

3.5 WATER RESOURCES

Ready access to an abundant supply for water is an important consideration in siting power plants, as water is necessary for steam generation, cooling, and process water. The following sections describe the water resources (surface and groundwater) near the Mesaba Energy Project alternatives and the associated utility and transportation corridors.

3.5.1 West Range Site and Corridors

The following sections identify the prominent surface water features and describe the major drainage areas and watersheds associated with the West Range.

3.5.1.1 Surface Water Sources

The West Range Site lies in the northern region of the Upper Mississippi River Basin Watershed. Table 3.5-1 lists the major surface water bodies near the Mesaba Generating Station. Figure 3.5-1 illustrates the major drainage areas throughout the Mesaba Generating Station and associated utility and transportation corridors.

There are three primary watersheds within the vicinity of the West Range Site. The Prairie River watershed encompasses the northern portion of the project site. The southern portion of the Power Station lies in a sub-watershed that drains into the CMP. The CMP watershed does not have a surface hydrologic connection to the other watersheds since the CMP does not have a surface water outlet. The Swan River watershed is south of the CMP sub-watershed. Both the Prairie River and the Swan River drain to the Mississippi River.

There are a number of water features (natural lakes, water-filled mine pits, and rivers/streams) located in the area surrounding the proposed generating station. The primary natural lakes in the area include Dunning Lake, adjacent to the east edge proposed generating station property; Big Diamond Lake, to the southeast of the proposed plant; and **Little Diamond Lake and Holman Lake**, to the south. **As mining ceased in areas along the Iron Range, and associated dewatering operations ended, many of the pits filled with water, some to the point that they have connected with adjacent pits.** Specifically, these pits include the CMP and the HAMP Complex. Figure 3.5-2 provides a map of the locations of these water features near the proposed power station. **Because disused mine pits shown on figures in this EIS have been filling with surface water and groundwater, the areas within these pits shown as surface waters based on available geographic information system data may not represent the actual extent of surface waters currently in these pits.** Because the abandoned mine pits are being considered as sources of raw water for the power station, Table 3.5-2 lists the current capacity of each mine pit.

Table 3.5-1. Surface Water Bodies

Surface Water	Watershed	FEMA ¹ Designated Floodplain	Public Water ²	Special Water ³	MPCA Designated Impaired Water ⁴	Target TMDL Study ⁵	Source of Impairment
Big Diamond Lake	Swan River		X				
Canisteo Mine Pit (CMP)	Swan River						
Dunning Lake	Prairie River		X				
Greenway Mine Pit	Prairie River						
Hill-Annex Mine Pit (HAMP)	Swan River						
Holman Lake (Hill Lake)	Swan River		X				
Lind Mine Pit (LMP)	Prairie River						
Little Diamond Lake	Swan River		X				
Lower Panasa Lake	Swan River		X		X	NO	Mercury FCA ⁶
Mississippi River		X	X	X	X	NO	Turbidity, Low oxygen Mercury FCA ⁶
Oxhide Creek	Swan River		X				
Oxhide Lake	Swan River		X		X	NO	Mercury FCA ⁶
Prairie River	Mississippi River	X	X				
Snowball Creek	Swan River		X				
Swan River	Mississippi River	X	X		X	NO	Fecal coliform Low oxygen Mercury FCA ⁶
Trout Creek	Swan River		X				
Trout Lake	Swan River		X	X	X	NO	Mercury FCA ⁶
Twin Lakes	Swan River		X				
Upper Panasa Lake	Swan River		X		X	NO	Mercury FCA ⁶
West Hill Mine Pit	Prairie River						

¹Federal Emergency Management Agency (FEMA)

²MNDNR Designated Public Water

³MPCA Designated Special Water

⁴MPCA Designated Impaired Water, 2006 EPA Draft 303(d) list of impaired waters. No data does not necessarily mean that the water body is not impaired. It may be that the water body has either not been sampled or there are not enough data to make an impairment determination.

