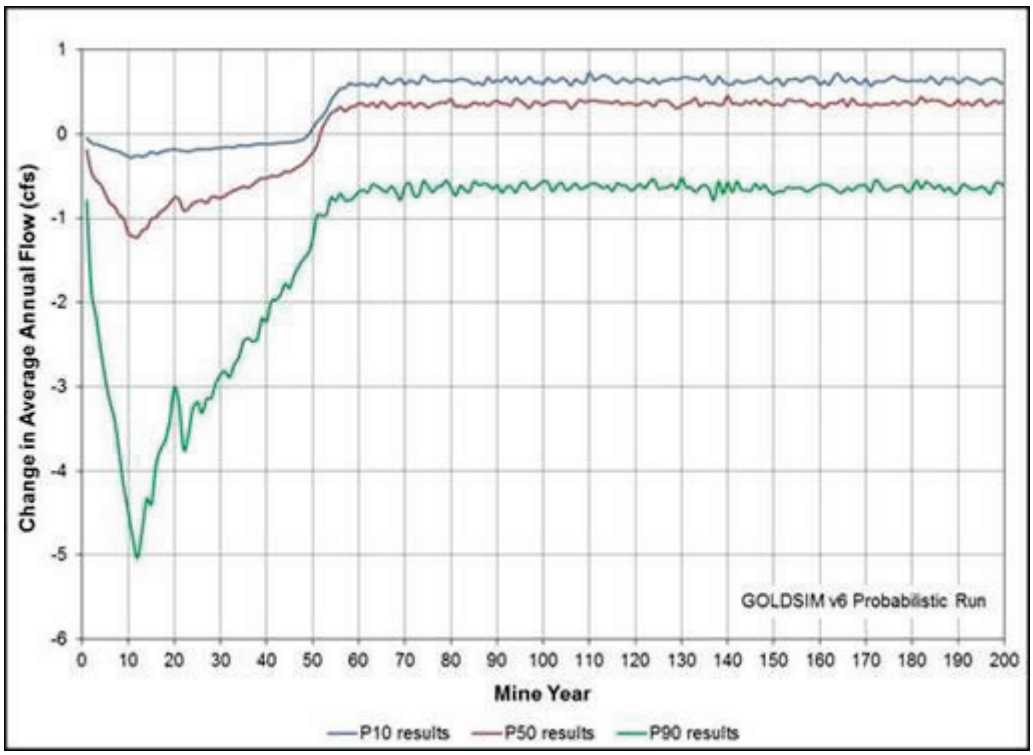

Figure 6.2.2-2 Change in Average Annual Stream Flow at SW-004a

Downstream of SW-004a and upstream of Colby Lake, contributions to the tributaries to the Partridge River from existing LTVSMC pits total approximately 6.2 cfs. In year 2070, Northshore is expected to stop pumping water to the Upper Partridge River. Elimination of this pumping activity would decrease Upper Partridge River flows by approximately 5.0 cfs on an annual average basis.

Depressed water levels in the Northshore Peter Mitchell Pit also influence the flows of the Upper Partridge River by redirecting surficial aquifer recharge into the Peter Mitchell Pit that would have otherwise fed the Partridge River. Northshore currently pumps water out of the Peter Mitchell Pit into the Partridge River, which has the effect of replacing the redirected recharge water. However, because pumping to the Partridge River is sporadic, the Partridge River experiences more variable flow than would have occurred without the pumping.

In year 2070, pumping to the Partridge River from the Peter Mitchell Pit is anticipated to end. The volume of aquifer recharge water redirected from the Partridge River Watershed would then become a function of the Peter Mitchell Pit lake elevation, which would be at its lowest point in 2070 and refill over approximately a decade to its final planned pit lake elevation, which is below the elevation of the Partridge River. It is expected that surficial aquifer recharge water that would have fed the Partridge River would be redirected to the Peter Mitchell Pit as long as the elevation of the Peter Mitchell Pit remains below the Partridge River.

Colby Lake

Cumulative hydrologic effects on Colby Lake would be influenced by activities in the Upper Partridge River identified above and three additional activities: 1) NorthMet Project Proposed Action pumping from Colby Lake in mine years 1 to 20, at an average rate of 1.7 cfs, for Plant Site operational needs; 2) Laskin Energy Center pumping from Colby Lake, at a rate of 4.2 cfs, to support its operations; and 3) City of Hoyt Lakes POTW pumping with a net effect of a 0.1 cfs decrease.

This recognized, Colby Lake water elevations are regulated and managed and this ultimately dictates flows from Colby Lake into the Lower Partridge River. Partridge River flows into Colby Lake during peak flow events are diverted through a set of gates to the Whitewater Reservoir, thereby mitigating potential increases in flows to the Lower Partridge River from this source. There is a minimum regulated water level threshold of 1,439 amsl on Colby Lake as required under MDNR Water Appropriation Permit 1949-0135. As this threshold is approached, water is pumped out of Whitewater Reservoir to Colby Lake to increase water elevations in the lake and, with it, flow to the lower Partridge River. Due to Colby Lake's hydrologic relationship with the Whitewater Reservoir, as well as regulated management, no impacts to hydrology in Colby Lake are expected.

Lower Partridge River

Historically, water has been discharged from SD-026 south of the Tailings Basin at various rates into Second Creek, a tributary to the Lower Partridge River. The NorthMet Project Proposed Action would stop this flow. Flows from SD-026 would be augmented by the NorthMet Project Proposed Action to maintain flows that existed prior to the installation of the containment system. Due to this augmentation, discharges from SD-026 could deviate ±0.1 cfs from the baseline. This impact would be added to Mesabi Nugget's 7.4 cfs seasonal discharge increase and an unknown impact from the proposed Mesabi Mining Project.

Bedrock Flow Direction North of the Mine Site

Pit lake elevations for the NorthMet Proposed Action and Northshore mining operations would vary for both facilities through operations, reclamation, and closure. Differences in pit water level elevations between the facilities could influence the direction of bedrock groundwater flow between the NorthMet and Northshore mines. However, a second mechanism may also influence bedrock flow direction: downward leakage from wetlands and surficial materials into bedrock. If downward leakage rates were high enough relative to NorthMet and Northshore pit water level elevations, a bedrock groundwater mound could be created that would prevent bedrock groundwater from traveling from the NorthMet Mine Site to the Northshore mine. A groundwater mound would occur if the highest elevation of the bedrock groundwater profile

were above the pit water levels at each site. The mound would represent a groundwater flow divide between the mines and would indicate that there is no continuous unidirectional flow between them.

At present, the lack of response seen in bedrock well data north of the NorthMet Mine Site, despite the influence of progressively decreasing Northshore Peter Mitchell Pit water level elevations, is consistent with the idea that there is some downward leakage into bedrock from wetlands and surficial materials. Furthermore, if the surface water source were adequate (e.g., in wetlands), scoping calculations show that the vertical hydraulic conductivity used in MODFLOW for surficial deposits would be high enough for sufficient downward leakage to occur to create a bedrock groundwater mound. However, it is uncertain if enough water would be available at ground surface to support this level of leakage (MDNR et al. 2015c).

Of the approximately 28 inches of precipitation falling annually in the NorthMet Project area, scoping calculations suggest that 5 in/yr would need to reach bedrock to create a bedrock groundwater mound for the long-term closure condition (post-year 2080) and up to 8 in/yr under worst-case conditions (year 2070). Surface water available for downward leakage is influenced by evapotranspiration, runoff, and baseflow to the Partridge River (MDNR et al. 2015c).

Given available information, development of a naturally forming bedrock groundwater mound over the course of both NorthMet and Northshore mining operations through closure is not certain. Therefore, the possibility of a northward bedrock groundwater flowpath cannot be ruled out. Monitoring of bedrock groundwater levels would be required and possibly mitigation applied to prevent it (MDNR et al. 2015c). For information on mitigation and monitoring of the NorthMet Project Proposed Action related to this issue, see Sections 5.2.2.3.5 and 5.2.2.3.6.

6.2.2.3.2 Embarrass River Watershed

In general, flows in the Embarrass River have been affected to a minor extent by municipal water withdrawals and wastewater discharges, and, since the mid-1950s, by mining (e.g., seepage from the existing LTVSMC Tailings Basin). Most of these discharges are relatively continuous, although there can be wide variations in their magnitudes, most of which are attributable to precipitation trends. Larger discharges tend to coincide with either snow melt or large storm events when flows in the Embarrass River are typically high, thereby reducing the magnitude of these discharges. On the other hand, there can be less discharge during drier periods when river flows are lower. Including the NorthMet Project Proposed Action, there are seven past, present, and reasonably foreseeable future activities that could affect the hydrology of the Embarrass River. The existing or predicted future hydrologic effects of these activities are briefly described below and summarized in Table 6.2.2-2. The average net hydrologic effect listed reflects the extent to which the particular activity impacts natural average annual flow in the Embarrass River. For example, flooded pit overflows (without artificial management) are assumed to generally reflect natural flow contributions.

Table 6.2.2-2 Existing Cumulative Effects on Embarrass River Hydrology by Activity

Activity	Average Net Hydrologic Effect (cfs)	Location of Effects	Discharge Timing	Magnitude	Duration
City of Babbitt POTW	+0.1	Upper and Lower Embarrass River	Continuous	Relatively consistent	Long-term ongoing
LTVSMC Area 5NW Pit	+1.2	Upper and Lower Embarrass River	Continuous	Varies	Long-term ongoing
ArcelorMittal Laurentian Deposit	-5.1	Lower Embarrass River	Continuous	Varies	Ongoing until mid-2010s then ceasing
ArcelorMittal East Reserve Deposit	+9.3	Lower Embarrass River	Continuous	Varies	Ongoing until ~2025
City of Aurora POTW	-0.3	Lower Embarrass River	Continuous	Relatively consistent	Long-term ongoing
City of Biwabik POTW	0.0	Lower Embarrass River	Continuous	Relatively consistent	Long-term ongoing
NorthMet Project Proposed Action Plant Site WWTP	±1.0	Upper and Lower Embarrass River	Continuous	Relatively consistent	Long-term

Sources: PolyMet 2015i; MPCA2012i; MPCA 2012j; MPCA 2013g; MPCA 2013h; MPCA 2014c; MPCA 2014d.

- City of Babbitt POTW – The City of Babbitt uses several wells, some of which are in the Dunka River Watershed, as its water supply source, and discharges 0.33 cfs of treated wastewater effluent to the headwaters of the Embarrass River. Since some of this discharge is Dunka River Watershed water, it is estimated that the City of Babbitt provides an annual average net increase of 0.1 cfs to the Embarrass River.
- LTVSMC Pits (Cliffs Erie Pits) – Pit 5NW overflows to Spring Mine Creek, a tributary of the Embarrass River. This pit has an overflow discharge of approximately 1.2 cfs, but its flow varies with precipitation and has been measured as low as 0.23 cfs.
- NorthMet Project Proposed Action Plant Site – Tributaries extending north of the Tailings Basin would be augmented to maintain existing flows within ±20 percent. The effect of the NorthMet Project Proposed Action decreases with distance downstream, as can be seen at PM-13, where the maximum change in flow is an approximate 3 percent decrease in the annual average flow during operations, with a long-term closure decrease of less than 2 percent.
- ArcelorMittal Laurentian Deposit – This is a taconite mine that has been in operation since approximately 1993. The mine has three permitted dewatering discharges to an unnamed tributary of the Lower Embarrass River (immediately downstream of Esquagama Lake), but only one is actively used (SD-003). This mine is expected to close sometime in the late 2010s, at which time pit dewatering would stop, and flow to the Embarrass River would be reduced until the pit floods.

  Pit dewatering discharges averaged approximately 5.1 cfs annually between 2012 and 2014 (MPCA 2010a; MPCA 2011f; MPCA 2012i). Discharges were reasonably constant over the period, with most monthly values ranging between 4.5 and 6.0 cfs. Flows similar to these are expected until the mine closes, at which time pit dewatering and discharge to the Embarrass

River would stop. This would result in a net reduction in flow to the Embarrass River of approximately 5.0 cfs until the pit floods.

- ArcelorMittal East Reserve Deposit – This is an open-pit taconite mine, which began operations (East Reserve #1) in 2008. The second pit (East Reserve #2) is permitted and is operating as of 2014.

  The first pit has a single permitted dewatering discharge (SD-005) to an unnamed tributary of the Lower Embarrass River (immediately downstream of Esquagama Lake). Pit dewatering discharges from East Reserve #1 averaged approximately 2.7 cfs from 2012 to 2014, but this discharge would likely gradually increase as the pit gets deeper. When discharging, the flow rate is constant, but currently there are several months of the year (primarily in winter) when no discharge occurs. At some yet-to-be-determined point, East Reserve #2 would be opened and pit dewatering would begin through a second permitted discharge (SD-006). The East Reserve Deposit (Pit 1 and Pit 2) would have a combined permitted discharge to the Lower Embarrass River of up to 9.3 cfs, though the actual discharge would likely vary seasonally, and as the mines are developed, at a rate somewhat lower than that. As with the Laurentian Mine, it is important to note that a substantial portion of the permitted discharge replaces natural runoff that is captured by the pit watershed.

- City of Aurora POTW – The City of Aurora withdraws approximately 0.32 cfs from the St. James Pit, a former natural ore pit within the Embarrass River Watershed, and discharges approximately 0.31 cfs of treated wastewater to Silver Creek, which drains to the St. Louis River. Therefore, this withdrawal represents a loss of water from the Embarrass River Watershed of 0.32 cfs.

- City of Biwabik POTW – The City of Biwabik withdraws approximately 0.25 cfs from the Canton Pit for municipal water supply and discharges treated wastewater to a tributary of Embarrass Lake at approximately the same rate. There is effectively no net loss of water associated with the City's water usage.

The net effect of these hydrologic changes would be an approximately 5.2 cfs increase in flow, plus about a 2.6 cfs (operations) to 1.6 cfs (closure) reduction as a result of the NorthMet Project Proposed Action, for a total increase in flow of between 7.8 and 3.6 cfs at the confluence with the St. Louis River, or about 7 percent of average annual flow (assuming an average annual flow of about 117 cfs for a 180.8 square mile watershed with an average annual flow of 0.65 cfs per square mile based on flow at the McKinley gage).

6.2.2.4 Cumulative Effects on Surface Water Quality

This section discusses cumulative effects on water quality for the Partridge River and the Embarrass River.

6.2.2.4.1 Partridge River

Water quality in the Partridge River has been affected by discharges from the Northshore Mine, discharges/overflows from several former LTVSMC pits, and two permitted discharges from Minnesota Power's Laskin Energy Center for decades. As mentioned in Section 5.2.2, the NorthMet Project Proposed Action does not propose any surface water discharges (other than flow augmentation to Second Creek) until the West Pit overflows and the WWTF begins

discharging around year 52. However, non-contact stormwater runoff, unrecoverable groundwater seepage from the five groundwater flowpaths (i.e., from the waste rock stockpiles, pits, Ore Surge Pile, WWTF, and Overburden Storage and Laydown Area), and the WWTF discharge would all serve as potential contaminant sources. Stormwater from undisturbed areas of the proposed Mine Site would be similar in chemistry to current runoff from the proposed Mine Site area. The WWTF discharge would be permitted under the NPDES permitting program.

The NorthMet Project Proposed Action is predicted to meet or not cause or add to an exceedance of all surface water quality evaluation criteria at all evaluation locations within the Partridge River watershed for the entire 200-year modeling period. Consequently, there would not be potential cumulative environmental impacts. The scope of cumulative impacts analysis is therefore focused on parameters with a potential to bioaccumulate in aquatic organisms or adversely impact wild rice, an important cultural resource. As a result, the cumulative effects analysis focuses on sulfate (because of its relationship with mercury methylation and wild rice) and mercury (because it is the only parameter on the Partridge River 303(d) list). Mercury is only discussed from a water quality perspective; the potential cumulative effects of the NorthMet Project Proposed Action on the bioaccumulation of methylmercury in fish are discussed in Section 6.2.6.3.3.

Sulfate

Sulfate is a concern along the Partridge River because of the presence of waters supporting the production of wild rice immediately downstream of the NorthMet Project area (including evaluation locations SW-005 and SW-006 immediately above Colby Lake and the portion of the river below Colby Lake). According to available surface water monitoring data, including sulfate sampling conducted as part of recent wild rice field surveys (Barr 2009b, 2011a, 2012a, and 2013m), sulfate concentrations in the Upper Partridge River range from 0.5 to 21 mg/L, which are slightly elevated relative to baseline conditions, assumed to be similar to values in the South Branch of the Partridge River reported in the 1970s (average of 5.2 mg/L). Sampling in Colby Lake found a range of concentrations between 37 and 42 mg/L. Downstream of Colby Lake, sulfate concentrations increase as the result of groundwater seepage into the surficial aquifer from inactive mine pits (e.g., Pit 6 with a sulfate concentration of about 1,200 mg/L) and overflow from inactive mine pits (i.e., Pit 2W, which discharges intermittently at about 4.5 cfs with a sulfate concentration of approximately 125 mg/L). Pit 1 water is discharged October through March with a daily average flow of 7.4 cfs and an average sulfate concentration of 478 mg/L (MPCA, Pers. Comm., March 24, 2015). Pit 2WX, Pit 6, Pit 9, and Pit 9s are not currently discharging surface water. Average sulfate concentrations in the Partridge River in 2013 were 71.3 mg/L at station S005-752, which is just downstream of the confluence with Second Creek at the County Road 110 Bridge. The wild rice surveys found sulfate concentrations as high as 1,100 mg/L in Second Creek.

The baseline sulfate concentrations found in the Partridge River reflect the effects of discharges from existing activities within the watershed. Table 6.2.2-3 summarizes the relative sulfate load contributions from the various identified activities in the watershed. In terms of historic increases in Lower Partridge River sulfate concentration, three important existing loads of sulfate to the Lower Partridge River include the Mesabi Nugget operation, the previous SD-026 seep from the

existing LTVSMC Tailings Basin, and the Mesabi Mining Pit 6 seepage, all entering Lower Partridge River via Second Creek.

Table 6.2.2-3 Cumulative Sulfate Loadings to the Partridge River by Activity

Activity	Average Discharge/ Release Rate (cfs)	Representative Sulfate Concentration (mg/L)	Average Sulfate Load (kg/d)
Northshore Mine Operations	2.6	28	178
Northshore Mine Closure	0.0	NA	NA
City of Hoyt Lakes POTW	0.4	~0(1)	~0
Mesabi Nugget	7.4 (7 mo.)	473	6,480
Mesabi Mining Site Existing Conditions[1]	0.0	0.0	0.0
Mesabi Mining Project	unknown	unknown	unknown
Laskin Energy Center	-4.2	No change in loading	No addition to ambient load
Cliffs Erie Pits 2/2E/2W	4.5	125.	1,380
Cliffs Erie Pit 3	0.9	74	163
Cliffs Erie Pit 5SW	0.8	85	166
NorthMet Project Proposed Action Plant Site WWTP	0.5 (operations & closure)	10	12.23 (operations & closure)
NorthMet Project Proposed Action Plant Site WWTF	0.65	9	14.3

Sources: PolyMet 2015i; PolyMet 2015r; MPCA 2012l; MPCA 2012m; MPCA 2013h; ; MPCA 2013j; MPCA 2013k; MPCA 2014d; MPCA 2014e; MPCA 2014f; USDOE and MDC 2009, Table 5.3-4; MDNR et al. 2014c).

Note:
[1] Does not include the subsurface sulfate contribution from Pit 6, which is likely to have a similar concentration.

Modeling of the NorthMet Project Proposed Action indicates that when the project causes or adds to an exceedance, the magnitude change in concentration is less than 0.9 percent. Therefore, the NorthMet Project Proposed Action should not adversely affect downstream waters that support the production of wild rice (see Tables 5.2.2-31, 5.2.2-44, and 5.2.2-45). The potential cumulative effect of sulfate on mercury methylation in the Partridge River Watershed is discussed below.

Mercury

Based on sampling in studies done for PolyMet, it is estimated that current total mercury concentrations average about 3.3 ng/L in the Upper Partridge River (Barr 2011a) and between 4.6 and 8.7 ng/L in Colby Lake.

Details of the effect of the NorthMet Project Proposed Action on mercury deposition impacts and mercury concentrations are discussed in Section 5.2.7. Table 6.2.2-4 summarizes the relative mercury contributions from the various identified activities in the watershed. Research has found that taconite tailings are effective in sequestering mercury from seepage. Analog data from natural lakes and mine pit lakes in northeastern Minnesota suggest that mercury concentrations generally remain below the GLI's 1.3 ng/L standard, despite precipitation averaging

approximately 13 ng/L mercury. Mercury in surface waters undergoes transformations when exposed to sunlight, which can limit its concentration in lakes. For example, methylmercury degrades to soluble oxidized mercury in sunlight, which in turn degrades to elemental mercury, which volatilizes from lakes. Further, much of the mercury in lakes associates with particulate matter, which often settles to the bottom.

The NorthMet Project Proposed Action is predicted to result in a net decrease in mercury loadings to the Partridge River from 24.2 grams per year to 23.0 grams per year. This would primarily be a result of a decrease in natural runoff (with a total mercury concentration of 3.6 ng/L) and a proportional increase in water discharged from the West Pit via the WWTF (with a total mercury concentration of 1.3 ng/L). As discussed above, sulfate concentrations and loadings from the NorthMet Project Proposed Action to the Partridge River are predicted to remain about the same as existing conditions, so the NorthMet Project Proposed Action would not be contributing additional sulfate that could promote mercury methylation. Therefore, the NorthMet Project Proposed Action would not likely contribute to cumulative effects on mercury loading in the Partridge River.

Table 6.2.2-4 Cumulative Mercury Loadings to the Partridge River by Activity

Activity	Average Discharge/ Release Rate (cfs)	Representative Mercury Concentration (ng/L)	Average Mercury Load (kg/d)
Northshore Mine Operations	2.6	0.7	4.5E-06
Northshore Mine in Closure	0.0	0.0	0.0
City of Hoyt Lakes POTW	0.4	7.7	7.5E-06
Mesabi Nugget	7.4	0.6	8.2E-06
Mesabi Mining Site Existing Conditions	0.0	0.0	0.0
Mesabi Mining Project	unknown	unknown	unknown
Laskin Energy Center	-4.2	No change in loading	0.0
Cliffs Erie Pits 2E/2W[1]	4.5	1.0	1.1E-05
Cliffs Erie Pit 3	0.9	0.55	1.2E-06
Cliffs Erie Pit 5SW	0.8	0.55	1.1E-06
NorthMet Project Proposed Action Plant Site WWTP	0.5 (operations & closure)	1.0–1.3	1.2E-06 to 1.6E-06
NorthMet Project Proposed Action Mine Site WWTF (closure)	0.65	1.0–1.3	1.6E-06 to 2.1E-06

Sources: PolyMet 2015i; PolyMet 2015r; MPCA 2012i; MPCA 2012j; MPCA 2012k; MPCA 2013g; MPCA 2013h; MPCA 2013j; MPCA 2014b; MPCA 2014c; MPCA 2014d; MPCA 2014e; MPCA 2014f; MDNR et al. 2014c; MPCA, Pers. Comm., March 24, 2015.;

Note:
[1] Does not include the subsurface mercury contribution from Pit 6, which is likely to have a similar concentration.

6.2.2.4.2 Embarrass River

Section 5.2.2.3.3 contains a detailed discussion of modeled water quality changes in the Embarrass River at PM-13. The placement of the Embarrass River headwaters and Spring Mine Creek on the MPCA 2012 Impaired Waters list indicates that aquatic biota are already under stress in this system (MPCA 2012n). Although stressors have not been identified, the water quality change predicted under the NorthMet Project Proposed Action would have potential to add to these stressors. Therefore, this cumulative effects analysis focuses on sulfate (because of its relationship with mercury methylation and wild rice) and mercury (because it is the only parameter on the 303(d) list). Mercury is only discussed here from a water quality perspective; the potential cumulative effects of the NorthMet Project Proposed Action on the bioaccumulation of methylmercury in fish are discussed in Section 6.2.6.3.3.

Sulfate

Sulfate is a concern within the Embarrass River because of the presence of waters supporting the production of wild rice downstream of PM-13. Present sulfate concentrations in the Embarrass River downstream of the NorthMet Project area are elevated well above natural background levels and currently exceed the wild rice sulfate standard of 10 mg/L. Median sulfate concentration at PM-12, upstream of any historic mining activity, is about 7.2 mg/L compared to a median of about 39.4 mg/L at PM-13. This increase in sulfate concentrations is primarily attributable to the Pit 5NW overflow (average discharge at SD-033 of 1.2 cfs and sulfate concentration of 1,088 mg/L) and seepage from the existing LTVSMC Tailings Basin (average surface and groundwater seepage of 5.7 cfs and a range of mean sulfate concentrations from 109 to 185 mg/L). The combined effects of the Tailings Basin containment system and stream augmentation would reduce the predicted P90 sulfate concentration (see Section 5.2.2.1.3) at PM-13 by about 50 percent relative to the CEC scenario model results.

Considering cumulative downstream effects, the Embarrass chain of seven lakes tend to attenuate the sulfate concentrations by dilution and biological uptake, with concentrations gradually declining in a downstream direction from 21.3 mg/L in Embarrass Lake to 17.1 mg/L at the outlet from Esquagama Lake.

The existing sulfate concentrations in the Embarrass River reflect the effects of discharges from existing activities within the watershed. Table 6.2.2-5 summarizes the relative sulfate load contributions from the various identified activities in the watershed.

Table 6.2.2-5 Cumulative Sulfate Loadings to the Embarrass River by Activity

Activity	Average Discharge/ Release Rate (cfs)	Representative Sulfate Concentration (mg/L)	Average Sulfate Load (kg/d)
City of Babbitt POTW	0.1	37.4	9.1
LTVSMC Area 5NW Pit	1.2	1,088	3,194
ArcelorMittal Mine (Laurentian and East Reserve Mine)	9.3	186	4,232
City of Aurora POTW	0.3[1]	NA	NA
City of Biwabik POTW	0.0	0.0	0.0
NorthMet Project Proposed Action Plant Site WWTP	5.7 (operations) 4.3 (closure)	10.0	139 (operations) 105 (closure)

Sources: PolyMet 2014w; MPCA 2012d; MPCA2012i; MPCA 2012j; MPCA 2013g; MPCA 2013h; MPCA 2014c; MPCA 2014d; PolyMet 2015i; MPCA, Pers. Comm., April 29, 2013.

Note:
[1] Discharge is to the St. Louis River.

The NorthMet Project Proposed Action would reduce the sulfate load from the existing LTVSMC Tailings Basin as a result of the containment of tailings seepage by the containment system and subsequent treatment via the WWTP before discharge as part of the tributary stream flow augmentation. This NorthMet Project Proposed Action would result in a greater than 40 percent overall reduction in sulfate loading at PM-13 and would have a positive effect on reducing the sulfate concentration in the Embarrass River downstream of PM-13 (where wild rice is present), the chain of lakes, and the Lower Embarrass River. The Embarrass River at PM-13 would still have sulfate concentrations well above 10 mg/L (see Table 5.2.2-48).

Mercury

The Embarrass River is not on the 303(d) list of impaired waters for mercury impairment; however, several lakes downstream of the NorthMet Project Proposed Action along the Embarrass River are listed for "mercury in fish tissue" impairment, including Sabin, Wynne, Embarrass, and Esquagama lakes. These lakes are not covered by the statewide mercury TMDL, but are impaired waters and in need of a TMDL pollution reduction study. These waters are not included in Minnesota's regional mercury TMDL because the mercury concentrations in fish are too high to be returned to Minnesota's mercury water quality standard through reductions in mercury emissions from Minnesota sources alone. Based on limited sampling in studies done by PolyMet, it is estimated that total mercury concentrations in the Embarrass River averaged 4.8 ng/L at monitoring station PM-12 and 4.0 ng/L at monitoring station PM-13 from 2004 to 2013. Methylmercury concentrations in the Embarrass River averaged 0.5 ng/L at PM-12 and 0.4 ng/L at PM-13 over the same period (see Section 4.2.2.1.4). The overall average total mercury concentration at two discharge locations at the existing LTVSMC Tailings Basin (SD-026 and SD-004) over a 5-year period was 1.0 ng/L, indicating relatively low mercury concentrations in the seepage from this basin. All monitoring results were well below average concentrations in precipitation (approximately 13 ng/L), suggesting that some mercury appears to be sequestered in the existing LTVSMC tailings.

As discussed in Section 5.2.2.3.4, mercury would be released from the Tailings Basin via seepage, discharge from the WWTP, and volatilization from the Tailings Basin pond. As with the Mine Site, analog data and simple mass balance model estimation methods were used to estimate future mercury concentrations. Table 6.2.2-6 summarizes the relative mercury contributions from the various identified activities in the watershed. As discussed in Section 5.2.2.3.4 and above, research indicates that mining itself is not expected to appreciably affect total mercury discharges; rather, the greater concern is the potential for sulfate discharges/releases to promote mercury methylation.

Table 6.2.2-6 Cumulative Mercury Loadings to the Embarrass River by Activity

Activity	Average Discharge/ Release Rate (cfs)	Representative Mercury Concentration (ng/L)	Average Total Mercury Load (kg/d)
City of Babbitt POTW	0.1	2.6	6.4E-07
Cliffs Erie Area 5 NW Pit	1.2	0.93	2.7E-06
City of Aurora POTW	0.3[(1)]	NA	NA
City of Biwabik POTW	0.0	0.0	0.0
ArcelorMittal Mines (Laurentian and East Reserve Mine)	9.3	1.6	3.6E-05
NorthMet Project Proposed Action Plant Site WWTP	5.7 (operations) 4.3 (closure)	1.0–1.3	1.4E-05 to 1.8E-05 (operations) 1.1E-05 to 1.4E-05 (closure)

Sources: PolyMet 2014w; PolyMet 2015i; MPCA2012i; MPCA 2012j; MPCA 2013g; MPCA 2013h; MPCA 2014b; MPCA 2014c; MPCA 2014d.

Note:
[1] Discharge is to the St. Louis River.

The NorthMet Project Proposed Action is predicted to result in a net increase in mercury loadings to the Embarrass River of up to 0.2 grams per year (from 22.3 grams per year to 22.5 grams per year), which represents about a 1 percent increase. This increase is primarily attributable to the redirection of surface runoff diverted via the drainage swale constructed east of the Tailings Dam East Dam directly to Mud Lake Creek at an assumed mercury concentration of 3.5 ng/L (versus a seepage concentration of 1.0 ng/L). The Tailings Basin Containment System, which collects seepage from the Tailings Basin, with an estimated mercury concentration of 1.0 ng/L, routes it to the WWTP, which discharges with an assumed mercury concentration of 1.3 ng/L, which is considered conservative in that the WWTP and the greensand filter are expected to remove some mercury from effluent.

Overall, the NorthMet Project Proposed Action is predicted to result in a net decrease of mercury-loadings of approximately 1.0 grams per year (i.e., a net decrease of 1.2 grams per year in the Partridge River and a net increase of 0.2 grams per year in the Embarrass River), which is too small to distinguish from natural background variability using available laboratory methods. Therefore, the NorthMet Project Proposed Action would not contribute to cumulative effects on mercury loading to the St. Louis River.

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6.2.3 Wetlands

The cumulative effects analysis for wetlands included both a quantitative analysis as well as a qualitative analysis for determining cumulative effects to wetlands. An analysis was done to determine cumulative effects of direct impacts from all past, present, and reasonably foreseeable future projects to wetlands, lakes, and deepwater resources (i.e., mine pits) located in the Partridge River and Embarrass River watersheds (PolyMet 2015b). Three time periods were used in the effects analysis, including pre-settlement, existing, and the foreseeable future. In addition, a qualitative analysis was done: 1) to assess the potential cumulative wetland indirect effects (Section 6.2.3.4.4), and 2) for cumulative wetland effects for the St. Louis River below the ordinary high water mark from its confluence with the Embarrass River to Lake Superior (Section 6.2.3.4.5). A qualitative assessment of the potential impacts of climate change on wetlands is discussed in Section 5.2.7.2.4 and 6.2.7.

6.2.3.1 Approach

An estimate of pre-settlement wetland, lake, and deepwater (i.e., mine pits) acreages within the Partridge River and Embarrass River watersheds was developed using the USFWS NWI maps and the original survey maps developed using data from the original General Land Office surveys (PolyMet 2015b).

Existing wetland, lake, and deepwater resources were estimated using wetland delineations completed in the area, NWI maps, USGS National Hydrograph Dataset (to estimate lacustrine waterbodies), and MDNR Mesabi Mining features in combination with 2010 LiDAR data and aerial photographs from 2003, 2008, 2009, and 2010 to estimate deepwater or mine pit waterbodies (PolyMet 2015b).

Federal, state, and local agencies were contacted to identify foreseeable future actions within the Partridge River and Embarrass River watersheds. Agency officials were asked to identify actual or potential development projects that may occur in these two watersheds during the life of the NorthMet Project Proposed Action. The projects and their proposed mitigation for this assessment are provided below (PolyMet 2015b):

- The NorthMet Project Proposed Action, located in the Embarrass and Partridge River watersheds, would directly affect 913.8 acres of wetlands located within the NorthMet Project area over the next 20 years (see Table 6.2.3-1). Approximately 321 acres of deepwater habitat is planned at the Mine Site at the conclusion of the NorthMet Project Proposed Action.
- The proposed Mesabi Mining Project, located in the Partridge River Watershed, has identified the potential for approximately 267 acres of direct wetland impact over the life of the project (see Table 6.2.3-1). Approximately 1,601 acres of deepwater habitat is planned at the conclusion of the project, resulting in an increase of 49 acres from existing 1,552 acres of deepwater habitat (see Table 6.2.3-1).
- The ArcelorMittal Deposit East Reserve Project, located in the Embarrass River Watershed, has identified the potential for 116.2 acres of direct wetland impact over the life of the project (see Table 6.2-3-1). Through 2014 there have been 67.1 acres of direct wetland impacts, which have been accounted for under present conditions. Therefore, potential future

wetland impacts of 49.1 acres would still be anticipated over the life of the project (see Table 6.2.3-1). Approximately 275 acres of deepwater habitat is planned at the conclusion of the project, resulting in an increase of 275 acres from the existing zero acres of deepwater habitat.

