APPENDIX 19-A
KSM PROJECT ENVIRONMENTAL NOISE ASSESSMENT

Rescan™

KSM PROJECT

Noise Technical Report

PREPARED FOR:

Engineers and Scientists

RESCAN ENVIRONMENTAL SERVICES LTD.

DECEMBER 2012

Consultants in Acoustics

KSM PROJECT

Noise Technical Report

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EXECUTIVE SUMMARY

BKL Consultants Ltd. (BKL) has been retained by Rescan Environmental Services Ltd. (Rescan) to provide an environmental noise assessment for the proposed KSM Project (the Project). This report provides noise modelling predictions and noise impact assessment to contribute to the overall Environmental Assessment Certificate Application (EAC Application) of the Project. Modelling was completed using nationally and internationally recognized standards (ISO 9613-2, ANSI S12.17, ANSI S2.20-1983, ECAC Doc 29 and NMPB-Routes-2008), as implemented in the outdoor sound propagation software Cadna/A, in-house developed Matlab programs and US Federal Aviation Administration (FAA) INM. The noise modelling predictions at human receptors were compared to the environmental noise criteria in Health Canada's *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise*, April 2011. Noise modelling predictions for wildlife receptors were compared with various published sources including Environment Canada.

The objectives of the assessment were to predict sound levels for both the Construction and Operation phases due to mine site, open pit blasting, access road traffic and helicopter sound sources. ISO 9613 indicates that the accuracy is +/-3 dBA at source to receiver distances of up to 1000 metres and unknown at distances greater than 1000 metres. For individually modelled noise sources (ventilation fans, mobile equipment and roads), the estimated accuracy of the chosen sound power levels is +/-5 dBA.

No offsite receivers were predicted to receive noise levels higher than the limits suggested by Health Canada under various assessments of speech interference, sleep disturbance, annoyance and low-frequency noise induced rattling. However, Health Canada also recommends that the sleep disturbance criteria be applied to onsite mining camps. It is predicted that three onsite camps will receive noise levels above the adopted L_n 57 dBA criteria for sleep disturbance. Therefore, noise mitigation should be considered during the detailed design of the onsite camps to provide indoor sound levels that do not exceed L_n 30 dBA and L_{AFmax} 45 dBA.

Only wildlife receptors in close proximity (<2km) from the centre of mining activities were predicted to receive continuous levels in excess of those suggested by Environment Canada.

The only wildlife location that was shown to have any adverse effects to event noise levels from blasting was the mountain goat habitat in close proximity to the mine (<5km). Mountain goat populations occurring within approximately 300m (slant distance) of helicopter flight tracks may suffer adverse effects.

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List of Abbreviations and Acronyms

Abbreviation/Acronym	Definition
%HA	Percent Highly Annoyed
$\%HA_{LF}$	Percent Highly Annoyed in the presence of low-frequency noise
ANFO	Ammonium Nitrate and Fuel Oil (explosive)
ANSI	American National Standards Institute
ASA	Acoustical Society of America
BC	British Columbia
BKL	BKL Consultants Ltd.
BMP	Best Management Practices
BSI	British Standards Institute
dB	Decibel
dBA	A-weighted decibel
dBC	C-weighted decibel
EA	Environmental Assessment
EAC	Environmental Assessment Certificate
FAA	United States Federal Aviation Administration
GIS	Geographic Information System
Hz	Hertz
INM	Integrated Noise Model
ISO	International Organization for Standardization
kHz	Kilohertz
km	Kilometre
KSM	Kerr-Sulphurets-Mitchell Mining Project
km^2	Square kilometre
kph	Kilometres per hour
L_{AE}	A-weighted sound exposure level
L_{AFmax}	Maximum A-weighted, fast time constant sound level
L_{CE}	C-weighted sound exposure level
L_d	Daytime (07:00 to 22:00) equivalent sound level
L_{dn}	Day-night equivalent sound level
L_{eq}	Equivalent sound level
L_n	Nighttime (22:00 to 07:00) equivalent sound level
L_{peak}	The maximum absolute value of the instantaneous sound pressure
L_w	Sound power level
LFN	Low Frequency Noise
L_{LF}	Sum of sound levels in the 16-, 31.5- and 63-Hz octave bands
m	Metre
masl	Metres above sea level
NIHL	Noise Induced Hearing Loss
Project	The KSM Project
RMS	Root Mean Square
s	Second
TNT	Trinitrotoluene (explosive)
WHO	World Health Organization

1 INTRODUCTION

BKL Consultants Ltd. (BKL) has been retained by Rescan Environmental Services Ltd. (Rescan) to provide an environmental noise assessment for the proposed KSM Project (the Project). This report documents the predicted noise exposure levels at potentially impacted human and wildlife receiver locations nearby following completion of the Project. The noise modelling predictions at human receptors were compared to the environmental noise criteria in Health Canada's *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise* (Health Canada 2011). Noise modelling criteria for wildlife receptors were compared with published literature as referenced in the in the Wildlife Effects Assessment (Chapter 18). A glossary and introduction to sound and environmental noise assessment are presented in Appendices A and B.