⁵Total Maximum Daily Load

⁶Fish Consumption Advisory

Source: Excelsior, 2006a

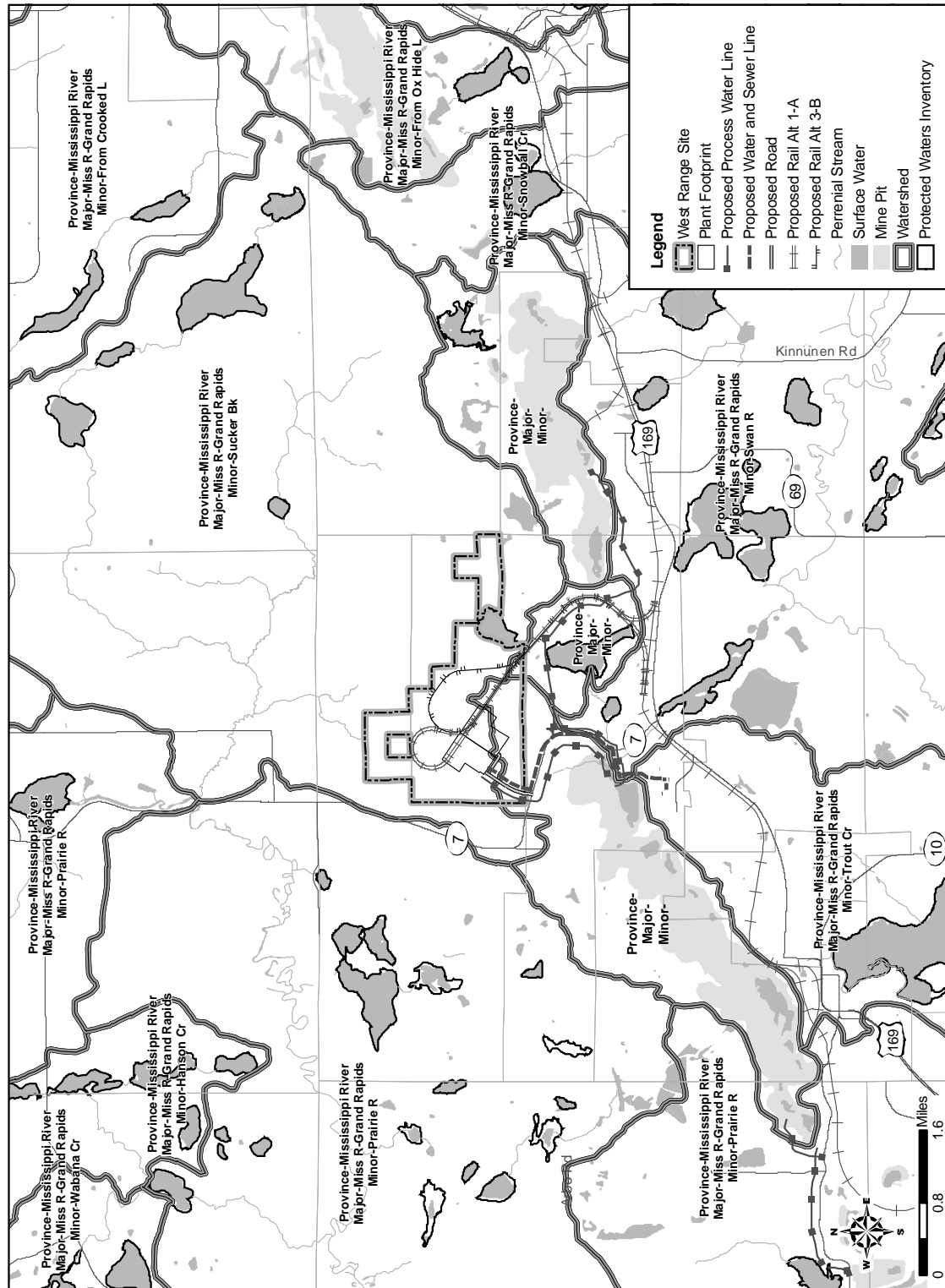


Figure 3.5-1. West Range Drainage Features

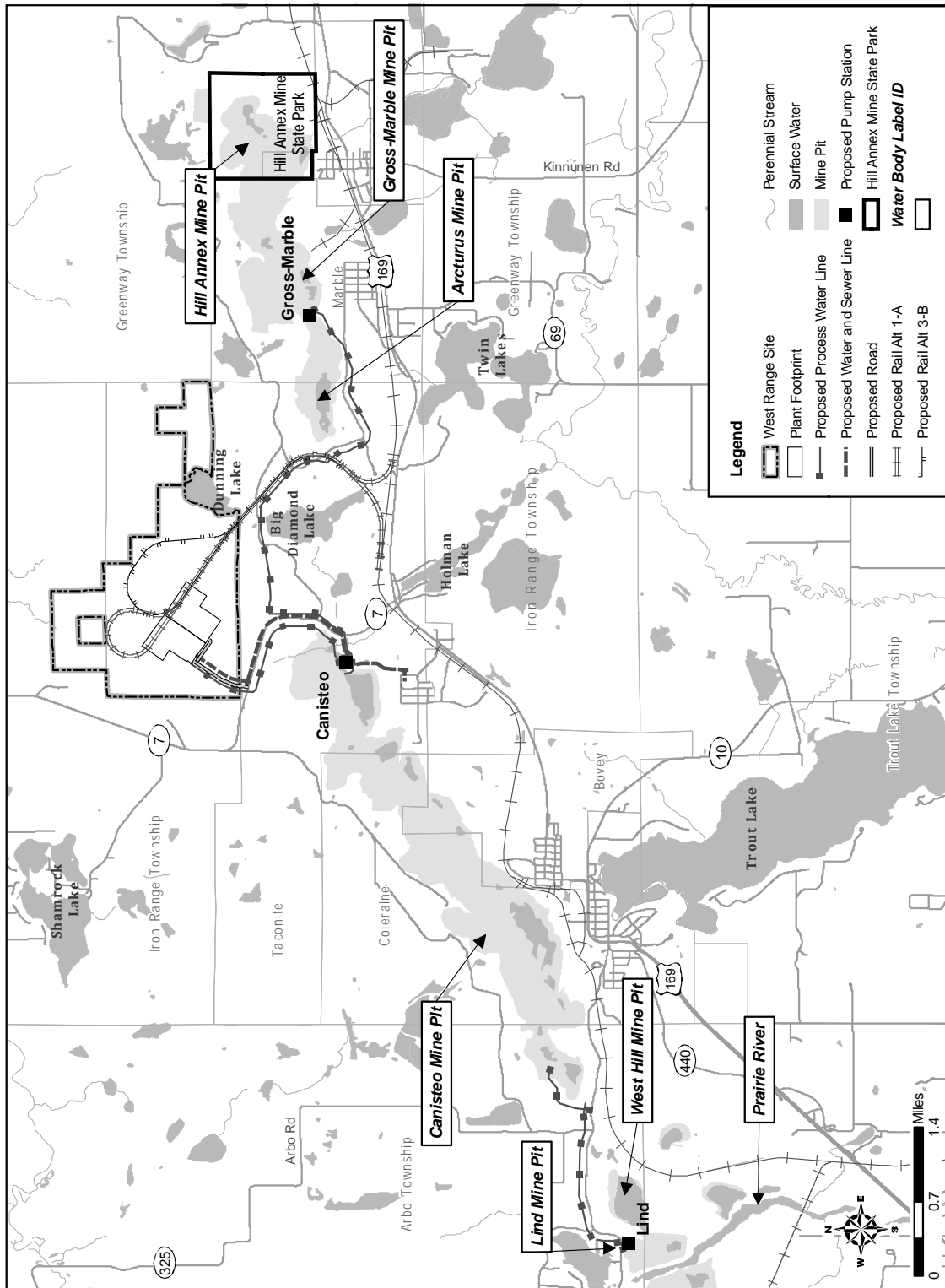


Figure 3.5-2. West Range Surface Waters

Table 3.5-2. Capacity of West Range Mine Pits (November 2005)

Water Source	Water Surface Elevation (feet)	Surface Area (acres)	Estimated Volume (acre-feet)
CMP	1,309	1,400	150,000
HAMP Complex			
Hill-Annex Mine Pit	1,249	216	20,600
Arcturus Mine Pit	1,269	105	4,490
Gross/Marble Mine Pit	1,249	141	11,100
LMP	1,265	82	8,310

Source: Excelsior, 2006a; Acronyms: CMP – Canisteo Mine Pit; HAMP – Hill-Annex Mine Pit; LMP – Lind Mine Pit.

In addition, there are a number of existing operations that use some of these water features as source water. Table 3.5-3 presents a summary of existing MNDNR water appropriation permits near the West Range Site.

Table 3.5-3. Existing Water Appropriation Permits for Surface Waters Near The West Range Site

Permitee	Resource	Permitted		Reported Pumping (Million Gallons)				
		GPM	MG/Y	2000	2001	2002	2003	2004
Jackson, Allen	Mississippi River	250	13	ND	ND	2.2	ND	ND
Schwartz Redi Mix Inc.	West Hill-Annex Pit	900	39	ND	ND	ND	ND	21.6
MNDNR	Hill-Annex Tailing Basin	4,500	500	ND	ND	ND	ND	70.3
MNDNR	Hill-Annex Mine	7,000	3,416	ND	ND	621.1	1,550.3	1,374
U of MN	Prairie River	500	7	ND	ND	ND	ND	ND
U of MN	Prairie River	1,000	60	6.7	17	18.1	25.6	20.1
U of MN	Prairie River	1,000	60	7.8	ND	0.4	23.4	26.5
Blandin Paper Co.	Mississippi River	30,000	7,000	7,985	7,041	6,350	6,429	6,088
Jackson, Allen	Mississippi River	265	4	2.8	ND	ND	2.5	ND
Swan Lake Country Club	Oxhide Creek	540	10	4.6	8.5	9.2	8.4	5.8
City of Coleraine	Trout Lake	400	41	37	19.7	19.7	12.1	11.9

ND – No Data
 Source: Excelsior, 2006a

The following sections provide more detail about the primary water bodies that are being considered as raw water sources or receiving waters for discharges from the Mesaba Generating Station.

Canisteo Mine Pit Complex

The CMP Complex is made up of a number of abandoned mine pits. The CMP is situated northeast of the city of Grand Rapids and immediately north of the cities of Coleraine, Bovey, and Taconite. The entire mine pit complex is approximately 4.5 miles long and 0.5 miles wide and has a drainage area of approximately 4,536 acres. The pit complex has a maximum depth of approximately 300 feet and a surface area of almost 1,400 acres. The water surface elevation in the mine pit on November 1, 2005 was

1,308.75 feet mean sea level (msl), which corresponds to a surface area of 1,393 acres and a water volume of 149,500 acre-feet.

The CMP Complex currently does not have a surface outlet. Water enters the complex through surface water runoff and groundwater inflow. Outflow consists only of groundwater seepage and evaporation. The amount of surface and ground water that currently enters the mine pit is greater than the amount of water lost by seepage and evaporation, which results in a net inflow of water. The water surface elevation has continued to rise since pumping of the CMP ceased in September 1985.

The CMP Complex has been modeled with the WATBUD model, which is a water balance model developed by the MNDNR, used to evaluate and predict water inflows and outflows for surface water bodies. The MNDNR has also monitored the water surface elevation in the mine pit and monitoring wells since 1989, and used these data to calibrate the WATBUD model and develop stage-storage relationships for the pit.

Using the stage-storage data from 1989 to 1995, the CMP had a net average inflow of 3,164 gallons per minute. From 1995 to present, recharge rates range from 810 gallons per minute to 4,190 gallons per minute, with an average of 2,580 gallons per minute. The stage-storage data has also indicated that the net inflow decreases as the level of the water in the pit reaches 1,300 feet msl, which is the elevation of the bedrock surrounding the pit. Results of the most recent (2005) modeling effort indicate that the CMP Complex will overflow within the next 4.5 to 8.5 years.

The USGS also conducted a study of the groundwater flow between the CMP and the surrounding aquifers (Jones, 2002). This study modeled the groundwater flows over varying CMP water level elevations (from 1,300 to 1,324 feet msl) and estimated the net inflow of groundwater into the CMP ranged from 628 gallons per minute at the 1,300 feet msl to 40 gallons per minute at the 1,324 feet msl. The 1,324 feet msl is the level at which the CMP will begin to overflow. **Following publication of the Draft EIS, MNDNR announced its plans to construct a gravity outflow device from the CMP to the Prairie River that would allow the CMP to be maintained at an MNDNR-determined maximum water level (Scenic Range News Forum, 2009).**

Jones (2002) found that some groundwater outflow from the CMP did occur at the 1,300 feet msl. The outflow occurred in the area between the CMP and Trout Lake, which is also the location of the two groundwater wells used by the City of Coleraine **and the City of Bovey** as their source from drinking water. The modeling also indicated that the net outflow drops to zero at CMP water levels at or below 1,292 feet msl.