- The ArcelorMittal Deposit Push Back Project, located in the Embarrass River Watershed, has identified the potential for approximately 23 acres of direct wetland impact over the life of the project (see Table 6.2.3-1). Approximately 107 acres of deepwater habitat may develop at the conclusion of the project, resulting in an increase of 107 acres from the existing zero acres of deepwater habitat.
- The Mining Resources Austin Powder Project, located in the Embarrass River Watershed, has identified the potential for 3.4 acres of direct wetland impact over the life of the project (see Table 6.2.3-1). No deepwater habitat is planned at the conclusion of the project.
- The Mining Resources Corsica Basin Project, located in the Embarrass River Watershed, has identified the potential for approximately 50 acres of direct wetland impact over the life of the project (see Table 6.2.3-1). No deepwater habitat is planned at the conclusion of the project.
- The Laskin Energy Park is located in the Partridge River Watershed and south of the Minnesota Power Laskin Energy Center (see Table 6.2.3-1). It is located adjacent to Colby and Whitewater Lakes, near the City of Hoyt Lakes. If every lot in the 220-acre industrial park was fully developed, the potential direct wetland impacts could range from zero to seven acres. The amount of wetland mitigation that may be conducted in the Partridge River Watershed is unknown at this time.
- St. Louis County Public Works are planning eight bridge replacements in the Partridge River and Embarrass River watersheds over the next 10 years. These bridge replacements generally directly impact 10,000 ft^2 of wetlands or less, so the maximum direct wetland impact from the bridge projects would be about 1.8 acres (see Table 6.2.3-1).

Table 6.2.3-1 below summarizes the direct wetland effects, proposed wetland mitigation, and the existing and future deepwater habitat, as well as the proposed net change for wetlands and deepwater habitat that would occur from the foreseeable future actions that were identified within the wetland CEAA. Tables 6.2.3-2 and 6.2.3-3 summarize the overall wetland and water resources found during the pre-settlement condition time period and that currently exist within the CEAA. Tables 6.2.3-4 and 6.2.3-5 summarize the overall wetland and water resources that would be expected to be future conditions within the CEAA when taking into account the projects that were assessed within the CEAA direct wetland effects and future deepwater habitat as presented in Table 6.2.3-1.

Table 6.2.3-1 Future Conditions for Wetland and Deepwater Habitat Resources for the Foreseeable Future Actions within the Partridge River and Embarrass River Watersheds

Project Name	Wetland Impact (acres)	Proposed Wetland Mitigation (acres)	Net Change in Wetlands (acres)	Existing Deepwater Habitat (acres)	Future Deepwater Habitat (acres)	Net Change in Deepwater (acres)
Partridge River Watershed[1]						
NorthMet Project Proposed Action	-767.6	0.0	-767.6	0.0	321.0	321.0
Mesabi Mining Project	-266.8	0.0	-266.8	1,552.0	1,601.0	49.0
Laskin Energy Park - worst case scenario	-6.8	0.0	-6.8	0.0	0.0	0.0
St. Louis County Public Works Bridge Replacements	-0.9	0.0	-0.9	0.0	0.0	0.0
Total - Partridge River Watershed with Project	**-1,042.1**	**0.0**	**-1042.1**	**1,552.0**	**1,922.0**	**370.0**
Total - Partridge River Watershed without Project	**-274.5**	**0.0**	**-274.5**	**1,552.0**	**1,601.0**	**49.0**
Embarrass River Watershed[1]						
NorthMet Project Proposed Action	-146.2	0.0	-146.2	0.0	0.0	0.0
NorthMet Project Proposed Action	-28.6[2]	NA[2]	-28.6	0.0	0.0	0.0
St. Louis County Public Works Bridge Replacements	-0.9	0.0	-0.9	0.0	0.0	0.0
ArcelorMittal East Reserve	-49.1	0.0	-49.1	0.0	275	275
ArcelorMittal Pushback	-23.5	0.0	-23.5	0.0	107	107
Mining Resources – Powder Basin (Biwabik)	-3.4	0.0	-3.4	0.0	0.0	0.0
Mining Resources – McKinley	-50.1	0.0	-50.1	0.0	0.0	0.0
Total - Embarrass River Watershed with Project	**-301.8**	**0.0**	**-301.8**	**0.0**	**382**	**382**
Total - Embarrass River Watershed without Project	**-127.0**	**0.0**	**-127.0**	**0.0**	**382**	**382**

Source: PolyMet 2015b.

Notes:
[1] The (-) represents a loss of water resources acres and the (+) represents a gain of water resources acres.
[2] These wetlands as exempt because the wetlands are located within the LTVSMC Permit to Mine Ultimate Tailings Basin Limit boundary and are not regulated by state and federal wetland regulations (see Section 5.2.3).

To estimate the future projected wetland, lake, and deepwater resource effects from the NorthMet Project Proposed Action, the Mesabi Mining Project, the Laskin Energy Park project, and the St. Louis County bridge replacements, the maximum effect acreages were used to calculate total acreages. The projected foreseeable future conditions were estimated by calculating the net change in wetlands, lakes, and deepwater resources (see Table 6.2.3-1) and then adding this future projected development of wetland, lake, and deepwater resources to the existing resource totals (PolyMet 2015b).

6.2.3.2 Cumulative Effects Assessment Area

6.2.3.2.1 Spatial

The Partridge River and Embarrass River watersheds were used as the spatial boundary for wetland cumulative effects, as these are the only watersheds in which proposed direct and indirect wetland effects would occur. A qualitative analysis of cumulative wetland effects for the St. Louis River below the ordinary high water mark from its confluence with the Embarrass River to Lake Superior was also evaluated based on a qualitative estimate of flow changes in the river.

6.2.3.2.2 Temporal

The pre-settlement condition time period represents wetland, lake, and deepwater resources as they existed prior to mining and urban development in the late 1800s to early 1900s. The existing conditions time period represents those resources as they exist today, prior to the development of the NorthMet Project Proposed Action. The future conditions time period represents wetland, lake, and deepwater resources expected to be present following the conclusion and long-term closure of the NorthMet Project Proposed Action. It was assumed that the future conditions represent the time period after the conclusion of the future projects when the mine pits would have flooded with water (PolyMet 2015b).

6.2.3.3 Cumulative Actions

This assessment included physical cumulative effects on wetland, lake, and deepwater resources associated with the current and foreseeable mining actions listed below (PolyMet 2015b). The following reasonably foreseeable cumulative actions were included in the cumulative effects assessment for wetlands:

- ArcelorMittal East Reserve Project;
- ArcelorMittal Deposits Push Back;
- LTV Steel Mining Company Former LTVSMC Pits;
- Laskin Energy Park;
- Mesabi Mining Project;
- Mesabi Nugget;
- Mining Resources Austin Powder Basin Project;
- Mining Resources Corsica Basin Project;
- Minnesota Power Laskin Energy Center;
- Northshore Mine;
- Northshore Closure; and
- St. Louis County Public Works Bridge Replacements.

6.2.3.4 Cumulative Effects Assessment

6.2.3.4.1 Pre-settlement Wetland and Water Resources

A relationship (ratio) was developed between the NWI mapping and pre-settlement mapping of wetland, lake, and deepwater resources to serve as an adjustment factor. This factor converted the original survey data to the standards of the NWI data for estimating the pre-settlement wetland, lake, and deepwater resources within disturbed areas of each watershed.

Partridge River Watershed

Using the disturbance at the township level (0.2 percent in the entire township and 0.4 percent for the portion within the watershed), the ratio of NWI to pre-settlement wetlands, lakes, and deepwater resources was calculated to be 1.21 for the least-disturbed township in the Partridge River Watershed. This ratio indicates there were approximately 21 percent more wetlands, lakes, and deepwater resources identified on the NWI maps than on the pre-settlement maps for the Partridge River Watershed (PolyMet 2015b).

Disturbance in the townships located within the Partridge River Watershed ranged between 0.4 and 52 percent, with approximately 15 percent of the entire Partridge River Watershed containing substantial human disturbance since settlement of the area. The disturbance types in the watershed consisted of: mining features such as stockpiles, mine pits, roads, and other infrastructure (82 percent of the disturbed areas); municipal/residential development (e.g., cities of Aurora and Hoyt Lakes) with some barren land and cultivated crops (13 percent of the disturbed areas); and roads and railroads (5 percent of the disturbed areas). Approximately 85 percent of the Partridge River Watershed was deemed to be relatively undisturbed; therefore, NWI mapping was used in these areas to represent pre-settlement conditions for wetlands, lakes, and deepwater resources (PolyMet 2015b).

Based on the original survey maps, approximately 2,991 acres of wetland were mapped within the disturbed areas in the Partridge River Watershed. This wetland acreage was adjusted to 3,620 acres using the 1.21 adjustment factor. After accounting for the disturbed areas, a total of 33,601 acres of wetlands was identified in the 101,812-acre watershed, comprising 33 percent of the watershed (see Table 6.2.3-2).

Based on the original survey maps, 24 acres of lake were mapped within the disturbed areas in the Partridge River Watershed. This lake acreage was adjusted to 29 acres using the 1.21 adjustment factor. After accounting for the disturbed areas, a total of 2,688 acres of lake was identified in the 101,812-acre watershed, comprising 3 percent of the watershed (see Table 6.2.3-2).

No deepwater resources were identified in the watershed for the pre-settlement conditions (see Table 6.2.3-2).

Table 6.2.3-2 Pre-settlement Wetland and Water Resources by Watershed

Watershed	Total Land Area (Acres)	Wetland Area		Lake Area		Deepwater Area	
		Acres	% of Watershed	Acres	% of Watershed	Acres	% of Watershed
Partridge River	101,812	33,601	33	2,688	3	0	0
Embarrass River	116,797	34,650	30	3,121	3	0	0

Source: PolyMet 2015b.

Embarrass River Watershed

Using the disturbance at the township level (0.6 percent in the entire township and 0.7 percent for the portion contained within the watershed), the ratio of NWI to original survey wetlands, lakes, and deepwater resources was calculated to be 0.85 for the least-disturbed township in the Embarrass River Watershed. Based on this analysis, the ratio of NWI to original survey wetlands, lakes, and deepwater resources was calculated to be approximately 15 percent fewer wetlands, lakes, and deepwater resources identified on the NWI maps than the original survey maps for the Embarrass River Watershed (PolyMet 2015b).

Disturbance in the portions of townships located within the Embarrass River Watershed range between 0.7 percent and 63 percent, with approximately 12 percent of the entire Embarrass River Watershed containing substantial human disturbance since settlement of the area. The disturbance types in the watershed consisted of: mining features including stockpiles, mine pits, roads, and other infrastructure (61 percent of the disturbed areas); municipal/residential development (e.g., cities of Babbitt, Biwabik, Gilbert, and McKinley) with some barren land and cultivated crops (27 percent of the disturbed areas); and roads and railroads (12 percent of the disturbed areas). Approximately 88 percent of the Embarrass River Watershed was deemed to be relatively undisturbed; therefore, NWI mapping was used in these areas to represent pre-settlement conditions for wetlands, lakes, and deepwater resources (PolyMet 2015b).

Based on the original survey maps, approximately 2,388 acres of wetland were mapped within the disturbed areas of the Embarrass River Watershed. This wetland acreage was adjusted to 2,030 acres using the 0.85 adjustment factor. After accounting for the disturbed areas, a total of 34,650 acres of wetlands was identified in the 116,797-acre Embarrass River Watershed, comprising approximately 30 percent of the watershed (see Table 6.2.3-2).

Based on the original survey maps, 224 acres of lake were mapped within the disturbed areas in the Embarrass River Watershed. This lake acreage was adjusted to 190 acres using the 0.85 adjustment factor. After accounting for the disturbed areas, a total of 3,121 acres of lakes was identified in the 116,797-acre watershed, comprising less than 3 percent of the watershed (see Table 6.2.3-2).

No deepwater resources (i.e., mine pits) were identified in the watershed for the pre-settlement conditions (see Table 6.2.3-2).

6.2.3.4.2 Existing Wetland and Water Resources

Partridge River Watershed

A total of 31,318 acres of existing wetlands was identified in the 101,812-acre watershed, comprising 31 percent of the land area (see Table 6.2.3-3). There has been a decrease of approximately 2,283 acres of wetland; this represents a 7 percent reduction in wetland area compared to pre-settlement conditions (PolyMet 2015b).

A total of 3,194 acres of lakes was identified in the 101,812-acre watershed, comprising 3 percent of the land area (see Table 6.2.3-3). There has been an increase of approximately 506 acres of lakes; this represents a 19 percent increase in lake area compared to pre-settlement conditions (PolyMet 2015b).

A total of 3,146 acres of deepwater resources (i.e., mine pits) was identified in the 101,812-acre watershed, comprising 3 percent of the land area (see Table 6.2.3-3). There has been an increase of 3,146 acres of deepwater resources in the watershed compared to no deepwater resources present under pre-settlement conditions (PolyMet 2015b).

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

Table 6.2.3-3 Existing Wetland and Water Resources by Watershed

	Total Land Area	Wetland Area		Lake Area		Deepwater Area	
Watershed	(Acres)	Acres	% of Watershed	Acres	% of Watershed	Acres	% of Watershed
Partridge River	101,812	31,318	31	3,194	3	3,146	3
Embarrass River	116,797	34,249	29	2,904	3	977	1

Source: PolyMet 2015b.

Embarrass River Watershed

A total of 34,249 acres of existing wetlands was identified in the 116,797-acre watershed, comprising 29 percent of the land area (see Table 6.2.3-3). There has been a decrease of approximately 401 acres of wetlands; this represents a 1 percent reduction in wetland area compared to pre-settlement conditions (PolyMet 2015b).

A total of 2,904 acres of lakes was identified in the 116,797-acre watershed, comprising 3 percent of the land area (see Table 6.2.3-3). There was a decrease of approximately 217 acres of lakes in the watershed; this represents a 7 percent reduction in lake area compared to pre-settlement conditions (PolyMet 2015b).

A total of 977 acres of deepwater resources (i.e., mine pits) was identified in the 116,797-acre watershed, comprising less than 1 percent of the land area (see Table 6.2.3-3). There has been an increase of 977 acres of deepwater resources in the watershed compared to no deepwater resources present under pre-settlement conditions (PolyMet 2015b).

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

6.2.3.4.3 Future Wetland and Water Resources

Partridge River Watershed

The NorthMet Project Proposed Action in combination with present and reasonably foreseeable future projects would likely result in the following cumulative wetlands effects:

- Approximately 30,276 acres of wetlands are projected to be present in the 101,812-acre watershed in the foreseeable future, comprising 30 percent of the land area (see Table 6.2.3-4). The change in wetlands, as a proportion of all wetlands within the study area, would be a 10 percent reduction from pre-settlement conditions and a 3 percent reduction compared to existing conditions (PolyMet 2015b).
- Approximately 3,194 acres of lakes are projected to be present in the 101,812-acre watershed in the foreseeable future, comprising 3 percent of the land area (see Table 6.2.3-4). The change in lakes, as a proportion of the total study area, would be a 19 percent increase from pre-settlement conditions and there would be no changes compared to existing conditions (PolyMet 2015b).
- Approximately 3,516 acres of deepwater resources are projected to be present in the 101,812-acre watershed in the foreseeable future, comprising 3 percent of the land area (see Table 6.2.3-4). The change in deepwater resources, as a proportion of the total study area, would be an introduction of 3,516 acres of new deepwater resources (compared to zero pre-settlement) and a 12 percent increase compared to existing conditions (PolyMet 2015b).

Some of these projects would include mitigation of wetlands, lakes, and deepwater resources in the Partridge River Watershed.

Table 6.2.3-4 Future Wetland and Water Resources by Watershed under the NorthMet Project Proposed Action

Watershed	Total Land Area (Acres)	Wetland Area		Lake Area		Deepwater Area	
		Acres	% of Watershed	Acres	% of Watershed	Acres	% of Watershed
Partridge River	101,812	30,276	30	3,194	3	3,516	3
Embarrass River	116,797	33,947,	29	2,904	3	1,359	1

Source: PolyMet 2015b.

Under the NorthMet Project No Action Alternative, development of other projects (and associated effects on and mitigation of wetlands, lakes, and deepwater resources in the Partridge River Watershed) would still occur under the foreseeable future conditions.

Under the NorthMet Project No Action Alternative, approximately 31,044 acres of wetlands have been projected to be present in the 101,812-acre watershed in the foreseeable future, comprising 30 percent of the land area (see Table 6.2.3-5). The change in wetlands, as a

proportion of all wetlands within the study area, would be an 8 percent reduction from pre-settlement conditions and a 1 percent reduction compared to existing conditions (PolyMet 2015b).

Similar to under the NorthMet Project Proposed Action, under the NorthMet Project No Action Alternative, approximately 3,194 acres of lakes are projected to be present in the 101,812-acre watershed in the foreseeable future, comprising 3 percent of the land area (see Table 6.2.3-5). The change in lakes, as a proportion of the total study area, would be a 19 percent increase from pre-settlement conditions and there would be no changes compared to existing conditions (PolyMet 2015b).

Under the NorthMet Project No Action Alternative, approximately 3,195 acres of deepwater resources are projected to be present in the 101,812-acre watershed in the foreseeable future, comprising 3 percent of the land area (see Table 6.2.3-5). The change in deepwater resources, as a proportion of the total study area, would be an introduction of 3,195 acres of new deepwater resources (compared to zero pre-settlement) and a 2 percent increase compared to existing conditions (PolyMet 2015b).

Table 6.2.3-5 Future Wetland and Water Resources by Watershed under the NorthMet Project No Action Alternative

Watershed	Total Land Area (Acres)	Wetland Area		Lake Area		Deepwater Area	
		Acres	% of Watershed	Acres	% of Watershed	Acres	% of Watershed
Partridge River	101,812	31,044	30	3,194	3	3,195	3
Embarrass River	116,797	34,122	29	2,904	3	1,359	1

Source: PolyMet 2015b.

Embarrass River Watershed

The NorthMet Proposed Project, in combination with present and reasonably foreseeable future projects, would likely result in the following cumulative wetlands effects:

- Approximately 33,947 acres of wetlands are projected to be present in the 116,797-acre watershed in the foreseeable future, comprising 29 percent of the land area (see Table 6.2.3-4). The change in wetlands, as a proportion of all wetlands within the study area, would be a 2 percent reduction from pre-settlement conditions and a 1 percent reduction compared to existing conditions (PolyMet 2015b).
- Approximately 2,904 acres of lakes are projected to be present in the 116,797-acre watershed in the foreseeable future, comprising 3 percent of the land area (see Table 6.2.3-4). The change in lakes, as a proportion of the total study area, would be a 7 percent reduction from pre-settlement conditions and there would be no changes compared to existing conditions (PolyMet 2015b).

- Approximately 1,359 acres of deepwater resources are projected to be present in the 116,797-acre watershed in the foreseeable future, comprising a 1 percent of the land area (see Table 6.2.3-4). There would be an introduction of 1,359 acres of new deepwater resources (compared to zero pre-settlement) and there would be a 39 percent increase in deepwater resources compared to existing conditions (PolyMet 2015b).

Under the NorthMet Project No Action Alternative, development of other projects (and associated effects on and mitigation of wetlands, lakes, and deepwater resources in the Partridge River Watershed) would still occur under the foreseeable future conditions.

Under the NorthMet Project No Action Alternative, approximately 34,122 acres of wetlands have been projected to be present in the 116,797-acre watershed in the foreseeable future, comprising 29 percent of the land area (see Table 6.2.3-5). The change in wetlands, as a proportion of all wetlands within the study area, would be a 2 percent reduction from pre-settlement conditions and less than 1 percent reduction compared to existing conditions (PolyMet 2015b).

Similar to under the NorthMet Project Proposed Action, under the NorthMet Project No Action Alternative, approximately 2,904 acres of lakes are projected to be present in the 116,797-acre watershed in the foreseeable future, comprising 3 percent of the land area (see Table 6.2.3-5). The change in lakes, as a proportion of the total study area, would be a 7 percent reduction from pre-settlement conditions and there would be no changes compared to existing conditions (PolyMet 2015b).

Similar to the NorthMet Project Proposed Action, under the NorthMet Project No Action Alternative, approximately 1,359 acres of deepwater resources are projected to be present in the 116,797-acre watershed in the foreseeable future, comprising 1 percent of the land area (see Table 6.2.3-5). The change in deepwater resources, as a proportion of the total study area, would be an introduction of 1,359 acres of new deepwater resources (compared to zero pre-settlement) and there would be a 39 percent increase in deepwater resources compared to existing conditions (PolyMet 2015b).

6.2.3.4.4 Qualitative Assessment of Cumulative Potential Indirect Effects

It is difficult to predict indirect wetland effects within the CEAA, as well as to know what the potential indirect wetland effects would be for the projects assessed other than the NorthMet Project Proposed Action. However, based on the amount of potential indirect wetland effects that could occur from the NorthMet Proposed Action, there could be 0.1 to 12.0 percent cumulatively lost, in addition to the direct wetland impacts assessed, within the Partridge and Embarrass River watersheds.

Based on the wetlands crossing analog zones analysis approach, the acreage of wetlands whose hydrology would have a high likelihood of being affected by drawdown at the Mine Site is 866.9 acres. The wetlands categorized as high likelihood are dominated by one alder thicket (848 acres) that has approximately 4 acres (less than 1 percent) within the 0-1,000 ft analog impact zone. The remainder of this wetland (more than 99 percent) is located more than 1,000 ft away from the edge of the mine pits and extends out to the edge of Area 1 (see Figure 5.2.3-6). Furthermore, based on this method, there would be 1,854.5 acres of wetlands within the 0-2,000 ft zone and 2,147.6 acres within the 0-3,500 ft zone that could be affected by potential drawdown. Based on this approach, the total projected potential indirect effects from all six

factors that were assessed under this method could be up to 7,694.2 acres of wetlands potentially indirectly affected by the NorthMet Project Proposed Action. Therefore, the potential indirect cumulative effect from the NorthMet Project Proposed Action, in addition to the direct wetland impacts assessed, under this method would range between 1.3 to 12 percent.

Based on the method approach of wetlands within analog zones, the acreage of wetlands whose hydrology would have a high likelihood of being affected by drawdown at the Mine Site is 46.4 acres. Furthermore, based on this method, there would be 348.4 acres of wetlands within the 0-2,000 ft zone and 733.3 acres within the 0-3,500 ft zone that could be affected by potential drawdown. Based on this approach, the total projected potential indirect effects from all six factors that were assessed under this method could be up to 6,568.8 acres of wetlands potentially indirectly affected by the NorthMet Project Proposed Action. Therefore, the potential indirect cumulative effect from the NorthMet Project Proposed Action, in addition to the direct wetland impacts assessed, under this method would range between 0.1 to 10.2 percent.

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

The XP-SWMM model developed for the Partridge River identified that the changes in average annual flow (and therefore stage) of the Partridge River would be within the naturally occurring annual variation for the Partridge River. Section 5.2.2 provides more details on the XP-SWMM model. Therefore, no potential indirect cumulative wetland effects are identified for the wetlands abutting the Partridge River.

The St. Louis River is located downstream of the Partridge River. Effects on flows (and, by extension, water surface elevations) generated by the NorthMet Project Proposed Action are anticipated to be less than those estimated for the Partridge River and within the natural variation of flow within the St. Louis River (e.g., less than 1 percent reduction in average annual flow as measured at the confluence of the Embarrass River with the St. Louis River). Therefore, no potential indirect cumulative wetland effects are identified for the wetlands within the St. Louis River below the ordinary high water mark, from its confluence with the Embarrass River to Lake Superior.

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6.2.4 Vegetation

The cumulative effects analysis for vegetation focuses on potential losses of vegetative cover types, plant communities, MBS Sites of Biodiversity Significance, and ETSC plant species. As described below, the NorthMet Project Proposed Action would contribute to a loss of vegetative cover and ETSC plant species populations, which would combine with other past, present, and reasonably foreseeable future actions in the CEAA. Given the risk to the viability of ETSC species and their sensitivity to changes to their habitat from development projects, the analysis focuses on these species. Wildlife habitat is addressed in Section 6.2.5.

6.2.4.1 Approach

The GIS data presented in Sections 4.2.4 and 5.2.4 was compared to other actions within the CEAA, and the cumulative effects were assessed. Specifically, GIS data were obtained from the MDNR regarding the GAP, which is vegetation land cover types derived from satellite imagery, and listed ETSC plant species within the NHIS database.

GIS analysis was used to calculate effects on the resources described above. The effects were calculated for habitat types, classifications, and species where they physically overlap tailings piles, mine pits, tailings basins, roads, buildings, or other new infrastructure associated with the cumulative actions below.

NorthMet Project Proposed Action-related effects on the 10 state-listed ETSC plant species that may be present in the NorthMet Project area were identified and evaluated in Section 5.2.4.2. As discussed below, of these 10, three have a distribution that may be subject to cumulative effects. No federally listed ETSC plant species would be affected by the NorthMet Project Proposed Action (see Section 5.2.4.2). Because six of the ETSC species are also RFSS plants, the analysis below also applies to the known RFSS plants in the NorthMet Project area.

This section evaluates the potential cumulative effects of the NorthMet Project Proposed Action on these 10 ETSC plant species. Potential future effects were identified by analyzing Taking Permits (issued by the USFWS or MDNR to authorize activities resulting in the loss of federally or state-listed species), as well as GIS information from the MDNR, to determine the extent of expected losses from recently permitted projects.

6.2.4.2 Cumulative Effects Assessment Area

The NorthMet Project Proposed Action's CEAA boundary for vegetation is described below, both spatially and temporally.

6.2.4.2.1 Spatial

The CEAA for evaluation of cumulative effects on vegetation is defined geographically by the portion of the Mesabi Iron Range encompassed by the Nashwauk Uplands and Laurentian Uplands ecological subsections (see Figure 6.1.1-1). The ecological subsections are described in detail in Section 4.2.4.1. The area has been limited to the Mesabi Iron Range as it is a definable physiographic region encompassing the region's mining, which represents the largest and most influential land use within a reasonable distance from the NorthMet Project area.

6.2.4.2.2 Temporal

Overall habitat composition changes in the ecological subsections were evaluated as the temporal area of assessment, based on pre-settlement conditions (approximately 1890) through the present day (1990 to present). These timespans are indicative of past and relatively current trends in regional habitat changes relevant to the CEAA. An estimate of future trends would be based on estimated development/habitat loss, direct loss of species and individuals, and the regulatory requirements for protected species and habitats (i.e., approximately 40 years, which is consistent with the life of the NorthMet Project Proposed Action, including construction, operations, and closure).

6.2.4.3 Contributing Past, Present, and Reasonably Foreseeable Actions

As noted previously, it is not possible to identify all past activities that may contribute to a cumulative effect. Similarly, all present activities would continue to affect the environment. The impacts of these combined activities are described in Chapter 4, Affected Environment. This assessment includes physical cumulative effects on vegetation cover types and protected ETSC plant species associated with current and foreseeable mining actions listed below. The following reasonably foreseeable projects and/or actions, described further in Section 6.1.1.2, are included in the cumulative effects assessment for vegetation:

- ArcelorMittal Deposits (Laurentian and East Reserve deposits);
- ArcelorMittal Deposit Push Back;
- Cliffs Erie Pellet Yard;
- Community growth and development;
- Essar Steel;
- Forestry on public and private lands;
- Magnetation (Coleraine, Keewatin, Chisholm);
- Mining Resources (Sherman Basin);
- MDOT Highway 53 Relocation;
- St. Louis County Public Works Bridge Replacements;
- United Taconite Mine Expansions; and
- U.S. Steel Keetac Mine Expansion Project.

This analysis also looked at the six actions listed below:

- LTV Steel Mining Company (Former LTVSMC Pits);
- Mesabi Mining Project;
- Mesabi Nugget;
- Northshore Mine;
- Northshore Mine Ultimate Pit Progression Project; and

- U.S. Steel Minntac Mine.

Using best available information, the NHIS data and MDNR Taking Permit data were reviewed and no vegetation records were available for these six actions. As a result, these actions are not considered in the cumulative effects analysis for vegetation.

6.2.4.4 Cumulative Effects Assessment

6.2.4.4.1 Evaluation Criteria

The cumulative effects assessment on vegetation is guided by evaluation criteria, which are outlined below:

- Direct effects on vegetative cover types, plant communities, MBS Sites of Biodiversity Significance, and rare species would occur through clearing, filling, and other construction activities. Direct effects would include the removal of vegetation in the construction, operation, maintenance, or closure of the NorthMet Project Proposed Action when an ETSC plant species is removed (i.e., taking of an individual plant or entire plant populations).
- An indirect effect occurs on vegetation when a change in conditions results in a change over time in cover type, plant community, or MBS Sites of Biodiversity Significance, or a rare species experiences a change in vegetative composition. Potential indirect effects on vegetation may include changes in hydrology, deposition of particulate matter (dust), changes in successional stage, alteration of microclimate (e.g., tree removal resulting in drier soil conditions, rise or fall in water table, loss of pollinators, or loss of fungal associates in the rooting zone), new or increased erosion and sedimentation, and invasion of non-native species.

6.2.4.4.2 Existing Baseline Conditions and Past Losses

As discussed in detail in Chapter 4, past changes in cover types show a mixed pattern of gains and losses from the 1890s to the 1990s (see Table 6.2.4-1). These trends are continuing today and would be expected to continue into the future. In the Laurentian Uplands subsection, few cover types discussed below have decreased. In the Nashwauk Uplands subsection, many of the cover types have experienced declines over this period, with the largest percentage decline to upland coniferous forests and upland conifer-deciduous mixed forests. Among the ETSC plant species that occur within the NorthMet Project area boundaries, ternate, or St. Lawrence, grapefern (*Botrychium rugulosum*) is most likely to occur in the upland coniferous type (see Table 6.2.4-2). Floating marsh marigold (*Caltha natans*) and least grapefern (*Botrychium simplex*) are most likely among these species to occur in the lowland deciduous type. Floating marsh marigold occupies edges of ponds, lakes, and streams in the lowland deciduous type, and least grapefern also occupies open wetlands, grasslands, and disturbed areas; consequently, a loss in lowland deciduous types is a less accurate reflection of trends in these species' habitats. While it appears the Laurentian Uplands subsection lost a large portion of shrublands, it is likely that habitat type was allowed to grow older, which explains the increases in upland coniferous and deciduous forests. The opposite is true for the Nashwauk Uplands subsection. Upland forest types were likely harvested in this subsection, which resulted in the increase of younger stands and shrubland habitat types.

Table 6.2.4-1 Changes in Habitat Acreage between 1890 and 1990 by Ecological Subsection

Habitat Type	Percentage of Laurentian Uplands Gain/(Loss)	Percentage of Nashwauk Uplands Gain/(Loss)
Lowland coniferous forest	7	(4)
Lowland deciduous forest	<1	2
Upland coniferous forest	4	(8)
Upland deciduous forest	2	(1)
Upland conifer-deciduous mixed forest	<1	(5)
Shrubland	(15)	9
Aquatic environments	1	<1
Disturbed[1]	na	na
Cropland/Grassland[1]	na	na

Source: MDNR 2006a.

Note:
[1] "na" indicates that insufficient data were available to determine percent coverage within the ecological subsections, although these habitat types likely occurred at low levels.

This conclusion should be qualified by the understanding that the mapped habitat type does not precisely match the habitat actually used by an ETSC or RFSS plant species. Because these plant species occupy preferred habitats within larger mapped habitat types, the effect of habitat loss may not directly correlate on a 1:1 basis to the effect on a plant species. Given this lack of precision and uncertainty, the analysis assumed that large losses in mapped habitat types represent a trend in losses of preferred habitat types for these ETSC or RFSS plant species.

Table 6.2.4-2 Preferred Habitat for State-listed ETSC/RFSS Plant Species and Most Likely Associated Habitat Types

Species	Preferred Plant Species Habitat	Corresponding Map Habitat Type
Botrychium campestre	Prairies, dunes, railroad sidings, fields	Disturbed; Cropland/ Grassland
Botrychium pallidum[1]	Open, disturbed habitats, log landings, roadsides, dunes, sandy gravel pits	Disturbed; Cropland/ Grassland
Botrychium rugulosum[1]	Generally open habitats, such as old log landings and edges of trails	Disturbed; Upland coniferous
Botrychium simplex[1]	Generally open habitats, such as old log landings, roadside ditch, trails, open fields, base of cliff, railroad rights of way	Disturbed; Cropland/Grassland; Lowland deciduous
Caltha natans[1]	Shallow water of pools, ditches, sheltered lake margins, slow moving creeks, sloughs/oxbows, pools in shrub swamps	Aquatic environments; Lowland coniferous; Lowland deciduous
Eleocharis nitida[1]	Mineral soil of wetlands, often with open canopy and disturbance, such as logging roads/ditches through wetlands	Lowland coniferous; Disturbed
Juncus stygius var. americanus[1]	Shallow pools in non-forested peatlands, often in a sedge-dominated community	Lowland coniferous
Platanthera clavellata	Coniferous swamps, fens	Lowland coniferous
Ranunculus lapponicus	Lowland conifer forests and peat bogs	Lowland coniferous
Torreyochloa pallida	Pond/stream margins, lowland coniferous forest	Aquatic environments; Lowland coniferous

Source: MDNR 2011k; USFS 2010d.

Note:
[1] These species are also RFSS plants as tracked by the USFS.

