5.2.8 Noise and Vibration

This section describes effects on humans, including effects on recreational and cultural/spiritual activity, of noise, vibration, and airblast related to the NorthMet Project Proposed Action. The effects on wildlife are described in Section 5.2.5.

Summary

Both noise and vibration dissipate with distance. The residences closest to the mine are at a distance where blasting and other NorthMet Project Proposed Action-related noise would not be heard. The NorthMet Project Proposed Action would comply with all daytime and nighttime regulatory noise limits at sensitive receptors, and the changes in total noise level from current conditions during nighttime operations would not be perceptible. Immediate access to areas around the mine would be restricted, but tribal members who may have a cultural and spiritual connection to archaeological sites in the Superior National Forest, in areas immediately near the mine, may occasionally experience noise and/or vibration associated with the NorthMet Project Proposed Action.

5.2.8.1 Methodology and Evaluation Criteria

This section describes the methodologies and criteria used to evaluate potential noise, ground vibration, and airblast at areas of the Mine Site and Plant Site, NorthMet Project Proposed Action-related sound levels were estimated using the International Standards Organization (ISO) 9613-2 sound-propagation model. The Site Law Formula was the basis for estimating vibration effects. Airblast was estimated using the Terrock model. Each is a desktop model that estimates project effects using site-specific conditions. Estimated effects were compared to federal, state, or local regulations or to project design standards, as appropriate. For noise and vibration, the area of potential effect was defined as a 20-mile radius from the Mine Site and a 20-mile radius from the Plant Site. The area of potential effect for airblast was the distance from the source where measured effects were below the known level for human effects.

5.2.8.1.1 Noise

Noise Impact Assessment Methodology

The noise impact assessment areas for the NorthMet Project Proposed Action include the noise-sensitive receptors within a 20-mile radius of the Mine Site and a 20-mile radius of the Plant Site. The 20-mile radius was selected in order to include the southern edge of the BWCAW, which is located approximately 20 miles north of the Mine Site and Plant Site. The ISO 9613-2 sound-propagation model (Acoustics-Attenuation of Sound during Propagation Outdoors) is accepted worldwide and was used to determine the extent of noise effects from the NorthMet Project Proposed Action. This model is the only one that encompasses a standardized method for calculating sound propagation and is the basis for most sophisticated computer modeling programs (Ray 2010). This sound-propagation model consists of octave-band algorithms with nominal mid-band frequencies from 63 to 8,000 Hz for computing the attenuation of sound originating from a point sound source or an assembly of point sources. The source(s) may be mobile or stationary. The model predicts equivalent continuous A-weighted sound pressure...
levels (\( L_{eq} \)) from sources of known sound emission and accounts for the following site conditions and physical effects:

- Meteorological conditions favorable to sound propagation (i.e., downwind propagation with wind speeds between 1 and 5 meters per second when measured 3 to 11 meters above the ground). This is a conservative approach because not all receptors may be located downwind of the sources (i.e., receptors located upwind would experience less noise since noise propagates farther downwind than upwind).
- Topography and the extent of ground absorption from different surfaces.
- Noise emission of each source, as well as its location and elevation.
- Location and elevation above local ground level of all sensitive receptors.
- Screening from any enclosures, barriers, earth berms, buildings, or vegetation.
- Attenuation due to distance (geometrical divergence) and atmospheric absorption.
- Increase in noise level due to reflections from nearby facades and reflective objects.

For the noise assessment of the NorthMet Project Proposed Action, ground topography or surface effects were modeled assuming that the area around the source and the receptors would be a mixed 50 percent hard non-absorptive ground (e.g., paved surfaces, water, ice, concrete, and all other ground surfaces having a low porosity) and 50 percent soft absorptive surface (e.g., ground covered by grass, trees, and farm land, and all other ground surfaces having a high porosity). This is a conservative assumption, as almost 100 percent of the ground adjacent to the mine sound sources and closest receptors is porous with more absorptive capacity that can attenuate noise levels. Temperature and relative humidity of 20 °C and 70 percent, respectively, were used in estimating the attenuation due to atmospheric absorption. Attenuation due to geometric divergence or spreading is mainly a function of the distance between the sound source and the receiver. A further conservative assumption is that the modeling analysis did not include any potential shielding effects from pit walls, waste rock stockpiles, berms, or vegetation.

Sound power levels for all equipment and trucks at the Mine Site and Plant Site were based on measured octave-band sound power data obtained from similar mine projects in Australia (Bassett Acoustics 2004; URS 2005). For modeling purposes, it was conservatively assumed that all equipment at the Mine Site and Plant Site would operate continuously.

**Noise Impact Assessment Criteria**

Noise effects are commonly judged according to two general criteria: the extent to which a project would exceed federal, state, or (where applicable) local noise regulations, and the estimated degree of disturbance to people who live in or use an area.

According to the noise standards for Minnesota (Minnesota Rules, part 7030.0040, subpart 2), permissible noise levels are broadly classified according to land uses such as residential, commercial, or industrial. The standards distinguish between daytime and nighttime noise, with less noise permitted at night. The standards list the sound levels not to be exceeded for more than 10 and 50 percent of the time (\( L_{10} \) and \( L_{50} \)) during any 1 hour period. The applicable Minnesota Noise Standards are shown in Table 5.2.8-1. Section 4.2.8 provides additional discussion of common noise levels.
Table 5.2.8-1  Applicable Noise Standards for Different Land Uses in Minnesota

<table>
<thead>
<tr>
<th>Noise Area Classification</th>
<th>Daytime (7 a.m. to 10 p.m.)</th>
<th>Nighttime (10 p.m. to 7 a.m.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L_{50}</td>
<td>L_{10}</td>
</tr>
<tr>
<td>1</td>
<td>60.0</td>
<td>65.0</td>
</tr>
<tr>
<td>2</td>
<td>65.0</td>
<td>70.0</td>
</tr>
<tr>
<td>3</td>
<td>75.0</td>
<td>80.0</td>
</tr>
</tbody>
</table>

Source: Minnesota Rules, part 7030.0040, subpart 2; MPCA 2008.

1 The land use activities associated with each Noise Area Classification (NAC) are described in Minnesota Rules, part 7030.0040, subpart 2 and MPCA 2008.

- Land use activities under NAC 1 include household units, group quarters, residential hotels, transient lodging camp grounds, correctional institutions, mobile home parks or courts, health and educational services, religious activities, resorts, camping and picnicking areas, motion picture production, and other cultural, entertainment, and recreational activities.

- Land use activities under NAC 2 include rail, road, water, and air transportation activities (passenger), wholesale and retail trade, parks, recreational activities (except entertainment assembly and race tracts), automobile parking, personal services, business services, and other professional services (repair, legal, and contract construction services).

- Land use activities under NAC 3 include manufacturing, petroleum refining and related industries, primary metal industries, race tracks, fair grounds and amusement parks, agricultural and fishing-related activities, retail trade (eating and drinking) and transportation, communication, and utilities (except transportation services and arrangements).

As shown in Table 5.2.8-1, the most stringent standard is the nighttime (10 p.m. to 7 a.m.) standard in a NAC 1, which is 50 dBA for no more than 50 percent of the time (L_{50}). In other words, a nighttime L_{50} of 50 dBA means that from 10 p.m. to 7 a.m., noise levels may not exceed 50 dBA more than 30 minutes in an hour. Similarly, a nighttime L_{10} of 55 dBA means that during these same hours, noise levels may not exceed 55 dBA more than 6 minutes in an hour.