Hill-Annex Mine Pit Complex

The HAMP Complex consists of the Arcturus, Gross-Marble, Hill-Trumbull, and Hill-Annex Mine Pits. These mine pits are located immediately north of the cities of Marble and Calumet, and cover an area of over three miles from east to west. The GMMP, and HAMP Mine Pits were separated by large volumes of waste material (tailings and overburden) deposited during the mining operations. Following the cessation of mining, the water levels in the pits began to rise, and the GMMP became connected to the Hill-Trumbull/Hill-Annex when the water surface elevation reached approximately 1,215 feet msl. The water surface elevation in the Arcturus is higher than that of the other pits, and has not developed a permanent surface connection to other pits; however water currently overflows from the Arcturus into the GMMP. The stage in the GMMP and Hill-Trumbull/Hill-Annex pits were measured at 1,246.70 feet and Arcturus was measured at 1,268.51 feet on November 1, 2005 (Excelsior, 2006b).

Until 1979, mining operations kept the HAMP Complex completely dewatered. After that time, dewatering continued at several of the mine pits, while other pits began to fill with water after dewatering ceased. By 1981, all mining operations had ceased (Barr, 1987) and all the mine pits started filling with surface and groundwater. In 1988, the HAMP was established as a state park that offered tours of the mine pit features and facilities. The park, which is managed by the MNDNR, Division of Parks and

Recreation, does operate a dewatering pump in order to keep the water level below some of the unique features of the mine, but due to limited funding, the dewatering operations cannot be operated more than 5.5 months a year. As a result, the water level has risen above some of the mine features and facilities.

The current water level in the park allows the MNDNR to give boat tours of the pit during the summer months. There are mine features and several historic structures below the current water surface elevation that are viewed during these tours. According to the MNDNR's Draft Management Plan for the park, it is preferred to dewater the mine pit to an elevation between 100 and 150 feet below the current water surface elevation to expose historic structures and improve the interpretive quality of the site, as well as protect the historic structures on the pit rim. However, the dewatering of the pit to this level is currently cost-prohibitive under the State Park's annual budget.

Inflows into the HAMP Complex include seasonal precipitation, surface and ground water components. Discharges from the system include evaporation, seepage (ground water outflow), and dewatering. The water levels in the HAMP Complex fluctuate as a result of the seasonal variations in evaporation, runoff, and dewatering. The dewatering operations at the HAMP by the MNDNR occur from the end of May until October, and the pumping averages 6,200 gpm while in operation.

Pumping records for the HAMP have been kept since 1973, and MNDNR staff continue to report dewatering volumes on a monthly basis, however stage data were not collected on a regular basis. Using the pumping records from 1973 to 1979, when the HAMP was in operation, the estimated recharge rate was determined to range from 3,230 to 4,030 gallons per minute. Since these recharge rates are based on keeping the pit empty, they are likely the maximum rates and should decrease as the water level in the pit rises.

For the Arcturus Mine Pit, given that the pit was completely dewatered on January 1, 1979, and was completely full by 1999, an average recharge rate of 2,150 gallons per minute was calculated.

Prairie River

The Prairie River lies within the Upper Mississippi River Basin Watershed and drains into the Mississippi River southeast of Grand Rapids and La Prairie. According to USGS data, the Prairie River watershed has an approximate drainage area of 360 square miles at the gauging station. The USGS also maintains a gauging station (gauge number 05212700) on the Prairie River, several miles upstream of its confluence with the Mississippi River. Prairie Lake lies on the Prairie River between the gauging station and the Mississippi River. Lake levels are controlled at an existing hydroelectric dam, located approximately 5 miles upstream of its confluence with the Mississippi River.

Flow data have also been collected at the gauging station from 1967 to 1983 and 2001 to present. Average monthly flow rates range from 50 to 200 cubic feet per second from August through March and range from 200 to 600 cubic feet per second range during the months of April, May, June, and July.

The Prairie River is being considered as a source of raw water for the West Range Power Station, and therefore, the raw water intake would be subject to the CWA rule 316(b) criteria regarding cooling water intake structures. The rule specifies that, for cooling water intake structures on fresh water rivers, the maximum amount of water that can be taken is "5 percent of the mean annual flow or 25 percent of the 7Q10¹, whichever is the lesser."

The mean annual flow in the Prairie River is 319 cubic feet per second, and five percent of that flow is equal to 16 cubic feet per second. The 7Q10 in the Prairie River was determined to be 22 cubic feet per second, and 25 percent of that flow is equal to 5.5 cubic feet per second. Since 25 percent of the 7Q10 is the smaller amount, the maximum amount of water that can be appropriated from the Prairie River at one

¹The 7Q10 is the seven day low flow average with a 10-year recurrence interval.

time is 5.5 cubic feet per second (2,468 gallons per minute). Only these data collected by MP at the Prairie Lake Dam from 1998 to 2004 were used in the determination of the mean annual flow and the 7Q10, since there was not a full year of record for 1997 and 2005.

Trout Lake

Trout Lake does not currently receive any surface water discharges from the CMP. Since the CMP water surface continues to rise, surface outlets for the CMP to Trout Lake have been evaluated by the MNDNR and Barr Engineering, and Trout Lake has been evaluated as a potential receiving water. The available studies (Excelsior, 2006b; Barr, 2004) identify a number of potentially negative and positive outcomes as a result of the CMP Complex discharging to Trout Lake.

Upper Panasa Lake

Upper Panasa Lake currently receives water from the HAMP Complex dewatering operations. The amount of water that is discharged ultimately to Upper Panasa Lake from the HAMP Complex is shown in Table 3.5-3. The impacts on Upper Panasa Lake resulting from the discharge water from the HAMP have not been studied.

Greenway Mine Pit

There are very little data on the Greenway Mine Pit. The pit has filled with water and has an outlet pipe that discharges to the Prairie River. Short Elliot Hendrickson, Inc. (SEH) personnel measured the pipe size, flow depth, and flow velocity at the pipe outlet (Excelsior, 2006b) and determined the outflow from the Greenway Mine Pit was approximately 1 cubic foot per second (450 gallons per minute) at the time of the field investigations.

West Hill Mine Pit

There are very little data on the West Hill Pit. The pit has filled with water and has an outlet pipe that discharges to the LMP. SEH personnel (November 2, 2005) measured the pipe size, flow depth, and flow velocity at the pipe outlet and determined the outflow from the West Hill Mine Pit was approximately 3.5 cubic feet per second (1,570 gallons per minute) at that the time of the field investigations.

Lind Mine Pit

There are very little data on the LMP. The pit has filled with water and has an outlet pipe that discharges to the Prairie River. SEH personnel (November 2, 2005) measured the pipe size, flow depth, and flow velocity at the pipe outlet and determined the outflow from the LMP was approximately 4 cubic feet per second (1,800 gallons per minute) at that time. A majority of the outflow comes from the West Hill Mine Pit (3.5 gallons per minute).

Holman Lake

Holman Lake was not considered as a source for process water, but was considered as a potential receiving water for cooling tower blowdown discharges (**note that there would no direct discharges to Holman Lake with use of the enhanced ZLD system. See Section 4.5 for updated discussions on potential impact to surface waters**). Holman Lake currently receives outflow from Little Diamond Lake, as well as surface water runoff. The lake previously received the dewatering discharge from the Canisteo Mine when the mine was operational. At that time, the water level in the lake was controlled by a concrete spillway. Currently, the water level is affected by a beaver dam built just upstream of the spillway. The lake is listed on MNDNR's Public Waters Inventory, but it is not currently designated for a particular water use classification, however there is a public swimming area on the eastern side of the lake. Some limited water quality information is available for Holman Lake.

3.5.1.2 Water Quality and Uses

The water needs of the Mesaba Generating Station at the West Range Site would be met by appropriating water out of the following nearby abandoned mine pits: the CMP, HAMP Complex, and the LMP. The Prairie River would also serve as a source of water supply and would be integrated into the mine pit water plan. Table 3.5-4 summarizes the current water quality of each water source. In general, the current concentration of each constituent is based on the median concentration of available qualified water quality analyses.