6.2.4.4.3 Environmental Consequences of Reasonably Foreseeable Actions on ETSC and RFSS Plant Species

Future effects on ETSC and RFSS plant species were evaluated by comparing ETSC plant species Taking Permits from the MDNR to the reasonably foreseeable actions within the cumulative spatial boundary. In addition, MDNR Lands and Minerals Division data provided reasonably foreseeable action footprints for comparison. These were combined with best available data that identified all known populations of ETSC plant species. Populations are defined as a number of individuals of a species within proximity to each other and within a defined habitat that can be self-sustaining under current conditions. MDNR NHIS populations that match the ETSC Taking Permits from the MDNR or are contained within them are presented below for the cumulative discussion. These populations can contain from a few to thousands of individual plants. Of the 10 ETSC plant species present in the NorthMet Project area, three species would also be affected by other cumulative projects within the CEAA (see Table 6.2.4-3). Cumulative effects on each of the state-listed ETSC species known to occur on the Mine Site are discussed below. As discussed in Section 5.2.4.2, no federally listed ETSC plant species would be affected by the NorthMet Project Proposed Action.

Table 6.2.4-3 Potential Future Effects on ETSC or RFSS Plant Species Populations Occurring from Reasonably Foreseeable Activities[1,2]

Species[1]	Other Projects Direct Effect (Populations)	Other Projects Indirect Effect (Populations)	NorthMet Project Proposed Action Total Effect (Populations)	Total Known Statewide Populations[3]	Percent of Known Statewide Populations Affected
Botrychium pallidum[4]	4	0	1	99	5
Botrychium rugulosum[4]	5	0	1	72	8
Botrychium simplex	3	0	3	210	3

Notes:
[1] Species upon which no other actions besides the NorthMet Project Proposed Action are expected to have effects are discussed in the "Proposed Action" section.
[2] 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.
[3] Statewide population data provided by Lisa Joyal (MDNR) on March 26, 2013.
[4] These species are also RFSS plants as tracked by the USFS.

Pale moonwort (*Botrychium pallidum*) is widely distributed across five Canadian provinces and eight U.S. states (Colorado, Maine, Michigan, Minnesota, Montana, South Dakota, Wisconsin, and Wyoming). The NorthMet Project Proposed Action would directly affect one population. The cumulative actions within the CEAA would directly affect four additional populations, while no populations are expected to be indirectly affected. In total, approximately 5 percent of the known populations in Minnesota would be directly affected by the NorthMet Project Proposed Action and other present or reasonably foreseeable activities (see Table 6.2.4-3). Due to its small size, the species is easily overlooked and additional populations may yet be located. *B. pallidum* was listed as a state endangered species in 1996 when there were just six documented occurrences in Minnesota. By 2009, the number had risen to 65 (MDNR 2011k). Its relatively short lifespan (emergence to senescence within four weeks) may account for the few populations documented to date. Given its preference for disturbed sites, the cumulative effects of the NorthMet Project Proposed Action and other reasonably foreseeable activities are not expected to jeopardize the presence of *B. pallidum* in Minnesota or in North America.

Ternate, or St. Lawrence, grapefern (*Botrychium rugulosum*) is widely distributed across three Canadian provinces and six U.S. states (Connecticut, Michigan, Minnesota, New York, Vermont, and Wisconsin). The NorthMet Project Proposed Action would directly affect one population of the species (see Section 5.2.4.2). Other reasonably foreseeable activities would directly affect five populations; no populations would be indirectly affected. In total, approximately 8 percent of the known populations in Minnesota would be directly affected by the NorthMet Project Proposed Action and other reasonably foreseeable activities (see Table 6.2.4-3). *B. rugulosum* was listed as a state threatened species in Minnesota in 1996 (MDNR 2011k). This species' tolerance for disturbance in early successional communities allows it to establish in areas previously disturbed by human activity. Because of this habitat preference, and the early successional habitats that develop around disturbed areas, the cumulative effects of the NorthMet Project Proposed Action and other reasonably foreseeable activities are not expected to jeopardize the presence of *B. rugulosum* in Minnesota or in North America.

Least grapefern (*Botrychium simplex*) is widely distributed across 34 U.S. states and 11 Canadian provinces. The NorthMet Project Proposed Action would directly affect three populations of the species. Other reasonably foreseeable activities would directly affect three populations; no populations would be indirectly affected. In total, approximately 3 percent of the known populations in Minnesota would be directly affected. Given its tolerance for disturbance and that the species is considered "secure," the cumulative effects of the NorthMet Project Proposed Action and other reasonably foreseeable activities are not expected to jeopardize the presence of *B. simplex* in Minnesota or in North America.

In addition to past, present, and reasonably foreseeable activities, other future changes in habitat types may affect ETSC plant populations. Forestry management generally has a greater influence on habitat acreage within the range of these ETSC plant species than does mining and other land development. It should be noted, however, that forestry management offers a greater range of options for ETSC plant species to co-exist with the practice, as it can mimic natural disturbances, whereas mining represents a complete land conversion that could affect long-term ETSC habitat availability. Between 2005 and 2014, the average annual forest acres within the Laurentian Uplands subsection that were harvested on state lands was approximately 1,034 acres (0.2 percent of the subsection) (MDNR 2006b). Between 2010 and 2019, the average annual forest acres within the Nashwauk Uplands subsection that were or will be harvested on state lands was approximately 1,189 acres (0.1 percent of the subsection) (MDNR 2010b). On average, 1 percent of timber land in the Superior National Forest is harvested annually (MDNR, Pers. Comm., April 26, 2012). Private timber harvest data are generally not available. The potential cumulative effects on the three state-listed ETSC species identified by this assessment are small relative to the extent of the populations and distribution within the Superior National Forest and within the state.

6.2.4.4.4 Effects from Acid (NO_2/SO_2) and Mercury Deposition

Acid (sulfuric and nitric) and mercury deposition from air sources could also affect vegetation and ETSC species. The sources and analysis are described in Section 6.2.7.5. These depositions may have an adverse effect on the overall biodiversity of terrestrial ecosystems, including forested habitats, cover types, and plant communities. These pollutants may travel long distances and contribute to complex chemical and physical reactions within a variety of forested habitats, which could contribute to increased vulnerability of sensitive vegetation. Additionally, these pollutants can be carried by precipitation into nearby lakes and rivers, which sustain some vegetation and forested habitats. The lakes (and their associated watersheds) in the vicinity of the CEAA include Heikkila Lake, Colby Lake, Sabin Lake, Wynne Lake, and Whitewater Lake.

As described in Section 6.2.7.5, since the NorthMet Project Proposed Action would have relatively low emissions of SO_2 and NO_2 and potential deposition of sulfate would be below both the Minnesota standard threshold value and the federal Class I threshold values, in combination with the overall reduction in sulfate and nitrate-producing emissions cumulatively since 2008, the actions and projects would not likely cause a cumulative effect on the ecosystems.

The MPCA estimated that over 90 percent of the mercury deposition within Minnesota is a result of other states and countries (MPCA 2013e). However, as described in Section 5.2.7.2.5, the Plant Site would be expected to contribute essentially all of the NorthMet Project Proposed Action-related mercury air emissions of 4.6 lbs/year, as the Mine Site only contributes potential emissions of less than 1.0 lb/yr (Barr 2011g). Based on the results of the MMREM evaluation

summarized in cumulative effects Section 6.2.6.3.3, the potential additional mercury load that might be added to the Embarrass River and the Partridge River from air emissions is not expected to adversely affect these ecosystems when compared to the variability in background mercury concentrations. Similarly, the mercury deposition on terrestrial environments is not expected to adversely affect these ecosystems when compared to variability in background mercury concentrations. Additional information on the cumulative analysis of acid and mercury deposition associated with air emissions is summarized in Section 6.2.6.3.3 and 6.2.7.5.

6.2.5 Wildlife

The cumulative effects analysis for wildlife focuses on potential losses of sensitive wildlife species (federally and state-listed species and Species of Special Concern, SGCN, RFSS, and other wildlife species), effects on wildlife habitat, and effects on wildlife travel corridors. The analysis reveals that, while some loss and fragmentation of wildlife habitat would occur as a result of the NorthMet Project Proposed Action and other cumulative projects in the CEAA, these actions would not further threaten special status wildlife species. See Section 6.2.4 for the discussion of potential cumulative effects from loss of vegetation cover types.

6.2.5.1 Approach

Cumulative effects on wildlife may include the loss and/or fragmentation of habitat and encroachments into critical wildlife travel corridors. Similar to the direct and indirect effects for the NorthMet Project Proposed Action, analysis was also conducted for cumulative effects on sensitive species such as federally or state-listed species, SGCN, and RFSS. These effects were assessed by evaluating the effects of the NorthMet Project Proposed Action with other past, present, and reasonably foreseeable future federal, state, and private actions.

Analysis of cumulative effects on wildlife was assessed both qualitatively and quantitatively using the following methods:

- MCWCS Action Plan, *Tomorrow's Habitat for the Wild & Rare* (MDNR 2006d);
- Marschner's Original Pre-settlement Vegetation Map of Minnesota as interpreted and analyzed by researchers, the Minnesota Forest Resources Council, and at the subsection level in the MCWCS approach by the MDNR (MFRC 2003a; MDNR 2006d); and
- Reports on mining, infrastructure, and forestry effects (e.g., Emmons & Olivier 2006; USFS 2004b); state timber harvest reports (MDNR 2006b; MDNR 2010b).

The MCWCS is a central component of MDNR's strategy for managing wildlife populations in the state; use of the strategy is therefore appropriate as the basis for assessing cumulative effects on wildlife habitat loss and fragmentation.

6.2.5.2 Cumulative Effects Assessment Boundary

6.2.5.2.1 Spatial

The spatial CEAA for wildlife includes the portions of the Mesabi Iron Range located within the Nashwauk Uplands and Laurentian Uplands ecological subsections (see Figure 6.1.1-1). The area has been limited to the Mesabi Iron Range, as it is a definable physiographic region encompassing the region's mining, which represents an influential land use in regards to wildlife and wildlife habitat.

6.2.5.2.2 Temporal

Overall habitat composition changes in the ecological subsections were evaluated as the temporal area of assessment, based on pre-settlement conditions (approximately 1890) through the present day (1990 to present). These timespans are indicative of past and relatively current trends in regional habitat changes relevant to the CEAA. An estimate of future trends is based on

estimated development/habitat loss, direct loss of species and individuals, and the regulatory requirements for habitat and protected species (e.g., approximately 40 years, which is consistent with the life of the NorthMet Project Proposed Action, including construction, operations, and closure).

6.2.5.3 Past, Present, and Reasonably Foreseeable Future Actions

The following projects and actions, described in Section 6.1.1.2, have been included in the cumulative effects analysis due to their potential effects on wildlife across the Laurentian Uplands and Nashwauk Uplands ecological subsections:

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits);
- ArcelorMittal Deposit Push Back;
- Cliffs Erie Pellet Yard;
- Community growth and development (regional), including road construction and expansion projects;
- Essar Steel Mine;
- Forestry practices (regional);
- LTV Steel Mining Company Former LTVSMC Pits;
- Magnetation (Coleraine, Keewatin, and Chisholm);
- Mesabi Mining Project;
- Mesabi Nugget;
- Mining Resources (Sherman Basin);
- MDOT US Highway 53 Virginia to Eveleth Relocation;
- Northshore Mine and Northshore Ultimate Pit Progression Project;
- United Taconite Mine Expansions;
- U.S. Steel Mine Expansion Project (Keetac); and
- U.S. Steel Minntac Mine and Extension Project.

6.2.5.4 Cumulative Effects Assessment

6.2.5.4.1 Wildlife Habitat

The study area for loss and fragmentation of habitat is the 810,000-acre Nashwauk Uplands and the 567,000-acre Laurentian Uplands ecological subsections. Forest composition changes from the pre-settlement period through current conditions are indicative of wildlife habitat trends. The MCWCS approach uses Marschner pre-settlement mapping as a baseline for describing changes taking place in vegetation types/ecosystems since the 1800s, using recent land cover data from the Minnesota GAP land cover data and reported by ecological subsection (MDNR 2006d). The effects on wildlife were evaluated by noting the change in amount of each Marschner habitat type in terms of the effect on wildlife species that use that habitat type.

Wildlife habitats that decreased in acreage from pre-settlement to current conditions present a higher risk of future SGCN population decreases and are in greater need of conservation in Minnesota.

The changes in habitat types in the Nashwauk Upland and Laurentian Upland subsections from pre-settlement through today are presented in Section 6.2.4.4, in Table 6.2.4-1. These data indicate an overall decrease in upland and lowland forest types in the Nashwauk Uplands ecological subsection during these periods. Forest types increased in the Laurentian Uplands.

In the majority of the region, forest communities have transitioned from predominately pine- and tamarack-dominated forests to aspen and other non-pine community-dominated forest species. Further, research indicates that current mature forest represents only about 4.4 percent of the old growth acreage that existed in the 1800s (Jaakko Poyry 1994). Forest composition has changed, and the MFRC (2003b) concluded that forest fragmentation has increased, with decreased patch sizes and more miles of forest edge.

Within the Laurentian Uplands and Nashwauk Uplands subsections, agricultural land use is minimal. Developed land including mined lands, non-mine related industrial use, commercial and residential use, cropland, and pasture total 11 percent of the Nashwauk Uplands and 1 percent of the Laurentian Uplands. The balance is higher quality wildlife habitat, including forest, wetlands, and open water.

Some wildlife species in northeast Minnesota are sensitive to habitat changes and may be adversely affected by change. Disturbance (such as fire and forestry) produces a landscape pattern that contains less habitat for species needing large habitat patches, such as ovenbirds, and poorer quality habitat for species requiring older and more diverse forest vegetation, such as northern goshawks (MFRC 2003a). Some wildlife populations are more affected by timber harvest and forest composition than others, and species whose habitat range edges are affected by forest composition changes are more likely to be affected (Jaakko Poyry 1994).

An assessment of cumulative effects through 2014 from forestry, and for an unstated near-term period from mining and non-mining development, was completed for the 12.5 million-acre Arrowhead Region, which includes the Laurentian Uplands and Nashwauk Uplands ecological subsections (Emmons & Olivier 2006). Potential disturbances to wildlife habitat within the Laurentian Uplands ecological subsection were primarily due to timber harvest and mining, and habitat types most likely to be affected included upland and lowland coniferous forest, upland deciduous forest, and upland shrub/woodland. Within the Nashwauk Uplands ecological subsection, mining activities and urban development were more likely to affect wildlife habitat, with upland deciduous forests and upland shrub/woodland habitats most affected (Emmons & Olivier 2006).

A subsequent study for the Keetac Expansion Project (Barr 2009a) expanded on a previous wildlife corridor and habitat analysis and quantified the effects on habitat from reasonably foreseeable mining and urban/development projects along the Iron Range (Emmons & Olivier 2006). The study differentiated between “high-impact” and “moderate-impact” features as related to mining and other urban/development. High-impact features create physically impenetrable barriers to wildlife including mining pits, in-pit activities, and operations plants and buildings. Moderate-impact features are areas that experience a change in topography, community structure, diversity, and function but would not be physically impenetrable for many

species, such as stockpiles, tailings basins, borrow areas, settling ponds, and haul roads. Moderate-impact areas may naturalize and revegetate over time (Barr 2009a).

6.2.5.4.2 Wildlife Travel Corridors

Wildlife could be affected by the NorthMet Project Proposed Action and other actions through a cumulative disruption of their travel corridors. These actions could pose additional barriers to wildlife movement by increasing the number of isolated patches of suitable habitat, increasing mortality during transit, and physically blocking travel. This may lead to increased population and genetic isolation and decreased meta-population dynamics, which in turn could lead to decreases in overall population stability and persistence. See Section 5.2.5.2.3 for a discussion on studies regarding wildlife corridor mitigation options.

Two studies have examined the potential cumulative effects of mining operations on wildlife movement along the Iron Range, the conclusions of which form the base of cumulative effect analysis in this FEIS: Emmons & Olivier (2006) supplemented with additional findings from Barr (2009a).

As noted in Chapter 4, there are 13 major wildlife travel corridors connecting large roadless blocks along the Mesabi Iron Range (Emmons & Olivier 2006). These corridors range from less than 0.1 mile to over 3.2 miles wide, with a total combined length of 20.2 miles.

Barr Engineering (2009a) also analyzed wildlife corridors along the Mesabi Iron Range, identifying five additional corridors (for a total of 18) along the same extent and differentiating between mine features that precluded wildlife movement (high-impact features) and mine features that were still passable and would potentially revegetate over time (moderate-impact features) (see Figure 6.2.5-1).

Effects on these wildlife travel corridors were classified as: 1) direct loss of habitat inside the corridor, 2) fragmentation of habitat inside the corridor, 3) isolation of a corridor by the creation of a barrier inside or near its termini, and 4) direct loss or fragmentation of large habitat blocks outside the corridor, which are the presumed destinations of the animals using the corridors. This analysis included the following projects that could potentially represent barriers to wildlife travel:

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits);
- Essar Steel Mine;
- Magnetation (Chisholm);
- Mesabi Mining Project;
- Mesabi Nugget;
- Mining Resources (Sherman Basin);
- Northshore Mine;
- U.S. Steel Keetac Mine Expansion Project; and
- U.S. Steel Minntac Mine Extension Project.

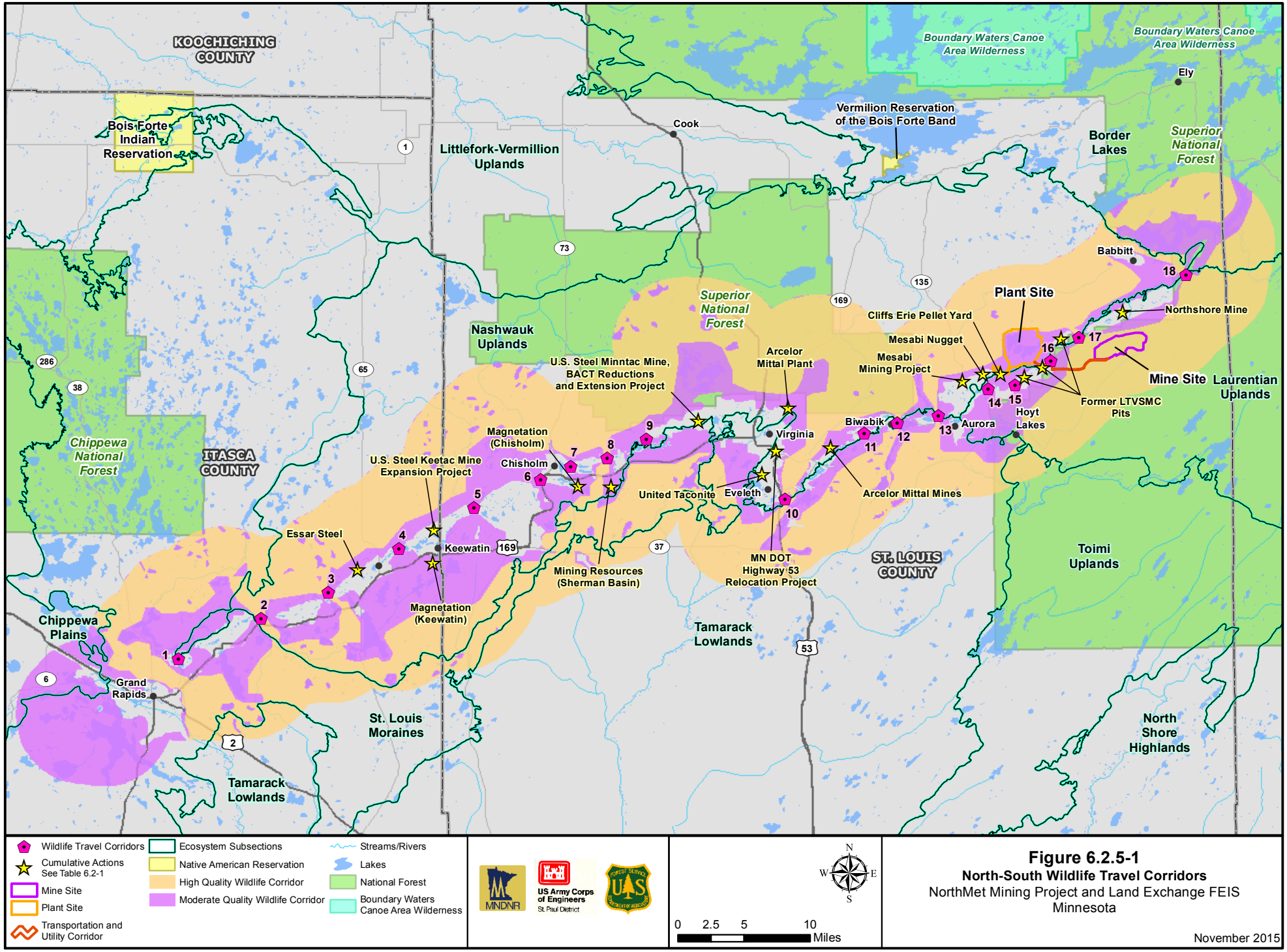

Figure 6.2.5-1
North-South Wildlife Travel Corridors
NorthMet Mining Project and Land Exchange FEIS
Minnesota
November 2015

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Of the 13 large mammal wildlife crossing corridors identified by Emmons & Olivier, two are in the vicinity of the Mine Site or Plant Site. The first is located approximately 1 mile southeast of the existing Plant Site (see Figure 6.2.5-1). Though small, this corridor has been identified as important (Emmons and Olivier 2006) and of moderate quality (Barr 2009a). The existing LTVSMC Tailings Basin is located within the corridor, but does not obstruct the entire width of it. The Tailings Basin provides poor habitat and is not likely to be heavily used by wildlife. Because current use is already limited, increased activity at the Tailings Basin is not likely to adversely affect wildlife movement through the corridor.

The second corridor is located approximately 0.5 mile northwest of the Mine Site. It has been identified as important (Emmons and Olivier 2006) and contains high quality habitat (Barr 2009a). Operations at the Mine Site would indirectly affect the corridor by reducing its size and acting as a source of noise and activity near the large habitat block southeast of the corridor. Though the Transportation and Utility Corridor is outside the wildlife corridors identified by Emmons & Olivier, it runs parallel and perpendicular to the corridors and would potentially affect wildlife use.

The other reasonably foreseeable projects may also affect the 18 wildlife travel corridors mapped by Emmons & Olivier and Barr (see Table 6.2.5-1 and Figure 6.2.5-1) (Emmons & Olivier 2006; Barr 2009a). These effects may include blocking or encroachment into the mapped wildlife corridors, which affects adjacent habitat that may make the corridor less valuable to wildlife, and increasing traffic along new or existing roads through the corridor. The effects on these corridors include complete loss (depending upon final extent of activities), habitat isolation, fragmentation, and/or minimal effect.

Table 6.2.5-1 Cumulative Effects on Wildlife Travel Corridors in the Mesabi Iron Range

Wildlife Travel Corridor	Project	Type of Effect
1	Urban Development, Highway Traffic	Minimal habitat isolation; may restrict wildlife travel through corridor due to roads, railroads, and potential expansion of the City of Grand Rapids.
2	Highway Traffic	Habitat isolation; may restrict wildlife travel through corridor due to highway traffic (US 169), which may increase over time.
3	Urban Development, Essar Steel	Direct loss of travel corridor; wildlife travel through the western half of the corridor is currently restricted by historical mining effects, eastern half of corridor would be directly affected by the Essar Steel project, resulting in overall loss of the corridor.
4	Highway Traffic, Essar Steel Mine, U.S. Steel Keetac Mine	Habitat isolation; may restrict wildlife travel through the corridor due to the Keetac Expansion project, which would be south of the corridor, and the Essar Steel project, which would be west of the corridor.
5	U.S. Steel Keetac Mine	Direct loss of travel corridor; wildlife travel through this corridor would be restricted by the U.S. Steel Keetac Mine and existing Hibbing Taconite, resulting in a direct loss of this low-quality corridor.

Wildlife Travel Corridor	Project	Type of Effect
6	Highway Traffic, Urban Development, U.S. Steel Keetac Mine	Fragmentation and direct loss of travel corridor; wildlife travel through this corridor is restricted by Hibbing Taconite to the west of the corridor, highway traffic on State Highway 73, and fragmentation of travel corridor habitat may occur due to urban development of Chisholm (on the northern end of the corridor) and Hibbing (on the southern end of the corridor).
7	Urban Development, Magnetation (Chisholm)	Habitat isolation; eastward expansion of Chisholm may restrict wildlife travel through this corridor. Scram mining operations south of the corridor may further restrict travel.
8	Highway Traffic, U.S. Steel Minntac, Mining Resources (Sherman Basin)	Habitat isolation; may restrict wildlife travel through corridor due to highway traffic (US 169) south of the corridor, U.S. Steel Minntac may affect habitat to the northeast of the corridor, while Mining Resources' scram mining activities may affect habitat to the south of the corridor.
9	U.S. Steel Minntac	Direct loss of travel corridor; the U.S. Steel Minntac mine pit expansion would eliminate eastern end of corridor.
10	Urban Development	Minimal effect; wildlife travel through this corridor may be restricted by expansion of Eveleth or Gilbert and associated roads.
11	ArcelorMittal Deposits	Habitat isolation and direct loss; wildlife travel through this corridor may be restricted by ArcelorMittal's Project, which would prevent access between northern and southern blocks of the corridor.
12	Urban Development	Minimal effect; wildlife travel through this corridor may be restricted by expansion of the City of Biwabik.
13	Mesabi Nugget, Mesabi Mining Project, Urban Development	Minimal effect; wildlife travel through this corridor may be restricted by westward expansion of the City of Aurora, and likely increase in traffic/noise due to the Mesabi Nugget Project.
14	Mesabi Nugget and Mesabi Mining Projects	Minimal effect; wildlife travel through this corridor may be restricted by the Mesabi Nugget Project, which would reduce the corridor width, but not eliminate use.
15	Mesabi Nugget and Mesabi Mining Projects	Minimal effect; wildlife travel through this corridor may be restricted by the Mesabi Nugget Project, which would reduce the corridor width, but not eliminate use.
16	NorthMet Project Proposed Action	Minimal effect; wildlife travel through this corridor may be restricted by noise and activities at the NorthMet Project Proposed Action Plant Site, which would be located northwest of the corridor.
17	NorthMet Project Proposed Action and Northshore Mine	Direct loss and fragmentation; the NorthMet Project Proposed Action would reduce habitat to southeast of the corridor. The NorthMet Project Proposed Action would not physically encroach into the corridor, but noise and activities at the NorthMet and Northshore mine operations could discourage use during mine operations.
18	Northshore Mine	Direct loss and fragmentation; possible expansion of Northshore mine eastward may block or fragment this corridor.

Sources: Emmons & Olivier 2006; Barr 2009a.

6.2.5.4.3 Special Status Species

In addition to habitat fragmentation and loss and effects on wildlife crossing corridors, wildlife species of concern in the Nashwauk Uplands and Laurentian Uplands ecological subsections are subject to other stressors that could result in cumulative effects. Traffic and activity related to mining projects, urban development, forestry, tourism, and road expansions all increase the risk for special status wildlife species and, as such, could result in cumulative effects. See Section 5.2.5.2.3 for a discussion on studies regarding wildlife corridor mitigation options.

The Canada lynx is listed as a threatened species by the federal government, and is listed as a species of special concern in Minnesota. The NorthMet Project Proposed Action and other cumulative actions would result in additional habitat fragmentation, and may increase pressures from loss of habitat and disruptions in travel corridors for Canada lynx. Forest management would contribute the largest acreage effect for lynx, but this effect would be offset by the regeneration of forest stands over time. Additional human activity due to the NorthMet Project Proposed Action and other cumulative actions would likely result in additional vehicle and rail traffic and the potential for collisions with lynx.

The northern long-eared bat is listed as a threatened species by the federal government, and is listed as a species of special concern in Minnesota. The NorthMet Project Proposed Action and other cumulative actions, including community growth and forest management, could affect northern long-eared bats through removal of summer roosting habitat and additional habitat fragmentation from timber harvests and road construction. The interim 4(d) rule specifies that forest clearing activities may not occur within the summer maternity roosting season within one quarter mile of known occupied roost trees or a known occupied hibernacula.

The gray wolf has been re-listed as threatened by the federal government, but it was removed from the Minnesota ETSC species list in 2013. The wolf had rebounded sufficiently that the state held a limited hunting season in 2012 through 2014. A 2014 winter survey by the MDNR (Erb et. al. 2014) estimated that 2,423 gray wolves were present in Minnesota, which, along with the 2012-2014 hunts, indicates that populations have stabilized to the point that the wolf in Minnesota is viable. The NorthMet Project Proposed Action and other cumulative actions may increase pressures from loss of habitat and disruptions in travel corridors which may affect the total numbers of animals in the future.

6.2.5.4.4 Effects from Acid (NO_2/SO_2) and Mercury Deposition

Acid depositions from sulfate (from SO_2 emissions) and nitrate (from NO_2 emissions) can have an adverse effect on terrestrial ecosystems, including forested wildlife habitat. These pollutants may travel long distances and contribute to complex chemical and physical reactions within a variety of habitats. These reactions could contribute to increased vulnerability of sensitive wildlife species and their habitats. Additionally, these pollutants can be carried by precipitation into nearby lakes and rivers, which wildlife species rely upon for food and water.

As described in Section 6.2.7.5, emissions from the NorthMet Project Proposed Action, in combination with other projects, would emit increased amounts of SO_2 and NO_2 emissions, resulting in a potential increase in acid deposition that may be too small to measure. However, the projects would not likely cause a cumulative effect on the ecosystems due to the NorthMet Project Proposed Action having relatively low emissions of SO_2 and NO_2 and potential deposition of sulfate and nitrate that are below both the Minnesota standard threshold value and

the federal Class I threshold values, in combination with the overall reduction in sulfate and nitrate-producing emissions cumulatively since 2008.

The MPCA estimated that over 90 percent of the mercury deposition within Minnesota is a result of other states and countries (MPCA 2013e). However, as described in Section 5.2.7.2.5, the Plant Site would be expected to contribute essentially all of the NorthMet Project Proposed Action-related mercury air emissions of 4.6 lbs/year, as the Mine Site only contributes potential emissions of less than 1.0 lb/yr (Barr 2011g). Based on the results of the MMREM evaluation summarized in cumulative effects Section 6.2.6.3.3, the potential additional mercury load that might be added to the Embarrass River and the Partridge River from air emissions is not expected to adversely affect these ecosystems when compared to the variability in background mercury concentrations. Similarly, the mercury deposition on terrestrial environments is not expected to adversely affect these ecosystems when compared to variability in background mercury concentrations. Additional information on the cumulative analysis of acid and mercury deposition associated with air emissions is summarized in Section 6.2.6.3.3 and 6.2.7.5.

6.2.6 Aquatic Species

The NorthMet Proposed Project Action could affect aquatic physical habitat and species via changes in flow and water quality in the Partridge River and Embarrass River. The analysis found the NorthMet Project Proposed Action would meet or not cause or add to exceedances of water quality evaluation criteria with the exception of aluminum (Section 5.2.2.3.3). For aluminum, ambient water quality already exceeds the Class 2B standard in the Embarrass River, but would increase in several tributaries to the Embarrass River as a result of a decrease in Tailings Basin seepage with low aluminum concentrations and a proportional increase in natural runoff with higher aluminum concentrations. Although all other solutes are predicted to meet Class 2B water quality standards, the aggregate of these solutes, primarily metals, has the potential to impact aquatic biota.

Although there is historic and current mining in the area, the water quality of these watersheds is generally good, with some exceptions. One exception involves portions of the Embarrass River that are included on the 303(d) list as impaired for "Fishes Bioassessment" (non-supportive of aquatic life and indicative of habitat stressors that limit aquatic life). Another exception relates to some lakes through which the Partridge River and Embarrass River flow that are on the 303(d) list of impaired waters for "mercury in fish tissue." The MDH has issued fish consumption advisories for the "mercury in fish tissue" impaired waters to provide site-specific consumption guidance on the quantity and frequency of fish species consumed. The following sections provide a quantitative and semi-quantitative analysis of the potential cumulative effects of the NorthMet Project Proposed Action and other activities in the Partridge River and Embarrass River watersheds.

Both the Partridge River and Embarrass River are tributaries to the St. Louis River, which flows through the Fond du Lac Indian Reservation and empties into Lake Superior near Duluth. A qualitative assessment of the cumulative effects to aquatic resources in St. Louis River has been included.

The St. Louis River is not included within the spatial scale of the NorthMet Project's cumulative effects analysis for these reasons:

- The NorthMet Project Proposed Action would not have any direct effects (i.e., habitat disturbance) on the St. Louis River, or even perennial waterbodies within the Partridge River and Embarrass River watersheds.
- The NorthMet Project Proposed Action would not pose any obstructions to fish movement between the St. Louis River and the Partridge River or Embarrass River.
- The NorthMet Project Proposed Action would result in about a 2 percent (about 6 cfs) reduction in average annual flow in the St. Louis River at the confluence with the Embarrass River during operations, and less than 1 percent reduction during closure. The NorthMet Project Proposed Action effects would be even less during low flows because of flow augmentation from Whitewater Reservoir once water levels in Colby Lake fall below 1,439 ft, which equates to a flow of approximately 13 cfs.

- With the proposed design modifications and engineering controls, the water quality model predicted 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 (CEC) 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.
- The NorthMet Project Proposed Action would result in a net decrease in overall mercury loadings (1.0 grams per year) with no detectable change in mercury concentrations to the St. Louis River.

Therefore, the NorthMet Project Proposed Action would not have any direct effects on aquatic habitat in the St. Louis River and would not have any measureable indirect effects on fish or aquatic invertebrates as a result in changes in flow or water quality, and, therefore, it would not contribute any measureable cumulative effects to the St. Louis River.

The NorthMet Proposed Project Action could affect aquatic physical habitat and species via changes in flow and water quality in the Partridge River and Embarrass River. The analysis found that changes in water chemistry would not exceed water quality evaluation criteria.

6.2.6.1 Spatial

This assessment considered past and present and reasonably foreseeable effects on aquatic species in the Partridge River and Embarrass River as reflected in existing baseline hydrologic and water quality conditions.

6.2.6.2 Temporal

The temporal scope of the analysis begins with existing conditions through the long-term closure of the NorthMet Project Proposed Action, including the cessation of Northshore Peter Mitchell Pit surface water discharges.