Land use activities under NAC 1 include household units or private residences, mobile home parks, transient lodging campgrounds and picnic areas, churches, schools, hospitals, and other cultural, entertainment, and recreational activities.

There are no federal or local noise regulations that would apply to the NorthMet Project Proposed Action.

In addition to state and federal standards, the degree of disturbance becomes a key factor in the evaluation of noise effects, which, in this case, includes a focus on residents in the vicinity of the NorthMet Project Proposed Action, as well as people who frequent the area for recreation, fishing, and hunting, and tribal members who may be involved in traditional natural resource harvests on national forest lands. The concept of human disturbance is known to vary with a number of interrelated factors including: changes in noise levels; the presence of other, non-project-related noise sources in the vicinity; people’s attitudes toward the project; the number of people exposed; and the type of human activity affected (e.g., sleep or quiet conversation as compared to physical work or active recreation).

NorthMet Project Proposed Action-related noise effects have been evaluated at sensitive receptors using the state daytime and nighttime noise standards (L_{50} and L_{10}) for NAC 1. These noise standards would apply to the NorthMet Project area throughout the years that the mine is operating (years 1 to 20), when elevated sound level activities from mining, hauling, and crushing operations would occur. The same noise standards would also apply to any potential noise source during closure and post-closure (i.e., after year 20).
Sound from project activities may be audible even if the sound level is lower than the background ambient level. This is because stationary (e.g., drill rigs, crushers) and mobile sources (e.g., dump trucks, graders) associated with mining and crushing activities at the Mine Site and Plant Site may be of a different quality (e.g., electric motor or diesel engine versus a bird call) than natural ambient sound.

It is assumed that noise associated with drilling, excavating, hauling, and crushing activities may be audible up to the location that sound level emitted from these project-related sources attenuates to a level that is 8 dBA below ambient A-weighted sound level. This is identified by the National Park Service at 64 Federal Register (FR) 3969-3972 for noise emitted by aircraft that may affect Park visitors. There may be some variability when comparing sound propagation from aircraft engines as done by the National Park Service versus project related sources (electric motors, diesel engines, etc). However, for the purpose of this analysis, the 8 dBA method is considered adequate to estimate audible distance from noise sources at the Mine Site and Plant Site. It should be noted that the area of audibility usually applies to certain areas considered by the National Park Service to require substantial restoration of natural quiet (64 FR 3969-3972). For this Project, the area of audibility or audibility impacts applies to the BWCAW only.\(^1\)

5.2.8.1.2 Vibration and Airblast

**Ground Vibration Impact Assessment Methodology**

The ground vibration impact assessment area for the NorthMet Project Proposed Action encompasses a 20-mile radius from the Mine Site. When an explosive is detonated in a blasthole, a pressure wave is generated in the surrounding rock. As this pressure wave moves from the borehole, it forms seismic waves by displacing particles in the earth (e.g., glacial till, bedrock). Ground vibration varies with distance from the blast, charge mass per hole, type of explosive, geological conditions, and blasting specifications. For similar geological conditions and blasting specifications, ground vibration varies with distance from the blast and charge mass per hole, according to the Site Law formula. This formula has been used for assessing ground vibration effects from blasting activities at multiple mine and quarry sites in Australia and has also been used in this assessment. The formula accounts for different rock types with a site constant \(K_g\) (see note in Table 5.2.8-4 for definition of \(K_g\)). Typical \(K_g\) factors for free-face hard or highly structured rock, free-face average rock, and heavily confined rock are 500, 1,140, and 5,000, respectively (Dyno Nobel 2010). This vibration assessment has been conducted using a range of these three \(K_g\) factors to allow for varying degrees of vibration transmission through different rock types.

\(^1\) Aside from the BWCAW, which is a place of pristine and natural quiet, area of audibility may also be determined for other non-pristine and less sensitive receptor locations such as recreational sites within the Project vicinity. However, since the area of audibility is calculated based on measured baseline levels for each receptor of concern, separate areas of audibility would be needed for each receptor type. Therefore, applying the area of audibility for the BWCAW for other non-pristine receptor locations would be conservative due to the expected higher baseline levels at these other non-pristine receptor locations in comparison to the low baseline levels measured at the BWCAW.
Airblast Overpressures Impact Assessment Methodology

The impact assessment area for airblast overpressure for the NorthMet Project Proposed Action is the same area that was used to evaluate ground vibration. An airblast is an airborne shock wave that results from the detonation of explosives. The magnitude of airblast overpressure levels at a point remote from the blast is a function of many parameters including charge mass (mass of explosive per drilled hole), confinement, burden (distance between two drilled holes and perpendicular to the free face), attenuation rate, shielding direction relative to the blast, and meteorological conditions at the time of the blast. The attenuation rate for low-frequency blast vibration has been found from experience to be a 9 dBL reduction per doubling of distance (Terrock Consulting Engineers 2009).

Analysis of blasting data from mines and quarries has permitted a relationship to be established between the maximum 120 dBL distance (the distance in front of the blast that the 120 dBL contour occurs), charge mass per hole, and burden using the Terrock model. This model has been used for assessing airblast effects from blasting activities at multiple mine and quarry sites in Australia and has also been used in this assessment. The model accounts for a dimensionless empirical constant, k_a (usually 250 for quarry and mine blasting), and determines the maximum distance to the 120 dBL contour from the blast site.

Ground Vibration and Airblast Overpressure Evaluation Criteria

Humans can feel ground vibration and airblast overpressures at levels well below those that can cause damage to property. Ground vibration and airblast overpressure limits, therefore, have two aspects: an environmental or acceptable human response (annoyance) limit, and a limit to prevent structural damage (which should be considered separately).

To minimize human annoyance and prevent structural damage to properties outside mining areas, the effects of ground vibration and air overpressure from blasting operations must meet the requirements of Minnesota Rules, part 6132.2900, subpart 2. According to the Minnesota Rules, the maximum PPV from blasting should not exceed 1 in/s (25.4 mm/s) at the location of a structure located on lands not owned or controlled by the permittee. Air overpressure on lands not owned or controlled by the permittee should not exceed 130 dB, as measured on a linear peak scale (dBL) sensitive to a frequency band ranging from 6 cycles per second to 200 cycles per second.

Ground vibration and air blast (overpressure) from rock blasting are primarily related to the weight of explosive detonated at any single instant and the distance to a structure or sensitive receptor.

Aside from the Minnesota Rules, there are no specific federal or local vibration regulations associated with mine blasting that would apply to the NorthMet Project Proposed Action.

5.2.8.2 NorthMet Project Proposed Action

5.2.8.2.1 Noise

The primary sources of noise from the Mine Site (3,014.5 acres) during operations would be drilling; blasting; excavation work (hydraulic excavators, front-end loaders); dump trucks hauling material along mine haul roads; material-handling activities at the Rail Transfer Hopper, Overburden Storage and Laydown Area, and Waste Rock Stockpiles; and train horns. Noise
would also be generated from auxiliary and support equipment such as tracked dozers, wheel
dozers, graders, water trucks, backhoes, and fuel trucks. The sound power levels for each of
these sources, based on data from operating mines, are summarized in Table 5.2.8-2.