Table 3.5-4. Current Water Quality for West Range Water Bodies

Constituent*	Units*	Water Quality Data*				
		CMP	HAMP Complex	LMP	Prairie River	Holman Lake
Hardness	mg/L	308	229	n/a	n/a	n/a
Alkalinity	mg/L	180	163	178	76	186
Calcium	mg/L	55.3	59.1	73.2	50	50.2
Magnesium	mg/L	40.8	20.5	n/a	22	n/a
Iron	mg/L	<0.05	<0.05	n/a	n/a	0.75
Manganese	mg/L	<0.02	<0.02	n/a	n/a	0.04
Chloride	mg/L	5.15	5.2	4.9	1.3	8.4
Sulfate	mg/L	105	54.7	n/a	<5	10.1
TDS	mg/L	337	252	402	n/a	236
pH	mg/L	8.4	8.3	7.7	7.4	7.9
Aluminum	µg/L	<25	<25	n/a	91	n/a
Barium	µg/L	28.6	29.3	n/a	n/a	n/a
Cadmium	µg/L	<10	<10	n/a	n/a	n/a
Chromium (6+)	µg/L	<5	<5	n/a	n/a	n/a
Copper	µg/L	<10	<10	n/a	n/a	n/a
Fluoride	mg/L	n/a	n/a	n/a	n/a	n/a
Mercury	ng/L	0.9	0.9	0.8	0.59	<4.0
Nickel	µg/L	<5	<5	n/a	n/a	n/a
Selenium	µg/L	<2	<2	n/a	n/a	n/a
Sodium	mg/L	6.7	6.2	5.0	2.5	7.4
Specific Conductivity	µmhos/cm	476	418	n/a	171	n/a
Zinc (3)	µg/L	<10	<10	n/a	n/a	n/a
BOD	mg/L	<2	<2	n/a	n/a	n/a
COD	mg/L	<2	<2	n/a	n/a	n/a
TOC	mg/L	1.9	1.8	n/a	n/a	n/a
TSS	mg/L	2	<1	n/a	n/a	n/a
Ammonia (as N)	mg/L	<0.1	<0.1	0.1	0.018	<0.1
Phosphorus	mg/L	<0.1	<0.1	0.01	0.029	0.01

*n/a – no data available (not analyzed); mg/L – milligrams per liter; µg/L – micrograms per liter; ng/L – nanograms per liter; µmhos/cm – micromhos per centimeter; CMP – Canisteo Mine Pit; HAMP – Hill-Annex Mine Pit; LMP – Lind Mine Pit; TDS – total dissolved solids; BOD – biochemical oxygen demand; COD – chemical oxygen demand; TOC – total organic carbon; TSS – total suspended solids; N - nitrogen
 Source: Excelsior, 2006b

The natural surface water bodies within the project area are used for recreational purposes such as fishing, boating, and swimming. The CMP and the Greenway Mine Pit also host recreational uses, while the West Hill Mine Pit and the LMP do not have any known recreational uses.

3.5.1.3 Groundwater

Groundwater Quality and Quantity

The primary aquifer at the site is shallow Quaternary drift comprised of water-bearing sand and gravel deposits. Regionally, these aquifers occur beneath till and in ice contact features on the flanks of end moraines. End moraines are the ridge-like accumulation of till deposits marking a standstill position of a past or present glacier. Buried bedrock valleys in the region create variable thicknesses of Quaternary deposits. North of Taconite, Minnesota, Quaternary deposits range from approximately 10 to 40 feet thick, whereas, near the cities of Coleraine and Bovey (east of the site), Quaternary deposits are approximately 130 feet thick (USDI, 1965). Based on the results of geotechnical borings at the West Range Site, the unconsolidated deposits at the proposed facility consist of varying amounts of till and coarse alluvium, approximately 10 to 35 feet thick combined.

The West Range Site is located at a potentiometric high, and groundwater recharge area for the shallow aquifer is due to the presence of the Giants Range Batholith (Excelsior, 2006b). A groundwater divide (where the groundwater flow direction is north and south with surface water features primarily influencing the direction of shallow flow) is present near the West Range Site. On the site itself, where the facility will be located, the groundwater flow direction of the shallow aquifer appears to be north and northwestward based on groundwater elevation data collected from the on-site groundwater monitoring wells. Ultimately, groundwater in the shallow aquifer at the site discharges to tributaries and surface water bodies that subsequently discharge into the Prairie River.

Immediately south of the West Range Site, a bedrock aquifer exists underlying the Quaternary deposits (Excelsior, 2006b). Bedrock in the area (Giants Range Batholith, Pokegama Quartzite, Biwabik Formation, and Virginia Formation) has very little primary porosity. However, secondary porosity in the form of fractures and leached zones has developed within Biwabik Formation allowing it to act as an aquifer (Excelsior, 2006b). Regional groundwater flow within the Biwabik Formation is south from the Giants Range Batholith toward the Swan River—a regional groundwater discharge feature. The groundwater flow direction of this bedrock aquifer specifically on the West Range site is interpreted to be south and southwest toward the CMP.

Mining activities in the area have influenced the natural groundwater system in the area (Excelsior, 2006b). Fractures and leached zones within the Biwabik Formation appear greatest near the mine pit complexes. The mine pits have been excavated below the water table and groundwater head of the Quaternary and bedrock aquifers. Since the cessation of mining activities, **including dewatering of the mine pits**, water levels in the mine pits have been increasing due to **continued inflow of surface water and groundwater** into the mined excavations. **However, the rate and direction of groundwater flow (i.e., into or out of a mine pit) depends on the hydraulic head difference between the surface water elevation in a mine pit and the adjacent aquifer. For example, the findings of a study conducted by USGS indicated that as the CMP's water level increased from 1,300 to 1,324 ft, its inflow rate decreased by about 0.4 cfs, while its outflow rate increased by about 0.85 cfs (Jones, 2002).**

Transmissivities and hydraulic conductivities of various shallow sand and gravel aquifers in the region have been estimated (Excelsior, 2006b). In studying the hydrogeology of the CMP area, the MNDNR and USGS installed 18 monitoring wells in the Quaternary drift aquifer(s) and performed pumping tests and hydraulic conductivity slug tests.

Average calculated transmissivities for sand and gravel aquifers ranged from 98 to 300 square feet per day. Average calculated hydraulic conductivities for the sand and gravel aquifers ranged from 2.2 to 68 feet per day (Excelsior, 2006b). Hydraulic conductivities for the four wells on the site ranged from 0.5 to

32.5 feet per day. Locally, well yields typically range from 300 to 500 gallons per minute for wells completed in the Quaternary drift deposits (Excelsior, 2006b), with yields up to 1,000 gallons per minute. The Biwabik Formation is a good source of groundwater for domestic use and a fair source of supply for municipal and industrial use (Excelsior, 2006b). While the local aquifers have sufficient capacity to serve local municipal and residential groundwater users, these aquifers do not appear to have sufficient capacity to provide enough groundwater for the process water needs of the Mesaba Generating Station (10,000 gallons per minute peak requirements). Thus, a large number of wells would be required to pump enough water to meet the station's process water needs.

Although groundwater quantities and local aquifer capacities are limited (as far as being a source of process water supplies), it is feasible that one or more wells could be utilized to provide a potable water supply for the generating station. Several local public water supply wells are drilled into and utilize the Biwabik Formation.

Typically, groundwater quality in the region has moderate dissolved solids content, is moderately siliceous, is very hard, and contains high levels of iron and manganese frequently above the maximum recommended limits of 0.3 milligrams per liter for iron and 0.05 milligrams per liter for manganese (USDI 1965, Excelsior, 2006b). Sand, ice-contact sand and gravel, and buried outwash aquifers have adequate yield (5 gallons per minute or more) and suitable quality for domestic use (total dissolved solids less than 1000 milligrams per liter) (Excelsior, 2006b). Of these, only buried outwash aquifers have suitable yield (900 gallons per minute or more) and quality (total dissolved solids less than 500 milligrams per liter, iron content less than 0.3 milligrams per liter, and hardness less than 180 milligrams per liter) for municipal or industrial use (Excelsior, 2006b).

Groundwater Depth and Recharge Sources

The potentiometric surface of the shallow Quaternary aquifer at the area is approximately 1350 to 1400 feet msl (Excelsior, 2006b), approximately 10 to 60 feet below ground surface (bgs). Static groundwater elevations of the shallow aquifer(s) have been recorded by MNDNR in a series of monitoring wells in the area of the CMP, and from the period between January 2001 and April 2005, the groundwater elevations ranged from 1280 to 1382 feet msl.

Groundwater flow is influenced by mine pits in the area (USDI, 1965); a potentiometric gradient exists between the surface water in mine pit lakes and groundwater in surrounding areas directing flow towards the mine pit complexes (Excelsior, 2006b). During periods of mine operation, dewatering in the mine pits reduced the amount of lateral flow (north to south) through bedrock and Quaternary deposits, and decreased potential vertical recharge to the bedrock aquifer south of the mine pits (Excelsior, 2006b).

Municipal wells for the cities of Bovey, Calumet, Coleraine, Marble, and Taconite are located south of the local mine pits (CMP and HAMP Complex). Table 3.5-5 summarizes the static water elevations and historic pumping in these wells.