6.2.6.3 Contributing Past, Present, and Reasonably Foreseeable Future Actions

The assessment discusses potential cumulative effects on surface water habitats and aquatic species associated with the following current and future actions listed below in conjunction with the NorthMet Project Proposed Action:

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits);
- City of Aurora POTW;
- City of Aurora POTW;
- City of Biwabik POTW;
- City of Hoyt Lakes POTW;
- LTV Steel Mining Company Former LTVSMC Pits;
- Mesabi Mining Project;

- Mesabi Nugget Project; and
- Northshore Mine Operations and Closure.

6.2.6.4 Cumulative Effects Assessment

6.2.6.4.1 Water Quality Effects

As described in Section 5.2.2, with the proposed design modifications and engineering controls, the water quality model predicted 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 (CEC) Scenario, 3) the frequency or magnitude of exceedances for NorthMet Project Proposed Action conditions was within an acceptable range, or 4) not attributable to NorthMet Project Proposed Action discharges. Nevertheless, while the NorthMet Project Proposed Action discharges would not cause or add to exceedances of water quality evaluation criteria, it could combine with other past, present and reasonably foreseeable future activities to create cumulative effects within the CEAA. The analysis below describes these combined effects to arrive at a finding that the NorthMet Proposed Action would not cause cumulative effects on aquatic resources within the CEAA. However, there is potential for cumulative effects on aquatic biota due to changes in water quality, especially in impaired waters for the Embarrass River, and in the Upper Partridge River from cessation of Northshore Mine dewatering post-closure. Cumulative effects related to water quality are summarized in Section 6.2.2.

The Class 2B standards were developed to be protective of aquatic life and to promote the "propagation and maintenance of a healthy community of cool or warm water sport or commercial fish and associated aquatic life, and their habitats" (*Minnesota Rules*, part 7050.0222). The chronic standards are restrictive standards and reflect "the highest water concentration of a toxicant to which organisms can be exposed indefinitely without causing chronic toxicity" (*Minnesota Rules*, part 7050.0218, subpart 3, item I).

The NorthMet Project Proposed Action, in combination with other reasonably foreseeable projects, could increase solute concentrations for many constituents in the Partridge River and Embarrass River. The NorthMet Project Proposed Action, in particular, but to some extent in combination with other existing and reasonably foreseeable projects, would shift maintenance of water quality in the Partridge River and Embarrass River from natural systems (i.e., essentially an ecosystem service) to mechanical systems (e.g., the NorthMet Project Proposed Action WWTF and WWTP). Given this shift resulting from the proposed design modifications and engineering controls, the water quality model predicted that the NorthMet Project Proposed Action discharges would not cause any significant water quality impacts. Impacts due to changes in water quality from NorthMet Project Proposed Action, in combination with other reasonably foreseeable projects, to aquatic species are not anticipated.

6.2.6.4.2 Physical Habitat Effects

Hydrologic changes are often one of the major sources of effects on fish and macroinvertebrate habitat. While many aspects of the hydrologic regime can be important to the maintenance of fish and macroinvertebrate assemblages, reduction in baseflow (the portion of streamflow from groundwater) is particularly relevant because it represents a change or even a loss of habitat.

Section 5.2.6.2 concluded that the NorthMet Project Proposed Action would reduce flow upstream of Colby Lake and in the Embarrass River by very small amounts from the current baseline habitat conditions. Alterations due to multiple projects in the Second Creek Watershed within the Partridge River Watershed along with the planned flow augmentation of Second Creek due to the NorthMet Project Proposed Action may contribute to small cumulative effects on aquatic habitat if flows fluctuate by more than 20 percent, but fluctuations of this magnitude are not expected (see Section 6.2.2). Changes in average annual flow of less than 20 percent would fall into the range of annual natural variability in terms of precipitation and would have minimal impacts to ecosystem function and aquatic species within the Embarrass River Watershed.

After 2070, when Northshore Mine dewatering discharge is predicted to end, there may be effects on the headwater Partridge River instream habitat due to loss of flow. The NorthMet Project Proposed Action, however, would not be expected to contribute measurably to this cumulative effect, but instead would incidentally reduce the effect downstream of SW-004 by discharging treated water in mine year 52.

6.2.6.4.3 Effects from Mercury

Estimated Mercury Deposition

The NorthMet Project Proposed Action, along with other reasonably foreseeable projects have the potential for adverse effects from mercury deposition on nearby lakes, including the Heikkila, Colby, Sabin, Wynne, and Whitewater lakes, the Partridge River and Embarrass River watersheds, and the aquatic biota within these waterbodies.

The cumulative effects of mercury from the NorthMet Project Proposed Action and other cumulative actions on risks to fish consumption were analyzed using the MMREM. As described in Section 5.2.7.2.5, the MMREM assessed the potential changes in fish mercury concentrations in the following nearby lakes (Barr 2015f):

- Heikkila Lake;
- Colby Lake;
- Sabin Lake;
- Wynne Lake; and
- Whitewater Lake.

The five lakes are located within 12 km, about 7 miles, of the Plant Site. Heikkila Lake, Sabin Lake, and Wynne Lake are included in the Embarrass River watershed, while Colby Lake and Whitewater Lake are closest to the Plant Site and are part of the Partridge River watershed. The closer a lake is to the Plant Site, the greater the potential for more effects from deposition related to Plant Site operations.

The MMREM method relies on empirical fish contamination data (Barr 2012b), combined with the principle of proportionality between mercury in fish and atmospheric deposition (MPCA 2006a). As other cumulative analyses have identified that local impacts from mercury deposition are small and likely not measureable in terms of fish mercury concentration within 10 kilometers of a single project, it is expected that projects located further away would have fewer impacts. Consequently, it has been determined that the maximum extent of the quantitative cumulative impact assessments using the MMREM is about 25 kilometers (about 16 miles) from the specific project of interest (Barr 2015f). The analysis considered deposition from the NorthMet Project Proposed Action and the Mesabi Nugget emissions over existing risks. The Mesabi Nugget Large Scale Demonstration Plant was assessed because it is the only "reasonably foreseeable" project within 25 km of the NorthMet Project Proposed Action.

Because of uncertainty in speciation of emissions of the NorthMet Project Proposed Action, two speciation scenarios were used for assessing potential effects for the NorthMet Project (Barr 2015f), while only one scenario was used to evaluate the Mesabi Nugget Large Scale Demonstration Plant emissions since there was no uncertainty in the speciation of the emissions from this action. The first scenario for the NorthMet Project Proposed Action represents a conservative overestimation of oxidized mercury (25 percent elemental mercury, 50 percent oxidized mercury, and 25 percent particle bound mercury), while the second scenario is a more conservative and more likely speciation for air emissions (80 percent elemental mercury, 10 percent oxidized mercury, and 10 percent particle bound mercury) that is considered to provide a worst-case emissions scenario for the NorthMet Project Proposed Action. The scenario for the Mesabi Nugget Large Scale Demonstration plant evaluates 99.3 percent elemental mercury (see Section 5.2.7.2.5).

The current MPCA-estimated mercury atmospheric deposition rate is 12.5 $\mu g/m^2/yr$ for northeast Minnesota (MPCA 2007), which translates into about 250 pounds of mercury currently being deposited onto the St. Louis River Watershed (3,600 square miles) every year due to background deposition. The potential total annual deposition in the watershed from the NorthMet Project Proposed Action is estimated to be about 0.17 pounds per year (Barr 2012b), which is less than 0.1 percent of the estimated 250 pounds per year of mercury already being deposited to the St. Louis River watershed due to background deposition.

The cumulative analysis assessment showed that projected increase in mercury concentrations from the two reasonably foreseeable cumulative sources in the fish for the five lakes ranges from 0.3 to 1.8 percent (when considering both speciation scenarios), of which the increased percentage from the NorthMet Project Proposed Action alone ranges from 0.2 to 1.6 percent. Therefore, although the NorthMet Project Proposed Action would account for the majority of the increase, the total added mercury to the lakes is small compared to background conditions. The highest impact in fish concentration from the NorthMet Project Proposed Action alone was at Wynne Lake where the estimated incremental increase to fish tissue mercury concentration is 0.016 ppm. This estimated incremental change in fish mercury concentration is small compared to the background fish tissue mercury concentrations in Wynne Lake range, which range from

0.35 to 2.06 ppm. The increase to fish tissue mercury concentrations at the remaining four lakes was at or below 0.012 ppm (Barr 2013c) with the background fish tissue mercury concentrations in these lakes ranging from 0.12 ppm in Whitewater Lake to 2.06 ppm in Heikkila Lake (Barr 2015f). These potential increases would not be expected to have an appreciable effect on fish tissue mercury concentrations in the Embarrass River or Partridge River and would not have any effect on the current fish consumption advisories for the respective lakes.

Hazard Quotient

The Hazard Quotient is the ratio of the mercury concentration in fish to a health-based target of 0.2 ppm; a Hazard Quotient greater than 1 exceeds the health-based target. To estimate the potential incremental Hazard Quotient, the incremental methylmercury exposure in mg/kg body weight per day and the reference dose are accounted for in the calculation. The incremental Hazard Quotient calculation in the MMREM Spreadsheet uses the following methodology:

- Incremental daily mercury consumed (mg) = estimated incremental increase in fish mercury due to the Project (mg/kg) x the amount of fish consumed (e.g. 0.142 kg for a subsistence fisher);
- Incremental methylmercury exposure (mg/kg body weight per day) = Incremental daily mercury consumed x 1.07945 / adult body weight (70 kg); and then
- Incremental Hazard Quotient = incremental methylmercury exposure (mg/kg body weight per day) / Reference Dose of 1.00E-04 mg methylmercury/kg body weight per day (i.e., the ratio of the incremental methylmercury exposure divided by the reference dose in the same units).

The maximum incremental cumulative Hazard Quotient from the two reasonably foreseeable cumulative projects over existing fish mercury concentrations is 0.08 for recreational anglers, 0.61 for subsistence/tribal anglers, and 0.54 for subsistence fishers. This is only about a 0.3 to 1.8 percent increase over the existing incremental risk levels, for recreational, subsistence/tribal and subsistence anglers. Of this, the NorthMet Project Proposed Action would contribute approximately 59 to 92 percent of the incremental cumulative Hazard Quotient. Note that the current fish tissue concentration in the five lakes results in Hazard Quotients that exceed 1, leading to the need for the fish consumption advisories currently in effect (see Table 6.2.6-1).

Table 6.2.6-1 Analysis of Existing Hazard Quotients of Cumulative Impacts from Mercury Deposition for Five Lakes following Three Fish-Consumption Scenarios

Lake	MDNR #	Speciation Scenario	Recreational Angler[1]		Subsistence/Tribal Angler[2]		Subsistence Fisher[3]	
			Existing HQ	Incremental Cumulative HQ	Existing HQ	Incremental Cumulative HQ	Existing HQ	Incremental Cumulative HQ
Colby Lake	69024900	Scenario 1	4.3	0.05	32	0.4	28.4	0.35
		Scenario 2		0.02		0.1		0.10
Heikkila Lake	69025300	Scenario 1	3	0.05	22.3	0.4	19.8	0.35
		Scenario 2		0.01		0.1		0.09
Sabin Lake	69043401	Scenario 1	4.7	0.06	35.1	0.5	31.2	0.41
		Scenario 2		0.02		0.1		0.11
Whitewater Lake	69037600	Scenario 1	1.6	0.01	11.9	0.1	10.6	0.09
		Scenario 2		0.01		0.0		0.03
Wynne Lake	69043402	Scenario 1	6.2	0.08	46.2	0.6	41	0.54
		Scenario 2		0.02		0.2		0.15

Source: Barr 2012b.

Notes:
[1] Consumption rate assumed to be 30 grams/ day.
[2] Consumption rate assumed to be 224 grams/ day and approximates the allowed take of fish by a Tribal member (~180 pounds per year of fish).
[3] Consumption rate assumed to be 199 grams/day.

Water Mercury Mass Balance

In addition to atmospheric mercury deposition, water discharges from the NorthMet Project area would affect the mercury load in the Embarrass and Partridge rivers (and ultimately on downstream portions of the St. Louis River). As discussed in Section 5.2.2.3.4, a water mass balance was performed to assess mercury load from NorthMet Project Proposed Action. The mass balance indicated that overall, the NorthMet Project Proposed Action is predicted to result in a net decrease in mercury loading to the St. Louis River watershed and is not likely to result in an appreciable change in the mercury concentration in fish in waterbodies of the St. Louis River watershed, including the Embarrass River or Partridge River, or in the St. Louis River itself (Barr 2015f). Potential mercury increases from air deposition discussed above would not be expected to have any appreciable effect on inputs into the water quality mass loading calculations.

Statewide Mercury TMDL and Mitigation Measures

The MPCA Statewide Mercury TMDL is intended to provide the long-term framework to reduce mercury in fish within Minnesota lakes, including the five lakes targeted in this assessment. The MPCA and industries emitting mercury into the atmosphere are working to reduce Minnesota sources' contribution to fish contamination. Minnesota is relying on actions by other states and the USEPA to address deposition from long-range sources.

In the period of time between completion of the cumulative effects analysis background study for Minnesota Steel and the development of this FEIS, Minnesota stakeholders created an implementation plan for Minnesota's mercury TMDL (MPCA 2009c). Within the implementation plan, there is a process for assessing new and expanding sources of mercury in Minnesota. It is important to assess sources so that while existing sources reduce emissions, new sources do not interfere or confound the state's progress in reducing mercury emissions overall. At the recommendation of the Minnesota stakeholders, MPCA has developed guidance for new and modified sources of mercury in Minnesota (MPCA 2013d). The guidance requires sources to: employ best controls to reduce mercury emissions and apply emissions limits to permit conditions. MPCA has conducted a review of the NorthMet Project Proposed Action mercury emissions and has determined that it would not impede the reduction goals (MPCA 2013l). Thus, no minimization and mitigation plan would be required for the NorthMet Project Proposed Action (see Section 5.2.7.2.5). Mercury mitigation measures are summarized in Section 5.2.2.3.5 (water) and in Section 5.2.7.4 (air).

6.2.7 Air Quality

Several components of the NorthMet Project Proposed Action would combine with other past, present, and reasonably foreseeable proposed actions to cause cumulative effects on air quality. Of particular concern are the effects on Class I and Class II areas, especially with respect to acid deposition, particulates, and visibility impairment. Both direct and indirect effects of the NorthMet Project Proposed Action were used to calculate its effects in combination with those of other emission sources. Given the public's concern over air quality in the BWCAW and Voyageurs National Park, the analysis modeled how emissions from the NorthMet Project Proposed Action and other projects in the airshed would affect air quality and visibility in these areas.

6.2.7.1 Approach

Cumulative effects have been evaluated to assess the potential effects from other foreseeable projects that have been approved by regulatory agencies, but have not been implemented or accounted for in existing air quality conditions. The assessments of these projects, in combination with the NorthMet Project Proposed Action, were conducted to evaluate the overall effects on the NAAQS/MAAQS, the USEPA PSD Class I and Class II standards, and the USEPA Class I Visibility and Regional Haze criteria.

6.2.7.2 Cumulative Effects Assessment Area

6.2.7.2.1 Spatial

The CEAA for air quality is defined as those areas that are beyond the boundaries of the Plant Site, Mine Site, the Mesabi Nugget Ambient Air Boundary, and the Northshore Mine (labeled as St. Louis County Tax Records) identified on Figure 6.2.7-1. The cumulative receptors on the figure (in blue) provide spatial projection of the closest receptors used in the modeling that are at or beyond the four boundary areas identified above.

6.2.7.2.2 Temporal

Based on the approved model's limitations, this evaluation used a qualitative baseline of industrial growth within the Arrowhead Regional Airshed as indicative of the historical and more recent effects on air quality resulting in the current ambient conditions.

6.2.7.3 Past, Present, and Reasonably Foreseeable Future Actions

The air quality modeling used existing background to represent the cumulative effects from all past, present, and reasonably foreseeable future actions that affect air quality in the region.

6.2.7.4 Cumulative Effects Assessment

Air quality modeling analyses were conducted to assess cumulative effects on NAAQS, MAAQS, PSD Class II Increments, and Class I Increments using a similar modeling approach discussed in Section 5.2.7.2.1. However, relative to NAAQS, MAAQS, and PSD Class II Increments, the receptor locations were restricted to areas at and beyond the former LTVSMC ambient air boundary as defined in the Final SDD. However, the Class II modeling report for the

Plant Site included a more detailed and up-to-date assessment of combined effects at the Plant Site. For PSD Class I Increments, the cumulative analysis was conducted by adding the maximum effects from the NorthMet Project Proposed Action to the maximum effects from the cumulative analysis prepared for the Minnesota Steel EIS (MDNR and USACE 2007), in order to assess overall cumulative effects. The following sections describe the results of these assessments.

6.2.7.4.1 Cumulative Ambient Air Quality Effects (NAAQS/MAAQS)

As stated earlier, an assessment of the Plant Site was conducted using the same modeling approach as presented in Section 5.2.7, except that receptor locations were limited to the Plant Site's boundary combined with the shared properties of the Mesabi Nugget and Cliffs Erie Pellet Yard (using the former LTVSMC processing plant boundary) as the ambient air boundary. It should be noted that the NorthMet Project Proposed Action emissions were evaluated on both Mesabi Nugget and Cliffs Erie property. Figure 6.2.7-1 shows the ambient air boundary for the former LTVSMC processing plant. The cumulative analysis included potential emissions for all NorthMet Project Proposed Action sources, nearby sources as defined in the Final SDD, and additional sources agreed upon with the MPCA, as identified above.

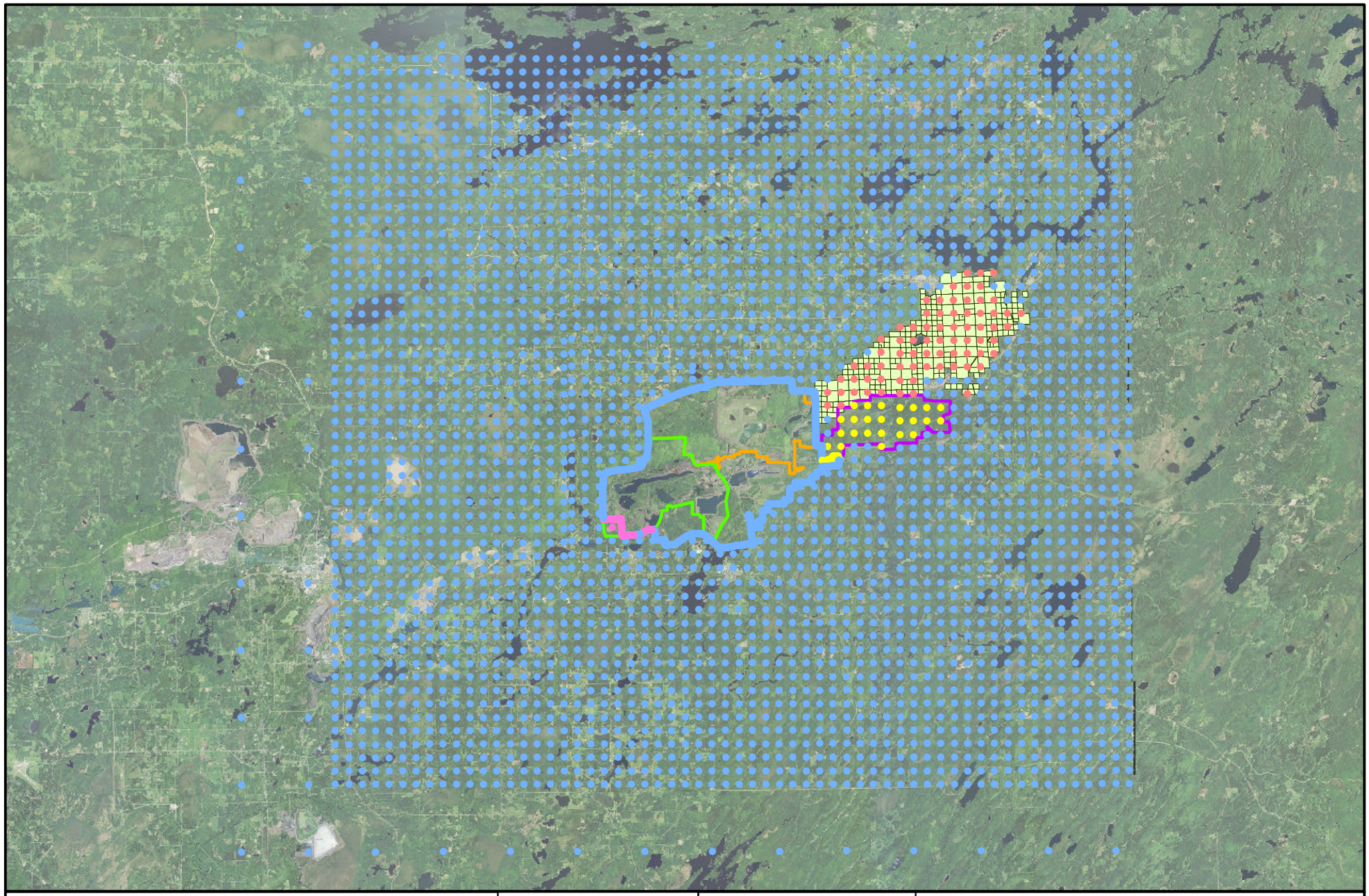

Figure 6.2.7-1
Ambient Air Boundary - EIS Cumulative NAAQS/Increment Receptor Grid NorthMet Plant Site EIS Class II Modeling Report
NorthMet Mining Project and Land Exchange FEIS
Minnesota
November 2015

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Table 6.2.7-1 summarizes the results of the cumulative NAAQS/MAAQS model analysis. These model results did not include tailpipe emissions from mobile sources (e.g., NOx from mine trucks) and were not included in the NAAQS or increment modeling. Except for the cumulative 1-hour SO_2 and 1-hour NO_2 effects, all other maximum cumulative effects were below the respective NAAQS and MAAQS, ranging from 24 percent to 97 percent of their respective standards. In order to compare with the applicable standards, the following calculated maximum concentrations were defined, as defined in Section 5.2.7, by the "highest nth high" concentration (HnH) as follows:

- 24-hour PM_{10} – H6H;
- 24-hour $PM_{2.5}$ and 1-hour NO_2 – H8H;
- 1-hour SO_2 – H4H;
- 3-hour and 24-hour SO_2 – H2H; and
- All annual – maximum.

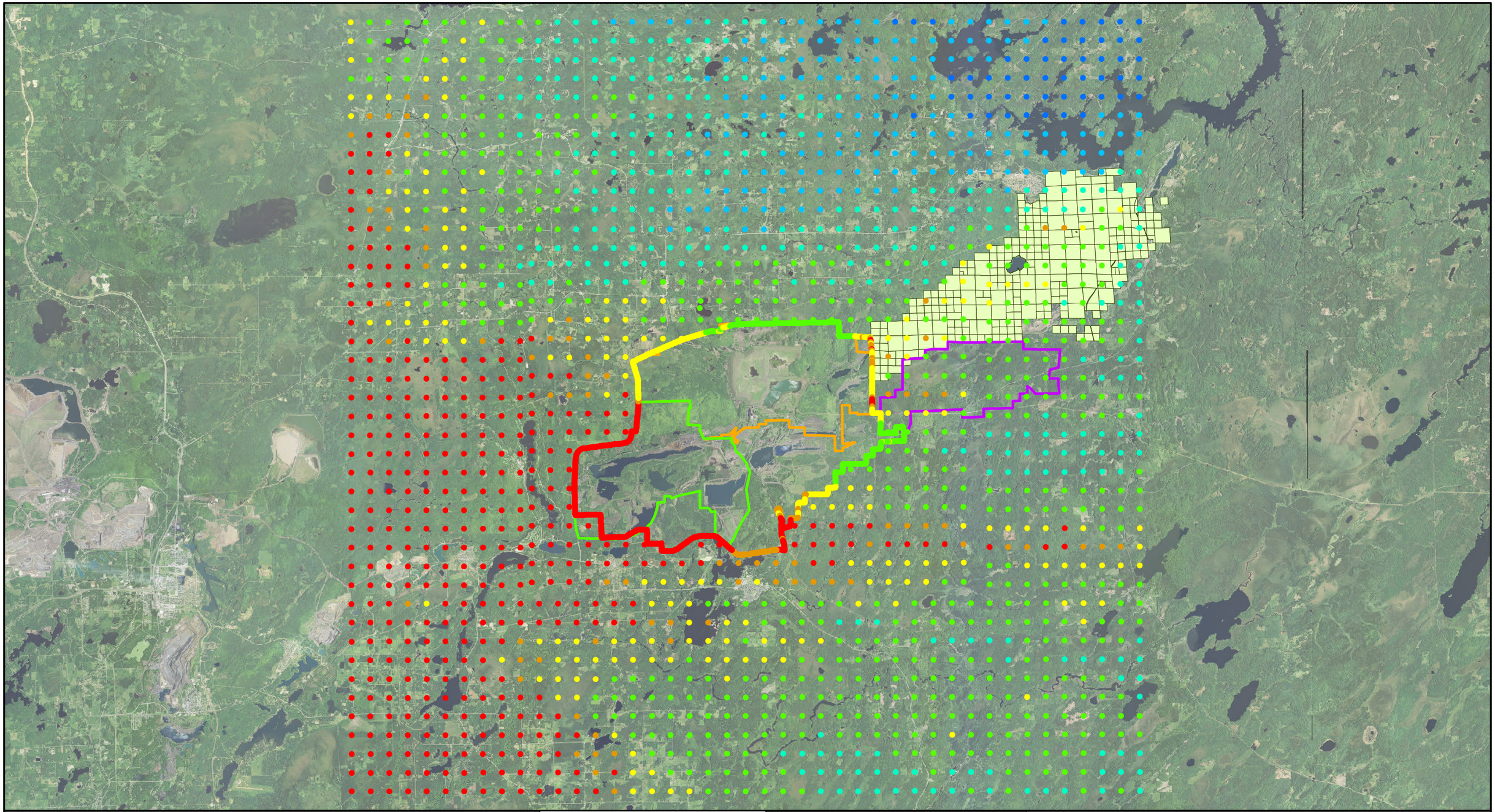
Ambient air background concentrations were added to modeled concentrations to determine compliance with NAAQS and MAAQS. Background concentrations represent the 2008 to 2010 values from the Blaine-Anoka Airport Monitor (the nearest monitoring station available for model input), Rosemont Monitor, and Virginia Monitoring Stations for NO_2, SO_2, and $PM_{10}/PM_{2.5}$, respectively.

The maximum predicted ambient 1-hour NO_2 concentration was 292 $\mu g/m^3$, which was predicted to occur to the southwest portion of the ambient air quality boundary, and exceeded the 1-hour NO_2 NAAQS (188 $\mu g/m^3$). The Plant Site modeled contribution at the location of maximum effect was 0.002 $\mu g/m^3$. Other receptors where concentrations were lower than the maximum but exceeded the 1-hour NO_2 NAAQS were predicted primarily on the western half of the receptor grid and were due to the nearby sources (see Figure 6.2.7-2). For all receptors that exceeded the 1-hour NO_2 NAAQS, the contributions from the Plant Site sources were less than the 1-hour NO_2 Significance Threshold of 7.5 $\mu g/m^3$ and are considered to have no significant contribution to the predicted exceedances.

Similarly, the maximum 1-hour SO_2 ambient concentration was predicted at the southwestern border of the ambient boundary with a value of 893 $\mu g/m^3$ and exceeded the 1-hour SO_2 NAAQS of 196 $\mu g/m^3$ (see Figure 6.2.7-3). The Plant Site maximum modeled contribution to this maximum was 0.002 $\mu g/m^3$, well below the 1-hour SO_2 SIL threshold of 7.8 $\mu g/m^3$. For all receptors that exceeded the 1-hour SO_2 NAAQS, the contributions from the Plant Site sources were less than the 1-hour SO_2 Significance Threshold, thus having no cumulative effect on any predicted exceedances.

It should be noted that modeled NAAQS exceedances do not mean that the region is in non-attainment for these standards. NAAQS attainment is determined by measuring the actual concentration of pollutants in the air by monitoring. There is no monitoring data in the region that indicates that NAAQS standards are not being met. The NAAQS model results represent the maximum allowable emissions from NorthMet and all of the nearby sources, not the actual emission rates or actual pollutant concentrations, which are lower. In addition, the model results represent worst case meteorological conditions and background pollutant concentrations. Because the NorthMet Project Proposed Action is considered a synthetic minor PSD source and

is not culpable for the modeled exceedances, per EPA guidance, permits can be issued for the project without addressing the modeled exceedances.



H8H Concentration ug/m

- 142 - 149
- 150 - 159
- 160 - 169
- 170 - 179
- 180 - 185
- 186 - 188
- 189 - 292

- Mesabi Nugget Ambient Air Boundary
- Mine Site Ambient Air Boundary
- Plant Site Ambient Air Boundary
- St Louis County Tax Records

MNDNR

US Army Corps of Engineers
St. Paul District

FOREST SERVICE
DEPARTMENT OF AGRICULTURE

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Figure 6.2.7-2
1-Hour NO_2 Cumulative Effect NAAQS Results
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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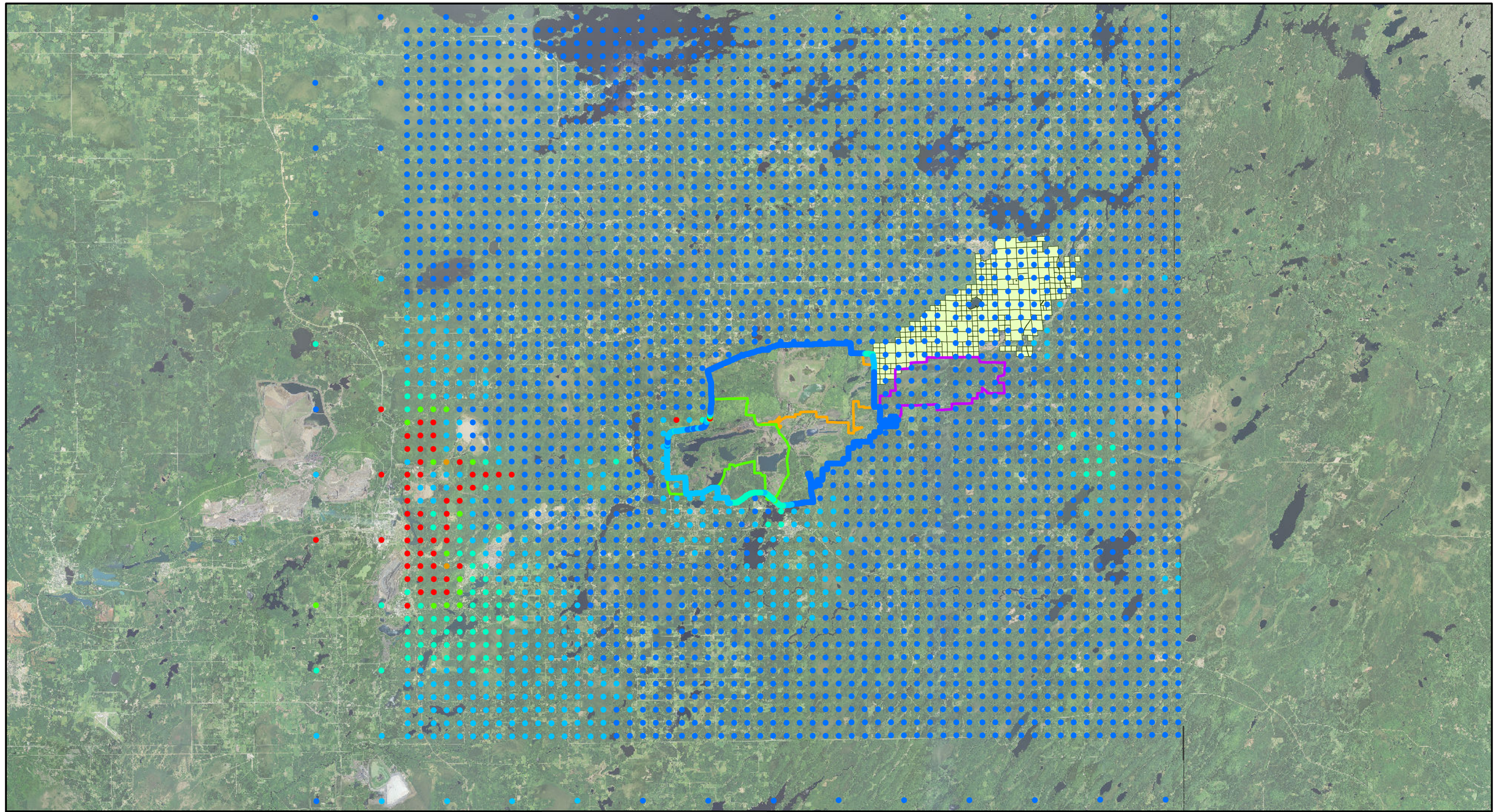

H4H Concentration ug/m³

- 61 - 100
- 101 - 130
- 131 - 160
- 161 - 180
- 181 - 190
- 191 - 196
- 197 - 925

- Mesabi Nugget Ambient Air Boundary
- Mine Site Ambient Air Boundary
- Plant Site Ambient Air Boundary
- St Louis County Tax Records

MNDNR

US Army Corps of Engineers
St. Paul District

FOREST SERVICE
DEPARTMENT OF AGRICULTURE

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Figure 6.2.7-3
1-Hour SO_2 Cumulative Effect NAAQS Results
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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The MPCA has taken actions to reduce emissions from taconite facilities, which, in concert with federal actions by USEPA regarding regional haze Best Available Retrofit Technology (BART) obligations for certain taconite facilities, will result in the evolution of controls at such facilities and permanent emissions reductions. The MPCA's Long Term Strategy contained in its Regional Haze SIP included administrative orders (AOs) requiring taconite companies to demonstrate compliance (via modeling and/or the implementation of emissions limits) with the one-hour NAAQS for NO_2 and SO_2. Subsequent to this, the USEPA implemented federal BART limits on the facilities. These federal BART limits have been stayed pending resolution of litigation. However, the USEPA is working through settlements with the facilities to ensure finalized limits. So to avoid interference with federal actions, the MPCA has deferred implementation of its AOs, but is retaining the AOs as a "backstop" if the USEPA fails to finalize federal BART limits.