Table 5.2.8-2 Maximum Sound Power Levels of Major Equipment and Trucks during
Operations at the Mine Site and Plant Site

<table>
<thead>
<tr>
<th>Noise Source Description</th>
<th>Octave Band Center Frequency (Hz)</th>
<th>Overall Linear-Weighted Sound Power Level (dBL)</th>
<th>Overall A-Weighted Sound Power Level (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>63.0</td>
<td>125.0</td>
<td>250.0</td>
</tr>
<tr>
<td>Mine Site</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotary Drill Rig</td>
<td>110.0</td>
<td>123.0</td>
<td>114.0</td>
</tr>
<tr>
<td>Hydraulic Excavator (31-cy)</td>
<td>111.0</td>
<td>122.0</td>
<td>118.0</td>
</tr>
<tr>
<td>Hydraulic Excavator (31-cy)</td>
<td>111.0</td>
<td>122.0</td>
<td>118.0</td>
</tr>
<tr>
<td>Hydraulic Excavator (31-cy)</td>
<td>111.0</td>
<td>122.0</td>
<td>118.0</td>
</tr>
<tr>
<td>Front-end Loader (21.5-cy)</td>
<td>112.0</td>
<td>111.0</td>
<td>112.0</td>
</tr>
<tr>
<td>Tracked Dozer (582-hp)</td>
<td>118.0</td>
<td>118.0</td>
<td>104.0</td>
</tr>
<tr>
<td>Tracked Dozer (582-hp)</td>
<td>118.0</td>
<td>118.0</td>
<td>104.0</td>
</tr>
<tr>
<td>Wheel Dozer (450-hp)</td>
<td>117.0</td>
<td>123.0</td>
<td>119.0</td>
</tr>
<tr>
<td>Grader (275-hp)</td>
<td>111.0</td>
<td>117.0</td>
<td>113.0</td>
</tr>
<tr>
<td>Grader (275-hp)</td>
<td>111.0</td>
<td>117.0</td>
<td>113.0</td>
</tr>
<tr>
<td>Water Truck (937-hp)</td>
<td>107.0</td>
<td>110.0</td>
<td>116.0</td>
</tr>
<tr>
<td>Water Truck (937-hp)</td>
<td>107.0</td>
<td>110.0</td>
<td>116.0</td>
</tr>
<tr>
<td>Wheel Loader (800-hp)</td>
<td>112.0</td>
<td>111.0</td>
<td>112.0</td>
</tr>
<tr>
<td>Backhoe (110-hp)</td>
<td>111.0</td>
<td>117.0</td>
<td>113.0</td>
</tr>
<tr>
<td>Fuel Truck (150-hp)</td>
<td>111.0</td>
<td>117.0</td>
<td>113.0</td>
</tr>
<tr>
<td>Fuel Truck (150-hp)</td>
<td>111.0</td>
<td>117.0</td>
<td>113.0</td>
</tr>
<tr>
<td>Dump Truck (240-ton)</td>
<td>95.0</td>
<td>100.0</td>
<td>109.0</td>
</tr>
<tr>
<td>Dump Truck (240-ton)</td>
<td>95.0</td>
<td>100.0</td>
<td>109.0</td>
</tr>
<tr>
<td>Dump Truck (240-ton)</td>
<td>95.0</td>
<td>100.0</td>
<td>109.0</td>
</tr>
<tr>
<td>Dump Truck (240-ton)</td>
<td>95.0</td>
<td>100.0</td>
<td>109.0</td>
</tr>
</tbody>
</table>
### Noise Source Description

<table>
<thead>
<tr>
<th>Noise Source Description</th>
<th>Octave Band Center Frequency (Hz)</th>
<th>Overall Linear-Weighted Sound Power Level (dBL)</th>
<th>Overall A-Weighted Sound Power Level (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine Site</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dump Truck (240-ton)</td>
<td>63.0 125.0 250.0 500.0 1000.0 2000.0 4000.0 8000.0</td>
<td>125.0 131.0 128.0 128.0 127.0 121.0 113.0 136.0</td>
<td>121.0 121.0 121.0 121.0 121.0 121.0 121.0 121.0</td>
</tr>
<tr>
<td>Dump Truck (240-ton)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dump Truck (240-ton)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dump Truck (240-ton)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Sound Power Level from all equipment at the Mine Site</td>
<td>125.0 131.0 128.0 128.0 127.0 121.0 113.0 136.0</td>
<td>121.0 121.0 121.0 121.0 121.0 121.0 121.0 121.0</td>
<td></td>
</tr>
<tr>
<td>Plant Site</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary Crusher</td>
<td>123.0 123.0 121.0 111.0 106.0 105.0 100.0 94.0</td>
<td>127.0 116.0</td>
<td>116.0</td>
</tr>
</tbody>
</table>

Notes:

1. Assumes all mine equipment and trucks would be in continuous operation at any given time at the Mine Site.
2. Sound power levels for all equipment and trucks at the Mine Site were taken from the Noise and Vibration Assessment for the Clermont Coal Mine Project, Queensland Australia, August 2004 (Bassett Acoustics, 2004). Sound power levels for backhoe and fuel trucks were not available and were assumed to be the same as for the graders due to their similar hp ratings.
3. Sound power levels for the primary crusher at the Plant Site (116 dBA) were taken from the McArthur River Mine Open Cut Project, Australia (URS 2005).
4. All mine and plant equipment were assumed to be approximately 5 meters from ground level.
5. Total sound power level from all equipment at the Mine Site was calculated by logarithmically adding all the octave-band sound power levels for each piece of equipment at the site.

To estimate potential noise effects on closest receptors, noise from proposed mine operations was modeled using the ISO 9613-2 sound-propagation model, as described in Section 5.2.8.1. The Mine Site assessment predicted effects at nine different receptor locations scattered throughout the vicinity of the site. The closest noise-sensitive areas to the Mine Site are shown on Figure 4.2.8-1; the closest of these is the City of Babbitt, located 6.5 miles north of the Mine Site. In addition to the nine identified receptors, other sensitive receptors such as trails and recreational sites (family campgrounds, camp sites, boating, fishing, swimming, and family picnic areas) within the Project vicinity are also shown on Figure 4.2.8-1. All major mine equipment and trucks shown in Table 5.2.8-2 were assumed to be operating simultaneously. Modeled sound levels from all mine equipment and trucks experienced at the nearest receptors during daytime and nighttime mine operations (excluding baseline levels and plant sources), are shown in Table 5.2.8-3.
Table 5.2.8-3 indicates that the highest noise levels that would be experienced during operations at the Mine Site would occur at the closest receptors in Babbitt. Excluding baseline levels, $L_{50}$ and $L_{10}$ noise levels from the Mine Site are 14.2 and 18.0 dBA, respectively. Due to the low noise contribution from the Mine Site sources, total $L_{50}$ and $L_{10}$ noise levels at Babbitt and other receptors during daytime and nighttime, inclusive of baseline noise levels, would remain the same (i.e., no change in baseline levels when combined with Mine Site noise levels). The predicted $L_{eq}$ at noise-sensitive receptors around the Mine Site were converted to $L_{50}$ and $L_{10}$ using a USEPA calculation methodology (USEPA 1974). The calculation was based on an assumed standard deviation of 3 dBA for sound level distribution.

The primary sources of noise along the Transportation and Utility Corridor would be trains and train horns used during ore transport from the Mine Site to the Plant Site. The noise from the trains and their horns is expected to have minimal effects because the railroad route between the two locations is approximately 4 to 5 miles from the nearest receptors. Up to 22 trains per day are expected to deliver ore to the Plant Site. This frequency of traffic is less than that experienced on the rail line during past mining operations.