Table 3.5-5. Pumping Groundwater Elevations City Municipal Wells

Date		Water Elevation	Pumping Rate	Duration
		ft msl	gpm	hours
Marble 1				
1926	During mining operations	1150	300	-
1955		1164	350	-
1977		1105	248	2
1994	After mining operations ceased	1177	400	-
1999		1189	385	-
2000		1195	420	-
2001		1200	390	-

Table 3.5-5. Pumping Groundwater Elevations City Municipal Wells

Date		Water Elevation	Pumping Rate	Duration
		ft msl	gpm	hours
2002		1232	270	-
2003		1203	350	-
Marble 2				
1955	During mining operations	1199	385	14
1965		1198	340	-
1977		1103	300	25
1989	After mining operations ceased	1236	270	-
1994		1193	300	-
1999		1196	330	-
2000		1201	360	-
2001		1203	310	-
2002		1207	-	-
2003		1221	220	-
Bovey 1				
1953	During mining operations	1256	650	10
Coleraine 1				
1918	During mining operations	1258	500	
Coleraine 3				
1976	During mining operations	1243	1012	5
Taconite 1				
1991	After mining operations ceased	1112	218	12

Average annual recharge to groundwater is approximately 5.7 to 7.6 inches (Excelsior, 2006b). Groundwater recharge to the shallow sand and gravel aquifer(s) is derived from precipitation infiltration and interconnections with surface water bodies (including mine pits that have filled with water). Groundwater recharge to the underlying Biwabik Formation bedrock aquifer is largely by vertical infiltration through the Quaternary deposits where the formation is not overlain by other bedrock (USDI, 1965). Lateral groundwater recharge occurs as groundwater travels south from the Giants Range Batholith.

Usage and Availability

Other than the four groundwater monitoring wells recently constructed, no wells are currently located on the property. However, numerous wells are located on surrounding properties. There are 23 domestic wells, 11 monitoring wells, three “other use” wells, and two public supply non-community transient wells in the area. The domestic supply wells are concentrated along CR 7, US 169, and north of Big Diamond Lake. These domestic wells utilize the Quaternary sand and or gravel aquifers.

Wells are also located adjacent to the CMP and the HAMP Complex. The wells adjacent to the mine pits are used for:

- Community Supply (10)
- Dewatering (1)
- Domestic (19)
- Industrial (2)

- Monitoring (38)
- Municipal (2)
- Public Supply (2)
- Other (7)

Public water supply wells for the cities of Bovey, Calumet, Coleraine, Marble, and Taconite are constructed in Quaternary and Biwabik Formation aquifers. Wells for the cities of Bovey and Coleraine are completed in the same unit of ice-stratified Quaternary drift (USDI, 1965). The wells receive limited amounts of recharge through infiltration and receive some recharge from Trout Lake (USDI, 1965). According to the County Well Index and DNR State Water Use Database System of Water Appropriations Permits, the City of Bovey has one municipal well (Unique No. 228834). This well has a 16-inch diameter casing completed in sand and gravel Quaternary deposits. The static water elevation was 1,268 feet msl at the time of installation (1953). This groundwater level was recorded when the CMP was dewatered for mining activities. The City of Bovey is permitted to pump the well at a rate of 35.0 million gallons per year. The reported volume of groundwater pumped from this well in 2004 was 29.6 million gallons per year.

The City of Coleraine has two wells (Coleraine 1 and **4**; Unique Nos. 241430 and 110457, respectively). Coleraine 1 is completed at a depth of **121** feet within undivided Quaternary drift. Coleraine 1 had a static water level of 1,283 feet msl at the time of well installation (1918). Coleraine **4** is **120** feet deep. It is completed within sand, gravel, and boulder Quaternary deposits. Coleraine **4** had a static water level of 1267 feet msl at the time of well installation (1976). The City of Coleraine is permitted to pump 80 million gallons per year from both wells. The reported pumped volume in 2004 was 52.2 million gallons per year for **both wells**.

The cities of Marble, Calumet, and Taconite each have two public water supply wells. These six wells draw water from the Biwabik Formation bedrock aquifer. Marble 1 (Unique No. 228842) is **500** feet deep. The static water level was 1224 feet msl at the time of well installation (1926). Marble 2 (Unique No. 228846) had a static water level was 1258 feet msl at the time of installation (1955). The city of Marble is permitted to pump 49.0 million gallons per year from both of the wells. The reported volume of groundwater pumped for both wells in 2004 was 12.8 million gallons per year.

Calumet 2 (Unique No. 228839) was completed at a depth of **495** feet in the Virginia and Biwabik formations. The static water elevation was 1178 feet msl at the time of installation (1943). Calumet 3 (Unique No. 228838) is **500** feet deep. It is completed in the Virginia and Biwabik formations. The City of Calumet is permitted to pump 22.0 million gallons per year from both wells. The reported volume of groundwater pumped in 2004 was 5.8 million gallons per year for Calumet 2 and 6.2 million gallons per year for Calumet 3.

The City of Taconite Well 1 (Unique No. 241489) is 384 feet deep and is completed in the Biwabik Formation bedrock aquifer. The approximate static groundwater elevation in the well at the time it was constructed (1926) was 1,273 feet msl. Taconite No. 2 (Unique No. 495997) is 394 feet deep and also utilizes the Biwabik Formation aquifer. Its static water elevation was 1290 feet msl at the time of installation (1991). The City of Taconite is permitted to pump 20 million gallons per year (total) from both wells. The reported volume of groundwater pumped in 2004 was 7.9 million gallons per year for Taconite 1 and 7.3 million gallons per year for Taconite 2.

The cities of Bovey, Calumet, Coleraine, Marble, and Taconite rely on groundwater resources for public water supplies. Each city has public water supply wells open to either the shallow sand and gravel aquifer (the cities of Bovey and Coleraine) or the Biwabik Formation bedrock aquifer (cities of Calumet, Marble, and Taconite). Due to the close proximity of these local public water supply wells to surface water bodies, a hydrologic connection may exist between the groundwater captured by the wells and local surface waters and mine pits. Due to the relatively high tritium concentrations detected by the Minnesota

Department of Health (MDH) in the groundwater pumped from some of these public water supply wells, the source water aquifers (Quaternary sand and gravel deposits and the Biwabik Formation) appear to recharge quickly (i.e., 50 years or less) and are therefore more sensitive to land surface activities and more vulnerable to potential contamination.

Permits

No groundwater use or withdrawal permits currently exist for the Mesaba Energy Project. As previously mentioned in Section 2.5.2.3, MNDNR Water Appropriation Permits for groundwater withdrawal/use have been issued to local municipalities for public water supply systems (the cities of Bovey, Calumet, Coleraine, Marble, and Taconite). Regionally, groundwater appropriation permits have also been issued to mining companies for dewatering and farms for agricultural purposes and irrigation.

Four well permits were obtained from the MDH for constructing the four groundwater monitoring wells installed on the West Range Site in July 2005. These permits will be reissued annually by the MDH to the facility as long as the wells are still necessary and utilized.

Should groundwater be used for a potable water supply for the facility, a well permit from the MDH will be required. If the amount of groundwater pumped from a well for potable water supplies exceeds 10,000 gallons per day or 1 million gallons per year, a Water Appropriation Permit will be required from the MNDNR.

During construction of Phase I and Phase II, dewatering may be necessary that will temporarily lower the shallow water table aquifer in small localized areas. If the dewatering is expected to exceed 10,000 gallons per day or 1 million gallons per year, a Water Appropriation Permit will be attained from the MNDNR.

Any necessary discharges from the facility will be properly managed in accordance with the NPDES permits issued for plant, and applicable state and local regulations to prevent degradation of source water aquifers used for public water supplies.

3.5.2 East Range Site and Corridors

The following sections identify the prominent surface water features and describe the major drainage areas and watersheds, land uses, soil classifications, and abandoned mine pits associated with the West Range.