Table 6.2.7-1 Results of Cumulative Class II NAAQS Modeling

Pollutant	Averaging Time	Maximum Modeled Concentration (µg/m^3)	Background (µg/m^3)	Total (µg/m^3)	NAAQS/ MAAQS (µg/m^3)
SO_2	1-hour	887	6	**893**	196/1300
	3-hour	772	12	784	NA/915
	24-hour	249	6	255	NA/365
	Annual	24	1	25	NA/40
PM_{10}	24-hour	41	36	77	150/150
	Annual	5	14	19	NA/50
$PM_{2.5}$	24-hour	17	17	34	35/65
	Annual	4	6	10	15/15
NO_2	1-hour	202	90	**292**	188/NA
	Annual	6	18	24	100/100

Note: Concentrations in **Bold** indicate exceedance with standard.

6.2.7.4.2 Cumulative Class II Increment Effects

Cumulative Class II Increment analysis was completed for PM_{10}, NO_X, and SO_2 for all increment consuming NorthMet sources at both the Mine Site and Plant Site. The modeling included all sources at maximum emission rates plus all nearby increment-consuming (and expanding) emissions sources identified in Section 5.2.7.1.4. Increment consuming (or expanding) sources are all sources with emission increases (or decreases) after the PSD Major Source baseline date for that pollutant. The results of the increment analyses are shown in Table 6.2.7-2, along with a comparison to the allowable Class II PSD increments.

The data in Table 6.2.7-2 summarize the PSD Class II Increment modeling results and demonstrate that the NorthMet Project Proposed Action, in conjunction with all other neighboring PSD sources, would satisfy all state and federal increment limits.

Table 6.2.7-2 Results of Cumulative Class II PSD Increment Analysis

Pollutant	Averaging Time	Cumulative Modeled Concentrations (µg/m3)	PSD Increment Limits (µg/m3)
SO_2	3-hour	11	512
	24-hour	1.9	91
	Annual	0.2	20
PM_{10}	24-hour	18	30
	Annual	3	17
NO_X	Annual	0.9	25

6.2.7.4.3 Cumulative Class I Increment Effects

Based upon the analysis presented in Section 5.2.7, the only modeling analysis with results above the acceptable screening thresholds was the 24-Hour Class I SIL for PM_{10} at BWCAW, which triggers a cumulative modeling assessment. The PM_{10} maximum modeled effect was below the SIL at Voyagers National Park, but Voyagers National Park receptors were included at the request of MPCA. The NorthMet Project Proposed Action is not a major source; however, a cumulative assessment was prepared following the same methodology that is used for assessing effects from major sources. A cumulative assessment requires modeling of all PSD increment consuming and expanding facilities within 300 km of BWCAW. The cumulative emission inventory, containing increment consuming and expanding sources, was obtained from MPCA. No other major sources within the region have submitted permit applications since the inventory was prepared. Recently permitted new sources, which have not begun operation or have recently begun operation, are also included in the inventory, as are certain minor sources near the Class I areas selected by MPCA.

The April 2006 FLM guidance suggests that area and mobile sources may be included in the cumulative effect assessment. However, PM_{10} emissions from these sources is small in the region due to its rural nature; furthermore, total population in the nearby counties has decreased since the minor source baseline trigger date. Therefore, no increase in area and mobile sources emissions are expected to have occurred, and these emissions are not included in the increment assessment.

Modeling was conducted to assess the 24-hour average PM_{10} concentrations within the Class I areas from the cumulative source inventory, and compared to effects from the NorthMet Project Proposed Action alone. The maximum concentration from project emissions was added to the maximum 24-hour PM_{10} concentration from the comprehensive cumulative analysis. This is a conservative approach, since the maximum modeled concentration due to the project sources is not at the same location and time as the maximum from the comprehensive assessment. Table 6.2.7-3 summarizes the results of the analysis, showing that the cumulative Class I 24-hour PM_{10} is below the Class I PSD increment, indicating that the full increment has not been consumed. Furthermore, sufficient increment remains in the area to allow for future growth.

Table 6.2.7-3 Results of Cumulative Class I PSD PM_{10} Increment Analysis

Class I Area	Averaging Time	Maximum Modeled Air Concentration For NorthMet Modeled Emissions ($\mu g/m^3$)	Maximum Modeled Air Concentration For Cumulative Modeled Emissions (MPCA Inventory[1]) ($\mu g/m^3$)	Total Cumulative Modeled Air Concentration ($\mu g/m^3$)[2]	PSD Increment Limit ($\mu g/m^3$)
BWCAW	24-hour	0.33	1.76	2.09	8
Voyageurs National Park	24-hour	0.13	0.22	0.35	8

Notes:
[1] The MPCA inventory includes the NorthMet Project Proposed Action, but not the same emission data that were modeled for the SDEIS.
[2] The value is conservative because the NorthMet Project Proposed Action is included in both the MPCA inventory and the modeling done for the NorthMet Project Proposed Action alone for the SDEIS.

6.2.7.5 Cumulative Effects of Acid Deposition on Ecosystems

The potential for cumulative effects of acid deposition on ecosystems was evaluated in terms of the potential increased acidification on the terrestrial and aquatic systems within a six county area (Carlton, Itasca, St. Louis, Koochiching, Lake, and Cook counties) from 1980 to 2015, as defined in the Final SDD (MDNR 2005). The pollutants of consideration included both wet and dry deposition due to sulfate depositions from SO_2 emissions to the air and nitrate deposition from NO_2 emissions to the air. Both of these pollutants can be exposed to long-range transport and are subject to complex chemical and physical reactions prior to being washed out by precipitation into lakes and rivers. MPCA has estimated that over 90 percent of the acid deposition within Minnesota is a result of out-of-state emissions from long-range transport (State of Minnesota 1985). Findings from other states and NAPAP (Mahoney et al. 1998) led the USEPA to develop the federal Acid Deposition Control Program.

Based upon the most recent information available at the time this cumulative analysis was conducted by PolyMet in January 2012, there are approximately 11 new projects for the six-county area, including the NorthMet Project Proposed Action. Collectively, without accounting for recent past reductions or expected future reductions, these sources could emit up to an additional 6,635 tons per year NO_x and 2,807 tons per year SO_2, if all were constructed and operated (Barr 2012o). This represents approximately a 12 percent and 7 percent increase, respectively, in the estimated emissions for the two pollutants in the six county "zone of interest" through 2009 (Carlton, Itasca, St. Louis, Koochiching, Lake, and Cook counties). However, due to the projected decreases in emissions from the Minnesota Power Arrowhead Regional Emission Abatement proposal in combination with various federal programs, including the implementation of the taconite and electric utility Maximum Achievable Control Technologies (MACTs), Best Achievable Retrofit Technology (BART) on Regional Haze Program and Clean Fuels Regulations, the overall emissions would be reduced by 5,503 tpy and 3,292 tpy for NO_2 and SO_2 respectively, since 2009 (Barr 2012o). In addition, supplemental decreases in emissions from the two pollutants are expected to occur due to other reasonably foreseeable actions.

As such, the emissions from the NorthMet Project Proposed Action, in combination with other projects, would emit increased amounts of SO_2 and NO_2 emissions, resulting in a potential increase in acid deposition that may be too small to measure. However, due to the NorthMet Project Proposed Action having relatively low emissions of SO_2 and NO_2 and potential deposition of sulfate and nitrate are below both the Minnesota standard threshold value(up to 11 kilograms per hectare of wet sulfate to be deposited within the designated sensitive resource areas of Minnesota during any 52-week period) and the federal Class I threshold values, in combination with the overall reduction in sulfate and nitrate-producing emissions cumulatively since 2008, the projects would not likely cause a cumulative effect on the ecosystems.

6.2.7.6 Cumulative Visibility Effects

A cumulative effects analysis assessing the potential visibility effects on Federal Class I areas was performed to provide information for the DEIS (Barr 2006h). Also, in addition to the quantitative assessment of cumulative PM_{10} increment consumption in the BWCAW described in Section 6.2.7.4.3, a semi-quantitative assessment of potential cumulative PM_{10} air concentrations and the potential effect on increment consumption in Minnesota Class I areas was also completed (Barr 2012o).

6.2.7.7 Cumulative Effects Analysis – Class I Visibility

To help determine the potential effects on visibility impairment in the Class I areas in Minnesota from the NorthMet Project Proposed Action when combined with all other concurrent projects, a cumulative effects analysis for visibility was performed by PolyMet. The semi-quantitative analysis took into account the NorthMet Project Proposed Action along with other projects that were recently permitted or are currently in the permitting or environmental review process. The results of the analysis were described in a technical report – *Cumulative Impacts Analysis Minnesota Iron Range Industrial Development Projects; Assessment of Potential Visibility Impacts in Federal Class I Areas in Minnesota* (hereafter called the '2006 Visibility Class I Study' [Barr 2006h]). An updated report was also submitted in 2012 (Barr 2012o). The 2006 Visibility Class I Study addresses the effects of the NorthMet Project Proposed Action and all other past and "reasonably foreseeable" proposed projects consistent with the SDD. This analysis focused on a four-county project area (Itasca, St. Louis, Lake, and Cook counties).

The analysis presented here represents an update to the study previously prepared for the DEIS (Barr 2006h). The updated analysis includes a six-county project area (two additional counties added: Koochiching and Carlton), additional projects, and updated information on some projects included in the 2006 study (Barr 2012o). These updates were incorporated to make the analysis consistent with the work done in Minnesota to address the federal Regional Haze Rule since the 2006 Visibility Class I Study was submitted to the state agencies.

6.2.7.8 Background on the Regional Haze Rule

The USEPA published regulations in July 1999 intended to improve visibility in the nation's Class I areas. On June 15, 2005, the USEPA issued final amendments to the July 1999 rule. This rule and amendments are referred to as the Regional Haze Rule. Minnesota has two Class I areas—the BWCAW and Voyageurs National Park. In addition, emissions from Minnesota contribute to visibility impairment to Michigan's Isle Royale National Park Class I area. The rule requires that by year 2064, visibility in the Class I areas reflect no man-made impairment and

also requires the installation of BART emission controls that reduce visibility impairment, for certain industrial facilities emitting air pollutants. The MPCA submitted a SIP to the USEPA in 2009, updated in 2012, that describes a 2018 visibility goal that makes reasonable progress towards the ultimate 2064 goal. Minnesota's Regional Haze SIP outlines the 2018 visibility goal and includes a target for 30 percent reduction in combined NOx and SO_2 emissions by 2018 from 2002 levels from point sources in Northeast Minnesota that emit over 100 tons per year of either NOx and SO_2 (MPCA 2009a).

Minnesota has been included in the Cross-State Air Pollution Rule (CSAPR), as described in 40 CFR 52.1240-1241. In 2011, the USEPA proposed that the emissions reductions in CSAPR achieved greater reasonable progress than source-specific BART determinations for power plants. As such, Minnesota has submitted a Regional Haze SIP Supplement (MPCA 2012g) to substitute CSAPR for BART for power plants. On June 12, 2012, the USEPA partially approved the SIP supplement. The partial approval allowed the substitution of CSAPR for BART of power plants; however, it failed to approve the BART emission limits for the taconite facilities. The partially approved plan also includes the identification of Class I areas, calculating baseline and natural visibility, establishing reasonable progress goals, adopting a long-term strategy for progress toward visibility goals, providing a monitoring strategy, and consulting with other states and FLMs prior to development of a regional haze plan. On February 6, 2013, the USEPA issued a Federal Implementation Plan (FIP) to set emissions standards for the six taconite facilities in Minnesota (and one in Michigan). The FIP is currently stayed by the United States Eighth Circuit Court of Appeals, while the USEPA works with the taconite facilities to settle litigation challenging the 2013 federal limits. While the level of final limits is not known at this time, it is expected that any final limits would result in significant emissions reductions, of NOx in particular, at the affected facilities.

6.2.7.8.1 Summary of the 2006 Visibility Class I Study Scope (Updated in 2011) – Background

Regional Haze and Visibility Impairment

The USEPA defines "regional haze" as visibility impairment caused by the cumulative air pollutant emissions from numerous sources over a wide geographic area (USEPA 2003). The primary pollutants that are contributing to regional haze in Minnesota's Class I areas are anthropogenic emissions of fine particulate matter ($PM_{2.5}$). $PM_{2.5}$ includes ammonium sulfate, ammonium nitrate, and organic carbon matter (MPCA 2009a). Each of these components can be naturally occurring or can be the result of human activity. The natural levels of these species result in some level of visibility impairment in the absence of any human influences, and would vary with season, daily meteorology, and geography (USEPA 2003).

There are two categories of fine particulates: primary and secondary. Fine particulates, 2.5 microns or less in diameter, that are placed directly into the atmosphere are called primary particulates. Secondary particulates are formed as a secondary pollutant by the chemical transformation of NOx, SO_2, or VOC. Secondary particulates are the main contributor to regional haze. Both categories of fine particulates (primary and secondary) can be transported long distances.

Coarse particles between 2.5 and 10 microns in diameter do contribute to light extinction. However, these particles tend to settle out from the air more rapidly than fine particles and can

be found relatively close to their emission sources (USEPA 2004, MPCA 2005), so emissions from the NorthMet Project Proposed Action in this size range are not likely to impact Class I areas.

Measuring Visibility

Visibility is characterized by the light extinction coefficient and haze index. Additional description on these two measures of visibility is provided below.

Light Extinction Coefficient

The light extinction coefficient is the sum of the atmospheric concentration of each species of interest multiplied by a corresponding coefficient. The light extinction coefficient is referred to as b_{ext} and has units of 10^{-6} m^{-1} or $(10^{6}$ $m)^{-1}$, or as typically labeled, inverse megameters (Mm^{-1}). Data from the Interagency Monitoring of Protected Visual Environments (IMPROVE) network is used to calculate light extinction coefficients for those Class I areas where monitoring is conducted.

Haze Index (Deciview)

The haze index or deciview (dv) was developed to address the issue that light extinction coefficients are non-linear with respect to human perception of visual changes. The dv is derived from calculated light extinction, and is designed such that uniform changes in haze correspond approximately to uniform incremental changes in perception, across the entire range of conditions, from pristine to highly impaired (40 CFR Part 51.301).

Visibility Impairment "Cumulative Impact" Approach

The scope of the updated cumulative effects on visibility for the NorthMet Project Proposed Action was completed in essentially four general steps:

- Assess the IMPROVE data for Voyageurs National Park and the BWCAW to provide the current status of particulate air concentrations and haze index including a trends analysis where there is sufficient data. PM_{10} concentrations are used to assess particulate concentration trends.
- Assess available information from the Regional Haze State SIP that identifies emission sources and/or emission source regions as significant contributors to ambient air concentrations in the Class I areas located in Minnesota.
- Evaluate local, statewide, and national SO_2, NOx, and PM_{10} emissions and trends using existing emission inventory data.
- Evaluate the cumulative effects from the proposed projects based on the potential increases in SO_2, NOx, and PM_{10} emissions and concurrent reductions from current and reasonably foreseeable projects and the expected decrease in state and national emissions.

Analysis Boundaries

The following boundaries were identified to define the extent of the analysis for the visibility cumulative effects study:

- The timeframe for the trends analysis, both past and future.
- The timeframe for this analysis is 1990 to 2035.
- Other "reasonably foreseeable" actions to be assessed in addition to the NorthMet Project Proposed Action.

The following projects and actions are considered to be underway or "reasonably foreseeable":

- Proposed Projects:
  - Excelsior Energy, Mesaba Energy Project, Coal Gasification Power Plant;
  - Essar Steel Minnesota LLC (formerly Minnesota Steel Industries), Mining/Taconite/DRI/Steel Plant;
  - Essar Steel Minnesota LLC, Project Modifications;
  - Mesabi Nugget, Large Scale Demonstration Plant;
  - Mesabi Mining Project; Northshore Mining Company, Furnace 5 Reactivation Project;
  - NorthMet Mining Project;
  - Sappi Cloquet Plant Expansion;
  - UPM/Blandin Paper Mill Expansion, Project Thunderhawk;
  - U.S. Steel Keetac Expansion Project; and
  - United Taconite Green Production Project.
- Emission Reduction Projects:
  - Hill Wood Products major modification amendment;
  - Minnesota Power Taconite Harbor Energy Center Unit 2, Emission Control Modifications;
  - Minnesota Power Laskin Energy Center Unit 2, NOx Reductions;
  - Minnesota Power Boswell Energy Center Unit 3;Northshore Mining Company: BART Reductions;
  - U.S. Steel Minntac BACT Reductions; and
  - United Taconite BART Reductions.
- Regulatory and other actions:
  - Implementation of the CSAPR (40 CFR parts 52.1240-1241); and
  - Implementation of the Regional Haze Rule and BART Rule.
- On-road mobile source programs:
  - Fuel blending standards; and
  - Tier II/Low-sulfur gasoline.
- Non-road mobile source programs:

- Control of emissions from unregulated non-road engines;
- Locomotive/marine engine reductions;
- Non-road diesel rule; and
- Updates and additions to the NAAQS for SO_2, NO_2, $PM/PM_{2.5}$, and ozone, including 1-hour NO_2 and SO_2 standards.

Geographic Area that May be Affected ("Zone of Impact")

The "zone of impact" is defined as the area of concern to be evaluated for potential cumulative effects due to the above-listed actions. Based on the scope defined in the SDD for the NorthMet Project Proposed Action, the selected zone of impact is defined as Voyageurs National Park and the BWCAW. Voyageurs National Park is primarily located in St. Louis County, while the BWCAW encompasses parts of St. Louis, Lake, and Cook counties.

Assessment of Existing Conditions

An assessment of the baseline visibility conditions for Minnesota's Class I areas is based on monitoring data from the IMPROVE program. Monitor sites from both the BWCAW (monitor ID: BOWA1) and Voyageurs National Park (monitor ID: VOYA2) were included in the analysis. The IMPROVE website (http://vista.cira.colostate.edu/improve/Default/htm) along with the Visibility Information Exchange Web System (VIEWS) (http://vista.cira.colostate.edu/views/Web/Data/DataWizard.aspx), provide ambient air concentrations for particulate speciated by chemical and relative humidity data. Although another site collected data at Voyagers National Park (VOYA1), it was not used in the trend analysis due to a lack of continuous measurements and change in monitoring location, a comparison with VOYA2 was made. The VIEWS website provides the total light extinction coefficient from aerosol measurements and relative humidity.

Minnesota achieved its modeled 34 percent emissions reduction goal for total SO_2 emissions (2002-2018) by 2008, and saw a 61 percent reduction by 2011. Minnesota achieved a 38 percent emissions reduction in total NOx emissions by 2011, nearly reaching its entire (2002-2018) modeled emissions reduction goal of 41 percent. Based on this, the MPCA has determined that its existing, USEPA-approved Regional Haze SIP (the 2009 Regional Haze SIP and the 2012 Regional Haze SIP Supplement) is adequate to meet the requirements of the Regional Haze Rule and to ensure achievement of the established reasonable progress goals for Minnesota's Class I areas. The plan requires no further substantive revision to achieve established goals for visibility improvement and emissions reductions.

Natural, local, state, national, and international emission sources contribute to visibility impairment in Minnesota's Class I areas. Minnesota's Regional Haze SIP recognizes that the main states that contribute to visibility impairment in Minnesota's Class I areas are Minnesota, Wisconsin, Illinois, Iowa, Missouri, and North Dakota. .

The Regional Haze SIP includes a modeling analysis of the potential contributions to light extinction for ammonium sulfate and ammonium nitrate on the 20 percent worst days by Minnesota and surrounding states for the projection year 2018 for BWCAW and Voyageurs National Park. The analysis indicates that Minnesota is the single largest contributor to visibility impairment at approximately 30 percent. The remaining 70 percent of the estimated contribution

is from surrounding states such as Iowa, Illinois, and Wisconsin, as well as other distant areas. Northeast Minnesota sources make up approximately 50 percent of the contribution of visibility impairment coming from Minnesota (MPCA 2009a) or about 15 percent of the total from all sources.

6.2.7.9 Summary of Emission Trends

Table 6.2.7-4 shows the estimated potential emissions of SO_2, NOx, and PM_{10} from each of the proposed projects included in this analysis. Concurrent emission reductions are provided for comparison to the emissions estimated for the proposed projects. Proposed projects were included only if they were not operating for most of 2009. This cutoff date was chosen since the monitoring and emission inventory data used to assess the past or existing conditions includes information up to 2009. Any sources not operating during most of 2009 were not included in the analysis of the existing conditions and therefore need to be considered in the assessment of future cumulative effects.

Emissions of both NO_x and SO_2 have been reduced in northeast Minnesota by reductions from power generation facilities. However, both power generation facilities and the mining facilities contribute to visibility impairment in the area. As discussed in the *Background on Regional Haze* section above, the MPCA currently has a Regional Haze SIP goal to reduce combined NO_x and SO_2 emissions from northeast Minnesota from 2002 levels by 30 percent by 2018. Current MPCA estimates indicate that emission reductions at power generation facilities and additional reasonably foreseeable projects in northeast Minnesota are not enough to meet the current Regional Haze SIP goal; however, they are on track to meeting the reduction goal. Therefore, additional mitigation or reductions may be necessary.

Even though there is a net increase in PM_{10} for all the proposed projects combined, direct PM_{10} emissions are not considered to be a concern for visibility impairment in the BWCAW or Voyageurs National Park as described in Minnesota's Regional Haze SIP (MPCA 2009a).

Table 6.2.7-4 Maximum Potential SO_2, NO_x, and Particulate Emissions from the Proposed Projects in the Six-County Project Area CEAA in Comparison to Emission Reductions

Project	City/County	SO_2 (tpy)	NO_x (tpy)	PM_{10}[18] (tpy)	BACT/ MACT[18]
Increases					
Excelsior Energy, Mesaba Energy Project[1]	Taconite or Hoyt Lakes, St. Louis or Itasca County	1,390	2,872	532	Yes
Mesabi Nugget LSDP[2]	Hoyt Lakes, St. Louis County	417	955	587	Yes
Mesabi Mining Project[3]	Hoyt Lakes, St. Louis County	7	298	1,260	Yes
Essar Steel Minnesota LLC (formerly Minnesota Steel)[4]	Nashwauk, Itasca County	421	1,505	1,354	Yes
Essar Steel Minnesota LLC Project Modifications[5]	Nashwauk, Itasca County	146	-69	-90	Yes
Northshore Mining Company, Furnace 5 Reactivation[6]	Silver Bay, Lake County	56	200	149	Yes

Project	City/County	SO_2 (tpy)	NO_x (tpy)	PM_{10}[18] (tpy)	BACT/ MACT[18]
PolyMet Mining, NorthMet Project[7]	Hoyt Lakes, St. Louis County	40	473	1,186	No
Sappi Cloquet[12]	Cloquet, Carlton County	1	162	29	Yes
UPM/Blandin Paper Mill Expansion, Project Thunderhawk[8]	Grand Rapids, Itasca County	213	169	-7	Yes
U. S. Steel Keewatin, Keetac, Expansion[9]	Keewatin, Itasca and St. Louis County	81	35	1,284	Yes
United Taconite Green Production Project[13]	Forbes, St. Louis County	35	35	-10	No[13]
Total Increases		2,807	6,635	6,274	--
Reductions					
Minnesota Power Taconite Harbor Energy Center Unit 2, Emission Control Modifications for SO_2, NO_x, and Mercury[11]	Schroeder, Cook County	-1,549	-423	--	--
Minnesota Power Laskin Energy Center Unit 2, NO_x Reductions[10,11]	Hoyt Lakes, St. Louis County	0	0	--	--
Minnesota Power Boswell Energy Center Unit 3[(11)]	Cohasset, Itasca County	-4,224	-6,372	--	--
U. S. Steel Minntac BACT Reductions[15]	Mtn. Iron, St. Louis County	--	-1,973	--	--
Hill Wood Products[14]	Cook, St. Louis County	--	--	-14	--
Northshore Mining Company: BART Reductions[11,17]	Silver Bay, Lake County	-583	-1,159	--	--
United Taconite BART Reductions[11,17]	Forbes, St. Louis County	-1,954	--	--	--
Total Reductions		-8,310	-9,927	-14	--
Net Reductions/Increase		**-5,503**	**-3,292**	**6,260**	--

Notes:

[1] Emission estimates (Phase I and Phase II) based on emissions used in the air quality analysis in the draft EIS (USDOE and MDC 2007), website: http://nepa.energy.gov/documents/EIS-0382_Mesaba_FEIS_Vol_1.pdf. Accessed on May 5, 2011.

[2] Mesabi Nugget's Proposed Large Scale Demonstration Plant (LSDP): No crushing/grinding at the site; receive concentrate from offsite. Technical Support Document for MPCA permit 13700318-003. Included in Northeast Minnesota Plan Project Tracking for MPCA SIP, version 1-20-2011.

[3] Preliminary emission estimates Barr Engineering, as of 1/29/2011.

[4] Baseline emission from Potential to emit from Technical Support Document for Minnesota Steel (MPCA permit #06100067-002).

[5] Project modifications preliminary emission estimates Barr Engineering, emission estimate from EI Spreadsheet submitted to MPCA on 4/5/2011.

[6] Northshore Mining's Furnace 5 Project: reactivating two crushing lines, nine concentrating lines, one pellet furnace (Furnace 5); new sources emissions only (MPCA permit #07500003-003). Although construction for the project was completed prior to the January 1, 2009 cut-off date for this analysis, due to plant turnaround and current demand, the furnace has not yet operated at a capacity reflecting the expected increase and is therefore included in this evaluation.

[7] PolyMet Mining's Proposed Facility: crushing/grinding of ore, reagent and materials handling, flotation, hydrometallurgical processing, mobile emissions. Emission estimates from Barr 2012r (RS57).

[8] Net Emission Increase from Blandin Project Thunderhawk MPCA permit #06100001-009. No change in emissions for -010 or -011. Note that this project was not built.

[9] U.S. Steel Keetac Mine, and Keetac (Keewatin) mine expansion and restart of taconite processing line – preliminary emission calculations, Barr Engineering. Submitted to MPCA in May 2011 permit application. NOx emission increase is from the baseline actual emissions used to determine PSD applicability. Although there would be a small increase in actual emissions, there would be a decrease in the allowable emissions.

[10] Minnesota Power completed installation of the Low NOx burner system project in Spring 2010. Although actual 2009 emissions already show reductions in excess of the anticipated reductions from 2002 levels, additional reductions are expected to result from the use of the low NOx burners in 2010 and future years. A reduction of zero is used in this analysis because the actual future restrictions are unknown.

[11] Emission estimates provided by the MPCA from the "Northeast Minnesota Plan Emission Tracking Spreadsheet" 1-20-2011. Reductions are the estimated reduction from 2002 emissions minus any reduction in actual emissions that has occurred between 2002 and 2009.

[12] Net emission change estimates from final EAW dated 5/1/2009. Plant expansion, new paper machine, new boiler.

[13] United Taconite Green Production Project – Involves fuel changes and improvements to concentrator and the Line 1 pellet plant to increase pellet production and was a PSD minor project. Because it was a PSD minor project, specific considerations for BACT/MACT were not required. However, the Line 1 pellet plant has an existing wet scrubber to control particulate and SO_2 emission, Emissions estimates are taken from the Technical Support Document of Permit Number 13700113-005 authorizing the project on August 19, 2010.

[14] Net emissions increase from TSD of Air Emission Permit No. 13700030-003.

[15] Reductions calculated based on data in "US Steel Minntac Line 7 Low NOx Main Burner Final Testing Report", May 13, 2011 of 3,990 ton per year goal for NOx emissions and the 2009 actual emissions provided in the MPCA "Northeast Minnesota Plan Emissions Tracking Spreadsheet" 1-20-2011.

[16] PM_{10} emissions estimates include stationary and fugitive emissions for all sources at a facility.

[17] The MPCA RH SIP is still being reviewed by the USEPA for approval including the recommended BART determinations for affected facilities. Actual BART requirements are pending discussions with the MPCA and have not yet been implemented.

[18] Abbreviations: tpy = tons per year
BACT = Best Available Control Technology
MACT = Maximum Achievable Control Technology
SO_2 = sulfur dioxide
PM_{10} = particulate matter less than 10 micrometers in size
NO_x = nitrogen oxides
NA = not applicable

6.2.7.9.1 Summary of Visibility Cumulative Effects Analysis

The following items outline the results and environmental consequences of the 2011 Visibility Class I Study and newly released IMPROVE data:

1. **Visibility progress:** Both of Minnesota's Class I areas have seen improvements in worst-day visibility conditions. Minnesota has achieved the reasonable progress goal for Voyageurs, and excluding the effects of the 2011 Pagami Creek Wildfire, would be expected to do so for Boundary Waters. The MPCA reported the measured progress towards meeting the 2018 RPG at Voyageurs and Boundary Waters (MPCA 2014h). IMPROVE data currently exists through 2014; the FEIS goes through 2010. The MPCA used data through 2013 in their recent 5-year progress report (MPCA 2014h). The 5-year trends in the FEIS are sensitive to the baseline and end date selected and hence are of limited value. Since visibility is impaired at all Class I areas, the trend must go down to achieve the goals of the regional haze program. The appropriate question is whether the visibility measurements are going down at a fast enough pace; therefore, the appropriate comparison is to the glide slope.
2. **Sulfate and Nitrate Particles Are Largest Contributor to Visibility Impairment.** Ammonium sulfate, ammonium nitrate, and organic carbon matter particulates are the largest contributors to visibility impairment in both Class I areas. The ammonium sulfate and nitrate are due to emissions of SO_2 and NO_x, respectively.

3. **Overall Emissions Decreases in Pollutants that are Precursors to Sulfate and Nitrate Particulates.** When the emissions from the proposed projects in northeast Minnesota are viewed together with the concurrent emission reduction projects of SO_2 and NO_x from power generation facilities in northeast Minnesota, there is a net decrease in emissions of both pollutants in the six-county area of northeast Minnesota. As noted in the Environmental Consequences section above, current MPCA estimates indicate that emission reductions at power generation facilities and additional "reasonably foreseeable" projects in northeast Minnesota are not enough to meet the current Regional Haze SIP goal. Therefore, additional mitigation or reductions may be necessary to reach the 2018 goal.
4. **30 Percent of Visibility Impairment Due to Minnesota Emissions and 70 Percent Due to Out-of- State Emissions**. Predictive modeling done in support of the Minnesota Regional Haze SIP shows that Minnesota sources are expected to contribute approximately 30 percent of the visibility impairment at Minnesota's Class I areas and approximately 14 percent of the visibility impairment at Isle Royale (MPCA 2009a). Of the visibility impairment in the Minnesota Class I Areas, Northeast Minnesota sources contribute about half of the total from Minnesota sources or 15 percent overall. The remainder is likely due to sources in other states and Canada. Emissions from Minnesota are the single largest contributor to regional haze at its own Class I areas.
5. **Net Effect from Proposed Projects.** The net effect from the proposed projects, the voluntary reductions of power generation facilities, and the foreseeable regulatory actions shown in Table 6.2.7-2 would likely reduce emissions of SO_2 and NO_x in Minnesota. However, as addressed above, the MPCA has developed Regional Haze SIP goals to reduce combined NO_x and SO_2 from 2002 levels. The reduction is 20 percent by 2012 and 30 percent by 2018. Based on current projections including the NorthMet Project Proposed Action, the reductions addressed in this section are not projected to be enough to meet the 2018 goal. The reductions would be enough to meet the 2012 goal.

In the event that additional emission reduction measures are required by the MPCA to meet Regional Haze SIP goals, emissions from the NorthMet Project Proposed Action may be included for reduction consideration through the MPCA's Regional Haze Rule and permitting programs.

6.2.7.10 Climate Change

As noted in Section 5.2.7, and in this cumulative effects assessment, the construction and operation of the NorthMet Proposed Action would emit gases known to contribute to global climate change. For an in-depth discussion of global climate change, please refer to the Keetac Project EIS published in 2010 (MDNR and USACE 2010). That EIS's cumulative effects assessment provided an exhaustive discussion of the state of scientific knowledge and policy framework regarding global climate change and has been incorporated by reference to this EIS as background information provided by the CEQ regulations (40 CFR 1502.21).

The Keetac EIS found the following:

- Global GHG emissions increased by about 19.6 percent between 1990 and 2004;
- U.S. GHG emissions increased by about 17 percent between 1990 and 2007; and
- Minnesota GHG emissions (for all economic sectors) increased by about 16.2 percent between 1990 and 2006.

It should be noted that for the global figure, a portion of the increase in GHG emissions can be attributed to deforestation and biomass decay. Nevertheless, these numbers show a definite increasing trend in anthropogenic sources of GHGs, which the IPCC has determined is contributing to an increase in global temperatures (MDNR and USACE 2010).

As noted in Section 5.2.7, the NorthMet Proposed Action would directly produce approximately 196,342 mtpy of GHG. Table 6.2.7-5 shows the amount of GHG that the NorthMet Proposed Action would produce in comparison to global, national, and Minnesota GHG emissions. It shows that the NorthMet Proposed Action's direct GHG emissions would be several orders of magnitude lower than total global, national, and even statewide GHG emissions.

Table 6.2.7-5 Greenhouse Gas Emissions

	Total GHG Emissions (million mtpy)	Proposed Action GHG Emissions as a Proportion of Total
Global	49,000	0.00038%
National	7,282	0.0026%
Minnesota	159.4	0.12%
NorthMet	0.1963	

Source: Barr 2012l.

Given the minor GHG contribution of the NorthMet Proposed Action to global GHG emissions, it is impossible to predict how much the NorthMet Proposed Action would factor into climate change, as noted in the Keetac EIS on Page 5-35. In general, increased GHG emissions from the NorthMet Project Proposed Action contribute to a cumulative adverse effect on the earth's climate. Based on the science available, there is the potential that climate change could have a significant effect on terrestrial and aquatic systems and economies worldwide. However, determining the significance of any single project is beyond the capabilities of current science.