The primary sources of noise from the Plant Site would be crushers. Noise from other sources such as pumps at the tailing basin area is expected to be minor in comparison to noise from the crushers, and as such was not quantified. The sound power level for the crushers was estimated to be 116 dBA (Table 5.2.8-2). Sound-propagation modeling was performed for the crushers using the ISO 9613-2 sound-propagation model and assumptions described in Section 5.2.8.1. Modeled sound levels experienced at the nearest receptors during ore-crushing operations, plus baseline levels (excluding baseline levels and mine sources), are shown in Table 5.2.8-4.
### 5.2.8 NOISE AND VIBRATION

#### Table 5.2.8-4

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Distance to Mine Site (miles)</th>
<th>Direction</th>
<th>$L_{eq}$</th>
<th>$L_{50}$</th>
<th>$L_{10}$</th>
<th>$L_{eq}$</th>
<th>$L_{50}$</th>
<th>$L_{10}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Residences (R-1)</td>
<td>4.2</td>
<td>N</td>
<td>14.5</td>
<td>13.5</td>
<td>17.3</td>
<td>14.5</td>
<td>13.5</td>
<td>17.3</td>
</tr>
<tr>
<td>Hoyt Lakes (R-2)</td>
<td>5.6</td>
<td>S</td>
<td>11.0</td>
<td>9.9</td>
<td>13.8</td>
<td>11.0</td>
<td>9.9</td>
<td>13.8</td>
</tr>
<tr>
<td>Boy Scout Camp (R-3)</td>
<td>6.5</td>
<td>S</td>
<td>9.2</td>
<td>8.2</td>
<td>12.0</td>
<td>9.2</td>
<td>8.2</td>
<td>12.0</td>
</tr>
<tr>
<td>Babbitt (R-4)</td>
<td>11.8</td>
<td>NE</td>
<td>2.1</td>
<td>1.1</td>
<td>4.9</td>
<td>2.1</td>
<td>1.1</td>
<td>4.9</td>
</tr>
<tr>
<td>Skibo (R-5)</td>
<td>10.5</td>
<td>SE</td>
<td>3.5</td>
<td>2.5</td>
<td>6.3</td>
<td>3.5</td>
<td>2.5</td>
<td>6.3</td>
</tr>
<tr>
<td>Aurora (R-6)</td>
<td>6.7</td>
<td>SW</td>
<td>9.0</td>
<td>7.9</td>
<td>11.8</td>
<td>9.0</td>
<td>7.9</td>
<td>11.8</td>
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<tr>
<td>Ely (R-7)</td>
<td>24.4</td>
<td>NE</td>
<td>0.0</td>
<td>0.0</td>
<td>3.8</td>
<td>0.0</td>
<td>0.0</td>
<td>3.8</td>
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<tr>
<td>BWCA Wilderness (R-8)</td>
<td>23.0</td>
<td>N</td>
<td>0.0</td>
<td>0.0</td>
<td>3.8</td>
<td>0.0</td>
<td>0.0</td>
<td>3.8</td>
</tr>
<tr>
<td>Tower (R-9)</td>
<td>15.4</td>
<td>NW</td>
<td>0.0</td>
<td>0.0</td>
<td>3.8</td>
<td>0.0</td>
<td>0.0</td>
<td>3.8</td>
</tr>
</tbody>
</table>

1. N=North, S=South, NW=Northwest, NE=Northeast, SW=Southwest, SE=Southeast

Table 5.2.8-4 indicates the highest nighttime $L_{50}$ and $L_{10}$ levels that would be experienced at the closest receptor (private residences, 4.2 miles north of the Plant Site) due to operations at the Plant Site are 13.5 and 17.3 dBA, respectively, exclusive of baseline levels. Due to the low noise contribution from the Plant Site crushers, total $L_{50}$ and $L_{10}$ at the private residences and other receptors during daytime and nighttime, inclusive of baseline noise levels, would remain the same (i.e., no change in baseline levels at closest receptors when combined with Plant Site noise levels).

The total combined noise effect from operations at the Mine Site, Transportation and Utility Corridor, and Plant Site, plus baseline levels, is discussed in Section 5.2.8.2.3. The area of audibility is also discussed in Section 5.2.8.2.3.

### 5.2.8.2.2 Ground Vibration and Airblast Overpressure

The potential for ground vibration from hauling material via dump trucks along the mine haul road is expected to be low since rubber-tired vehicles do not generate any significant amount of ground vibration. However, blasting at the Mine Site could affect surrounding residential receptors and structures or buildings with regard to ground vibration and airblast overpressure.

The potential effects of ground vibration and airblast overpressure are discussed below.
Ground Vibration from Blasting at the Mine Site

Except at very close distances to a blast, when permanent ground displacement could occur, ground vibration is an elastic wave motion and the ground returns to its original position after the wave passes. The attenuation rate varies based on the characteristics of the rock through which the vibration travels. Characteristics such as faults and jointing planes, degree and depth of weathering, and the top soil profile contribute to a wide variation of vibration levels.

The potential effect of ground vibration from blasting at the Mine Site was assessed using the Site Law formula, as described in Section 5.2.8.1. The vibration assessment was conducted over a range of $K_g$ factors that represent the vibration transmission through different types of ore or waste rock. Using the Site Law formula and appropriate blast parameters, the limiting distances (i.e., distances beyond which an effect would not occur using different $K_g$ factors) for ore and waste rock blasts at ground vibration levels ranging from 0.5 to 25.4 mm/s were calculated and are shown in Table 5.2.8-5. Ground vibration contours from blasting at the Mine Site are shown on Figure 5.2.8-1 (based on a maximum $K_g$ factor of 5,000 for heavily confined rocks).

### Table 5.2.8-5 Limiting Distances for Ore and Waste Rock Blasts at Incremental Ground Vibration Levels

<table>
<thead>
<tr>
<th>Ground Vibration, PPV (mm/sec)</th>
<th>Limiting Distance from Blast, D (m)(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$K_g = 500$</td>
</tr>
<tr>
<td>25.4</td>
<td>375</td>
</tr>
<tr>
<td>20</td>
<td>435</td>
</tr>
<tr>
<td>15</td>
<td>521</td>
</tr>
<tr>
<td>10</td>
<td>671</td>
</tr>
<tr>
<td>5</td>
<td>1,035</td>
</tr>
<tr>
<td>3</td>
<td>1,424</td>
</tr>
<tr>
<td>1</td>
<td>2,830</td>
</tr>
<tr>
<td>0.5</td>
<td>4,365</td>
</tr>
</tbody>
</table>

Notes:
- $K_g =$ Site specific empirical constant for predicting ground vibration levels (dimensionless). Usually determined by site calibration. Typical $K_g$ factors for free face hard/highly structured rock, free face average rock, and heavily confined rock are 500, 1140, and 5000, respectively.
- \(^1\) Limiting distances for predicting ground vibration levels from blasting were estimated based on the charge mass per hole (3,388 kg/hole). The charge mass per hole was estimated using the blast parameters and specification for this project such as blasthole diameter (311 mm), hole length (22.6 m), burden (8.84 m), spacing (10.1 m), and explosive density (1.69 kg/m\(^3\)).
Note: Assumed site constant (kg) of 5,000 (heavily confined rock)

Figure 5.2.8-1
Predicted Ground Vibration Contours from Blasting at the Mine Site
NorthMet Mining Project and Land Exchange PSDEIS
Minnesota

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The environmental effects of blasting at non-ferrous mining operations are regulated by the MDNR to ensure that the effects of ground vibrations from production blasts would not be detrimental to human health or welfare or property outside the mining area. According to *Minnesota Rules*, part 6132.2900, subpart 2, the maximum PPV from blasting shall not exceed 1 in/s (25.4 mm/s) at the location of a structure located on lands not owned or controlled by the permittee. Assuming a worst-case $K_g$ of 5,000 (heavily confined rocks) and 3,388 kg (7,471 lbs) of explosives per blast hole, the limiting distance for blasts at ground vibration levels of 25.4 mm/s (1 in/s) is 1,581 meters (0.98 mile) and the impact area for this Minnesota ground vibration limit is approximately 11,334 acres (Table 5.2.8-5; Figure 5.2.8-1). None of the human or structural receptors are located within this ground vibration impact area. The maximum ground vibration level for the closest human or structural receptor in the City of Babbitt, 6.5 miles north of the Mine Site, from the blast site is predicted to be on the order of 1.24 mm/s (0.05 in/s). The predicted ground vibration at all nearby human and structural receptors resulting from blasting at the Mine Site would be well below the applicable limits in Minnesota. Blasting would not occur at night.