3.5.2.1 Surface Water Sources

Major watersheds throughout the project area are shown in Figure 3.5-3. The drainage area boundaries shown on Figure 3.5-3 were delineated from the USGS maps of the area. This map, and therefore the drainage area boundaries, does not represent the altered hydrology in this area that has taken place due to mining activities in recent years. The East Range Site lies within the northwest region of the Lake Superior Watershed. The major surface water bodies near the project site are shown in Figure 3.5-4 and listed in Table 3.5-6. **Note that disused mine pits shown on figures in this EIS have been filling with surface water and groundwater. Therefore, the areas within these pits shown as surface waters based on available geographic information system data may not represent the actual extent of surface waters currently in these pits.**

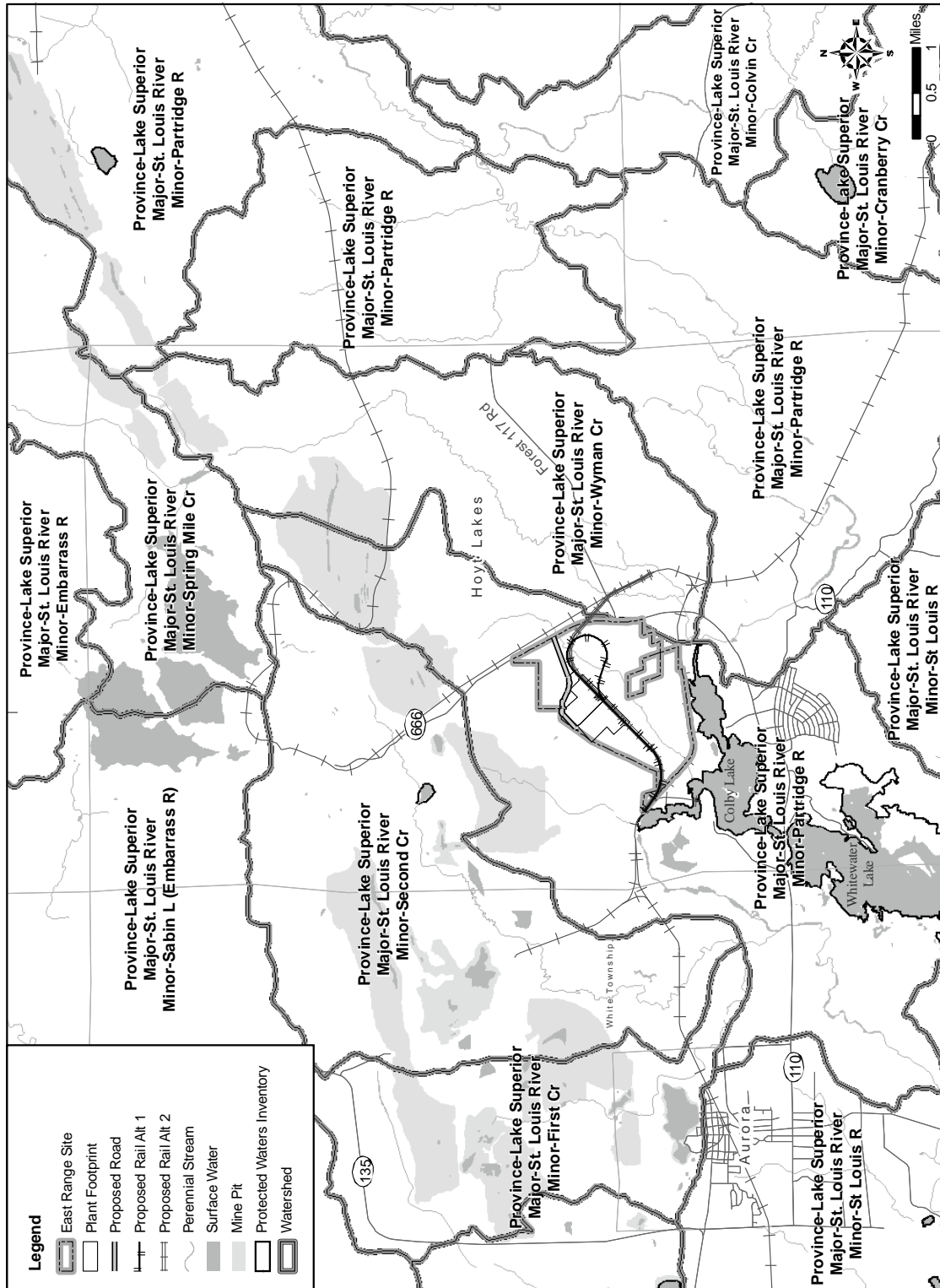


Figure 3.5-3. East Range Drainage Features

Table 3.5-6. East Range Surface Water Bodies

Surface Water	Watershed	FEMA ¹ Designated Floodplain	Public Water ²	Special Water ³	Impaired Water ⁴	Target TMDL Study ⁵	Impairment
St. Louis River	Lake Superior	X	X		X	2011	Mercury FCA ⁶
Partridge River	St. Louis River	X	X				
2WX Pit	Partridge River						
2E Pit	Partridge River						
3 Pit	Partridge River						
Wyman Creek	Partridge River		X	X			
5S Pit	Wyman Creek						
6 Pit							
Colby Lake	Partridge River		X		X	2011	Mercury FCA⁶
Whitewater Reservoir	Partridge River	X	X		X	2011	Mercury FCA ⁶
First Creek	Partridge River	X	X				
St. James Mine	First Creek			X			
9S Pit	First Creek						
Donora Mine / 9N	First Creek						
1W / 1 Pit	First Creek						
Little Mesaba Lake	First Creek						
Second Creek	First Creek	X	X				
Stephens Creek	Second Creek						
Stephens Mine	Second Creek						
Knox Mine	Second Creek						
2W Pit	Second Creek						

¹ Federal Emergency Management Agency

² MNDNR Designated Public Water

³ MPCA Designated Special Water

⁴ MPCA Designated Impaired Water, 2006 EPA Draft 303(d) list of impaired waters

⁵ Total Maximum Daily Load

⁶ Fish Consumption Advisory

Surface Waters shown in bold were considered for either a raw water source or receiving waters for discharges.

Source: Excelsior, 2006a

Most surface water runoff eventually flows into Colby Lake or the Partridge River. Mining activities within this drainage area have significantly altered the regional hydrology. Changes to the hydrology in the watershed include removal of trees and soil, creation of mine pits and other depressions, and changes in topography.

There are a number of mine pits near the East Range Site (see Figure 3.5-4). In locations where mining activities have ceased, these mine pits are filling with water from both groundwater infiltration and surface water runoff. In 2004, the MNDNR completed a study that evaluated the water levels in several of the abandoned mine pits. Data was collected and modeled (using the WATBUD model) for pits

2E, 2W, 2WX, and 6, in order to predict when the pits would overflow and what the average and peak overflow rates would be. In addition, hydrologic changes to Colby Lake, Whitewater Reservoir, and St. James Pit were evaluated as part of the study. Pits 5N, 5S, 9N, and 9S were not included in the study, as they have reached their static water levels (i.e., they would not overflow like the pits near the West Range Site).

Though water levels in several of the pits may rise, unlike the Canisteo and Hill-Annex Mine Pits, there is no immediate need to control water levels in any of the pits on the East Range Site. Therefore, water supplies from any of the individual East Range pits can be pumped as necessary to meet demands of the generating station.

3.5.2.2 Water Quality and Uses

The current water surface elevation, water surface area and estimated water volume in the following mine pits affected by the Proposed Action are summarized in Table 3.5-7.

Table 3.5-7. Abandoned Mine Pit Water Sources

Water Source	Bottom Elevation ¹ (ft)	Water Surface Elevation ² (ft) (11/2005)	Surface Area ³ (acres) (11/2005)	Estimated Volume ³ (acre-ft) (11/2005)
2E	1,427	1,492.2	84	1,700
2W	1,282	1,413	183	13,430
2WX	1,331	1,405.4	322	8,880
6	1,276	1,426.6	207	18,850
3	1,522	1,586.7	ND	ND
5N	ND	ND	ND	ND
5S	ND	ND	ND	ND
9N / Donora	1,493	1,547.2	ND	ND
9S	1,396	1,475.2	ND	ND
Stephens	1,377	ND	ND	ND
Knox	1,362	ND	ND	ND

¹ Bottom elevations are based on blast maps and aerial contour mapping provided by Cliffs-Erie.

² Water surface elevations are based on field surveys provided by Cliffs-Erie.

³ Surface area and estimated volumes were obtained from the MNDNR March, 2004 East Range Hydrology Report.

ND – No data

Source: Excelsior, 2006a

Lakes near the East Range Site are used primarily for recreational purposes, such as fishing, boating, and swimming. Most of the mine pits are located on property owned by mining interests and therefore have little public recreation activity. Cooling water for the Syl Laskin Power Plant comes from Colby Lake. Water from Whitewater Reservoir is used to augment water levels in Colby Lake when needed. Limited water quality information is available for the water sources for the East Range Site. Analytical data supplied by Excelsior Energy for two of the mine pits is presented in Table 3.5-8. The concentration of each constituent shown is based on the median concentration of available qualified water quality analyses.

