SCOPING ENVIRONMENTAL ASSESSMENT WORKSHEET DATA SUBMITTAL - FIGURES
NOTES:
1. Base air photo from the U.S. Department of Agriculture Farm Service Agency, Aerial Photography Field Office.
2. Hydrographic data from Minnesota Department of Natural Resources.

LEGEND
- Primary Road
- Secondary Road
- Underground Mine Area
- Plant Site
- Ventilation Raises and Ventilation Access Road
- Water Intake Corridor
- Non-Contact Water Diversion Area
- Transmission Corridor
- Off-Site Electrical Substation
- County Boundary

FIGURE 2-1
GENERAL PROJECT LAYOUT
TWIN METALS MINNESOTA
Date: SEPTEMBER 2019
<table>
<thead>
<tr>
<th>Activity</th>
<th>Construction</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year -3</td>
<td>Year -2</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>Q1</td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction start</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site Development &amp; Access Roads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portal and Decline Development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mine &amp; Mine Infrastructure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentrator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tailings Dewatering Plant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry Stack Facility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commissioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stope Mining Begins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commissioning &amp; Ramp-up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial Production</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scale: NOT TO SCALE
Date: SEPTEMBER 2019
NOTES:
1. Base air photo from the U.S. Department of Agriculture Farm Service Agency, Aerial Photography Field Office.
2. Digital elevation model hillshade downloaded from MnTopo.
3. Hydrographic data from Minnesota Department of Natural Resources.

LEGEND

- Facilities
- Decline
- Secondary Road
- River/Stream
- Project Area
- Ventilation Raises and Ventilation Raise Access Road
- Underground Mine Area

Scale: 0 200 400 Feet
Date: SEPTEMBER 2019
FIGURE 3-7
MINE DESIGN TYPICAL DRIFT SECTIONS

Preliminary
NOT FOR CONSTRUCTION

Twin Metals Minnesota

Scale: NOT TO SCALE
Date: SEPTEMBER 2019
Coarse Ore Stockpile Section View

Coarse Ore Feed Conveyor

Coarse Ore Reclalm Feeders

Coarse Ore Reclalm Conveyor
NOTES:
1. Base air photo from the U.S. Department of Agriculture Farm Service Agency, Aerial Photography Field Office.
2. Hydrographic data from Minnesota Department of Natural Resources.

FIGURE 3-13
TAILINGS MANAGEMENT SITE LAYOUT
TWIN METALS MINNESOTA
Scale: Date: SEPTEMBER 2019

Path: X:\FOTH\IE\Twin Metals MN\16T777-01\GIS\mxd\SEAW\Figure 3-13 - Tailings Management Site Layout.mxd Date: 10/4/2019
NOTES:
1. Base air photo from the U.S. Department of Agriculture Farm Service Agency, Aerial Photography Field Office.
2. Hydrographic data from Minnesota Department of Natural Resources.

LEGEND
- Facilities
- Piping
- Culvert
- Electrical Transmission Line
- Fence
- Vegetative Screen
- Primary Road
- Secondary Road
- Underground Mine Area
- Project Area
- Plant Site
- Water Intake Corridor
- Lake/Pond
- Freshwater Pipeline to Plant Site
- Valve
- Intake Pumps (Primary and Standby) with Roof Hatch Above, Approx. 25 HP Vertical Turbine Pumps

TWIN METALS MINNESOTA
FIGURE 3-16
WATER INTAKE FACILITY AND ACCESS ROAD PLAN AND GENERAL ARRANGEMENT

Scale: 0 150 300 Feet
Date: SEPTEMBER 2019
Notes

1. TOP OF BEDROCK ESTIMATES SHOWN IN THE PROFILES ARE BASED ON DATA FROM THE MINNESOTA GEOLOGICAL SURVEY (OFR2016-04) DOWNLOADED FEBRUARY 12, 2018.