Figure 5.2.8-1 shows that there are no residences, recreational sites, trails, or State wild rice waters/beds within the Minnesota ground vibration impact area (11,334 acres). The closest recreational site is a family picnic area located approximately 9 miles south of the Mine Site and Plant Site (near Skibo). This family picnic area as well as other recreational sites located further away such as those near Birch Lake and South Kawishiwi River are outside the impact area. The closest wildlife corridor located northeast of the Mine Site is also outside the impact area. The Upper St. Louis River contains wild rice waters and beds used by tribal members for traditional resource harvests. The wild rice beds are usually in close proximity to State wild rice waters such as Mud Lake and Birch Lake (north of Mine Site), Lobo Lake and Sand Lake (east of Mine Site), Stone Lake and Seven Beaver Lake (southeast of Mine Site), Cranberry Lake (south of Mine Site), and Hay Lake (west of Plant Site). There are no wild rice beds or State wild rice waters within the impact area.

Though not depicted on Figure 5.2.8-1 due to sensitivity regarding cultural resources and locations, three archaeological sites have been identified within the NorthMet Project area: Spring Mine Lake Sugarbush, Mesabe Widjiu [Laurentian Divide], and BBLV Trail Segment #1 (USFS #01-569). The Spring Mine Lake Sugarbush and the Mesabe Widjiu are located more than 2 miles away from the Mine Site (approximately 1 mile from the Plant Site). Since ground vibration impacts from blasting at the Mine Site would be experienced less than a mile from the blast site, both archaeological sites are expected to be outside the ground vibration impact area (11,334 acres). The BBLV Trail Segment #1 (USFS #01-569) used by the Ojibwe people during early mineral exploration hundreds of years ago, remains an important cultural and spiritual connection for the Bands. The BBLV Trail Segment #1 (USFS #01-569) crosses the NorthMet Project area. Portions of the trail segment that cross the Mine Site are expected to be within the ground vibration impact area and may experience ground vibration levels close to the Minnesota standards. Details of the location and uses of the archaeological sites are discussed in Section 4.2.9, Cultural Resources.

Based on the information above, ground vibration levels from mine blasting are expected to be below the Minnesota ground vibration standards for humans and structures (*Minnesota Rules*, part 6132.2900, subpart 2), including people that use the Superior National Forest for recreational activities such as family campgrounds, camp sites, fishing, boating, swimming, and
5.2.8 NOISE AND VIBRATION

family picnic areas. Immediate access to areas around the mine would be restricted, but tribal
members who may have a cultural and spiritual connection to archaeological sites in the Superior
National Forest, in areas immediately near the mine, may occasionally experience ground
vibration associated with the NorthMet Project Proposed Action. Mitigation measures for the
impacted cultural resource areas are discussed in Section 5.2.9, Cultural Resources. During the
closure and post-closure phases (i.e., after year 20), blasting at the Mine Site would cease, so no
blast-related ground vibration would occur. Machinery, such as planters used to restore and
rehabilitate the Mine Site during the closure phase, would not generate a significant amount of
ground vibration. Therefore, potential ground vibration levels during the closure and post-closure
phases are expected to be below the Minnesota ground vibration standards for humans and
structures (Minnesota Rules, part 6132.2900, subpart 2).

Airblast Overpressure from Blasting at the Mine Site

The airblast overpressure effect from the Mine Site was assessed using the Terrock model, as
described in Section 5.2.8.1. Using this analytical method for ore and/or waste rock blasts at the
Mine Site, the 120 dBL distance for the assumed blast specifications is a maximum of 3,451
meters (2.2 miles) in front of the blast (Table 5.2.8-6). The incremental distances for airblast
overpressure levels from 100 to 130 dBL were calculated using an attenuation rate of a 9 dBL
decrease per doubling of distance (Terrock Consulting Engineers 2009). Airblast contours for
these overpressure levels from blasting at the Mine Site are shown on Figure 5.2.8-2.
Figure 5.2.8-2
Predicted Airblast Contours from Blasting at the Mine Site
NorthMet Mining Project and Land Exchange PSDEIS
Minnesota

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Plant Site
Mine Site

Miles

0 1 2 4 6
### Table 5.2.8-6 Limiting Distances for Ore and Waste Rock Blasts at Incremental Airblast Overpressure Levels

<table>
<thead>
<tr>
<th>Hole Diameter, ( d ) (mm)</th>
<th>Charge Mass per Hole, ( M ) (kg/hole)</th>
<th>Distance to the 120 dBL Contour, ( D_{120} ) (m)</th>
<th>Distance to the 130 dBL Contour, ( D_{130} ) (m)</th>
<th>Distance to the 125 dBL Contour, ( D_{125} ) (m)</th>
<th>Distance to the 115 dBL Contour, ( D_{115} ) (m)</th>
<th>Distance to the 110 dBL Contour, ( D_{110} ) (m)</th>
<th>Distance to the 105 dBL Contour, ( D_{105} ) (m)</th>
<th>Distance to the 100 dBL Contour, ( D_{100} ) (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>311</td>
<td>8,839</td>
<td>3,388</td>
<td>3,451</td>
<td>1,602</td>
<td>2,351</td>
<td>5,065</td>
<td>7,434</td>
<td>10,912</td>
</tr>
</tbody>
</table>

Note: Based on the computed distance for the 120 dBL contours, the distances for the other airblast contour levels (130 dBL, 125 dBL, 115 dBL, 110 dBL, 105 dBL, and 100 dBL) were calculated using an attenuation rate of 9 dBL decrease per doubling of distance.

As with ground vibration, the environmental effects of airblasts are regulated by the MDNR. According to Minnesota Rules, part 6132.2900, subpart 2, air overpressure on lands not owned or controlled by the permittee shall not exceed 130 dBL. The distance from the Mine Site to the 130 dBL compliance level is 1,602 meters (1 mile) and the impact area for this Minnesota airblast overpressure limit is approximately 11,469 acres. None of the receptors (buildings or structures) is close enough to the Mine Site to achieve this level of exposure (Figure 5.2.8-2). The maximum airblast overpressure level for the closest receptor in the City of Babbitt is predicted to be approximately 106 dBL. The predicted airblast overpressures at all nearby receptors resulting from blasting activities at the Mine Site would be below the applicable limits in Minnesota. Blasting would not occur at night.

Figure 5.2.8-2 shows that there are no residences, recreational sites, trails, or State wild rice waters/beds within the Minnesota airblast overpressure impact area (11,469 acres). The closest recreational site is a family picnic area located approximately 9 miles south of the Mine Site and Plant Site (near Skibo). This family picnic area as well as other recreational sites located further away such as those near Birch Lake and South Kawishiwi River are outside the impact area. The closest wildlife corridor located northeast of the Mine Site is also outside the impact area.