Table 3.5-8. Water Quality Data for East Range Water Sources

Constituent*	Units*	Water Quality Data*	
		Mine Pit 2WX	Mine Pit 6
Hardness	mg/L	n/a	n/a
Alkalinity	mg/L	310	411
Calcium	mg/L	23.2	46.7
Magnesium	mg/L	73.5	253.5
Chloride	mg/L	17.1	10.6
Sulfate	mg/L	n/a	n/a
TDS	mg/L	449	1,585
pH	mg/L	8.5-8.6	7.7-8.6
Mercury	ng/L	0.9	0.65
Sodium	mg/L	28.7	51.5
Specific Conductivity	umhos/cm	711	1,678
TOC	mg/L	1.8	1.9
TSS	mg/L	<2	<3.3
Ammonia (as N)	mg/L	<0.1	<0.1
Phosphorus	mg/L	<0.1	<0.1

*n/a – no data available (not analyzed); mg/L – milligrams per liter; µg/L – micrograms per liter; ng/L – nanograms per liter; umhos/cm – micromhos per centimeter; TOC – total organic carbon; TSS – total suspended solids; N – n nitrogen
 Source: Excelsior, 2006b

3.5.2.3 Groundwater

Groundwater Quality and Quantity

The surface geology at the site consists of Quaternary outwash and brown silty till. The primary aquifer at the site is shallow outwash deposits comprised of fine to coarse-grained sand and gravel. The static water level in wells near the proposed site is approximately 10 to 40 feet bgs.

Underlying the Quaternary deposits at the site is argillite and greywacke of the Virginia Formation. The formation ranges in total thickness from 0 to 2,000 feet. Although the formation typically has a low yield, fractures in the top of the unit may be used for domestic or stock wells. The Virginia Formation is typically used in conjunction with iron formation aquifers that contain larger water supplies (Excelsior, 2006b). North of the site, the Biwabik formation is upper most bedrock where the Virginia Formation is not present. Secondary porosity in the form of fractures and leached zones has developed within Biwabik Formation allowing it to act as an aquifer (Excelsior, 2006b). The total thickness of the Biwabik formation in the area ranges from 0 to 800 feet. Regional groundwater flow within bedrock in the area is south, from a bedrock high created by the Giants Range Batholith. The Duluth Complex is the upper most bedrock west of the site. Gabbro of the Duluth Complex is massive with low porosity and permeability and therefore a poor source of water. However, where fractures create secondary porosity, the formation may be used for domestic or stock supply wells.

Typically, groundwater quality in the region is of the calcium magnesium bicarbonate type (Excelsior, 2006b). In some areas water from the argillite, greywacke, and gabbro is sodium-softened. In other areas, water from these units is of sodium chloride type, deep wells may produce saline water. Water in the Biwabik formation is of good quality and suitable for use without softening or iron removal and is lower in total dissolved solids than other sources. Water from the Quaternary drift aquifer is also of the calcium magnesium bicarbonate type. Total dissolved solids from the Quaternary aquifer have been measured as high as 1,800 milligrams per liter. Surface contamination has impacted the surface aquifer in

some locations, and where this has occurred, high nitrogen concentrations are the most common contaminant. As well as bedrock aquifers, water produced from drift may have high iron content (Excelsior, 2006b).

Groundwater Depth and Recharge Sources

The potentiometric surface of the shallow Quaternary aquifer at the area is approximately 1440 to 1490 feet msl, approximately 10 to 40 feet bgs (Excelsior, 2006b). The static water level for the bedrock aquifer is approximately 10 to 40 feet bgs. Groundwater flow at and near the site is likely southwest towards Colby Lake.

Usage and Availability

No wells are currently located on the East Range Site. However, numerous wells are located on surrounding properties and include 18 monitoring wells and one domestic well. The monitoring wells are owned by St. Louis County and MP; the domestic well is also owned by MP. The wells range in depth from 14 to 90 feet and are completed in unconsolidated deposits.

Permits

No groundwater use or withdrawal permits currently exist for Mesaba Phase I and Phase II. Water Appropriation Permits have been issued by the MNDNR to CE for wells located within Township 59 North, Range 14 West, Section 29. Three permits were issued for pumping up to 10,512 millions of gallons per year to the corporation; however, there is no reported pumping for the last four years. No unique well numbers are reported for the permits.

Available drawdown for the Quaternary drift aquifer is approximately 5 to 100 feet; the available drawdown for the bedrock aquifer is approximately 100 to 200 feet. Yields for wells completed in the Quaternary drift reach 10 gallons per minute for domestic wells and 1400 gallons per minute for public supply wells.

3.6 FLOODPLAINS

This section discusses the existing floodplain conditions for the affected areas of the two site alternatives. Width, depth, and velocity of streams and rivers vary based on their position within the watershed. Waterways in the upper portion of the watershed generally can be characterized as first order streams lacking an active floodplain and can have varying water depths. As a stream migrates towards base level, the stream order typically increases in proportion to the size of the watershed and result in the development of a noticeable floodplain and potential flooding.

Since flooding events can be very costly natural disasters, the Federal Emergency Management Agency (FEMA), through the National Flood Insurance Program, enables property owners to purchase insurance protection against losses from flooding. The prerequisite for eligibility in the National Flood Insurance Program is that the potentially affected community must adopt and enforce a floodplain management ordinance to reduce future flood risks, particularly with respect to new construction. Therefore, the FEMA Flood Insurance Study floodway maps were used to determine locations of potential flood hazards associated with the Proposed Action.

3.6.1 Local Hydrology Features

3.6.1.1 West Range Site

The West Range Site is in the Upper Mississippi River Basin Watershed. Local watersheds consist of the Prairie River and Swan River sub-watersheds. Both the Prairie River (to the north and west of the site) and the Swan River (to the south) are tributaries to the Mississippi River. The project area also contains numerous small streams and wetland areas that drain into tributaries of the Mississippi River.

3.6.1.2 East Range Site

The East Range Site lies in the St. Louis River Watershed, located in the northwest quadrant of the Lake Superior Watershed. The Partridge River, to the south and east of the site, and the Embarrass River (to the west of the site) join with the St. Louis River, which ultimately drains into Lake Superior. The site also contains many small streams, natural and man-made lakes, and wetland areas that drain into local waterways.

3.6.2 Flood Hazard Areas

Floodplain management activities of the National Flood Insurance Program include the development of Flood Insurance Rate Maps (FIRMs) for flood insurance rating purposes. A FIRM is a map that outlines flood risk zones within communities for insurance purposes. FIRMs are issued, published, and distributed by FEMA to a wide range of users including: private citizens, community officials, insurance agents and brokers, lending institutions, and other Federal agencies. A FIRM is usually issued following a Flood Insurance Study prepared by FEMA that summarizes the analysis of flood hazards within the subject community.

Flood Insurance Studies include detailed engineering studies to map predicted flood elevations at specified flood recurrence intervals. Generally, Flood Insurance Studies are concerned with peak discharges in streams and rivers for the 100- and 500-year storm events and includes engineering analyses of flood elevations for each flood recurrence interval. Based on the results of the engineering analyses flood risk zones are assigned for insurance purposes. The 100-year floodplain is defined as areas that have a 1.0 percent annual chance of flooding. The 500-year floodplain is defined as areas that have a 0.2 percent annual chance of flooding.

FEMA has adopted a maximum allowable increase of water surface elevation of 1.0 foot for a 1.0 percent annual chance (100-year recurrence interval) flood event as the national standard for floodplain management purposes. However, several states and municipalities have adopted more stringent criteria with a less than 1.0-foot allowable increase of water surface elevations.

3.6.2.1 West Range Site Floodplains

The City of Taconite (FEMA Community Number 270209) and Itasca County (FEMA Community Number FM270200, Panels 0675A, 0700A, and 0800A) are the only areas within the vicinity of the site that have published FEMA FIRM panels. The Cities of Coleraine, Bovey, Marble, and Calumet are unmapped; therefore, FEMA does not have defined flood hazard zones within those communities.

According to the FIRM panels, the 100-year floodplains near the West Range Site are found along the major rivers, including the Mississippi, Prairie, and Swan Rivers. The floodplains along these rivers are generally about 1,500 feet wide, but extend to almost 1 mile wide in some areas. The exception to this are two large floodplains that are more than 10 square miles in size; one located on the Prairie River at Prairie Lake; and the other on the Swan River just north of its confluence with the Mississippi River. The nearest identified 100-year floodplain is approximately 1 mile northwest of the West Range Site, along the Prairie River. These floodplains are shown in Figure 3.6-1.

The only 500-year floodplains found in the area are located in Grand Rapids, along the Mississippi River.

3.6.2.2 East Range Site Floodplains

Table 3.6-1 describes the communities and corresponding FIRM panels near the East Range Site.