TWIN METALS MINNESOTA

FIGURE 3-17
WATER INTAKE FACILITY PLAN, PROFILE, SECTIONS, AND DETAILS

Scale: SEE ABOVE Date: SEPTEMBER 2019

PRELIMINARY
NOT FOR CONSTRUCTION
NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN FEET [METERS].
2. DIMENSIONS OF OVER-LINER DRAINS VARY. REQUIRED CROSS-SECTION OF GRAVEL FOR FEEDER DRAINS IS 5.4 FT² [0.5M²] (AVERAGE WIDTH=3.3 FT [1.0 M], HEIGHT=1.6 FT [0.5 M]).
3. DIMENSIONS OF UNDER-LINER DRAINS VARY. REQUIRED CROSS-SECTION OF GRAVEL FOR FEEDER DRAINS IS 5.4 FT² [0.5M²] (WIDTH=3.3 FT [1.0 M], HEIGHT=1.6 FT [0.5 M]).
4. 1.6 FT [0.5 M] THICK LAYER OF COMPACTED TAILINGS PLACED OVER THE GEOMEMBRANE PRIOR TO PLACING OVER-LINER DRAIN.
5. WOVEN GEOTEXTILE WILL BE USED FOR SEPARATION, NOT FILTRATION.
6. FOUNDATION TO BE STRIPPED OF TOPSOIL, ORGANICS AND UNSUITABLE MATERIALS. FOUNDATION SHALL HAVE AN ALLOWABLE BEARING PRESSURE OF 150 kPa TO SUPPORT LINER SYSTEM. A BEDDING LAYER OF LOCAL, SUITABLE BORROW, MINIMUM 0.6 FT [0.15 M] THICK WILL BE PLACED AND DENSELY COMPACTED OVER ANY EXPOSED BEDROCK.
1. ORIGINAL GROUND SURVEY PROVIDED BY TWIN METALS MINNESOTA, RECEIVED ON APRIL 26, 2016.
2. SEEPAGE CUTOFF SURFACE WILL HAVE GRASS VEGETATION IN SOME LOCATIONS, RIPRAP ARMOUR IN OTHERS AND EXPOSED BEDROCK IN OTHERS.
**Notes**

ABOUT TRANSITION SLOPE:
SLOPES THROUGH TRANSITION WILL VARY
DEPENDING ON MATERIAL AS FOLLOWS:
1. FOR FILL CONDITION: FROM 3% TO 3(H):1(V)
2. FOR CUT CONDITION (THROUGH OVERBURDEN):
   FROM 3% TO 3(H):1(V)
3. FOR CUT CONDITION (THROUGH BEDROCK):
   FROM 5% TO 1(H):1(V)

---

**FIGURE 3-20**
TYPICAL DITCH SECTIONS

**SCALE = 1:400**

---

**LEGEND:**
- COMPACTED CLEAN FILL
- CLEAN FILL PROTECTIVE COVER
- DRAINAGE COVER
- COMPACTED FILTERED TAILINGS
- ROAD GRAVEL SURFACE
- COMPACTED LOW PERMEABILITY SOIL
- GROUT CURTAIN
- SUITABLE FOUNDATION (PREPARED OVERBURDEN OR COMPACTED FILL)
- BEDROCK
- 60-m LLDPE Geomembrane

---

**PRELIMINARY NOT FOR CONSTRUCTION**
NOTES:
1. Topographic data from Minnesota Department of Natural Resources.
3. Boundary Waters Canoe Area Wilderness, Mineral Management Corridor and State Forest data from Minnesota Department of Natural Resources.

LEGEND
- Primary Road
- Secondary Road
- River/Stream
- Lake/Pond
- Municipal Boundary
- County Boundary
- Boundary Waters Canoe Area Wilderness
- Boundary Waters Canoe Area Wilderness Mineral Management Corridor
- State Forests - Statutory Boundaries
- State Forests - Management Units
- Project Area
- Underground Mine Area
- Plant Site
- Tailings Management Site
- Non-Contact Water Diversion Area
- Water Intake Corridor
- Ventilation Raises and Ventilation Raise Access Road
- Access Road Corridor

TWIN METALS MINNESOTA
FIGURE 4-1
BWCAW MINERALS MANAGEMENT CORRIDOR AND MDNR STATE FOREST MANAGEMENT UNITS
NOTES:
1. Hydrographic data from Minnesota Department of Natural Resources.
3. 1854 Treaty Ceded Territory data from The Great Lakes Indian and Wildlife Commission.