Though not depicted on Figure 5.2.8-2 due to sensitivity regarding cultural resources and locations, three archaeological sites have been identified within the NorthMet Project area: Spring Mine Lake Sugarbush, Mesabe Widjiu [Laurentian Divide], and BBLV Trail Segment #1 (USFS #01-569). The Spring Mine Lake Sugarbush and the Mesabe Widjiu are located more than 2 miles away from the Mine Site and (approximately 1 mile from the Plant Site). Since airblast impacts from blasting at the Mine Site would be experienced approximately 1 mile from the blast site, both archaeological sites would be outside the airblast impact area (11,469 acres). As noted previously, the BBLV Trail Segment #1 (USFS #01-569) crosses the NorthMet Project area. Portions of the trail segment that cross the Mine Site would be within the airblast impact area and may experience airblast levels close to the Minnesota standards. Details of the location and uses of the archaeological sites are discussed in Section 4.2.9, Cultural Resources.

Based on the information above, airblast overpressure levels from mine blasting would be below the Minnesota airblast standards for humans and structures (Minnesota Rules, part 6132.2900, subpart 2); including people that use the Superior National Forest for recreational activities such as family campgrounds, camp sites, hiking, fishing, boating, swimming, and family picnic areas. Immediate access to areas around the mine would be restricted, but tribal members who may...
have a cultural and spiritual connection to archaeological sites in the Superior National Forest, in areas immediately near the mine, may occasionally experience airblast overpressures associated with the NorthMet Project Proposed Action. Mitigation measures for the impacted cultural resource areas are discussed in Section 5.2.9, Cultural Resources.

During the closure and post-closure phases (i.e., after year 20), blasting at the Mine Site would cease, so no airblast overpressures would occur during the closure and post-closure phases.

**Vibration and Airblast Overpressure from Rail Transport**

The transport of ore via trains from the Mine Site to the Plant Site could generate ground vibration within a few feet of the rail ROW, but due to the low volume of trains, such vibration levels are expected to be below the Minnesota ground vibration standards for humans and structures (*Minnesota Rules*, part 6132.2900, subpart 2). No blasting would occur along the Transportation and Utility Corridor, so ground vibration or airblast overpressure effects are not expected in this area.

**Vibration and Airblast Overpressure at Plant Site**

The crushers, water pumps (near the Tailings Basin) and other large stationary equipment that would be located at the Plant Site are designed to ensure that potential ground vibration effects are minimized to acceptable levels. Therefore, during operation, vibration levels at the receptors closest to the Plant Site would be below the Minnesota vibration standards for humans and structures (*Minnesota Rules*, part 6132.2900, subpart 2). No blasting would occur at the Plant Site, so ground vibration or airblast overpressure effects are not expected.

### 5.2.8.2.3 Total Noise Effects from NorthMet Project Proposed Action Operations

To determine the combined noise effect of the NorthMet Project Proposed Action, the total noise generated from operations at both the Mine Site and Plant Site was logarithmically added to the existing ambient daytime and nighttime baseline levels. Noise effects from rail transport were also assessed, but qualitatively.

Operations at the Mine Site and Plant Site would occur 24 hours per day. The total noise that would be experienced at any receptor location during the daytime (7 a.m. to 10 p.m.) and nighttime (10 p.m. to 7 a.m.) would be equal to the combined noise from both the mining and hauling operations at the Mine Site and the ore-crushing operations at the Plant Site, plus baseline noise levels.

Decibels are logarithmic values, so calculating the additive effect of two separate noise sources is a logarithmic calculation rather than an algebraic addition. This means that individual sound levels cannot be added directly to get the combined sound level. This also means that the greater the distance between two sound levels, the smaller the effect the lesser dB level will have on the total sound level.

The total noise associated with NorthMet Project Proposed Action operations when mining, hauling, and ore-crushing operations occur concurrently was calculated using data from Tables 5.2.8-3 (Mine Site) and 5.2.8-4 (Plant Site), along with baseline noise levels, and is summarized in Table 5.2.8-7. The calculations for daytime and nighttime noise levels are presented for comparison with the Minnesota noise standards. Aside from comparison to absolute noise limits, the NorthMet Project Proposed Action was also evaluated based on projected noise increases...
above baseline levels (i.e., 3 dB threshold of perception per MPCA 2008). In all cases, the
NorthMet Project Proposed Action, when in operation, would comply with the applicable
standard. Figures 5.2.8-3, 5.2.8-4, 5.2.8-5, and 5.2.8-6 show L_{50} and L_{10} noise contours at 5 dBA intervals during the daytime and nighttime.
### Table 5.2.8-7 Total Noise Associated with Concurrent Operations at the Mine Site and Plant Site (includes Baseline Levels)

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Daytime and Nighttime Baseline Noise Levels (dBA)</th>
<th>Daytime Noise Levels at Closest Receptors to Mine Site and Plant Site Operations (plus Baseline Levels), (dBA)</th>
<th>Nighttime Noise Levels at Closest Receptors to Mine Site and Plant Site Operations (plus Baseline Levels), (dBA)</th>
<th>Minnesota Daytime and Nighttime Noise Standards for Residential Areas (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Residences (R-1)</td>
<td>45.0 dBA (D); 35.0 dBA (N)</td>
<td>48.8 dBA (D); 37.8 dBA (N)</td>
<td>45.0</td>
<td>44.0</td>
</tr>
<tr>
<td>Hoyt Lakes (R-2)</td>
<td>45.0 dBA (D); 35.0 dBA (N)</td>
<td>48.8 dBA (D); 37.8 dBA (N)</td>
<td>45.0</td>
<td>44.0</td>
</tr>
<tr>
<td>Boy Scout Camp (R-3)</td>
<td>45.0 dBA (D); 35.0 dBA (N)</td>
<td>48.8 dBA (D); 37.8 dBA (N)</td>
<td>45.0</td>
<td>44.0</td>
</tr>
<tr>
<td>Babbitt (R-4)</td>
<td>45.0 dBA (D); 35.0 dBA (N)</td>
<td>48.8 dBA (D); 37.8 dBA (N)</td>
<td>45.0</td>
<td>44.0</td>
</tr>
<tr>
<td>Skibo (R-5)</td>
<td>45.0 dBA (D); 35.0 dBA (N)</td>
<td>48.8 dBA (D); 37.8 dBA (N)</td>
<td>45.0</td>
<td>44.0</td>
</tr>
<tr>
<td>Aurora (R-6)</td>
<td>45.0 dBA (D); 35.0 dBA (N)</td>
<td>48.8 dBA (D); 37.8 dBA (N)</td>
<td>45.0</td>
<td>44.0</td>
</tr>
<tr>
<td>Ely (R-7)</td>
<td>45.0 dBA (D); 35.0 dBA (N)</td>
<td>48.8 dBA (D); 37.8 dBA (N)</td>
<td>45.0</td>
<td>44.0</td>
</tr>
<tr>
<td>BWCA Wilderness (R-8)</td>
<td>34.0 dBA (D); 34.0 dBA (N)</td>
<td>33.2 dBA (D); 33.2 dBA (N)</td>
<td>34.0</td>
<td>23.4</td>
</tr>
<tr>
<td>Tower (R-9)</td>
<td>45.0 dBA (D); 35.0 dBA (N)</td>
<td>48.8 dBA (D); 37.8 dBA (N)</td>
<td>45.0</td>
<td>44.0</td>
</tr>
</tbody>
</table>