6.2.7.11 Potential Cumulative Inhalation Risk Assessment

A cumulative risk assessment was conducted to assess the estimated potential cumulative inhalation risk to a potential resident receptor which included background, non-Project air emissions. Potential projects considered for inclusion in the cumulative risk analysis were those within about 10 kilometers (about 6 miles) of the NorthMet Project Proposed Action and included the Mesabi Mining Project for particulate metals and NO_2 and the Minnesota Power Laskin Plant for NO_x.

A summary of the maximum estimated potential cumulative inhalation risk to a potential resident receptor from background exposure (calculated by the MPCA from ambient air monitoring data), non-NorthMet Project Proposed Action air emissions (Mesabi Mining Project and the existing Minnesota Power Laskin Plant), and NorthMet Project Proposed Action air emissions (the incremental risk estimated from the Mine Site and the Plant Site) are summarized in

Table 6.2.7-6. The estimated cumulative risk is compared to the incremental risk guideline values for a single facility or project, since there are no guideline values for cumulative risk, and is intended to provide a broad context for reviewing the results.

The potential incremental risk from the NorthMet Mine Site and Plant Site together contribute about 57 percent of the estimated potential cumulative acute risk. Total cumulative inhalation acute risk does not exceed the incremental acute risk guideline value of one. Potential incremental risk from the NorthMet Mine Site and Plant Site accounts for only 7 percent of the estimated potential total cumulative chronic noncancer risk. Potential cumulative noncancer chronic risks do not exceed the incremental chronic noncancer guideline value of one and are predominately from risks based on monitored background air concentrations. Potential incremental risk from the NorthMet Mine Site and Plant Site accounts for only 9 percent of the estimated potential total cumulative cancer risk (4E-05). Cancer risk from monitored background air concentrations (3E-05) is greater than the incremental cancer risk guideline value of 1E-05, thus cumulative risk is also above this value.

Table 6.2.7-6 Summary of Cumulative Inhalation Risks

Estimated Potential Inhalation Risk[1]	Cancer	Noncancer Chronic	Noncancer Acute
Background[2]			
Ambient Air (calculated by MPCA)	3E-05	1	0.4
Laskin Energy Center	NA	NA	0.01
Total Background	3E-05	1	0.4
Incremental[3]			
Mine Site and Plant Site	3E-06	0.1	0.6
Mesabi Mining Project	NA	0.1	0.03
Total Incremental	3E-06	0.2	0.6
Cumulative[4]			
Total Cumulative Inhalation Risk	4E-05	1	1
Report Calculated Values as Percentages	9	7	57

Source: Supplemental Air Emission Risk Analysis – Plant Site (Barr 2013j).

Notes:
[1] The maximum potential cumulative risk represents the highest risk from the four receptors evaluated in the supplemental analysis for the Plant Site (Barr 2013j).
[2] Background risks were calculated by the MPCA based on MPCA 2008-2010 monitoring data from Virginia, Ely and Cloquet.
[3] As per USEPA (2005) HHRAP guidance, all reported risk values are rounded to one significant digit. Totals, however, are calculated from unrounded values (i.e., two or more significant figures) and may differ from the value obtained by adding the rounded values shown in the table.
[4] LSDP = Large-Scale Demonstration Plant (Mesabi Nugget).

6.2.8 Noise and Vibration

As described in Section 5.2.8, there would be a long-term increase in the levels and duration of noise above ambient levels throughout the construction, operation, and reclamation period in the vicinity (approximately half-mile radius) of the Mine Site (approximately 11,456 acres affected) and Plant Site (approximately 568 acres affected). The total noise modeling results presented in Table 5.2.8-7 include sources from the Mine Site and Plant Site (NorthMet Project Proposed Action) plus baseline noise levels in the region, which includes existing noise sources from past and present actions near the NorthMet Project area such as Northshore Mine and Mesabi Nugget Plant (formerly Mesabi Nugget Phase I).

There are no other past, present, or reasonably foreseeable actions within the half-mile radius of the Mine Site and Plant Site that would interact in such a way as to have a cumulative effect on the receptors identified in Sections 4.2.8 and 5.2.8. Therefore, adverse cumulative noise and vibration effects are not expected on nearby sensitive receptors (residences/dwelling places, recreational sites, cultural sites) due to the distance of the NorthMet Project Proposed Action from the closest reasonable foreseeable action, Mesabi Mining Project (formerly Mesabi Nugget Phase II) (approximately 2 miles west of the Plant Site and 10 miles west of the Mine Site). Other reasonable foreseeable projects in the region are 25 to 55 miles away from the NorthMet Project Proposed Action and, as such, would have no cumulative effect on nearest receptors (see Figure 6.1.1-1 and Table 6.1.1-1). As indicated above, other past and present actions are already accounted for in the baseline or ambient levels. Actual noise and vibration source terms from future projects such as the Mesabi Mining Project were not publicly available, and contour maps for such future projects were not provided. It should be noted that even if noise and vibration source terms for the Mesabi Mining Project were available, such contour maps would not be expected to overlap with the NorthMet Project noise and vibration contours due to the distance between both projects (i.e., considering the rapid decay of sound with increased distance [6 decibel decrease per doubling of distance] and attenuation from individual mine pit walls [i.e., as the pits become deeper] and dense foliage [Superior National Forest]).

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6.2.9 Cultural Resources

The cumulative effects analysis for cultural resources focuses on past, present, and reasonably foreseeable future effects on historic properties and 1854 Treaty resources. This section provides a qualitative, and quantitative where appropriate and feasible, analysis of cumulative effects on historic properties eligible for listing on the NRHP, as well as 1854 Treaty resources. The approach to the analysis of cumulative effects on historic properties and 1854 Treaty resources has been informed through discussions and consultation between the Co-lead Agencies and the Bands.

6.2.9.1 Approach

Cumulative effects on cultural resources were assessed by evaluating the effects of the NorthMet Project Proposed Action in conjunction with other past, present, and reasonably foreseeable future federal, state, and private actions within the CEAA for cultural resources. The cumulative effects on cultural resources are described below in Section 6.2.9.2. The baseline conditions of cultural resources, as directly and indirectly affected by past actions, are described in Section 4.2.9, and direct and indirect effects from the NorthMet Project Proposed Action are described in Section 5.2.9.

Assessment of effects on cultural resources is done specific to the cultural resources identified within the CEAA. Although cultural resources surveys have been conducted within the Project area, no cultural resource surveys for the entire CEAA have been completed.

Cultural resource surveys are conducted on a project-by-project basis reflective of an individual project area. For cumulative effects analysis areas, generally the areas are too large and expansive to warrant a Section 106 equivalent cultural resources field survey. In such cases, therefore, a cumulative effects analysis is performed using a qualitative analysis of the cumulative effects analysis area for comparison purposes.

Section 4.2.9 provides background information on existing conditions as a result of field surveys and investigations within the APE of the NorthMet Project Proposed Action; however, there is no similar level of data specific to the entire CEAA to allow an impact assessment comparable to the one found in Section 5.2.9. Instead, data on cultural resources located within the CEAA that were previously recorded at the SHPO and the USFS were gathered and compiled in Section 6.2.9.4.1. These data included publically available information related to NEPA and NHPA analysis of potential impacts on cultural resources from other current and future projects within the CEAA. These data, along with the data presented in Section 4.2.9, were used to determine what cultural resource types are typically found within the CEAA. In turn the cumulative effects on cultural resources were analyzed qualitatively according to the cultural resource types typically found within the CEAA.

Cultural resources may be destroyed by erosion, construction, excavation, data collection, and looting; through the removal of artifacts from their surrounding contexts, moving the material such that it loses context; or through the removal or redeposition of artifacts and their surrounding context to another location. Cultural properties—including camps, structures, hunting and fishing sites, graves, and areas of particular religious or traditional importance—lose their integrity, and thus their potential eligibility for the NRHP, when they become degraded as a result of natural or human disturbance processes, or when the groups, such as the Ojibwe Bands,

who value these places, can no longer access them, thus losing their cultural connection to the site or place over time.

The determination of effects for cultural resources is based on a resource's eligibility for inclusion on the NRHP. It should be noted that the NRHP status of some cultural resources within the CEAA remain undetermined, and surveys would be required to determine if these resources would be eligible for inclusion in the NRHP. Effects on cultural resources listed in the NRHP, considered to be eligible for listing in the NRHP, or identified but unevaluated would be avoided or mitigated to the degree practicable as required by Section 106 of the NHPA of 1966 during implementation of federal undertakings. For all cultural resources listed in the NRHP, considered to be eligible for listing in the NRHP, or unevaluated, avoidance would continue to be the preferred mitigation strategy. For any historic properties unavoidably and adversely affected by a proposed project, mitigation measures would be developed as part of a Treatment Plan for that project.

In determining how the Bands have traditionally conducted their usufructuary rights on or near the NorthMet Project area, interviews of individual Band members of Bois Forte, Fond du Lac, and Grand Portage were conducted. Only the results of interviews with Bois Forte were made available. These interviews yielded little specific information concerning both recent-historic and contemporary use of natural resources by the Bands in the NorthMet Project area. This likely reflects limited subsistence gathering in the NorthMet Project area due to general inaccessibility. This lack of data also precludes the quantitative analysis of how Band members would be affected socioeconomically by effects on 1854 Treaty resources, as discussed in Section 5.2.10. The primary source of data for assessing effects from the NorthMet Project Proposed Action on 1854 Treaty resources is from the analysis of the environment discussed in detail in Section 4.2.9 of this EIS.

6.2.9.2 Cumulative Effects Assessment Area

The NorthMet Project Proposed Action's CEAA for cultural resources is described below, both spatially and temporally.

6.2.9.2.1 Spatial

The CEAA for cultural resources is defined as the area of the Mesabi Iron Range that is within the 1854 Ceded Territory (see Figures 6.1.1-1 and 1.1-1). The area has been limited to the Mesabi Iron Range as it is a definable region encompassing the region's mining, which represents the largest and most influential land use within a reasonable distance from the NorthMet Project area. Additionally, the area is further limited to the 1854 Ceded Territory as it is an area of cultural importance to the Bands.

At various times during consultation for the NorthMet Project Proposed Action, the Bands have proposed using an expanded area for analysis of cumulative effects on cultural resources and natural resources of significance to the Bands, including use of the 1854 Ceded Territory as the CEAA. The Co-lead Agencies believe that the use of the 1854 Ceded Territory as the CEAA for cultural resources would actually diminish the significance of any cumulative effect. By evaluating the effects of the NorthMet Project Proposed Action along with other past, present, and reasonably foreseeable future projects in the context of a much larger area with a much larger number of resources similar to those affected by the NorthMet Project Proposed Action,

the effect of the NorthMet Project Proposed Action on those resources is diminished. The cumulative effects analysis focuses on the specific resources, or types of resources, affected by the NorthMet Project Proposed Action within an area that is geographically meaningful considering the resource and project under review. For these reasons, the Co-lead Agencies believe that the CEAA used in this section is appropriate for this analysis.

6.2.9.2.2 Temporal

This evaluation includes a qualitative discussion of land use and public resource management developments within the 1854 Ceded Territory since the development and use of timber/mineral resources began as a result of European settlement in the area, from roughly the 1850s on.

6.2.9.3 Cumulative Actions

This assessment includes direct and indirect cumulative effects on cultural resources associated with current and foreseeable actions listed below. The following current and reasonably foreseeable projects, described in Section 6.1.1.2, are included in the cumulative effects assessment for cultural resources:

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits);
- ArcelorMittal Mines Push-Back Project;
- Community growth and development;
- Forestry practices (regional);
- LTV Steel Mining Company Former LTVSMC Pits;
- Mesaba Energy Project – West Range Site;
- Mesabi Mining Project;
- Mesabi Nugget;
- Mining Resources (Austin Powder Basin, Corsica Basin, Skubic Basin, and Sherman Basin);
- Minnesota Department of Transportation Highway 53 Relocation;
- Northshore Mine;
- Northshore Mine Ultimate Pit Progression Project;
- U.S. Steel Minntac Mine and Processing; and
- U.S. Steel Minntac Mine Extension Project.

6.2.9.4 Cumulative Effects Assessment

The NorthMet Project Proposed Action would result in both direct and indirect effects on historic properties and culturally important resources. Some of the historic properties affected by the NorthMet Project Proposed Action are part of a thematically related group of properties associated with Ojibwe land use patterns, while others could be thematically grouped by their relation to historic mining and development in Northern Minnesota. Cumulative effects on

natural resources of cultural significance to the Bands are addressed in more detail in the specific natural resources sections and are only summarized in this section.

Cumulative effects on historic properties may be both direct and indirect and result in the physical loss of properties or changes to location, setting, design, materials, craftsmanship, feeling, or associations. Similar to the analysis of the direct and indirect effects of the NorthMet Project Proposed Action, analysis was conducted for the cumulative effects on historic properties and natural resources of significance to the Bands. Cumulative effects were assessed by evaluating the effects of the NorthMet Project Proposed Action with other past, present, and reasonably foreseeable future federal, state, tribal, and private actions.

6.2.9.4.1 Cultural Resources Previously Recorded within the CEAA

There have not been comprehensive cultural resource surveys of the defined CEAA in its entirety. However, data on cultural resources located within the CEAA that were previously recorded at the SHPO and the USFS were gathered and compiled below. These data, along with the data presented in Section 4.2.9, were used to determine the known cultural resources within the CEAA and what cultural resource types are typically found within the CEAA. In addition to the quantative information that was available for analysis, the cumulative effects on cultural resources were also analyzed qualitatively according to the cultural resource types typically found within the CEAA. Also considered was the nature of some of the properties affected (i.e., thematic groups of properties), and the geographically extensive nature of some specific properties affected.

Archaeological Resources

Two archaeological sites have been previously recorded outside the NorthMet Project Proposed Action APE, but within the CEAA.

Site 21SL0457, the Jackson Site, consists of a sparse pre-contact-period lithic scatter identified on the surface of a ridgetop just west of US Highway 53 between Eveleth and Midway, Minnesota. The lithic material identified at the site appeared to be some form of taconite. Subsurface investigation of the site was not carried out as part of the 1995 site documentation. The site has not been evaluated for inclusion in the NRHP.

Site 21SL1128, the Staff Family Farmstead Site, consists of a cellar depression, two outbuilding foundations, a milk house, an isolated concrete pad, a root cellar, a stone-bordered depression, a well house depression, a surface dump, and an artifact scatter. The early 20th century farmstead is located within a general upland in Nichols Township, Minnesota. The site was recommended to be potentially eligible for listing in the NRHP per the *Historic Context Study of Minnesota Farmsteads, 1820-1960* for its association with the agricultural development of the Cutover Region of Minnesota and under Criterion D for its potential to yield important information regarding the agricultural development of St. Louis County.

Architectural Resources

Research indicates that 174 architectural properties and two historic districts have been previously inventoried outside the NorthMet Project Proposed Action APE, but within the CEAA.

The NRHP-Eligible Mountain Iron Mining Landscape Historic District comprises 10 properties and sites representing a system of open-pit natural ore mines, rail corridors, and other features associated with the early development of the Mesabi iron range between 1892 and 1909. The Mountain Iron Mining Landscape Historic District is located within the incorporated limits of the City of Mountain Iron.

The NRHP-Listed Virginia Commercial Historic District consists of 103 buildings, three vacant lots, and a clock tower. The district is located adjacent to Chestnut Street between 1st Avenue and 6th Avenue in the City of Virginia and reflects the city's main historical industries—mining and logging.

The majority of the architectural properties previously inventoried within the CEAA consists of residential structures, commercial and industrial buildings, mining-related developments, government facilities, and infrastructure-related improvements such as bridges and railroads. Of the 174 architectural properties previously identified within the CEAA, 31 are listed or eligible for listing in the NRHP. An additional 57 architectural properties, which have not been evaluated for listing in the NRHP or have been designated not eligible for listing in the NRHP, have been deemed locally significant.

6.2.9.4.2 Past Actions

The Ojibwe called the hills *Missabe*, the "sleeping giant"—land that lay undisturbed for millennia until the demand for iron drew prospectors to the area in the 1800s. On the Mesabi Range, stretching 100 miles from Grand Rapids to Babbitt, soft ore lay close to the surface, where it could be scooped from open pit mines. Prospectors came to Lake Vermilion in the 1860s to search for gold (Lamppa 2004). It was the discovery of iron ore on the Vermilion Range, however, that led vast tracts of land to be purchased (Risjord 2005). Explorations in 1890 by the Merritt brothers of Duluth—known as the "Seven Iron Men"—laid the groundwork for their Mountain Iron Mine, which marked the opening of the great Mesabi Range. Their second mine, opened at Biwabik in 1891, secured the Mesabi Range's future legacy in rich hematite ore. The Merritt brothers' railroad, the Duluth, Mesabi & Northern, carried its first carload of ore in 1892 to ore docks in Superior, Wisconsin, across the bay from Duluth, itself a major shipping port (Minnesota Historical Society 2008). A decade later, the Mesabi Range boasted over 100 open pit mines. From 1900 to 1980, the Mesabi Range contributed about 60 percent of the country's total iron ore output. Production peaked in the 1940s, when about 600,000,000 tons were shipped to serve the nation's needs during World War II. Production remained high in the 1950s, and then began to decline. It had taken less than 100 years for industrial demand to deplete the supply of high-grade ore (Risjord 2005).

In addition to the mining industry, thick forests of pine, fir, spruce, cedar, birch, and aspen covered much of what is now the Mesabi Range when the first Europeans arrived in Northern Minnesota. In the early 1860s, sawmills in Duluth, Superior City (modern-day Superior), and Beaver Bay found a growing market for timber, shipping lumber to other towns on the Lake and beyond. 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).

Both the mining and logging industries would forever change the relatively pristine environment that existed at the time of contact between Native Americans and Europeans in the mid-1600s.

The historic effects of these industries, prior to the development of historic preservation legislation in the 1960s (i.e., prior to NHPA), occurred with little analysis of cultural resource effects. Areas logged (such as past forestry practices), mined (such as the LTVSMC), roaded (such as past road construction and expansion projects), or otherwise subjected to extensive ground disturbance (such as past community growth and development) resulted in undocumented and unregulated effects on cultural resources. Cultural properties tend to degrade over time due to natural forces; however, many survive for hundreds or thousands of years. Modern human activity tends to exacerbate the damage and as a consequence cultural resources are being damaged and disappearing at an increasing rate. The CEAA exhibits effects as a result from modern use of the land. Cultural resources are likely to have sustained damage from previous mining, logging, road construction, recreation, wildfires and erosion resulting from these activities. Although difficult to quantify, the paucity of artifacts at some sites may be due to removal by artifact collectors.

Many specific use areas exist, or have existed, along the *Mesabe Widjiu.* Throughout the length of the Mesabi Iron Range, which includes a large portion of the *Mesabe Widjiu*, the setting and associated use areas have been affected by alterations to the landscape brought about by mining, community growth, road construction, and logging. Use of the *Mesabe Widjiu* and surrounding areas has changed as past development mines expanded and consumed areas once used by the Ojibwe. The setting of the *Mesabe Widjiu* and the association of the use areas and trails with the *Mesabe Widjiu* contribute to its significance.

As discussed in Section 4.2.9, an interconnected system of trails along the *Mesabe Widjiu* was documented in the 19th century GLO surveys. Past mining operations have directly affected the setting in many locations where this trail system was historically documented.

Historic documentation and oral history, as demonstrated through the Band member interviews conducted for the NorthMet Project Proposed Action, document Ojibwe occupation and use of the area throughout the CEAA. The Bands have ancestral ties to the CEAA and the Trygg Maps document a trail system and occupation sites at the time of the United States GLO surveys in the mid-to-late 1800s. Landscapes such as the *Mesabe Widjiu* are part of Ojibwe oral history and traditional practices. From the signing of treaties in the 19th century to the expansion of mining operations today, mining activities in the Mesabi Iron Range likely have had substantial cumulative effect on historic properties of traditional religious and cultural significance to the Ojibwe Bands; however, the details concerning these effects are not well understood.

To address cumulative effects related to historic properties associated with taconite mining, the period that is most relevant to cumulative effects runs from 1957 (Initiation of Erie activities within the CEAA) to the present day. The concentrator building, railroads, and the majority of contributing structures were built in present form between 1957 and 1958. These structures and transportation features continued to be used in the industrial taconite process through 2001, when LTV idled activities at the Mine Site. The properties remained relatively unaltered throughout this period of use; however, there were regular periodic upgrades, maintenance, and engineering system improvements. Given the dynamic and evolving nature of mining landscapes, certain features were created, utilized, and subsequently abandoned throughout the 50-odd years of taconite mining. Mine Area No. 2, for example, was opened in 1957, but eventually merged with Mine Area No. 3 sometime after 1970. Concurrent with this evolving landscape is the movement of transportation infrastructure such as railroads and access roads, which typically have a dynamic and shifting use-life. The Erie/LTVSMC Tailings Basin is another mining feature that

evolved extensively from 1957 through 2001. The spatial massing, height, and footprint of this particular feature changed regularly while mining was occurring, and its current form is vastly different than that during the period of significance for Erie. Following LTVSMC's bankruptcy in 2001 and idling of the mine site, the vast majority of the structures were deactivated, and the system railroads were not used. Cliffs Erie continued to provide site security, but maintenance activities were not known to have occurred. PolyMet acquired options to the Plant Site through Cliffs Erie in 2005/2006. Outside of general maintenance to the Administration Building, PolyMet has not initiated any notable maintenance or rehabilitation projects in the APE. The pelletizer building was demolished in 2007, though it is the only structure from Erie's period of significance that has been removed.

6.2.9.4.3 Current and Future Actions

Known or newly identified cultural resources, as part of current and future projects, are evaluated for their eligibility for listing on the NRHP based on their integrity at the time of documentation and evaluation. The combination of the implementation of an Unanticipated Discovery Plan (minimizing effects on unknown cultural resources that may be inadvertently encountered), as well as associated mitigation measures, and/or a Treatment Plan would mitigate cumulative effects on cultural resources. As discussed in Sections 4.2.9 and 5.2.9, identified cultural resources would be evaluated and avoided or minimized to the degree practicable as required by Section 106 of the NHPA during implementation of the NorthMet Project Proposed Action. Although continued current development could affect cultural resources, considerations such as these conducted through the NEPA and NHPA processes would help to mitigate many of the effects caused by currently proposed projects. However, cumulative effects on cultural resources could include reasonably foreseeable incremental effects in the form of unauthorized artifact collection and inadvertent disturbance in the CEAA caused by increased human activity.

The following current and reasonably foreseeable projects have the potential to effect cultural resources: ArcelorMittal Mines, Essar Steel Project, Mesabi Nugget and Mesabi Mining Project, Northshore Mine, and U.S. Steel Minntac Project. Generally, these types of large mining and energy projects could have similar types of direct and indirect effects (e.g., physical disturbance; introduction of visual, atmospheric, or audible elements; change in character; etc.), although how they affect the significance of a given cultural resource (i.e., the reason for its potential eligibility in the NRHP) could be different. It is important to note that, while the Mesaba Energy projects are outside of the CEAA, they are located immediately adjacent to it. Because many historic properties of traditional religious and cultural significance are not as readily documented for the cultural resources practitioner and the physical boundaries of properties, such as *Mesabe Widjiu*, for example, generally consist of a subjective boundary-based social, cultural, or traditional perceptions or perspectives of the property, these projects were included within the CEAA for analysis purposes. Larger categories of current and future regional projects, such as forestry practices, road construction and expansion projects, and community growth and development would not generally be expected to have unmitigated adverse impacts to historic properties due to the requirements of Section 106 of the NHPA for federal undertakings and various other local and state historic preservation requirements. There could be effects to historic properties, however, due to projects occurring on private lands where no local, state, or federal permits are required.

Landscape properties can be exposed to a number of potential direct and indirect effects. Not all effects to a landscape property, such as *Mesabe Widjiu*, would result in an adverse effect. For instance, larger landscape properties may allow for changes in landscape to a non-contributing portion of the property or minor changes to the landscape or setting. Factors to consider would include the scale of the landscape, the prominence of the affected elements, the magnitude of the proposed project, and the permanency of the change.

For large-scale natural landscapes, such as the *Mesabe Widjiu*, the relationship of landscape characteristics and integrity is complex, as discussed in Section 4.2.9 and 5.2.9. As is the case in Northern Minnesota, the compatibility of the *Mesabe Widjiu* and historic and modern mining presents change, an inescapable part of any landscape. In the case of the *Mesabe Widjiu,* direct impacts can come from new construction or incompatible land uses, such as modern logging, mining, growth or development of commercial or residential areas, transportation construction, or other activities that reshape the land or disturb significant aspects of the landscape.

For the *Mesabe Widjiu*, setting is an essential component of its use by Band members. Once pristine in nature, peacefulness and solitude contribute to its cultural significance as a traditional and sacred location. Indirect effects outside the *Mesabe Widjiu's* boundaries can constitute intrusions when such changes introduce incompatible visible, audible, or atmospheric elements. Ultimately, such effects could result in an interruption in the continuity of its historic integrity or use. More directly, changes in land ownership or segregation of the landscape or a specific use area could result in inaccessibility for Band members to experience the property for the very factors that made it eligible.

In the case of Native American trails, anticipated direct and indirect effects would come in the form of continuing segmentation and disassociation of once-related sites and resources. In particular, changes to the trail system due to expanded mining operations, would also have residual effects on this and potentially other cultural resources. Visual effects on these trails would also continue indefinitely and are considered to be cumulative, as well. There would also be continued cumulative visual intrusions (shape of the landscape) and noise effects on this type of cultural resource, as the NorthMet Project Proposed Action and other current and future projects are visible along the trails.

Direct and indirect effects on the Spring Mine Lake Sugarbush and other more finite historic properties of traditional religious and cultural significance would be similar to those described above for the *Mesabe Widjiu* and Native American trails. In addition to those mentioned above, effects could result from increases in human access leading to subsequent disturbance (e.g., looting, vandalism, and trampling) of historic properties and features. These effects could result from the establishment of corridors or facilities in otherwise intact and inaccessible areas, or increased human access. Additionally, historic properties with natural resources components, such as the Spring Mine Lake Sugarbush, could be exposed to other indirect effects such as those related to water, air, and invasive species.

Additionally, within the CEAA, there are significant historic mining properties that have structural components. Reuse of the Erie Mining Company Concentrator Building as part of the NorthMet Project Proposed Action is an example of a known mining property that would be affected within the CEAA. A mining landscape still being worked may retain integrity if modern extraction methods and character are similar to those practiced historically, important physical elements remain, and comparable properties are less intact. Continued use of a property also may

destroy it, such as modern mining, which obliterates all traces of earlier mining activity. Continued mining on the Mesabi Iron Range has and would continue to eliminate, or alter, the landscape or structures resulting from prior mining activity, which may qualify for the NRHP. This is a cumulative effect of mining on historic mining properties that is inherent in the mining industry itself.

The NorthMet Project Proposed Action has essentially provided a temporary reprieve in demolition and site reclamation activities required by *Minnesota Rules*, part 6132.3200, which calls, among other remediation activities, for the removal of mining equipment, facilities, railroad tracks and ties (not required by common carriers), and structures. This administrative rule is applicable to the other Erie infrastructure, and is cited here for review purposes:

> *Minnesota Rules*, part 6132.3200 CLOSURE AND POSTCLOSURE MAINTENANCE, Subpart 2, E(4). Within three years after closure begins, or within a longer period if approved by the commissioner, the following shall be accomplished:
>
> (b) permittee-owned power plants and associated facilities except public utilities, transmission lines, pipelines, docks and associated facilities, and railroads except common carrier transportation facilities shall be removed or provisions made for continued subsequent use; and
>
> (c) all other equipment, facilities, and structures shall be removed and foundations razed and covered with a minimum of two feet of surface overburden.

PolyMet would be required to implement a closure and remediation plan for the Mine Site in the event of permitting. Specific language regarding the removal of structures and features is available in Section 3.2.2.3.12. Given the requirements for closure pursuant to *Minnesota Rules*, part 6132.3200, it is reasonable to assume that all buildings and structures not approved for potential future use within the APE of the NorthMet Project Proposed Action that are considered to be contributing to the overall Erie Mining Landscape Historic District would be demolished and reclaimed after the 20-year mining period.

The Co-lead Agencies are working with the consulting parties on the terms of an MOA resolving adverse effects to historic properties. It is anticipated that the MOA will include resolution measures that mitigate potential cumulative effects on these properties. The MOA will be executed and the NHPA process will be completed prior to the Co-lead Agencies' issuance of Records of Decision.

6.2.9.4.4 1854 Treaty Resources

Given the broad range of resources under the term "1854 Treaty resources," the reader should reference the appropriate natural resource sections for detail regarding cumulative effects on specific natural resources of concern.

As discussed in Section 5.2.9.2.2, the NorthMet Project Proposed Action would have effects on 1854 Treaty resources, that is, those plant and animal species that are traditionally or culturally important to the Bands. Band members' use of the NorthMet Project area, and the entire CEAA, is not well-defined through research, and did not emerge through interviews. Noise and other consequences of operations could affect migration or other animal species behavior. The NorthMet Project Proposed Action could affect the availability or use of 1854 Treaty resources

for some Band members through real or perceived factors, as discussed further in Section 5.2.9.2.2.

Construction and operation of the NorthMet Project Proposed Action and other past, present, and reasonably foreseeable future projects are not likely to reduce overall availability of 1854 Treaty resources that are typically part of subsistence activities in the 1854 Ceded Territory. As with the NorthMet Project Proposed Action itself, some individuals and localized populations may be affected by other projects in the CEAA, but overall species populations are expected to remain available. Effects on the environment, including those from increased mercury, are all expected to meet the standards and regulations set forth by the appropriate state or federal agency or program. These laws are intended to protect important natural and cultural resources and include but are not limited to the ESA, the CWA, and the CAA. Cumulative effects on 1854 Treaty resources are difficult to quantify when the effects are within environmental standards yet above current baseline conditions. As such, cultural effects on the Bands would be difficult to quantify in regards to such incremental increases below standards or effects on species where appropriate mitigation is used. However, it is anticipated that current and future projects would mitigate for potential effects on 1854 Treaty resources.

6.2.10 Socioeconomics

Socioeconomics includes demographic characteristics of population, employment, income, market composition, public finance, housing, public services, and the economic characteristics of subsistence activities. The cultural aspects of subsistence, specifically for Native American populations, are discussed in the Cultural Resources section of Chapter 5. Individual subsistence products (e.g., wild rice, game animals, etc.) are discussed in appropriate resource-specific sections.

The assessment found that, while the NorthMet Project Proposed Action and other past, present, and reasonably foreseeable future actions would generate economic activity within the CEAA, the combined actions would not cause cumulative socioeconomic effects.

6.2.10.1 Approach

As discussed in Chapter 5, many of the socioeconomic effects of the NorthMet Project Proposed Action—such as increased population, housing demand, and effects on public facilities and services—are functions of the jobs and revenue that the NorthMet Project Proposed Action would create, as modeled using IMPLAN. Conclusions in this analysis were drawn using readily available data for the cumulative actions under consideration and IMPLAN estimations for the NorthMet Project Proposed Action.

Evaluation of socioeconomic cumulative effects is based largely on the number of new full-time (or full-time equivalent) jobs created by operation of the cumulative actions. While specific factors may vary, other socioeconomic effects (earnings, value added, demand for housing and community services, etc.) are presumed to vary proportionally with employment changes.

6.2.10.2 Cumulative Effects Assessment Area

6.2.10.2.1 Spatial

The CEAA for socioeconomics includes effects associated with the NorthMet Project Proposed Action, combined with other industrial (including mining) projects located within the portion of the Mesabi Iron Range encompassed by St. Louis, Lake, and Cook counties (see Figure 6.2.10-1). As with the NorthMet Project Proposed Action (see Section 5.2.10), iron, taconite, and precious metal mining in the Mesabi Iron Range have helped to define the region's socioeconomic conditions for decades. While mining activity has decreased greatly from its peak in the middle of the 20th century, it remains an important economic factor.

Tourism and other economic activity associated with the region's high-quality recreation and natural areas (such as BWCAW) are also important economic and land use drivers. These economic contributions are based largely on socioeconomic preferences (e.g., retirees choosing to live in the region to be close to recreational resources), rather than definable projects or activities. The CEAA for socioeconomics includes many of the largest and most important recreational and tourist resources in northeastern Minnesota.