LEGEND
- Primary Road
- Secondary Road
- County Boundary
- River/Stream
- Project Area
- Lake/Pond
- Underground Mine Area
- 1854 Treaty Ceded Territory
- Plant Site
- Tailings Management Site
- Non-Contact Water Diversion Area
- Transmission Corridor
- Water Intake Corridor
- Ventilation Raisers and Ventilation Raise Access Road
- Access Road Corridor

FIGURE 4-2
1854 TREATY CEDED TERRITORY
Superior National Forest Plan Management Areas
- General Forest
- Recreation Use in a Scenic Location
- Research Natural Area
- Semi Primitive Motorized Recreation
- Unique Biologic Area

ZONING LEGEND
Conservancy District - City of Babbitt
Forest Agricultural Management - St Louis County
Forest and Recreation - Lake County
Industrial - St Louis County
Mineral Mining - City of Babbitt
MU: Multiple Use - St Louis County
Residential - St Louis County
Residential Recreational - Lake County
Shoreland Multiple Use - Lake County
Unknown or Undifferentiated - City of Babbitt
Shoreland Zoning Provisions

NOTES:
1. Hydrographic data from Minnesota Department of Natural Resources.
2. Horizontal datum based on NAD 1983.

FIGURE 4-3 ZONING AND LAND USE MAP
Scale: 2000 ft = 1 in Date: SEPTEMBER 2019
NOTES:
1. Hydrographic data from Minnesota Department of Natural Resources.

INSET MAP LEGEND
- Private Residence
- Resort
- Residential Recreational - Lake County
- Project Area: Johnson Lake
- River/Stream
- Lake/Pond

PRIVATE LANDS ZONING LEGEND
- Forest Agricultural Management - St Louis County
- Forest and Recreation - Lake County
- Industrial - St Louis County
- Mineral Mining - City of Babbitt
- Residential - St Louis County
- Residential Recreational - Lake County

NOTES: LEGEND
1. Hydrographic data from Minnesota

FIGURE 4-4
PRIVATE LANDS ZONING

Scale: 2,500 Feet Date: SEPTEMBER 2019
NOTES:
Generalized Stratigraphy of the Maturi Deposit

**ATA Series:** Thick upper aspect of the SKI dominated by medium-grained intergranular anorthositic troctolite and troctolitic anorthosite. Commonly weakly to moderately foliated.

**Main AGT:** Thick homogenous package of medium-grained ophitic augite troctolite. Interpreted to be the liquid phase of the SKI.

**PEG:** Pegmatoidal to coarse-grained anorthositic troctolite to anorthositic gabbro. Largely barren.

**BMZ (Basal Mineralized Zone):** Heterogeneous package of mineralized dominantly troctolitic rocks consisting of the UH, S3, S2, and S1 subunits.

**Upper Gabbro:** Upper mafic phase of the Anorthositic Series. Typified by coarse-grained oxide olivine gabbro to anorthositic gabbro.

**An Series:** Lower feldspathic aspect of the Anorthositic Series typified by foliated very coarse-grained anorthosite to medium-grained ophitic gabbroic anorthosite or anorthositic gabbro.

**Upper Basalt:** Tholeitic basalt inclusion of the extrusive phase of the Mid-Continent Rift.

**GRB (Giants Range Batholith):** Heterogeneous Archean (~2.68 Ga) granitoid batholith. Dominant lithologies of porphyritic quartz monzonite to diorite. Locally exhibits sulfide mineralization near the contact with and within the contact metamorphic aureole of the SKI.
Underground Mine Area Does Not Extend Under Birch Lake Reservoir

NOTES:
1. Quaternary sediments and lake bathymetry not shown as thicknesses and depths are generally less than 20 feet and not seen at this scale.
2. Hydrographic data from Minnesota Department of Natural Resources.
4. Horizontal and vertical scale are as shown. Vertical exaggeration is 1.