Notes:
- **D**= Daytime; **N** = Nighttime; **NA** = Not applicable (there are no L_{eq} standards for noise under the Minnesota Noise Standards).
- Total noise levels during daytime and nighttime were estimated by logarithmically adding the predicted noise levels from operations at the Mine Site (Table 5.2.8-3) and Plant Site (Table 5.2.8-4) with the existing baseline noise levels (baseline levels are provided in Table 4.2.8-3).
Figure 5.2.8-3
Predicted Daytime L50 Noise Contours at Closest Receptors (Includes Baseline L50 Levels)
NorthMet Mining Project and Land Exchange PSDEIS
Minnesota
August 2013

Notes:
Baseline daytime L50 for all receptors except BWCAW = 44.0 dBA
Baseline daytime L50 for BWCAW = 23.4 dBA
Notes:
Baseline daytime L10 for all receptors except BWCAW = 48.8 dBA
Baseline daytime L10 for BWCAW = 33.2 dBA

Figure 5.2.8-4
Predicted Daytime L10 Noise Contours at Closest Receptors (Includes Baseline L10 Levels)
NorthMet Mining Project and Land Exchange PSDEIS
Minnesota
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August 2013

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Predicted Nighttime L50 Noise Contours at Closest Receptors (Includes Baseline L50 Levels)

NorthMet Mining Project and Land Exchange PSDEIS
Minnesota

Figure 5.2.8-5

Notes:
Baseline nighttime L50 for all receptors except BWCAW = 34.0 dBA
Baseline nighttime L50 for BWCAW = 23.4 dBA

MN L50 Nighttime Noise Standard: 50 dBA

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Figure 5.2.8-6
Predicted Nighttime L10 Noise Contours at Closest Receptors (includes Baseline L10 Levels)
NorthMet Mining Project and Land Exchange PSDEIS
Minnesota
DRAFT SUBJECT TO REVISION
August 2013

Notes:
Baseline nighttime L10 for all receptors except BWCAW = 37.8 dBA
Baseline nighttime L10 for BWCAW = 33.2 dBA

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Daytime Operation Impacts (7 a.m. to 10 p.m.)

Table 5.2.8-7 and Figures 5.2.8-3 and 5.2.8-4 present the total estimated daytime L50 and L10 levels that would be experienced at the closest receptors to the Mine Site and Plant Site. Noise from Mine Site and Plant Site operations, plus baseline levels, are predicted to be well below the Minnesota daytime noise standards of 60 dBA (L50) and 65 dBA (L10) for residential areas, trails, recreational sites (family campgrounds, campsites, boating, fishing, swimming, and family picnic areas), and State wild rice waters and beds (used by tribal members for traditional resource harvests). As an example of how the total noise level is calculated, the L50 daytime level of 44 dBA for private residences shown in Table 5.2.8.7 is the result of adding 10.9 dBA (daytime L50 levels from Mine Site operations only, excluding Plant Site operations and baseline levels), 13.5 dBA (daytime L50 levels from Plant Site operations only, excluding Mine Site operations and baseline levels), and 44 dBA, which is the assumed daytime L50 baseline level. The result of the logarithmic addition indicates that noise from the Mine Site and Plant Site have no measurable effect on the baseline conditions of the closest receptors. Figure 5.2.8-3 shows that the daytime L50 impact area for the closest receptors would be 6,629 and 255 acres at the Mine Site and Plant Site, respectively. Similarly, Figure 5.2.8-4 shows that the daytime L10 impact area for the closest receptors would be 6,266 and 242 acres at the Mine Site and Plant Site, respectively. These receptors are well outside the daytime impact areas. The closest recreational site is a family picnic area located approximately 9 miles south of the Mine Site and Plant Site (near Skibo). This family picnic area as well as other recreational sites located further away such as those near Birch Lake and South Kawishiwi River are outside the daytime impact area. The Upper St. Louis River contains wild rice beds harvested by tribal members. The wild rice beds are usually in close proximity to State wild rice waters such as Mud Lake and Birch Lake (north of Mine Site), Lobo Lake and Sand Lake (east of Mine Site), Stone Lake and Seven Beaver Lake (southeast of Mine Site), Cranberry Lake (south of Mine Site), and Hay Lake (west of Plant Site). Details of the location and uses of the cultural/tribal resource areas are discussed in Section 4.2.9, Cultural Resources. The closest wildlife corridor located northeast of the Mine Site is also outside the daytime impact area. The highest daytime noise levels, including baseline levels, predicted for the closest NAC 1 receptor to the Mine Site (i.e., Babbitt (R-4)) were 44 dBA (L50) and 48.8 dBA (L10). The daytime noise effect of the Mine Site on Babbitt is an increase of 0 dBA (L50) and 0 dBA (L10) from baseline levels. Similarly, the highest daytime noise levels, including baseline levels, predicted for the closest NAC 1 receptor to the Plant Site (i.e., Private Residences (R-1)) were 44 dBA (L50) and 48.8 dBA (L10). The daytime noise effect of the Plant Site on the private residences is an increase of 0 dBA (L50) and 0 dBA (L10) from baseline levels. This 0 dBA increase is below the 3 dBA threshold of perception per the MPCA’s Guide to Noise Control in Minnesota (MPCA 2008) and would not be perceptible to residents, recreational users, or tribal members that use the State wild rice waters and beds for harvesting purposes. As discussed earlier, noise from trains and train horns during ore transportation during the day from the Mine Site to the Plant Site is expected to be minimal because the railroad route between the two is approximately 4 to 5 miles from the nearest receptors. Up to 22 trains per day are expected to deliver ore to the Plant Site. This frequency of traffic is less than that experienced on the rail line during past mining operations.

Blasting at the Mine Site is a source of impulsive or non-continuous noise. Blasting noise is not included in the noise level estimates shown in Table 5.2.8-7 because mine-blasting is typically an instantaneous event (not continuous or steady), and would occur only during daytime periods.
PolyMet expects that blasting of ore and waste rock would take place approximately once every 2 or 3 days. This would usually include separate blasts of ore and waste rock benches. Rock-blasting could potentially have noise levels ranging from 111 to 115 dBA at 50 feet from the blasting site. With modern blasting techniques, the blasting would be experienced by the nearest receptors as a faint warning whistle or siren, followed by a very brief, muted clap of thunder. Public acceptance is generally improved by scheduling blasting at the same time every day to further reduce the startle factor. The closest receptor (City of Babbitt) is located 6.5 miles from the Mine Site, so noise effects from blasting are not expected to be significant. In addition, noise effects from blasting would only occur during the early stages of mining, when blasting occurs at the surface down to a few feet below ground levels. As the depth of the pit increases over the life of the mine, noise effects from blasting would be attenuated by the pit walls.

Though not depicted on Figures 5.2.8-3 and 5.2.8-4 due to sensitivity regarding cultural resources and locations, three archaeological sites have been identified within the NorthMet Project area: Spring Mine Lake Sugarbush, Mesabe Widjiu [Laurentian Divide], and BBLV Trail Segment #1 (USFS #01-569). The Spring Mine Lake Sugarbush and the Mesabe Widjiu are located more than 2 miles away from the Mine Site and approximately 1 mile from the Plant Site (approximated 2 miles from the Plant crushers). Based on these distances, both archaeological sites are expected to be outside the daytime noise impact area for the Mine Site (6,629 acres) and Plant Site (255 acres). As noted previously, the BBLV Trail Segment #1 (USFS #01-569) crosses the NorthMet Project area. Portions of the trail segment that cross the Mine Site and Plant Site are expected to be within the daytime impact area and may experience daytime noise levels close to the Minnesota standards. Details of the location and uses of the archaeological sites are discussed in Section 4.2.9, Cultural Resources.