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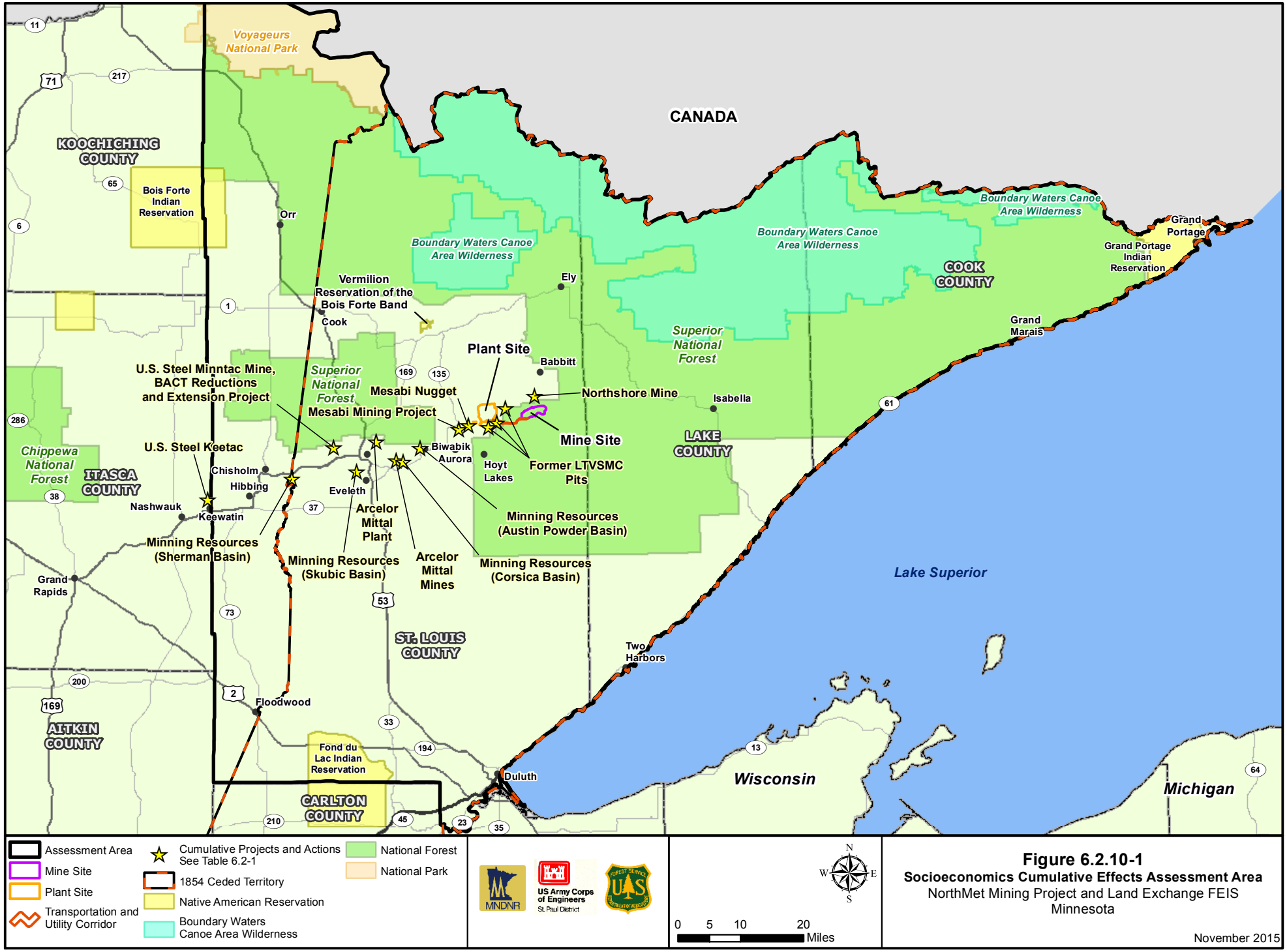

Figure 6.2.10-1
Socioeconomics Cumulative Effects Assessment Area
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

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6.2.10.2.2 Temporal

This evaluation focused on the existing and anticipated future use of the CEAA. Because mining and public resource management (including recreation and natural resource tourism) have been the primary drivers defining regional socioeconomic development within the CEAA for over 100 years, existing conditions are considered indicative and representative of historical mining and resource management activities.

6.2.10.3 Past, Present, and Reasonably Foreseeable Future Actions

For the purposes of this assessment, cumulative actions are those current and permitted mine projects located in the portion of the Mesabi Iron Range within St. Louis, Lake, and Cook counties. The socioeconomic effects of the region's recreation and tourism resources are discussed in Section 5.2.10, and no specific cumulative actions or activities related to these resources have been identified. These projects, described in Section 6.1.1.2, are listed below.

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits);
- ArcelorMittal Deposit Push-Back;
- LTV Steel Mining Company Former LTVSMC Pits;
- Mesabi Mining Project;
- Mesabi Nugget;
- Mining Resources, (Austin Powder Basin, Corsica Basin, Skubic Basin, and Sherman Basin;
- Northshore Mine;
- Northshore Mine Ultimate Pit Progression Project;
- U.S. Steel Keetac Mine (Keewatin);
- U.S. Steel Minntac Mine;
- U.S. Steel Minntac Extension Project; and
- United Taconite Mine Expansions.

The locations of these actions relative to the NorthMet Project Proposed Action are shown on Figure 6.2.10-1.

6.2.10.4 Cumulative Effects Assessment

Table 6.2.10-1 summarizes the anticipated cumulative effects of the NorthMet Project Proposed Action and cumulative actions. Existing studies, approved NEPA documents, and other information about the cumulative actions did not include detailed economic modeling—such as the IMPLAN model conducted for the Proposed Action. As shown in Table 6.2.10-1, these existing documents do estimate direct employment from some of the cumulative actions, but there are no substantive data or estimates of output and value added (as defined in Section 5.2.10.1). As a result, much of the analysis in this section is largely qualitative in nature.

Table 6.2.10-1 Summary of Socioeconomic Cumulative Effects

Project	Temporal Scale	New Direct Employment	
		Construction	Operation
NorthMet Project Proposed Action[1]	Future	764	360
ArcelorMittal Mines (Laurentian and East Reserve Deposits)	Present	0	0
ArcelorMittal Deposit Push Back	Reasonably Foreseeable	Undetermined	Undetermined
Mesabi Nugget	Present	Undetermined	Undetermined
Mesabi Mining Project[3]	Reasonably Foreseeable	250	220
Mining Resources, Austin Powder Basin	Reasonably Foreseeable	Undetermined	Undetermined
Mining Resources, Corsica Basin	Reasonably Foreseeable	Undetermined	Undetermined
Mining Resources, Skubic Basin	Reasonably Foreseeable	Undetermined	Undetermined
Mining Resources, Sherman Basin	Reasonably Foreseeable	Undetermined	Undetermined
Northshore Mine	Present	0	0
Northshore Mine Ultimate Pit Progression Project	Reasonably Foreseeable	Undetermined	Undetermined
U.S. Steel Keetac Mine (Keewatin)[4]	Present	500	170
U.S. Steel Minntac Mine[2]	Present,	Undetermined	0
U.S. Steel Minntac Mine, Extension Project[2]	Reasonably Foreseeable	Undetermined	0
United Taconite Mine expansions	Reasonably Foreseeable	Undetermined	Undetermined
Total, Cumulative Projects Only		**750**	**390**

Notes:
[1] Operations employment reflects typical year of operations.
[2] U.S. Steel announced in March that it will temporarily idle these operations due to low iron ore prices (Coyle 2015). Analysis assumes they are in full operation.
[3] Indicates the maximum typical construction employment.
[4] Reflects peak of 4-year construction period.

Construction of the above-mentioned projects would generate approximately 750 new jobs directly in the CEAA (in addition to jobs associated with projects whose employment needs are undetermined), one percent of the total existing study area employment. Given the timing of these projects, the effects are likely to be experienced across different geographies over time.

The operational phases of the cumulative actions would generate approximately 390 new jobs in the CEAA (in addition to jobs associated with projects whose employment needs are undetermined), less than one percent of the area's total current employment. Including indirect and induced employment, this figure could triple (based on multipliers associated with the NorthMet Project Proposed Action), resulting in approximately 1,170 total new jobs. Added to the NorthMet Project Proposed Action, cumulative effects on employment could surpass 1,934 total new jobs in the three-county study area.

Earnings and value added from the cumulative actions would likely be generated at a similar rate (per new employee) to the NorthMet Project Proposed Action. Therefore, it is estimated that the economic contribution of the cumulative actions, together, would likely match (and could exceed) that of the NorthMet Project Proposed Action.

Demand for housing and public services due to the cumulative actions would also likely match that of the NorthMet Project Proposed Action, although these demands would likely occur in cities and towns not evaluated in Section 5.2.10, such as Mountain Iron, Chisholm, and cities in other counties to the west, which would be in commuting distance to the cumulative actions, but that are not within commuting distance of the NorthMet Project Proposed Action. As of 2011, there were approximately 700 vacant, non-seasonal housing units in Itasca County (as well as 6,900 seasonal units, some of which could conceivably be converted or marketed for full-year use).

As with the NorthMet Project Proposed Action, some portion of these new employees are likely to already be residents of the CEAA, while some indirect and induced jobs may be filled by spouses or children of cumulative project employees. By comparison, St. Louis and Itasca counties have approximately 245,000 residents and 130,000 housing units (vacant and occupied) (US Census Bureau 2010b). Increases in population and housing demand to the cumulative actions would likely represent less than one percent of these figures. Such increases would not likely strain overall service capacity in the region due to existing capacity (see Section 5.2.10), but could create localized pressures on housing markets or public service agencies.

The cumulative actions would all occur in areas already affected by mining and many are, in fact, expansions of previous mining projects. These projects are largely on private land already zoned or otherwise designated for such activities. While EJ effects could occur on properly zoned land, there is no evidence that these cumulative actions would generate EJ effects associated with economic factors.

Increases of mercury in waterbodies from the NorthMet Project Proposed Action are discussed in Section 5.2.2.3.4, and cumulative increases are discussed in Section 6.2.2.4 and Section 6.2.6.3.3. Cumulative increases in mercury concentrations and the resultant increased mercury concentrations in fish tissue could constitute an EJ impact for Band members and other subsistence consumers of fish. However, the AERA assessed health effects for recreational and tribal fishermen and their families consuming fish that could potentially contain elevated bioaccumulated levels of methylmercury. A potential small change in fish mercury concentration was estimated based on modelled emissions and deposition. The potential change in methylmercury concentration is not statistically measureable given variability in background concentrations and current laboratory analytical methods (Barr 2013j). Therefore, there is no expected change in fish mercury concentrations, and no subsequent change in human health risks related to fish consumption (see Section 5.2.7.2.5). Also, this information is summarized in Section 7.3.4.4.3 of the FEIS.

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6.2.11 Recreation and Visual Resources

The NorthMet Project Proposed Action (including the Mine Site, Transportation and Utility Corridor, and Plant Site), occupies 7,650.1 acres of land near Hoyt Lakes and Babbitt, in St. Louis County, Minnesota. This includes public lands in the Superior National Forest, as well as private lands within the municipal boundaries of Hoyt Lakes and Babbitt.

6.2.11.1 Approach

The cumulative actions are evaluated to determine whether they would directly affect recreational lands or activities, or whether they would cause direct or indirect changes in recreational patterns or views on a regional scale.

6.2.11.2 Cumulative Effects Assessment Area

6.2.11.2.1 Spatial

The CEAA for recreation and visual resources includes the portion of the Mesabi Iron Range within St. Louis County (see Figure 6.1.1-1). The Mesabi Iron Range encompasses the region's mining activity, which has the greatest potential to affect recreational resources and activities.

This analysis also recognizes the Arrowhead Region's substantial existing high-quality recreational resources, such as BWCAW, Voyageurs National Park, and Superior National Forest. Changes in recreational activity associated with these sources are typically associated with socioeconomic preferences (e.g., increased population and/or changes in recreational preferences and patterns).

6.2.11.2.2 Temporal

This evaluation focused on existing and anticipated future activities that would affect recreation and visual resources within the CEAA. Existing conditions are considered indicative and representative of historical mining and resource management activities. Some additional qualitative consideration has been given to the pre-historic viewshed conditions documented by regional tribes in their cultural and religious teachings.

6.2.11.3 Contributing Past, Present, and Reasonably Foreseeable Actions

As noted previously, it is not possible to identify all past activities that may contribute to a cumulative effect. Similarly, all present activities would continue to affect the environment. The impacts of these combined activities are described in Chapter 4, Affected Environment. Activities included with the NorthMet Project Proposed Action for the assessment of cumulative effects are shown on Figure 6.1.1-1 and described in Section 6.1. Activities specifically associated with potential cumulative effects on recreation include permitted mines and other projects in portions of the Mesabi Iron Range in St. Louis County where future activities would likely be different from current activities. These projects include:

- ArcelorMittal Deposits (Laurentian and East Reserve Deposits);
- ArcelorMittal Deposit Push-Back;
- Mesabi Mining Project;

- Northshore Mine Ultimate Pit Progression Project;
- U.S. Steel Keetac Mine; and
- U.S. Steel Minntac Mine, Extension Project.

6.2.11.4 Cumulative Effects Assessment

The cumulative actions described in Section 6.2.11.3 are largely existing, expanded, or reconfigured mines on private land, totaling approximately 2,650 acres. Sources for the data regarding cumulative actions include MDNR and USACE 2007, USDOE and MDC 2007, and MDNR and USACE 2010.

6.2.11.4.1 Recreation

None of the cumulative actions would directly affect recreational lands such as local or state parks. The public's enjoyment of recreational activities in the region—such as hunting, fishing, boating, hiking, and winter sports—is tied in part to visual resources, as well as to factors such as the availability and quality of fish and other aquatic species, vegetation, and wildlife (particularly game species), noise, air quality, water quality, and wetlands. Direct and indirect effects on these resources are presented in their respective sections in Chapter 5.

The cumulative actions would all occur on or in close proximity to existing or previously mined land. Excluding effects related to noise, fisheries, air quality, and other effects described elsewhere in Chapters 5 and 6, and given the proximity of active and past mining and industrial activity to high-quality recreational activity in the Arrowhead Region (such as the BWCAW), there is no evidence that the activities associated with the NorthMet Project Proposed Action, in and of themselves, would directly affect the public's overall ability to hunt, fish, and conduct other recreational activities, or affect their overall recreational experience in the Arrowhead Region as a whole.

6.2.11.4.2 Visual Resources

Changes in visual conditions associated with the cumulative actions are expected to be comparable to those described for the NorthMet Project Proposed Action in Section 5.2.11.2.1. Whereas portions of the NorthMet Project Proposed Action would occur on previously unmined land, the mining-related cumulative actions would occur in areas where mine pits and processing facilities are already part of the visual landscape. After reclamation, the Northshore Mine Ultimate Pit Progression Project would introduce new visual elements to the mining area including: the construction of islands for bird habitat, areas for fish spawning, public access to the lake (post-closure) and flooding organic debris to aid in the initiation of biological productivity (MDNR 2014f).

6.2.12 Wilderness and Other Special Designation Areas

6.2.12.1 Approach

The Mine Site, Plant Site, and surrounding federal lands are not located within or adjacent to any wilderness areas, nor are there any special designation areas within or adjacent to the NorthMet Project area. For the purposes of analysis, the study area is an approximate 25-mile radius from the NorthMet Project area, as described below (see Figure 4.2.12-1).

For the purposes of this analysis, the term "wilderness" is defined by the Wilderness Act of 1964 (Public Law 88-577) (16 USC §1131–1136). Other special-designated areas (listed below) 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, research natural areas, national scenic or historic trails, wild or scenic rivers, unique biological areas, national natural landmarks, national historic landmarks, and national monuments, among others. They fall under the management jurisdiction of the federal land management agencies, including the MDNR, USFS, National Park Service, and USFWS.

- Designated Wilderness Areas within the study area:
  - BWCAW – 25 miles north of the NorthMet Project area.
- National Park System Units near the study area:
  - Voyageurs National Park – 50 miles northwest of the NorthMet Project area.
- State Parks within the study area:
  - Soudan Underground Mine State Park – 18 miles west of the NorthMet Project area;
  - Lake Vermilion State Park – 16 miles northeast of the NorthMet Project area;
  - Bear Head Lake State Park – 11 miles northeast of the NorthMet Project area; and
  - Iron Range Off-Highway Vehicle State Park – 17 miles northeast of the NorthMet Project area.
- Established and Candidate Research Natural Areas (cRNAs) within the study area:
  - The Big Lake-Seven Beavers Area – 12 miles east of the NorthMet Project area;
  - Keeley Creek Natural Area – 25 miles northeast of the NorthMet Project area; and
  - Dragon Lake – 25 miles east of the NorthMet Project area.
- Unique Biological Areas (UBAs) within the study area:
  - Little Isabella River – 25 miles east of the NorthMet Project area; and
  - Harris Lake National Natural Landmark – 20 miles northeast of the NorthMet Project area.
- National Historic Landmarks within the study area:
  - Soudan Iron Mine –18 miles northwest of the NorthMet Project area.

- Scenic Byways within the study area:
  - Superior National Forest Scenic Byway – a portion of the road is 9 miles southwest of the NorthMet Project area.
- Designated Recreation Trails within the study area:
  - Taconite State Trail – a portion of the trail is 15 to 17 miles north of the NorthMet Project area.

The cumulative actions have been evaluated against Class I air modeling to determine potential visual effects of haze from the NorthMet Project Proposed Action.

6.2.12.2 Cumulative Effects Assessment Area

6.2.12.2.1 Spatial

The CEAA for Wilderness and Other Special Designation Areas includes effects associated with the Proposed Action and combined with other industrial (including mining) or public works projects located within the portion of the Mesabi Iron Range encompassed by St. Louis County (see Figure 6.1.1-1). While no direct effects on wilderness character are anticipated, there may be measurable indirect cumulative air effects associated with the NorthMet Project Proposed Action. The CEAA for assessment of potential air effects on designated wilderness and other designated areas is the boundary of measurable air effects identified in Chapter 5.

6.2.12.2.2 Temporal

This evaluation includes a brief discussion of documented air quality degradation in the designated areas since the establishment of these wilderness or other designated areas.

6.2.12.3 Contributing Past, Present, and Reasonably Foreseeable Actions

As noted previously, it is not possible to identify all past activities that may contribute to a cumulative effect. Similarly, all present activities would continue to affect the environment. The impacts of these combined activities are described in Chapter 4, Affected Environment. Activities included with the NorthMet Project Proposed Action for the assessment of cumulative effects are shown on Figure 6.1.1-1 and described in Section 6.1.1. Activities specifically associated with potential cumulative effects on wilderness and other special designated areas include permitted mines and other projects in the portions of the Mesabi Iron Range in St. Louis County where future activities would likely be different from current activities. These projects include:

- Mesabi Mining Project;
- Mesabi Nugget;
- LTV Steel Mining Company Former LTVSMC Pits;
- Minnesota Power Laskin Energy Center;
- Minnesota Power Taconite Harbor Energy Center Unit 2, Emission control modifications;
- Northshore Mine;

- Northshore Mining Company Furnace 5 Reactivation Project;Northshore Mine Ultimate Pit Progression Project;
- U.S. Steel Minntac; and
- U.S. Steel Minntac Mine Extension Project.

6.2.12.4 Cumulative Effects Assessment

The cumulative actions described in Section 6.2.12.3 are largely existing, expanded, or reconfigured mines on private land.

Based on the detailed visibility analysis presented in the Air Quality Section (6.2.7), even though there would be a net increase in PM_{10} from the cumulative actions, these emissions would not impair visibility in the BWCAW or Voyageurs National Park as described in Minnesota's Regional Haze SIP (MPCA 2009a).

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6.2.13 Hazardous Materials

As described in Section 4.2.13 and 5.2.13, transport, handling, management, storage, and disposal of hazardous materials are a site-specific issue, and any potential event would unlikely contribute to measurable cumulative impacts.

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6.2.14 Geotechnical Stability

This topic relates to the waste material storage facilities (Tailings Basin, waste rock stockpiles, and Hydrometallurgical Residue Facility). The stability of these facilities is guided by local geology and design (operation and maintenance) and would not interact with other similar facilities outside of the NorthMet Project area. Given the discrete nature of these facilities, it has been concluded that no cumulative geotechnical effects would occur as a result of the NorthMet Project Proposed Action.

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6.3 CUMULATIVE EFFECTS BY RESOURCE FOR THE LAND EXCHANGE PROPOSED ACTION

6.3.1 Land Use

The cumulative effects analysis for land use for the Land Exchange Proposed Action focused on potential changes in the land area and boundary length of the Superior National Forest; changes in land fragmentation (i.e., size of patches of federal and non-federal properties) that would occur that could affect USFS management of the forest; changes in the extent or types of designated land uses, as defined by management area designations, where known; and changes in the potential for additional lands open to public use.

6.3.1.1 Approach

This section compared the types of data presented in Sections 4.3.1 and 5.3.1, for each of the projects within the CEAA Land Exchange Proposed Action boundary. Projects within the CEAA Land Exchange Proposed Action boundary were evaluated based on the most current available Superior National Forest land ownership GIS data, as well as the other datasets used in the land use discussions in Sections 4.3.1 and 5.3.1.

6.3.1.2 Cumulative Assessment Boundary

The CEAA Land Exchange boundary for land use is described below, both spatially and temporally.

6.3.1.2.1 Spatial

The CEAA for Land Exchange effects on land use was the entire Superior National Forest.

6.3.1.2.2 Temporal

This evaluation focused on the existing and anticipated future use of the CEAA for the life of the NorthMet Project Proposed Action (approximately 40 years). This includes the approximate 15-year life of the Superior National Forest Plan, which would extend through approximately 2019. Because Superior National Forest was established in 1909, existing conditions are considered indicative and representative of historical resource management activities.

6.3.1.3 Cumulative Assessment

The cumulative assessment for the Land Exchange Proposed Action portion focused on the net increase or decrease of land ownership, boundary managed, fragmentation, and management areas. Effects were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to GIS shapefiles of the Superior National Forest after all cumulative actions and the NorthMet Project Proposed Action alternatives occur.

The cumulative actions would result in a net increase in lands within the Superior National Forest. All of the lands that would be acquired are within the 1854 Ceded Territory and would thus replace the Mine Site lands with an equal or greater number of acres available for traditional land use by the Bands. Table 6.3.1-1 shows the management area designations that would result from the cumulative actions.

Table 6.3.1-1 Potential Increase/Decrease of Management Area Allocations Occurring from the Cumulative Actions

Management Area[1,2]	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
	Acres	Acres	Net Increase (Decrease)[3]	Acres	Net Increase (Decrease)[3]	Acres	Net Increase (Decrease)[3]
Eligible Wild, Scenic, and Recreational Rivers	32,298.8	32,339.5	40.7	32,339.5	40.7	32,339.5	40.7
General Forest	640,907.0	620,917.7	(19,989.3)	619,381.8	(21,525.2)	614,851.1	(26,055.9)
General Forest - Longer Rotation	411,825.7	400,805.7	(11,020.2)	402,052.3	(9,773.4)	406,519.2	(5,306.5)
Potential RNAs/cRNAs	19,006.8	19,296.8	290.0	19,296.8	290.0	19,006.8	(0.0)
Primitive Wilderness	300,786.3	334,046.5	33,260.2	334,046.5	33,260.2	334,046.5	33,260.2
Pristine Wilderness	114,380.0	124,370.4	9,990.4	124,370.4	9,990.4	124,370.4	9,990.4
Recreation Use in a Scenic Landscape	157,044.2	152,926.1	(4,118.1)	152,926.1	(4,118.1)	152,926.1	(4,118.1)
RNAs	3,170.1	3,170.1	0.0	3,170.1	0.0	3,170.1	0.0
Riparian Areas	17,893.5	18,081.2	187.7	17,859.8	(33.7)	17,859.8	(33.7)
Semi-primitive Motorized Recreation	68,733.6	64,595.9	(4,137.7)	64,595.9	(4,137.7)	64,595.9	(4,137.7)
Semi-primitive Motorized Wilderness	53,529.1	57,331.6	3,802.5	57,331.6	3,802.5	57,331.6	3,802.5
Semi-primitive Non-motorized Recreation	4,564.9	4,565.7	0.8	4,565.7	0.8	4,565.7	0.8
Semi-primitive Non-motorized Wilderness	343,149.2	381,092.9	37,943.7	381,092.9	37,943.7	381,092.9	37,943.7
UBAs	2,495.4	2,495.4	0.0	2,495.4	0.0	2,495.4	0.0
Unidentified	0.1	0.1	0.0	0.1	0.0	0.1	0.0
Total[4]	2,169,784.7	2,216,035.7	46,251.0	2,215,524.9	45,740.2	2,215,171.1	45,386.4

Notes:
1 See definitions of USFS management areas in Section 4.2.3.
2 Developed based off of Table 5.3.1-1.
3 Calculated as (Cumulative Action) minus (Existing Superior National Forest).
4 Totals may not match overall project area acreages due to rounding and/or due to inconsistencies in GIS data layers.

Table 6.3.1-2 summarizes the Superior National Forest boundary, acreage, and fragmentation involved in each of the cumulative actions.

Table 6.3.1-2 Potential Increase/Decrease of Superior National Forest Boundary, Acreage, and Fragmentation Occurring from the Cumulative Actions

	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
		Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)
Acreage in Superior National Forest controlled by USFS	2,171,603.9	2,217,701.2	46,097.3	2,217,197.7	45,593.8	2,216,831.0	45,227.1
Boundary length (linear miles)	10,054.8	9,185.9	(868.9)	9,207.1	(847.7)	9,215.2	(839.7)
Fragmentation (linear miles per acre)	0.005	0.004	(0.001)	0.005	0.0	0.004	(0.001)

The cumulative effects of the Land Exchange Proposed Action, Land Exchange Alternative B, and the Land Exchange No Action Alternative would all result in an increase to the federal estate by adding acreage to the 2,171,603.9 acres of USFS-managed land within the Superior National Forest. Furthermore, the cumulative actions would all result in net reduction of the perimeter around the USFS-managed portions of the Superior National Forest. Two of the three cumulative actions would slightly alter the existing ratio of fragmentation in the Superior National Forest of approximately 0.005 linear mile of boundary per acre of USFS-managed Superior National Forest land (see Table 6.3.1-2).

The Land Exchange and the cumulative projects would also include the following net land use effects:

- consolidation of federal ownership of land within Superior National Forest, specifically of land abutting Fall Lake, Gunflint Lake, and Little Gunflint Lake; land on Wolf Island; and 86,000 acres of currently designated school trust lands, resulting in decreased fragmentation and easier access by Forest Service managers;
- reduced mineral, residential, and commercial development potential within Superior National Forest and decreased conflict related to split surface and subsurface ownership;
- increased opportunities for public recreational use of stream and lake shorelines and semi-primitive non-motorized activities in the Superior National Forest;
- decreased opportunities for public recreational use of scenic landscapes and semi-primitive motorized activities in the Superior National Forest;
- contribution to local land use and economic goals such as growth and development of the Town of Crane Lake and School Trust Land revenue; and

- minimal net effect on land available for tribal use under the 1854 Treaty.

Land Exchange Alternative B would have similar effects, but to a lesser degree. Under the Land Exchange No Action Alternative, none of the effects described above would occur.

6.3.2 Water Resources

6.3.2.1 Surface Water

The cumulative effects analysis for water resources for the Land Exchange Proposed Action focused on the potential increases or decreases of water resources, including lakes, streams, and wild rice beds.

6.3.2.2 Approach

The cumulative projects were evaluated against water resources including the acreages and miles of shoreline for lakes, miles of public streams, and wild rice beds. This section evaluated the cumulative effects on water resources similar to those resources included in Section 5.3.2.

This section compared the types of data presented in Sections 4.3.2 and 5.3.2, but for each of the projects within the CEAA Land Exchange Proposed Action boundary. The GIS data obtained for the sections mentioned above were compared to projects within the CEAA Land Exchange Proposed Action boundary, and effects were determined based on this proximity. Specifically, NWI GIS data was used to determine the analysis.

6.3.2.3 Cumulative Effects Assessment Area

The project's CEAA Land Exchange Proposed Action boundary for water resources is described below, both spatially and temporally.

6.3.2.3.1 Spatial

The spatial boundary includes the Superior National Forest. The net increase or decrease of waterways that result from the Land Exchange Proposed Action and other cumulative actions have been examined in the context of the entire forest in Section 6.1.2.

6.3.2.3.2 Temporal

The temporal boundary includes the present through 2024 (the end of the second decade of the Forest Plan).

6.3.2.4 Cumulative Effects Assessment

The cumulative assessment for the Land Exchange Proposed Action portion focused on the net increase or decrease of water resources (acres/miles of shoreline for lakes, acreages of wild rice beds, and miles of streams). Effects were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to the Superior National Forest after all cumulative actions and alternatives occur.

Table 6.3.2-1 summarizes the amount and type of water resources in each of the cumulative actions.

Table 6.3.2-1 Potential Increase/Decrease of Water Resources Occurring from Cumulative Actions

Water Resource Types	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
		Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)
Public Water Lakes, Acres	73,307.8	80,562.9	7,255.10	8,0574	7,266.20	80,456.7	7,148.90
Public Water Lakes, Miles of Shoreline	5,232.2	5,627.1	394.90	5,627.3	395.10	5,624.8	392.60
Public Water Streams, Miles	2,196.0	2,243.5	47.50	2,242.4	46.40	2,236.5	40.50
Wild Rice Beds, Acres	10,452.4	11,093.3	640.90[1]	11,093.3	640.90[1]	10,964.8	512.40

Notes:
Totals may not match overall Land Exchange area acreages due to rounding and/or due to inconsistencies in GIS data layers.
[1] Excludes area of wild rice stands in Pike River. Presence of wild rice in the Pike River, which runs through Little Rice Lake, was noted in Barr's surveys (2011a; 2012a; 2013l), but the area of rice was not calculated. The net increase in wild rice due to the Land Exchange Proposed Action is approximately 125 acres.

The Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative cumulative effects would all result in an increase to water resource areas, including wild rice within the Superior National Forest.

6.3.3 Wetlands

The cumulative effects analysis for wetlands for the Land Exchange Proposed Action focused on the potential increases or decreases of wetland acres and wetland types.

6.3.3.1 Approach

The cumulative projects were evaluated against wetland acres and wetland types. This section evaluated effects on wetland resources similar to Chapter 5.

This section compared the types of data presented in Sections 4.3.3 and 5.3.3, but for each of the projects within the CEAA Land Exchange Proposed Action boundary (see Section 6.1.2 and Figure 6.1.2-1). The GIS data obtained for the sections mentioned above were compared to projects within the CEAA Land Exchange Proposed Action boundary and effects were determined based on this proximity. Specifically, NWI GIS data was used to determine the analysis. Floodplain data for the CEAA Land Exchange Proposed Action boundary was not available for all areas; therefore, an analysis was not performed.

6.3.3.2 Cumulative Effects Assessment Area

The project's CEAA Land Exchange Proposed Action boundary for wetlands is described below, both spatially and temporally.

6.3.3.2.1 Spatial

The spatial boundary included the Superior National Forest. The net increase or decrease of wetland resources that result from the Land Exchange Proposed Action and other cumulative actions has been examined in context of the entire forest.

6.3.3.2.2 Temporal

The temporal boundary included the present through 2024 (the end of the second decade of the Forest Plan).

6.3.3.3 Cumulative Effects Assessment

The cumulative assessment for the Land Exchange Proposed Action portion focused on the net increase or decrease of wetland resources (acres of wetlands and acres of wetland types). Effects were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to the Superior National Forest after all cumulative actions and the NorthMet Project Proposed Action alternatives occur.

Table 6.3.3-1 summarizes the amount and type of wetland resources in each of the Cumulative Actions.

Table 6.3.3-1 Potential Increase/Decrease of Wetland Resources Occurring from Cumulative Actions

	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
	Acres	Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)
Net Change in Wetlands	532,851.2	545,633.1	12,781.9	544,976.7	12,125.5	544,461.8	11,610.6
Wetland Types							
Freshwater Emergent Wetland	35,852.6	37,480.1	1,627.5	37,469.0	1,616.4	37,450.5	1,597.9
Freshwater Forested/Shrub Wetland	427,440.8	433,733.4	6,292.6	433,074.7	5,633.9	432,697.0	5,256.2
Freshwater Pond	14,609.8	14,988.8	379.0	14,990.2	380.4	14,989.5	379.7
Lake	51,763.1	56,123.9	4,360.8	56,135.8	4,372.7	56,020.1	4,257.0
Other	38.2	38.2	0.0	38.2	0.0	38.2	0.0
Riverine	3,146.7	3,268.8	122.1	3,268.8	122.1	3,266.4	119.7

The cumulative effects of the Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative would result in an increase to wetland resource areas as well as wetland types.

6.3.4 Vegetation

The cumulative effects analysis for vegetation for the Land Exchange Proposed Action focused on potential increases or decreases of land cover types, landscape ecosystems, MBS Sites of Biodiversity Significance, and ETSC plant species. Other comparisons that cannot be fully made include MIH types, age classes, mature patches, RFSS plants, and invasive non-native species.

6.3.4.1 Approach

This section compared the types of data presented in Sections 4.3.4 and 5.3.4, but for each of the projects within the CEAA Land Exchange Proposed Action boundary. The GIS data obtained for the sections mentioned above were compared to projects within the CEAA Land Exchange Proposed Action boundary, and effects were determined based on this proximity. Specifically, GIS data were obtained from the MDNR regarding GAP land cover types and listed ETSC plant species within the NHIS database. Data were obtained from the USFS MIH types, forest stand age classes, landscape ecosystems, RFSS plants, and invasive non-native species.

6.3.4.2 Cumulative Effects Assessment Area

The CEAA Land Exchange Proposed Action boundary for vegetation is described below, both spatially and temporally.

6.3.4.2.1 Spatial

The spatial boundary includes the Superior National Forest. The net increase or decrease of vegetation categories mentioned below that result from the Land Exchange Proposed Action and other cumulative actions has been examined in context of the entire forest. For state-listed ETSC plant species and RFSS species, federal and non-federal lands proposed for exchange are also analyzed in ecological context of the subsection.

6.3.4.2.2 Temporal

The temporal boundary includes the present through 2024 (the end of the second decade of the Forest Plan). The Forest Plan establishes management objectives for the landscape ecosystems (Forest Plan pages 2-61 through 2-78) primarily for composition (forest type) and age class distribution. All of these may be subject to change in a future plan revision (post-2019), but the second decade would incorporate this timeframe.

6.3.4.3 Cumulative Effects Assessment

The cumulative assessment for the Land Exchange Proposed Action portion focused on the net increase or decrease of vegetation cover types, MIH types, age classes, mature patches, landscape ecosystems, ETSC plant species, RFSS plants, and invasive non-native species. For all analyses, effects were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to the Superior National Forest after all cumulative actions and the NorthMet Project Proposed Action alternatives occur.

6.3.4.3.1 Effect of Cumulative Actions on Gap Analysis Program Land Cover Types

Effects were based on a net increase or decrease basis of GAP land cover type acres after all cumulative actions and the Land Exchange Proposed Action alternatives occur (see Section 6.1.2.2 for details on the Land Exchange actions) (see Table 6.3.4-1).