Table 3.6-1. Communities with Potentially Affected Floodplains near the East Range Site

Community	FEMA Community Number	FIRM Panel
St. Louis County	27137	N/A
City of Biwabik	270418	No Map
City of Eveleth	270422	Refer to St. Louis County* 950
City of Hoyt Lakes	270575	No Map
City of Iron Junction	270580	0001
City of Mountain Iron	270424	0002
City of Virginia	270426	No Map
St. Louis County	270416	825, 925, 950, 975, 1050

The City of Hoyt Lakes and the City of Virginia do not have published FEMA FIRM panels; therefore, there are no FEMA-defined floodplains within the jurisdictional boundaries of either of these two cities. Most of the 100-year floodplains in this area are along the St. Louis, Partridge, and Embarrass Rivers, as shown in Figure 3.6-2. The nearest identified 100-year floodplain is roughly 1 mile south-southwest of the East Range Site, along the Partridge River. There are no 500-year floodplains depicted on the FEMA maps in the area that would be affected by the East Range Site.

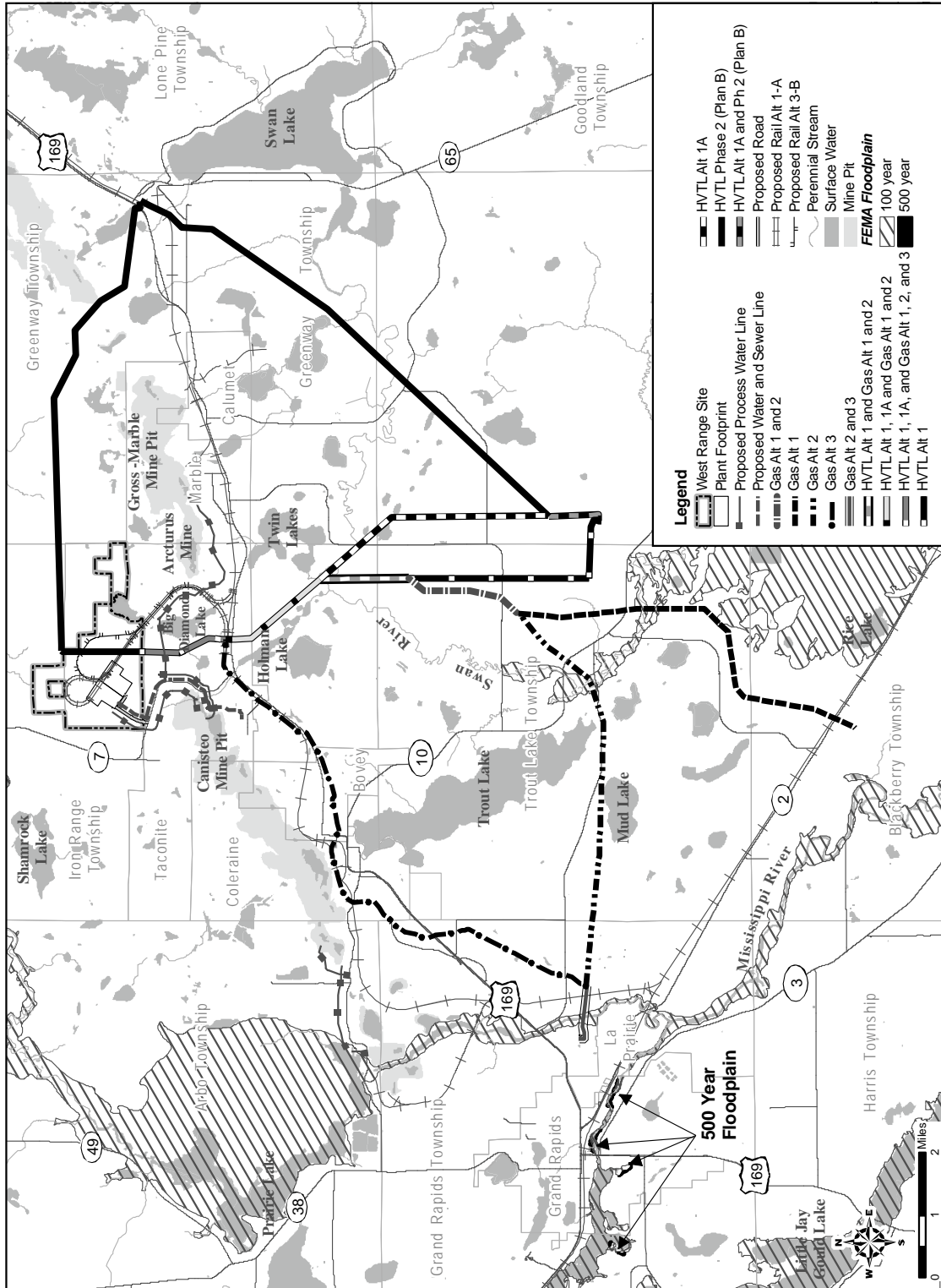


Figure 3.6-1. West Range Corridor FEMA Floodplains

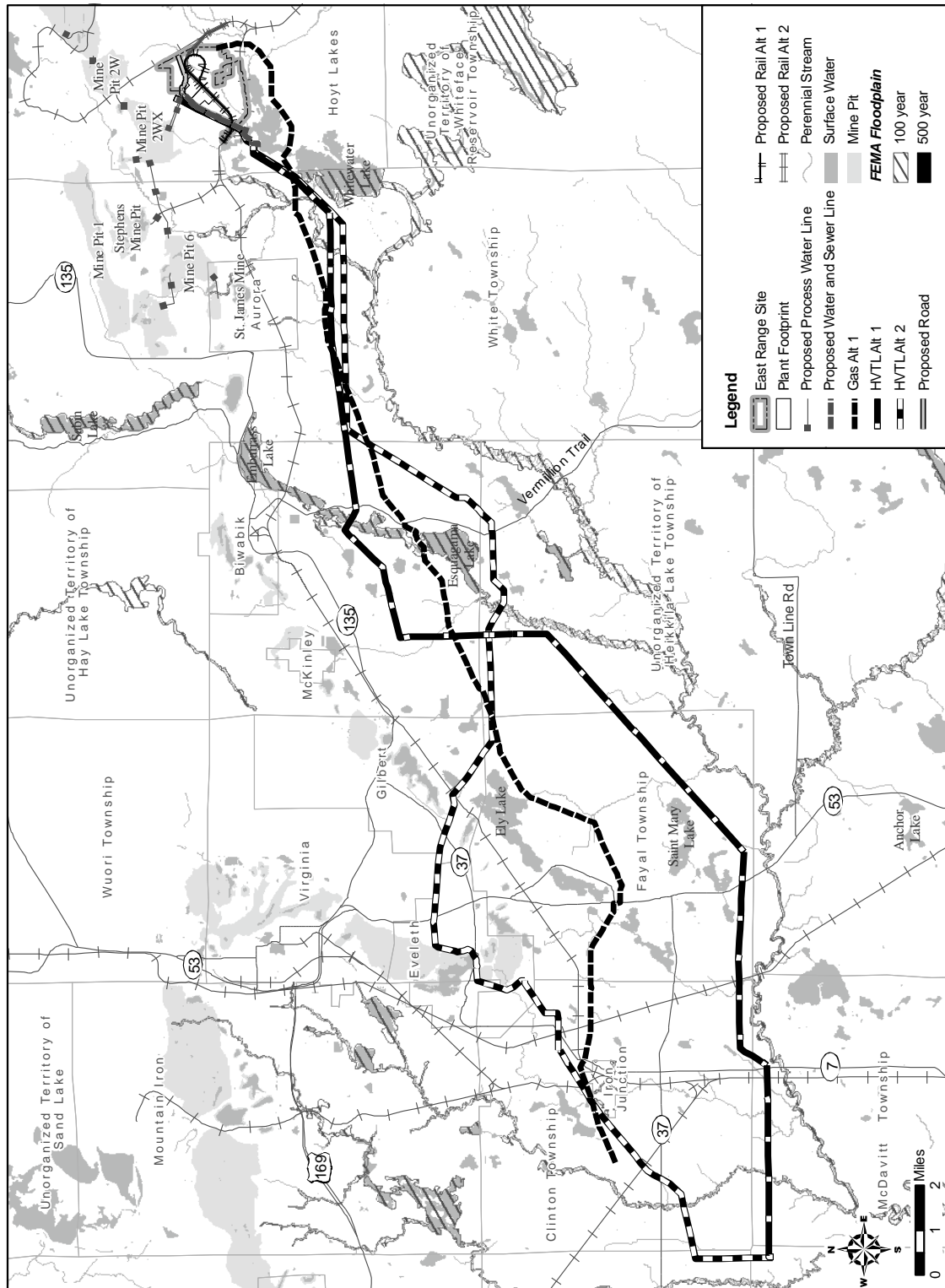


Figure 3.6-2. East Range Corridor and FEMA Floodplains