LEGEND
- Cross Section Line
- Primary Road
- Project Area
- Underground Mine Area
- Lake/Pond

Geologic Unit
- Main Augite troctolite
- Anorthositic troctolite to troctolitic anorthosite
- Basal Mineralized Zone
- Giants Range Batholith

TWIN METALS MINNESOTA
FIGURE 5-4
BEDROCK CROSS SECTION A-A' UNDERGROUND MINE AREA

Date: SEPTEMBER 2019

2952429 E
806973 N
295913 E
798850 N

Birch Lake Reservoir
Ground Surface

Underground Mine Area

Mat

MatAgc

Magt

TH1

TH2

TH3

A

A'
NOTES:
1. Quaternary sediments and lake bathymetry not shown as thicknesses and depths are generally less than 20 feet and not seen at this scale.
2. Hydrographic data from Minnesota Department of Natural Resources.
4. Horizontal and vertical scale are as shown. Vertical exaggeration is 1.

LEGEND
- Cross Section Line
- Primary Road
- Project Area
- Underground Mine Area
- Lake/Pond

Geologic Unit
- Magt: Main Augite troctolite
- Agc: Anorthositic troctolite to troctolitic anorthosite
- Mat: Basal Mineralized Zone
- Mbmz: Giants Range Batholith
NOTES:
1. Quaternary sediments and lake bathymetry not shown as thicknesses and depths are generally less than 20 feet and not seen at this scale.
2. Hydrographic data from Minnesota Department of Natural Resources.
4. Horizontal and vertical scale are as shown. Vertical exaggeration is 1.

LEGEND
- Cross Section Line
- Primary Road
- Project Area
- Underground Mine Area
- Lake/Pond

Geologic Unit
- Main Augite troctolite
- Anorthositic troctolite to troctolitic anorthosite
- Basal Mineralized Zone
- Upper Gabbro
- Anorthositic Series
- Upper Basalt
- Giants Range Batholith
NOTES:
1. Quaternary sediments and lake bathymetry not shown as thicknesses and depths are generally less than 20 feet and not seen at this scale.
2. Hydrographic data from Minnesota Department of Natural Resources.
4. Horizontal and vertical scale are as shown. Vertical exaggeration is 1.

LEGEND
- Cross Section Line
- Primary Road
- Project Area
- Underground Mine Area
- Lake/Pond

Geologic Unit
- Main Augite troctolite
- Anorthositic troctolite to troctolitic anorthosite
- Basal Mineralized Zone
- Upper Gabbro
- Anorthositic Series
- Giants Range Batholith

FIGURE 5-7
BEDROCK CROSS SECTION D-D'
UNDERGROUND MINE AREA

TWIN METALS MINNESOTA
Date: SEPTEMBER 2019
NOTES:
1. Hydrographic data from Minnesota Department of Natural Resources.
3. Soils data downloaded from the U.S. Department of Agriculture 
   (https://websoilsurvey.sc.egov.usda.gov). County Boundary Transmission Corridor
4. See Table 5-1 for soil descriptions.

LEGEND
- Primary Road
- Secondary Road
- River/Stream
- County Boundary
- Project Area
- Underground Mine Area
- Plant Site
- Tailing Management Site
- Non-Contact Water Diversion Area
- Transmission Corridor
- Water Intake Corridor
- Ventilation Raisers and Ventilation Raise Access Road
- Access Road Corridor

FIGURE 5-8
U.S. DEPARTMENT OF AGRICULTURE NRCS SOILS DATA

TWIN METALS MINNESOTA
U.S. DEPARTMENT OF AGRICULTURE NRCS SOILS DATA

Scale 1:25,000
Date: SEPTEMBER 2019

NOTES:
1. Hydrographic data from Minnesota Department of Natural Resources.
3. Soils data downloaded from the U.S. Department of Agriculture 
4. See Table 5-1 for soil descriptions.