Table 6.3.4-1 Potential Increase/Decrease of GAP Land Cover Types Occurring from Cumulative Actions

	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
Cover Types	**Acres**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
Aquatic environments	90,559.8	95,622.6	5,062.7	95,634.7	5,074.9	95,403.0	4,843.1
Cropland/ Grassland	8,639.8	8,205.8	(434.0)	8,210.2	(429.6)	8,187.0	(452.8)
Disturbed	3,599.5	3,203.2	(396.3)	3,252.2	(347.3)	3,286.1	(313.4)
Lowland coniferous forest	288,212.4	293,756.6	5,544.2	293,147.1	4,934.6	293,659.1	5,446.7
Lowland deciduous forest	9,303.4	9,342.2	38.8	9,336.3	32.9	9,324.3	20.9
Shrubland	239,549.4	241,123.3	1,573.9	241,151.4	1,601.9	239,870.6	321.2
Upland conifer-deciduous mixed forest	94,636.8	100,879.5	6,242.8	100,832.0	6,195.3	100,843.2	6,206.4
Upland coniferous forest	443,125.9	459,302.8	16,176.9	459,318.2	16,192.2	460,151.6	17,025.6
Upland deciduous forest	993,698.8	1,005,960.5	12,261.7	1,006,011.0	12,312.2	1,005,801.6	12,102.8
Total[1]	2,171,325.9	2,217,396.6	46,070.7	2,216,893.1	45,567.1	2,216,526.4	45,200.5

Notes:
[1] Totals may not match overall project area acreages due to rounding and/or due to inconsistencies in GIS data layers.

Under all cumulative Land Exchange scenarios (i.e., Land Exchange Proposed Action and all other exchanges and acquisitions, Land Exchange Alternative B and all other exchanges and acquisitions, and Land Exchange No Action Alternative with all other exchanges and acquisitions), there would be a decrease in disturbed areas and cropland/grassland cover types on the Superior National Forest. There would be an increase to the Superior National Forest of aquatic environments, lowland coniferous forest, lowland deciduous forest, shrubland, upland conifer-deciduous mixed forest, upland coniferous forest, and upland deciduous forest.

Generally, the effects of the Land Exchange Alternative B would be less pronounced than those of the Land Exchange Proposed Action since less land would be exchanged, but all other exchanges and acquisitions would continue.

6.3.4.3.2 Effect of Cumulative Actions on Landscape Ecosystems

Effects were based on a net increase or decrease basis of landscape ecosystem acres (see Table 6.3.4-2).

Table 6.3.4-2 Potential Increase/Decrease of Landscape Ecosystems Occurring from Cumulative Actions

	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
Landscape Ecosystem	**Acres**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
Dry-Mesic Red and White Pine	257,939.5	256,649.1	(1,290.4)	256,555.3	(1,384.2)	255,980.8	(1,958.7)
Jack Pine-Black Spruce	869,304.9	918,260.1	48,955.2	918,913.2	49,608.2	920,153.5	50,848.6
Lowland Conifer	398,395.6	407,344.1	8,948.5	406,709.7	8,314.0	406,184.2	7,788.6
Lowland Hardwood	25,754.6	25,219.0	(535.6)	25,154.2	(600.4)	25,154.2	(600.4)
Mesic Birch-Aspen-Spruce-Fir	376,587.2	369,552.4	(7,034.8)	369,239.3	(7,347.9)	369,239.3	(7,347.9)
Mesic Red and White Pine	185,392.5	183,251.9	(2,140.6)	183,233.8	(2,158.7)	182,739.5	(2,653.0)
Sugar Maple	56,390.0	55,718.9	(671.1)	55,679.4	(710.6)	55,679.4	(710.6)
Total[1]	2,169,764.4	2,215,995.6	46,231.2	2,215,484.8	45,720.4	2,215,131.0	45,366.5

Notes:
[1] Totals may not match overall project area acreages due to rounding and/or due to inconsistencies in GIS data layers.

Under all cumulative Land Exchange scenarios (i.e., Land Exchange Proposed Action and all other exchanges and acquisitions, Land Exchange Alternative B and all other exchanges and acquisitions, and Land Exchange No Action Alternative with all other exchanges and acquisitions), there would be a decrease in dry-mesic red and white pine, lowland hardwood, mesic birch-aspen-spruce-fir, mesic red and white pine, and sugar maple landscape ecosystems on the Superior National Forest. There would be an increase to the Superior National Forest of the jack pine-black spruce and lowland conifer landscape ecosystems.

6.3.4.3.3 Effect of Cumulative Actions on Minnesota Biological Survey Sites of Biodiversity Significance

Effects were based on a net increase or decrease basis of landscape ecosystem acres (see Table 6.3.4-3).

Table 6.3.4-3 Potential Increase/Decrease of MBS Sites of Biodiversity Significance Occurring from Cumulative Actions

	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
MBS Sites	**Acres**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
High Biodiversity Significance	127,903.3	145,448.3	17,544.9	146,846.8	18,943.4	151,106.3	23,203.0
Moderate Biodiversity Significance	111,250.4	146,528.4	35,278.0	145,771.5	34,521.1	145,771.5	34,521.1
Total	239,153.7	291,976.6	52,822.9	292,618.3	53,464.6	296,877.8	57,724.1

There would be an increase in MBS Sites of "High" and "Moderate" Biodiversity Significance on the Superior National Forest under all cumulative Land Exchange scenarios (i.e., Land Exchange Proposed Action and all other exchanges and acquisitions, Land Exchange Alternative B and all other exchanges and acquisitions, and Land Exchange No Action Alternative with all other exchanges and acquisitions). There would be greater increases in the "Moderate" sites than "High" sites under all scenarios.

6.3.4.3.4 Effect of Cumulative Actions on Management Indicator Habitat Types

Generally, the non-federal lands do not have any MIH types identified on them, as it is a federal designation. Additionally, not all federal lands have been fully mapped for MIH types. As a result, an MIH comparison cannot be made for the Superior National Forest before and after all exchanges and acquisitions. Additionally, age classes and mature patches cannot be fully analyzed since they are a subset of the MIH data.

6.3.4.3.5 Effect of Cumulative Actions on Endangered, Threatened, and Special Concern Plant Species

Effects on ETSC plant species were evaluated by comparing the MDNR NHIS database for the Superior National Forest before and after all exchanges or acquisitions would occur. Effects were based on a net increase or decrease basis of number of species to federal land holdings. No federally listed ETSC plant species would be affected by the Land Exchange Proposed Action. The Land Exchange Proposed Action and all exchanges and acquisitions would not result in the decrease or absence to the Superior National Forest of any of the 10 ETSC plant species listed for the NorthMet Project Proposed Action or 4 ETSC plant species listed for the Land Exchange Proposed Action.

Land Exchange Alternative B, and all exchanges and acquisitions, would not result in a decrease or absence to the Superior National Forest of any of the 10 ETSC plant species listed for the NorthMet Project Proposed Action or 4 ETSC plant species listed for the Land Exchange Proposed Action.

The Land Exchange No Action Alternative, and all exchanges and acquisitions, would not result in a decrease or absence to the Superior National Forest of any of the 10 ETSC plant species listed for the NorthMet Project Proposed Action or 4 ETSC plant species listed for the Land Exchange Proposed Action.

6.3.4.3.6 Effect of Cumulative Actions on Regional Foresters Sensitive Species Plants

Effects on RFSS plants were evaluated by comparing the federal RFSS GIS layer on the Superior National Forest before and after all exchanges and acquisitions. Effects were based on a net increase or decrease basis of species to the federal estate. Based on the GIS layer alone, there would be no change to RFSS plants on the Superior National Forest due to all exchanges and acquisitions. However, RFSS plants have not been identified on all federal and non-federal lands, and so a true comparison cannot be made.

6.3.4.3.7 Effect of Cumulative Actions on Invasive Non-native Species

Effects on the federal estate regarding invasive non-native plant species were evaluated by comparing the federal invasive non-native species GIS layer on the Superior National Forest before and after all exchanges and acquisitions. Based on the GIS layer alone, there would be no change to invasive non-native plant species on the Superior National Forest due to all exchanges and acquisitions. However, invasive non-native species have not been identified on all federal and non-federal lands, and so a true comparison cannot be made.

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6.3.5 Wildlife

The cumulative effects analysis for wildlife for the Land Exchange Proposed Action focuses on potential increases or decreases of habitat availability and occurrences of ETSC wildlife species.

6.3.5.1 Approach

This section evaluated effects on species similar to Chapter 5, but for the CEAA Land Exchange Proposed Action boundary. Land cover type GIS data from the MDNR, discussed in Section 6.3.4, determined available habitat for wildlife species. Federally and state-listed wildlife species were identified in the NHIS database. Data obtained from the USFS identified miles of roads and trails available for use by Canada lynx.

6.3.5.2 Cumulative Effects Assessment Area

The CEAA Land Exchange Proposed Action boundary for wildlife is described below, both spatially and temporally.

6.3.5.2.1 Spatial

The FEIS analyzed effects on the Canada lynx, gray wolf, and northern long-eared bat occurring within the federal and non-federal lands proposed for exchange.

State-listed species were analyzed on the federal and non-federal lands proposed for exchange.

6.3.5.2.2 Temporal

The temporal boundary includes the present through 2019.

6.3.5.3 Cumulative Effects Assessment

The cumulative assessment for the Land Exchange Proposed Action portion focused on the net increase or decrease of habitat types, of road and snow trail miles (for Canada lynx), and of ETSC and RFSS wildlife species occurrences.

6.3.5.3.1 Environmental Consequences of Reasonably Foreseeable Actions on Wildlife Habitat

Effects on key habitat type were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to GIS shapefiles of the Superior National Forest after all cumulative actions and the Land Exchange Proposed Action alternatives occur (see Section 6.1.2.2 for details on the Land Exchange actions). Effects were based on a net increase or decrease of habitat acres types to the federal estate (see Table 6.3.5-1).

Table 6.3.5-1 Potential Increase/Decrease of Key Habitat Types Occurring from Cumulative Actions

Increase or (Decrease) of Acres of Key Habitat Types	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
	Acres	Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)
Mature Upland Forest, Continuous Upland/Lowland Forest (MIH1-13)	1,828,977.3	1,869,241.7	40,264.4	1,868,644.5	39,667.2	1,869,779.8	40,802.4
Open Ground, Bare Soils (no MIH)	3,599.5	3,203.2	(396.3)	3,252.2	(347.3)	3,286.1	(313.4)
Grassland and Brushland, Early Successional Forest (no MIH)	248,189.2	249,329.1	1,139.9	249,361.6	1,172.4	248,057.6	(131.6)
Aquatic Environments (MIH 14)	90,559.8	95,622.6	5,062.7	95,634.7	5,074.9	95,403.0	4,843.1
Total[1]	2,171,325.9	2,217,396.6	46,070.7	2,216,893.1	45,567.1	2,216,526.4	45,200.5

Note:
[1] Totals may not match overall project area acreages due to rounding and/or due to inconsistencies in GIS data layers.

The cumulative effect of the Land Exchange Proposed Action, plus other exchanges and acquisitions, would result in an increase of wildlife habitat on the federal estate. While mature forest, grassland/ shrubland, and aquatic habitats would increase, there would be a decrease in habitat acres for disturbed areas. The cumulative effect of Land Exchange Alternative B plus other exchanges and acquisitions would result in a smaller but similar increase or decrease in wildlife habitat. The Land Exchange No Action Alternative, plus other exchanges and acquisitions, would result in an increase of wildlife habitat on the federal estate. Mature forest and aquatic habitats would increase, but there would be a decrease in acres for disturbed and grassland/shrubland habitats.

6.3.5.3.2 Environmental Consequences of Reasonably Foreseeable Actions on Special Status Wildlife Species

Effects on special status wildlife species were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to the Superior National Forest after all cumulative actions and the Land Exchange Proposed Action alternatives occur. Effects on special status wildlife species were evaluated by comparing the MDNR NHIS database for the Superior National Forest before and after all exchanges or acquisitions would occur. Effects were based on a net increase or decrease basis of species to the federal estate.

Based upon the MDNR NHIS database information, there would be a net decrease of special status wildlife species to the federal estate due to all three actions (Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative), plus other exchanges and acquisitions. According to available information, a species of special concern, the red-shouldered hawk (*Buteo lineatus*), would decrease due to one of the exchanges and acquisitions. Special status species studies that inform the NHIS database have not been completed for all federal and non-federal lands; therefore, a true comparison cannot be made.

There are 17 terrestrial wildlife species on the Superior National Forest RFSS list. These species are not legally protected and species studies have not been completed. Similar to the special status species studies mentioned above, a true comparison of the increase or decrease of RFSS species occurrences cannot be made.

6.3.5.3.3 Environmental Consequences of Reasonably Foreseeable Actions on the Federally Listed Species

Canada Lynx

The Superior National Forest, where the Land Exchange Proposed Action included in the CEAA is located, includes lynx habitat and habitat for lynx prey species. As discussed in Section 5.3.5.2.1, lynx habitat includes a wide variety of upland and lowland habitats and forest types/ages, shrubland, and grasslands, but excludes aquatic environments. Denning habitat is typically found in mature forest and is generally more dependent on forest age classes, with trees older than saplings and with a dbh greater than 5 inches. Snowshoe hare are the primary prey species for the Canada lynx, and hare habitat includes all types and age classes of forest and shrubland, but not aquatic environments, disturbed areas, or grassland/croplands. Unsuitable habitat includes aquatic environments and disturbed areas.

The effects on lynx habitat were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to the Superior National Forest after all cumulative actions and the Land Exchange Proposed Action alternatives occur. Effects were based on a net increase or decrease of habitat acres to the federal estate (see Table 6.3.5-2).

Table 6.3.5-2 Potential Increase/Decrease of Suitable Habitat Types for Canada Lynx and Prey Species Occurring from Cumulative Actions

Suitable Habitat for Lynx and Prey Species	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
	Acres	Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)
General Suitable Lynx Habitat (acres)	2,077,166.5	2,118,570.8	41,404.3	2,118,006.1	40,839.6	2,117,837.3	40,670.8
Suitable Denning Habitat (acres)	748,762.1	722,946.7	(25,815.4)	723,840.7	(24,921.4)	726,361.0	(22,401.1)
Suitable Snowshoe Hare Forage Habitat (acres)	2,068,526.8	2,110,365.0	41,838.2	2,109,795.9	41,269.1	2,109,650.4	41,123.6
Unsuitable Lynx Habitat (acres)	94,159.4	98,825.8	4,666.4	98,887.0	4,727.6	98,689.1	4,529.7

All three actions (Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative) plus other exchanges and acquisitions would result in some increases in general suitable lynx habitat, snowshoe hare forage habitat, and unsuitable habitat. Under all three actions plus other exchanges and acquisitions, there would be a decrease in lynx denning habitat, using mature MIH forest types as a predictor.

Lynx utilize snow pack trails and roads as travel corridors. The effects on lynx travel corridors were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to GIS shapefiles of the Superior National Forest after all cumulative actions and the Land Exchange Proposed Action alternatives occur. Effects were based on a net increase or decrease of miles of snow pack trails and established roads to the federal estate (see Table 6.3.5-3).

Table 6.3.5-3 Potential Increase/Decrease of Lynx Travel Corridors on the Federal Estate Occurring from Cumulative Actions

Travel Corridor Type	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
	Miles	Miles	Net Increase (Decrease)	Miles	Net Increase (Decrease)	Miles	Net Increase (Decrease)
Established Snow Pack Trails	1,818.7	1,803.5	(15.2)	1,803.0	(15.7)	1,803.0	(15.7)
Established Roads	3,167.3	2,968.2	(199.1)	2,968.3	(199.0)	2,972.1	(195.2)

All three actions (Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative), plus other exchanges and acquisitions, would result in a decrease in established road and established snow pack trails available for lynx use.

Gray Wolf

The Superior National Forest, where the Land Exchange Proposed Action included in the CEAA is located, includes gray wolf habitat and habitat for wolf prey species. As discussed in Section 5.3.5.2.1, wolf cover habitat includes a wide variety of upland and lowland habitats and forest types of immature to mature age classes. Forage habitat is typically found in young forest types. Unsuitable habitat includes aquatic environments and disturbed areas.

The effects on wolf habitat were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to the Superior National Forest after all cumulative actions and the Land Exchange Proposed Action alternatives occur. MIH types and age classes are not fully mapped on non-federal lands, and so a true comparison is impossible to make. Effects were based on a net increase or decrease of habitat acres to the federal estate (see Table 6.3.5-4).

Table 6.3.5-4 Potential Increase/Decrease of Gray Wolf Habitat on the Federal Estate Occurring from Cumulative Actions

	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
Suitable Habitat for Gray Wolf	**Acres**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
Forage Habitat (acres)	66,681.1	64,312.5	(2,368.6)	64,307.0	(2,374.1)	64,539.2	(2,141.9)
Cover Habitat (acres)	1,107,492.2	1,071,398.5	(36,093.7)	1,072,436.2	(35,056.0)	1,076,177.3	(31,314.9)

All three actions (Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative), plus other exchanges and acquisitions, would result in a decrease in forage and cover habitat available for gray wolves.

Northern Long-Eared Bat

The Superior National Forest, where the Land Exchange Proposed Action included in the CEAA is located, includes northern long-eared bat habitat. As discussed in Section 5.3.5.2.1, northern long-eared bat summer roosting habitat includes mature forest types. Forage habitat is typically found in mature forest understories or openings in such habitat types.

The effects on northern long-eared bat habitat were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to the Superior National Forest after all cumulative actions and the Land Exchange Proposed Action alternatives occur. MIH types and age classes are not fully mapped on non-federal lands, and so a true comparison

is impossible to make. Effects were based on a net increase or decrease of habitat acres to the federal estate (see Table 6.3.5-5).

Table 6.3.5-5 Potential Increase/Decrease of Northern Long-Eared Bat Habitat on the Federal Estate Occurring from Cumulative Actions

Suitable Habitat for Northern Long-Eared Bat	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
	Acres	Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)	Acres	Net Increase (Decrease)
Forage and Roosting Habitat (acres)	748,762.1	722,946.7	(25,815.4)	723,840.7	(24,921.4)	726,361.0	(22,401.1)

All three actions (Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative), plus other exchanges and acquisitions, would result in a decrease in forage and summer roosting habitat available for northern long-eared bats.

6.3.6 Aquatic Species

The cumulative effects analysis for aquatic species for the Land Exchange Proposed Action focused on the potential increases or decreases of surface water area and available shoreline, as these parameters are the limiting factors that determine the available aquatic species habitat.

6.3.6.1 Approach

The cumulative effects of the Land Exchange Proposed Action, in combination with other existing and reasonably foreseeable projects were evaluated against stream shoreline frontage, lake surface area, and lake shoreline frontage. This section evaluated effects on aquatic species available habitat similar to Chapter 5.

This section compared the types of data presented in Sections 4.3.6 and 5.3.6, but for each of the projects within the CEAA Land Exchange Proposed Action boundary. The GIS data obtained for the sections mentioned above were compared to projects within the CEAA Land Exchange boundary, and effects were determined based on this proximity. Specifically, DNR 24K Lakes and DNR 24K Streams GIS data were used to determine the analysis; however, a shoreline frontage index was not analyzed, as in Section 5.3.6, due to limited data availability.

The surface water features analyzed were assumed to correlate to available aquatic species habitat.

6.3.6.2 Cumulative Effects Assessment Area

The CEAA Land Exchange Proposed Action boundary for aquatic species habitat is described below, both spatially and temporally.

6.3.6.2.1 Spatial

The spatial boundary included the Superior National Forest. The net increase or decrease of surface water features or SGCN species that result from the Land Exchange Proposed Action and other cumulative actions has been examined in context of the entire Superior National Forest.

6.3.6.2.2 Temporal

The temporal boundary included the present through 2024 (the end of the second decade of the Forest Land and Resource Management Plan).

6.3.6.3 Cumulative Effects Assessment

The cumulative assessment for the Land Exchange Proposed Action portion focused on the net increase or decrease of surface water features and federal/state sensitive aquatic species (SGCN, ETSC, and RFSS species). Effects were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or acquisitions to GIS shapefiles of the Superior National Forest after all cumulative actions and the NorthMet Project Proposed Action alternatives occur.

6.3.6.3.1 Effect of Cumulative Actions on Net Increase/Decrease of Surface Water Features

Table 6.3.6-1 summarizes the surface water area and shoreline linear distance in each of the cumulative actions. For this qualitative assessment, it is assumed that the surface water features provide aquatic species habitat; however, the quality of that habitat could not be assessed or compared.

The effects of the cumulative actions for each scenario summarized below indicate there would be an increase in the lake area and lake shoreline distances, and a decrease in the riverine shoreline distances.

6.3.6.3.2 Environmental Effects of Cumulative Actions on Special Status Aquatic Species

Effects on special status aquatic species (federal and state ETSC, SGCN, and RFSS) were evaluated by comparing maps (derived from GIS data) of the existing Superior National Forest to the Forest if all cumulative actions and the alternatives to the Land Exchange were to occur. GIS analysis determined that no known special status aquatic species are located within the lands that would be relinquished or acquired by the Superior National Forest. However, it is likely that special status aquatic species habitat does exist on some of these lands, but the limited available data does not allow for an accurate comparison.

Table 6.3.6-1 Potential Increase/Decrease of Surface Water Resources Occurring from Cumulative Actions

	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
	Total	**Total**	**Net Increase (Decrease)**	**Total**	**Net Increase (Decrease)**	**Total**	**Net Increase (Decrease)**
Lake (acres)	80,885.0	88,067.5	7,182.5	88,080.7	7,195.7	87,961.7	7,076.7
Lake (shoreline miles)	7,145.6	7,641.6	496.0	7,642.1	496.5	7,639.1	493.5
Riverine (miles)	3,646.7	3,749.7	(103)	3,749.1	(102.4)	3,746.4	(99.7)

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6.3.7 Air Quality

This resource would not be subject to any cumulative effects as a result of the Land Exchange Proposed Action in conjunction with other past, present, or reasonably foreseeable actions.

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6.3.8 Noise and Vibration

It was determined that this resource has discrete spatial and/or temporal extents which limit their direct and indirect impacts to the immediate area around the NorthMet Project Proposed Action and Land Exchange Proposed Action. Therefore, it is expected that there would not be any cumulative effects when combined with other past, present or reasonably foreseeable actions.

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6.3.9 Cultural Resources

It was determined that this resource has discrete spatial and/or temporal extents which limit their direct and indirect impacts to the immediate area around the NorthMet Project Proposed Action and Land Exchange Proposed Action. Therefore, it is expected that there would not be any cumulative effects when combined with other past, present or reasonably foreseeable actions.

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6.3.10 Socioeconomics

The cumulative effects analysis for socioeconomics for the Land Exchange Proposed Action focused on changes to revenue streams, timber harvesting, employment related to forestry and timber activities, recreation, and amount of accessible 1854 Ceded Territory area and resources.

6.3.10.1 Approach

Criteria for evaluating the socioeconomic cumulative effects of the Land Exchange Proposed Action include:

- Changes in revenue streams (taxes, payment in lieu of taxes) and assessed market value associated with transfers of land from non-federal to federal ownership;
- Changes in the amount and value of land available for timber harvest and employment related to forestry and timber activities;
- Changes in visitation, recreational tourism spending to the Superior National Forest; and
- Changes in the amount of accessible 1854 Ceded Territory land and the availability of treaty resources (e.g., wild rice, fish, and game).

6.3.10.2 Cumulative Effects Assessment Area

The CEAA Land Exchange Proposed Action boundary for socioeconomics is described below, both spatially and temporally.

6.3.10.2.1 Spatial

The CEAA for socioeconomic effects of the Land Exchange Proposed Action is the portions of Superior National Forest in St. Louis, Lake, and Cook counties.

6.3.10.2.2 Temporal

This evaluation focuses on the existing and anticipated future use of the CEAA for the life of the NorthMet Project Proposed Action (approximately 20 years). This includes the approximate 15-year life of the Forest Plan, which would extend through approximately 2019. Because Superior National Forest was established in 1909, existing conditions are considered indicative and representative of historical resource management activities.

6.3.10.3 Cumulative Effects Assessment

The net socioeconomic effects of the Crane Lake Land Exchange would be a marginal increase in recreational activity (and thus regional tourism revenue) in the Superior National Forest, and increased economic benefit to the Town of Crane Lake due to additional development (consistent with existing plans).

The net socioeconomic effects of the Cook County Land Exchange would include increased revenue to Cook County through management activities (timber and development) on newly acquired parcels and reduced cost of federal management of the Superior National Forest and BWCAW.

The net socioeconomic effects of the School Trust Land Exchange and Land Acquisition would be a decrease in logging or mining activity (and thus timber and mineral revenue) in the Superior National Forest, and increased School Trust Land revenue due to additional development (consistent with existing plans).

The Fall Lake land acquisition and the Gunflint land acquisition would open additional areas of land to potential public use (as well as exercise of usufructuary rights under the 1854 Treaty) in an area that already experiences recreational activity (see Section 6.2.11). Any increases in economic activity associated with these expansions would be minimal. The Wolf Island Phase 2 land acquisition would also open additional areas of land to potential public and tribal use and would consolidate Forest Service ownership of Wolf Island and its documented historical resources. Any increases in economic activity associated with this acquisition would be minimal.

In summary, the Land Exchange Proposed Action and cumulative actions would consolidate federal ownership within the Superior National Forest, thus reducing costs associated with management activities. At the same time, the Land Exchange Proposed Action and cumulative actions would provide more land to federal and county governments that could generate economic activity (for those entities and for the region as a whole) through timber, development, or increased recreational use. Increased activity could result in increased employment related to timber, development, and/or recreation.

Net change in public land available under the 1854 Treaty would increase due to the NorthMet Proposed Action and Land Exchange Proposed Action; although the federal lands proposed for exchange would no longer be available. The Land Exchange Proposed Action would transfer 6,650.2 acres of USFS administered land to PolyMet for the NorthMet Project Proposed Action mine and acquire up to 6,722.5 acres of private land for administration by the USFS. The proposed land exchange is a discrete action for the sole purpose of resolving the instant conflict between surface and subsurface rights and would not spur additional conversion of land from private to public ownership.

There is no evidence that the land exchanges in question would create EJ effects.

Land Exchange Alternative B would have similar effects, although to a lesser degree.

Under the Land Exchange No Action Alternative, none of the effects described above would occur.

6.3.11 Recreation and Visual Resources

The cumulative effects analysis for recreation and visual resources for the Land Exchange Proposed Action focused on potential increases or decreases in recreation opportunities between recreation opportunity spectrum classes and in scenic integrity objective designated lands.

6.3.11.1 Approach

This section compared the types of data presented in Sections 4.3.11 and 5.3.11, for each of the projects within the CEAA Land Exchange Proposed Action boundary. Effects were determined based on GIS data for these projects, including USFS mapping of ROS classes and SIO designated lands.

ROS classes (see Section 4.2.11.1.1) were defined for the Superior National Forest by the USFS (1982). Likely ROS classes for the non-federal lands were identified by the USFS through the SDEIS process, and are generally the same as the existing mapped ROS classes on surrounding adjacent federal lands. GIS analysis was employed to determine the net change in acreage by ROS class.

SIOs (see Section 4.2.11.1.2) were defined for Superior National Forest by the USFS (1995). As with the ROS classes, likely SIO designations for the non-federal lands were identified through the SDEIS process and generally match the existing mapped SIO designations on surrounding adjacent federal lands. GIS analysis was employed to determine the net change in acreage by SIO.

6.3.11.2 Cumulative Effects Assessment Area

The CEAA Land Exchange Proposed Action boundary for recreation and visual resources is described below, both spatially and temporally.

6.3.11.2.1 Spatial

The spatial boundary for recreational resources included the Superior National Forest. The spatial boundary for visual resources included the Superior National Forest, including the viewshed of the federal tract. The net gain or loss of recreation and visual resources from the exchange and other foreseeable activities was examined in context of the entire forest.

6.3.11.2.2 Temporal

This evaluation focuses on the existing and anticipated future use of the CEAA for the life of the NorthMet Project Proposed Action (approximately 20 years). This includes the approximate 15-year life of the Forest Plan, which would extend through approximately 2019. Because Superior National Forest was established in 1909, existing conditions are considered indicative and representative of historical resource management activities.

6.3.11.3 Cumulative Effects Assessment

The cumulative assessment for the Land Exchange Proposed Action portion focused on the net increase or decrease of ROS classes and SIO-designated lands. For all analyses, effects were evaluated by comparing GIS shapefiles of the Superior National Forest before any exchanges or

acquisitions to GIS shapefiles of the Superior National Forest after all cumulative actions and the NorthMet Project Proposed Action alternatives occur.

Table 6.3.11-1 summarizes the net increase or decrease of recreation opportunity spectrum classifications in each of the cumulative actions.

Table 6.3.11-1 Potential Increase/Decrease of Recreation Opportunity Spectrum Classifications Occurring from Cumulative Actions

	Existing Superior National Forest	Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions		Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions	
Recreation Opportunity Spectrum	**Acres**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
Primitive	481,022.1	523,201.5	42,179.4	523,201.5	42,179.4	523,201.5	42,179.4
Roaded Natural	314,667.2	307,664.1	(7,003.1)	308,129.9	(6,537.3)	307,099.1	(7,568.1)
Rural	9,838.0	9,448.1	(389.9)	9,448.1	(389.9)	9,448.1	(389.9)
Semi-Primitive Motorized	954,020.3	933,211.6	(20,808.7)	932,391.0	(21,629.3)	935,194.1	(18,826.2)
Semi-Primitive Non-motorized	411,717.2	443,837.0	32,119.8	443,688.2	31,971.0	441,549.2	29,832.0
Urban	93.2	93.0	(0.2)	93.0	(0.2)	93.0	(0.2)
Total[1]	2,171,357.9	2,217,455.3	46,097.4	2,216,951.7	45,593.8	2,216,585.1	45,227.2

Notes:
[1] Totals may not match overall project area acreages due to rounding and/or due to inconsistencies in GIS data layers.

The cumulative actions from the Land Exchange Proposed Action would result in an increase to Primitive and Semi-primitive Non-motorized classes, and a decrease in Roaded Natural, Rural, Semi-primitive Motorized, and Urban classes. The Land Exchange Alternative B would result in an increase to Primitive and Semi-primitive Non-motorized classes while there would be a decrease in Roaded Natural, Rural, Semi-primitive Motorized, and Urban classes. The Land Exchange No Action Alternative would result in a decrease to Roaded Natural, Rural, Semi-primitive Motorized, and Urban classes, but an increase to Primitive and Semi-primitive Non-motorized classes.

The Cook County Land Exchange action would help consolidate federal ownership of land within BWCAW, but would not change recreational opportunities within BWCAW. The Fall Lake land acquisition action (see Section 6.1.2.2) would result in federal acquisition of tracts with recreational value along Fall Lake. The properties are located on the shores of Fall Lake, across from the Fall Lake boat landing/campground and within 0.5 mile of the Fall Lake entry to the BWCAW. The Gunflint Land acquisition action would result in federal acquisition of tracts with recreational value along Gunflint and Little Gunflint Lakes at the US-Canadian border along the "Voyageurs Route". The School Trust Land Exchange and Land acquisition action would help consolidate federal ownership of land within BWCAW and would not change recreational opportunities within the BWCAW, but would decrease opportunities for public recreational use of scenic landscapes and Semi-primitive Motorized activities in the Superior National Forest. The Wolf Island Phase 2 land acquisition action would result in federal

acquisition of the northern portion of Wolf Island, and consolidation of federal ownership of the entire island. The island has documented historical resources, and is close to the BWCAW (TPL 2012).

In summary, the cumulative actions would increase the amount of public land available and accessible for recreational activity; however, some specific recreational opportunities, such as recreational use of scenic landscapes and Semi-primitive Motorized activities in the Superior National Forest, would be diminished.

Table 6.3.11-2 summarizes the net increase or decrease of SIO classifications in each of the cumulative actions.

Table 6.3.11-2 Potential Increase/Decrease of Scenic Integrity Objectives Classifications Occurring from Cumulative Actions

	Existing Superior National Forest	**Superior National Forest – Land Exchange Proposed Action Plus other Exchanges and Acquisitions**		**Superior National Forest – Land Exchange Alternative B Plus other Exchanges and Acquisitions**		**Superior National Forest – Land Exchange No Action Alternative but other Exchanges and Acquisitions**	
SIO Classifications	**Acres**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**	**Acres**	**Net Increase (Decrease)**
High	344,508.1	341,220.9	(3,287.2)	341,018.8	(3,489.3)	341,000.7	(3,507.4)
Moderate	798,922.5	778,350.5	(20,572.0)	778,022.2	(20,900.3)	776,732.9	(22,189.6)
Low	158,944.9	149,235.3	(9,709.6)	148,980.6	(9,964.3)	149,907.3	(9,037.6)
Unclassified	22,177.12	21,722.9	(454.2)	21,778.9	(398.3)	21,786.8	(390.3)
Total	1,324,553.0	1,290,529.5	(34,023.5)	289,800.5	(34,752.5)	1,289,427.7	(35,125.3)

The cumulative actions from the Land Exchange Proposed Action, Land Exchange Alternative B, and Land Exchange No Action Alternative would result in a net decrease to the federal estate of acres of land with a High, Moderate, Low, and Unclassified SIO.

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6.3.12 Wilderness and Other Special Designation Areas

It was determined that this resource has discrete spatial and/or temporal extents which limit their direct and indirect impacts to the immediate area around the NorthMet Project Proposed Action and Land Exchange Proposed Action. Therefore, it is expected that there would not be any cumulative effects when combined with other past, present or reasonably foreseeable actions.

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6.3.13 Hazardous Materials

It was determined that this resource has discrete spatial and/or temporal extents which limit their direct and indirect impacts to the immediate area around the NorthMet Project Proposed Action and Land Exchange Proposed Action. Therefore, it is expected that there would not be any cumulative effects when combined with other past, present or reasonably foreseeable actions.

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6.3.14 Geotechnical Stability

It was determined that this resource has discrete spatial and/or temporal extents which limit their direct and indirect impacts to the immediate area around the NorthMet Project Proposed Action and Land Exchange Proposed Action. Therefore, it is expected that there would not be any cumulative effects when combined with other past, present, or reasonably foreseeable actions.

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