2 PROJECT DESCRIPTION

The proposed KSM Project is located in the coastal mountains of northwestern British Columbia at latitude 56.52°N and longitude 130.25°W. The site is 68 km northwest of Stewart, British Columbia and within 30 km of the British Columbia–Alaska border.

The proposed Mine Site is situated within the valleys of Mitchell Creek, McTagg Creek, and Sulphurets Creek. Sulphurets Creek is a main tributary of the Unuk River. The proposed PTMA is situated within the tributaries of Teigen Creek and Treaty Creek. Both these creeks are tributaries of the Bell-Irving River which flows to the Nass River. The Nass River and the Unuk River flow to the Pacific Ocean.

The topography varies from elevation 240 masl at the proposed Coulter Creek Access Road crossing of the Unuk River, to over 2,300 masl at the highest peak. A significant portion of the terrain occurs at tree-line and in the alpine. Glaciers and ice fields dominate the terrain to the north, east, and south of the proposed Mine Site. The glaciers have been receding in the last several decades.

Figure 2.1 is a general location map of the project area. Figure 2.2 shows an aerial view of the project location indicating the approximate location of the mine area, plant area and Tailing Management Facility.

The climate is generally typical of a temperate or northern coastal rainforest, with sub-arctic conditions at high elevations. Precipitation is high, with significant variation depending on altitude and location of nearby topographical features. Annual climate normal annual precipitation values within the study area range from 642 to 2047mm. The length of the snow-free season varies from about May through November at lower elevations, and from July through September at higher elevations.

Access roads to the property will follow the former Eskay Creek Mine access road with an extension along Coulter Creek to the west and Treaty Creek to the east. In addition, the property will be accessed via helicopter for selected construction and operation activities.

Pretium Resources who are working on the Brucejack Project are constructing an access road over the Knipple Glacier to the vicinity of Brucejack Lake, which is located about eight kilometres south of the proposed Mitchell pit. The closest road to the proposed PTMA is Highway 37 which is approximately 11 km to the north.

There are no settlements or privately owned land in the area and there is limited commercial recreational activity in the form of helicopter skiing, rafting tours, and guided fishing adventures. Large wildlife, such as deer and moose, are rare due to the rugged topography and restricted access; however, bears and mountain goats are common.

Figure 2.1 General Location Map (Source: Rescan)