LEGEND
- Primary Road
- Secondary Road
- River/Stream
- County Boundary
- Project Area
- Underground Mine Area
- Plant Site
- Tailing Management Site
- Non-Contact Water Diversion Area
- Transmission Corridor
- Water Intake Corridor
- Ventilation Raisers and Ventilation Raise Access Road
- Access Road Corridor

FIGURE 5-8
U.S. DEPARTMENT OF AGRICULTURE NRCS SOILS DATA

TWIN METALS MINNESOTA
U.S. DEPARTMENT OF AGRICULTURE NRCS SOILS DATA

Scale 1:25,000
Date: SEPTEMBER 2019
NOTES:
1. Hydrographic data from Minnesota Department of Natural Resources. River/Stream Project Area Transmission Corridor TWIN METALS MINNESOTA
3. Terrestrial Ecological Unit Inventory (soils) data from the United States Forest Service.
4. See Table 5-2 for soil descriptions.

LEGEND
- River/Stream
- Primary Road
- Secondary Road
- County Boundary
- Project Area
- Underground Mine Area
- Plant Site
- Tailings Management Site
- Non-Contact Water Diversion Area
- Transmission Corridor
- Water Intake Corridor
- Ventilation Rises and Ventilation
- Raise Access Road

FIGURE 5-9
U.S. FOREST SERVICE ELT SOILS DATA

Scale: 2,500 5,000 Feet
Date: SEPTEMBER 2019
NOTES:
1. Hydrographic data from Minnesota Department of Natural Resources.

LEGEND
- River/Stream
- Lake/Flood
- Average Quaternary Unconsolidated Material Thickness at Well Nest (feet) from Well As-Built Information

Unconsolidated Material Thickness (Feet)
- 0 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- 30 - 35

Project Area
- Underground Mine Area
- Plant Site
- Tailings Management Site
- Non-Contact Water Diversion Area
- Transmission Corridor
- Water Intake Corridor
- Ventilation Raising and Ventilation Raising Access Road
- Access Road Corridor

FIGURE 5-10 UNCONSOLIDATED MATERIAL THICKNESS

Scale: Date: SEPTEMBER 2019
NOTES:
1. Base air photo from Esri World Imagery map service.
2. Hydrographic and watershed data from Minnesota Department of Natural Resources. Horizontal datum based on NAD 1983.
3. Horizontal coordinates based on Minnesota State Plane North (feet).

LEGEND
- Place Name
- Major Watershed Boundary
- Minor Watershed Boundary
- River/Stream
- Lake/Pond
- Laurentian Divide
- County Boundary
- Boundary Waters Canoe Area Wilderness
- Project Area
- Underground Mine Area
- Plant Site
- Tailings Management Site
- Transmission Corridor

FIGURE 6-2
MINNESOTA DEPARTMENT OF NATURAL RESOURCES WATERSHEDS
Scale: 0 1.25 2.5 Miles Date: SEPTEMBER 2019
TWIN METALS MINNESOTA
MINNESOTA DEPARTMENT OF NATURAL RESOURCES WATERSHEDS
Scale: 0 1.25 2.5 Miles Date: SEPTEMBER 2019
NOTES:
1. Digital elevation model from the U.S. Geological Survey (https://viewer.nationalmap.gov/basic/).
3. Hydrographic data from Minnesota Department of Natural Resources.