Nighttime Operation Impacts (10 p.m. to 7 a.m.)

Table 5.2.8-7 and Figures 5.2.8-5 and 5.2.8-6 indicate that the total estimated nighttime L50 and L10 levels that would be experienced at the receptors closest to the Mine Site and Plant Site are expected to be below the Minnesota nighttime noise standards of 50 dBA (L50) and 55 dBA (L10). Figure 5.2.8-5 shows that the nighttime L50 impact areas for the closest residential areas, trails, State wild rice waters (used by tribal members for traditional resource harvests), and recreational sites would be 11,456 acres and 568 acres at the Mine Site and Plant Site, respectively. Similarly, Figure 5.2.8-6 shows that the nighttime L10 impact areas for the closest residential areas, trails, State wild rice waters, and recreational sites would be 10,695 acres and 503 acres at the Mine Site and Plant Site, respectively. These receptors are well outside the nighttime impact areas. As indicated above, the closest recreational site is a family picnic area located approximately 9 miles south of the Mine Site and Plant Site (near Skibo). This family picnic area as well as other recreational sites located further away such as those near Birch Lake and South Kawishiwi River are outside the nighttime impact area. There are no State wild rice waters or beds within the nighttime impact area. Details of the location and use of cultural/tribal resource areas are discussed in Section 4.2.9 and 5.2.9. The closest wildlife corridor located northeast of the Mine Site is also outside the impact area. Mine blasting and ore transportation via trains along the Transportation and Utility Corridor would not occur between 10 p.m. and 7 a.m., so there would not be noise effects associated with these activities at night.
The highest nighttime $L_{50}$ and $L_{10}$ levels, including baseline levels, predicted for the closest receptor to the Mine Site (i.e., Babbitt (R-4)) were 34 dBA and 37.8 dBA, respectively. The nighttime noise effect of Mine Site operations on Babbitt is a net increase of 0 dBA ($L_{50}$) and 0 dBA ($L_{10}$) from baseline levels. Similarly, the highest nighttime $L_{50}$ and $L_{10}$ levels, including baseline levels, predicted for the closest receptor to the Plant Site (i.e., Private Residences (R-1)) were 34.1 dBA and 37.9 dBA, respectively. The nighttime noise effect of the Plant Site on the private residences is an increase of 0.1 dBA ($L_{50}$) and 0.1 dBA ($L_{10}$) from baseline levels. This increase of 0.1 dBA is below the 3 dBA threshold of perception per the MPCA’s Guide to Noise Control in Minnesota (MPCA 2008) and would not be perceptible to residents, recreational users, and tribal members that use State wildrice waters and beds for traditional resource harvests. It should be noted that the noise model conservatively assumes that all mine equipment shown in Table 5.2.8-2 would be operating simultaneously during daytime and nighttime. Under actual conditions, the predicted noise levels would be lower because not all equipment would be operating simultaneously and some equipment would not operate at all during nighttime.

Though not depicted on Figures 5.2.8-5 and 5.2.8-6 due to sensitivity regarding cultural resources and locations, three archaeological sites have been identified within the NorthMet Project area: Spring Mine Lake Sugarbush, Mesabe Widjiu [Laurentian Divide], and BBLV Trail Segment #1 (USFS #01-569). The Spring Mine Lake Sugarbush and the Mesabe Widjiu are located more than 2 miles from the Mine Site and approximately 1 mile from the Plant Site (approximated 2 miles from the Plant crushers). Based on the distances, both archaeological sites are expected to be outside the nighttime noise impact areas for the Mine Site (11,456 acres) and Plant Site (568 acres). As noted previously, the BBLV Trail Segment #1 (USFS #01-569) crosses the NorthMet Project area. Portions of the trail segment that cross the Mine Site and Plant Site are expected to be within the nighttime impact area and may experience nighttime noise levels close to the Minnesota standards. Details of the location and uses of the archaeological sites are discussed in Section 4.2.9, Cultural Resources.

Mine-blasting and ore transportation via trains along the Transportation and Utility Corridor would not occur between 10 p.m. and 7 a.m., so there would not be noise effects associated with these activities at night.

**Summary of Daytime and Nighttime Operation Noise Impacts**

Based on the information above, the total predicted daytime and nighttime noise ($L_{50}$ and $L_{10}$) level experienced at NAC 1 areas such as the closest residential areas (the City of Babbitt north of the Mine Site, and private residences located north of the Plant Site), trails, recreational sites (including recreational sites at Birch Lake and South Kawashwi River), and State wild rice waters and beds used by tribal members for traditional resource harvests would meet the Minnesota daytime and nighttime noise standards. In addition, the projected noise increase above baseline levels would be below the 3 dBA threshold of perception. Immediate access to areas around the mine would be restricted, but tribal members who may have a cultural and spiritual connection to archaeological sites in the Superior National Forest, in areas immediately near the Mine Site or Plant Site, may occasionally experience noise associated with the NorthMet Project Proposed Action. Mitigation measures for the impacted cultural resource areas are discussed in Section 5.2.9, Cultural Resources.

During closure and post-closure (i.e., after year 20), the major noise sources and activities at the Mine Site and Plant Site (e.g., drilling, blasting, mining, excavation work, hauling, and crushing
operations) would cease. Progressive reclamation would occur throughout the 20-year mine life for features such as the permanent stockpile and pit areas at the Mine Site and at the exterior slopes of the Tailings Basin at the Plant Site. This would leave a smaller portion of the Mine Site and Plant Site needing to be reclaimed at closure. During the closure phase, machinery, such as planters, used to restore and/or rehabilitate the Mine Site and Plant Site and conduct other reclamation activities (e.g., structure demolition, dike removal, etc.) would generate some noise; however, such noise would occur over a short time period and mostly during daytime periods when increased noise levels would be more tolerable. Therefore, noise levels at the Mine Site and Plant Site during the closure and post-closure phases are expected to be below the Minnesota noise standards and below the 3 dBA threshold of perception.

**Area of Audibility for the Boundary Waters Canoe Area Wilderness**

The L₅₀ audibility area would be approximately 247,612 acres around the Mine Site and Plant Site, assuming all noise sources are operating simultaneously during daytime and nighttime (Figure 5.2.8-3 and 5.2.8-5). Similarly, the L₁₀ audibility area would be approximately 131,035 acres around the Mine Site and Plant Site, assuming all noise sources are operating simultaneously during daytime and nighttime (Figures 5.2.8-4 and 5.2.8-6). The BWCAW is outside this area of audibility. Therefore, sound from the Mine Site and Plant Site operations would not be audible at the BWCAW.

² While some receptors (e.g. residential areas like Babbitt and Hoyt Lakes and a family picnic area near Skibo) are within this area of audibility shown on Figures 5.2.8-3 to 5.2.8-6, it should be noted that the area of audibility was calculated based on the low measured baseline levels for BWCAW, which is a place of natural quiet (L₅₀ of 23.4 dBA and L₁₀ of 33.2 dBA). The baseline levels for the recreational sites and residential areas are likely higher than the BWCAW baseline levels (though actual measurements have not been taken at these areas), so actual area of audibility for these other receptors would be much smaller than that for BWCAW.
5.2.8.3 NorthMet Project No Action Alternative

Under the NorthMet Project No Action Alternative, the NorthMet Project Proposed Action would not occur and there would be no increase in noise and vibration levels in any of the areas proposed for project development. Therefore, there would be no change in existing noise and vibration levels at the closest receptors.