LEGEND
- Generalized Surface Water Drainage
- Boundary Waters Canoe Area Wilderness
- County Boundary
- Underground Mine Area
- Plant Site
- Tailings Management Site
- Transmission Corridor
- Watershed Boundary

Scale: Date: SEPTEMBER 2019

FIGURE 6-5
BIRCH LAKE RESERVOIR WATERSHED SURFACE DRAINAGE

TWIN METALS MINNESOTA
Vermilion L

Embarrass St TwoRvei

3. Existing surface water monitoring locations

Area Wilderness

2. Hydrographic and watershed data from

NOTES

FIGURE 6-6

SURFACE WATER MONITORING LOCATIONS

Twins Metals Minnesota Controlled Monitoring Locations

- Water Quality Monitoring Site
- Water and Flow Monitoring Site
- Stream Morphology
- Government Controlled Monitoring Locations

- Quality Monitoring Site
- Continuous Stream Flow and Stage Monitoring

- Lake Staging

SURFACE WATER HYDROLOGY AND WATER QUALITY MONITORING LOCATIONS

Plant Site

Tailing Management Site

Transmission Corridor

Legend

1. Base air photo from Eos World Imagery map service
2. Hydrographic and watershed data from Minnesota Department of Natural Resources
3. Existing surface water monitoring locations from Barr Engineering Co.
4. Horizontal datum based on NAD 1983
Horizontal coordinates based on Minnesota State Plane North (feet)

Scale

Date: September 2019

TWIN METALS MINNESOTA

Rainy River - Headwaters

St. Louis River

Vermilion River

Birch Lake Reservoir Dam

Garden Lake Reservoir Dam

TWIN METALS MINNESOTA

Foth
NOTES:
1. Figure is conceptual, not to scale and to be used for purposes of discussion.
FIGURE 6-10
EXAMPLE HYDROPHYSICAL LOG

Packer Test Interval
330 feet - WL
$k = 2.99E-07$ cm/s

900 feet - WL
$k = 1.56E-08$ cm/s

Packer Test Interval
1,098 - 1,118 feet
$k = 2.94E-06$ cm/s

Packer Test Depths:
1. 330 feet - WL: Constant Rate Extraction
2. 900 feet - WL: Constant Rate Extraction
3. 1,098 - 1,118 feet: Airlift Slug Out
4. 1,994 feet - TD: Airlift Slug Out
5. 2,900 feet - TD: Airlift Slug Out
NOTES:
1. Hydraulic conductivity data subject to data qualification filtering. All tests of zones >100 ft and tests which exceeded the resolution limits of test equipment were removed from plot.
2. When additional data and analysis becomes available, that information would be used to add to or modify the plot.
FIGURE 6-13
PROJECTED GROUNDWATER INFLOW TO MINE DEPTH VERSUS PERCENT OF MINE WORKINGS

LEGEND
- Hydraulic Conductivity
- Percent of Mining Below Mine Level

Scale: AS SHOWN
Date: SEPTEMBER 2019
Gick Creek
TH 1
Keeley Creek
South Kawishiwi River
Birch Lake Reservoir

NOTES:
1. Base air photo from the U.S. Department of Agriculture Farm Service Agency, Aerial Photography Field Office.
2. Well locations surveyed by Northern Lights Surveying Co.
3. Hydrographic data from Minnesota Water Resources Division.
5. Birch Lake Reservoir water elevation of 1419.5 ft msl is from the Minnesota Department of Natural Resources website (6/5/2019).
6. Birch Lake Reservoir water elevation of 1419.5 ft msl is from the Minnesota Department of Natural Resources website (6/5/2019).
1. Base air photo from the U.S. Department of Agriculture Farm Service Agency, Aerial Photography Field Office.
3. Hydrographic data from Minnesota Department of Natural Resources.
5. Birch Lake Reservoir water elevation of 1419.5 feet.
6. MN-1901B1 was not measured as the well was still in recovery phase from well development.

NOTE:
1. State air photo from the U.S. Department of Agriculture Farm Service Agency, Aerial Photography Field Office.
3. Hydrographic data from Minnesota Department of Natural Resources.
5. Birch Lake Reservoir water elevation of 1419.5 feet.
6. MN-1901B1 was not measured as the well was still in recovery phase from well development.
FIGURE 6-19
NATIONAL WETLANDS INVENTORY
SIMPLIFIED PLANT COMMUNITY CLASSIFICATION

NOTES:
1. Base air photo from the U.S. Department of Agriculture Farm Service Agency, Aerial Photography Field Office.
2. Hydrographic and National Wetlands Inventory (NWI) data from Minnesota Department of Natural Resources.
NOTES:
1. Base air photo from the U.S. Department of Agriculture Farm Service Agency, Aerial Photography Field Office.
2. Hydrographic and National Wetlands Inventory (NWI) data from Minnesota Department of Natural Resources.

FIGURE 6-20
NATIONAL WETLANDS INVENTORY CIRCULAR 39 CLASSIFICATION

1. Primary Road
2. Secondary Road
3. River/Stream
4. Lake/Road
5. County Boundary
6. Project Area
7. Underground Mine Area
8. Plant Site
9. Tailings Management Site
10. Non-Contact Water Diversion Area
11. Transmission Corridor
12. Water Intake Corridor
13. Ventilation Raise and Ventilation Raise Access Road
14. Access Road Corridor
15. Circular 39 Classification
- Type 1: Seasonally Flooded Basin, Floodplain Forest
- Type 2: Wet Meadow, Fresh Wet Meadow
- Type 3: Shallow Marsh
- Type 4: Deep Marsh
- Type 5: Shallow Open Water
- Type 6: Shrub Swamp, Shrub Carr, Alder Thicket
- Type 7: Wooded Swamps; Hardwood Swamp, Coniferous Swamp
- Type 8: Bogs; Coniferous Bogs, Open Bogs
16. Rivers and streams

Scale: FEET
Date: SEPTEMBER 2019
TH 1
CR 21
Bear Island River
Blueberry Lake Outlet
CR 120
South Kawishiwi River
Lee Creek
NFR 1900
Fi
H Bald Eagle Creek
CR 120
NFR 1901
R 21
TH 1
Kleeckey Creek
Kangas Creek
Tsi Lou.
Lake
Nira Creek
Harris Creek
August Creek
Dneley Creek
Stony River
NEW TOMAHAWK RD
Johnson Lake
One Pine Lake
Sos
Omaday Lake
Bogberry Lake
Canary Blueberry Lake
Lake
Pearl Lake
Hason Lake
Little Lake
Perch Kangas Lake
Lake
Whisper Lake
Heart Lake
August Lake
Harris Lake
Labrador Pond
Birch Lake
Reservoir Little Birch Lake
Reservoir
Spring Lake
Baird Lake
Climber Beaver Lake
Hut Lake
Sun Lake
Tony Lake
Starling Lake
Don's Lake
Shamrock Lake
Leatherleaf Lake
Sterno Lake
Pear Lake
Chow Lake
Gypsy Dunnigan Lake
Subsection Name
Border Lakes
Nashwauk Uplands
NOTES:
1. Base air photo from the U.S. Department of Agriculture Farm Service Agency, Aerial Photography Field Office.
2. Hydrographic and Ecological Classification System (ECS) data from Minnesota Department of Natural Resources.
3. Horizontal datum based on NAD 1983.
4. Horizontal coordinates based on Minnesota State Plane North (feet).

LEGEND
Primary Road
Secondary Road
River/Stream
Lake/Pond
County Boundary
Underground Mine Area
Plant Site
Tailings Management Site
Non-Contact Water Diversion Area
Transmission Corridor
Water Intake Corridor
Ventilation Rises and Ventilation Raise Access Road
Access Road Corridor

FIGURE 8-1
ECOLOGICAL CLASSIFICATION SYSTEM
SUBSECTIONS
ECOLOGICAL CLASSIFICATION SYSTEM
County Boundary
Subsection Name
Border Lakes
Nashwauk Uplands

Scale: 2,500 5,000
Date: SEPTEMBER 2019
NOTES:
1. Base air photo from the U.S. Department of Agriculture Farm Service Agency, Aerial Photography Field Office.
2. Hydrographic data from Minnesota Department of Natural Resources.

LEGEND
- Primary Road
- Secondary Road
- Underground Mine Area
- River/Stream
- Plant Site
- Lake/Pond
- Tailings Management Site
- County Boundary
- Non-Contact Water Diversion Area
- Transmission Corridor
- Water Intake Corridor
- Ventilation Rises and Ventilation
- Raise Access Road
- Access Road Corridor
- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Barren Land (Rock/Sand/Clay)
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Pasture/Hay
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetlands
- Groundwater Basins
- Evapotranspiration Basins
- Forest Disturbance
- Agriculture Land
- Urban Land
- Agricultural/Urban Land
- NaturalVegetation
- Wetlands
- Buildings
- Roads
- Railroads
- Other Structures

TWIN METALS MINNESOTA
FIGURE 8-3
U.S. GEOLOGICAL SURVEY
NATIONAL LAND COVER DATABASE
LAND COVER

Scale: 2,500 5,000 Feet
Date: SEPTEMBER 2019
TWIN METALS MINNESOTA

ECOLOGICAL SYSTEM LEGEND

- Candidate Mapped as Disturbed
- Complex community
- Fire-Dependent Forest/Woodland System
- Acid Peatland System
- Open Rich Peatland System
- Wet Forest System
- Wet Meadow/Carr System

NOTES:
1. Base air photo from the U.S. Department of Agriculture Farm Service Agency, Aerial Photography Field Office.
2. Hydrographic and Minnesota Biological Survey (MBS) data from Minnesota Department of Natural Resources.

MINNESOTA BIOLOGICAL SURVEY DATA

FIGURE 8-4
NOTES:
1. Base air photo from the U.S. Department of Agriculture/Farm Service Agency, Aerial Photography Field Office.
2. Hydrographic data from Minnesota Department of Natural Resources.
3. Wild rice survey data from Barr Engineering Co.
Horizontal coordinates based on Minnesota State Plane North (feet).

LEGEN
Primary Road
Secondary Road
River/Stream
Lake/Pond
County Boundary
Project Area
Underground Mine Area
Plant Site
Tailings Management Site
Non-Contact Water Diversion Area
Transmission Corridor
Water Intake Corridor
Ventilation Rises and Ventilation
Raise Access Road
Access Road Corridor

FIGURE 8-7
WILD RICE SURVEYS

Scale: $\frac{1}{500}$ Feet
Date: SEPTEMBER 2019

TWIN METALS MINNESOTA
FIGURE 10-2

VIEWSHED ANALYSIS LOCATIONS

NOTES:
1. Base air photo from the U.S. Department of Agriculture Farm Service Agency, Aerial Photography Field Office.
2. Hydrographic data from Minnesota Department of Natural Resources.
3. Horizontal datum based on NAD 1983.
4. Top of dry stack facility simulated at elevation 1,617.5 feet.
NOTES:
1. Base air photo from Esri World Imagery map service.
2. Project related facilities supplied by Twin Metals Minnesota.

LEGEND
- Ambient Noise Measurements taken Jan-Mar
- Ambient Noise Measurements taken April - Oct
- Primary Road
- Secondary Road
- Place Name
- River/Stream
- Plant Site
- Tailings Management Site
- Non-Contact Water Diversion Area
- Transmission Corridor
- Water Intake Corridor
- Ventilation Raises and Ventilation Raise Access Road
- Access Road Corridor
- Lake/Pond
- County Boundary
- Boundary Waters Canoe Area Wilderness
- Project Area
- Underground Mine Area

FIGURE 12-1
U.S. FOREST SERVICE
AMBIENT NOISE MEASUREMENT LOCATIONS

Scale: 0 1 2 Miles
Date: SEPTEMBER 2019
LEGEND
- Ecological Classification System Subsection
- Border Lakes Subsection
- Underground Mine
- Plant Site
- Tailings Management Site
- Non-Contact Water Diversion
- Transmission Corridor
- Water Intake Corridor
- Ventilation Rises and Ventilation Raise Access
- Access Road
- Project

NOTES
1. Basemap from Esri and its data suppliers.
2. Watershed and Ecological Classification System data from the Minnesota Department of Natural Resources.
3. Mining related data from Minnesota Department of Natural Resources Division of Lands and Minerals via email.