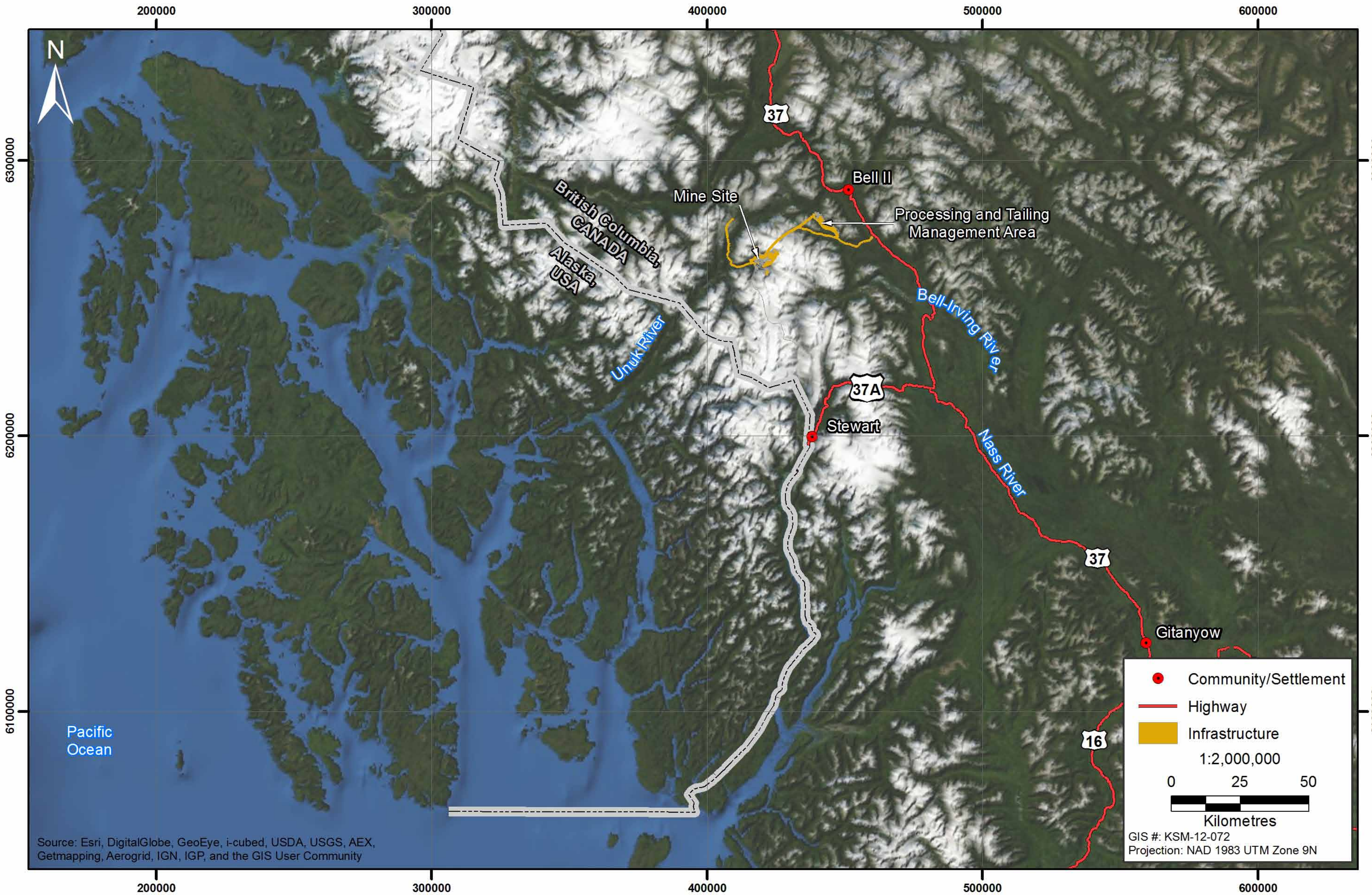

Figure 2.2

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KSM PROJECT

Project Aerial View

Figure 2.2

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3 STUDY OBJECTIVES

The Project location is currently described as an undisturbed wilderness with no noise impact relating to industrial activity. The construction and operation of the Project will introduce environmental noise sources largely in the form of construction equipment; haul vehicles, blasting as well as vehicle and helicopter traffic. The objective of this study is to perform a human health effects assessment at noise sensitive human receptors in accordance with the guideline published by Health Canada in April 2011, *Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise* (Health Canada 2011).

Continuous mining noise effects on wildlife will be determined in accordance with the guideline published by Environment Canada in 2010, *"The Environment Code of Practice for Metal Mines"* (Environment Canada 2010a). Noise effects due to helicopter overflights and blasting noise were determined from various sources of literature (Knight and Gutzwiller 1995; Efroymson and Suter 2001; Manci et al. 1988; Weisenberger et al. 1996; Reimers and Colman 2006).

In addition, mitigation options will be identified to avoid significant adverse effects where applicable.

3.1 Noise Predictions

The Application Information Requirements for the Project require that the Environmental Assessment Certificate (EAC) Application address noise effects on humans as well as on wildlife species that are sensitive to noise disturbance. While potential noise effects to wildlife are more fully addressed in the Wildlife Effects Assessment (Chapter 18), high level results have been present within this report to show noise impacts on wildlife for continuous project noise as well as event noise levels from helicopter overflights and blasting activities.

3.2 Human Health Effects Assessment

The Health Canada guideline states: "There are reasonable cause-and-effect associations linking noise exposure to hearing loss, sleep disturbance, interference with speech intelligibility, noise complaints and a high level of annoyance (World Health Organization 1999). Health Canada's advice is based on the expected changes between existing and predicted daytime and night-time sound levels (for construction, operation and decommissioning activities) at locations where people are or will be present, as well as on the characteristics of the noise (e.g. impulsive or tonal) or the type of community (e.g. urban, suburban or quiet rural areas)."

3.3 Wildlife Effects Assessment

The Environment Canada guideline recommends that ambient noise from mining operations and its effect on wildlife should meet the objectives for residential areas; Assessment on wildlife response to event noise levels from helicopter overflights and blasting were assessed per species on the basis of habitat lost due to event noise levels.

4 IDENTIFICATION OF POTENTIAL EFFECTS

Research has shown over the years that noise complaints do not correlate well with actual community disturbance/response. A proper assessment of the noise impact in situations such as this is important because decisions regarding noise mitigation requirements should be based on the actual significance of the noise impact.

This report summarizes BKL's assessment of six of the seven potential noise effects listed below. Quotes from the Health Canada guideline have been included to explain the potential effects. Noise Induced Hearing Loss (NIHL) has also been discussed but has not been assessed in this study.

4.1 Sleep Disturbance

From the Health Canada guideline: "Sleep disturbance includes the following effects of noise: difficulty falling asleep, awakenings, curtailed sleep duration, alterations of sleep stages or depth, and increased body movements during sleep.

Health Canada advises that the recommendations and guidelines of the WHO (WHO 1999) regarding sleep disturbance be taken into consideration in the EA. In quiet rural areas and susceptible populations such as those in hospitals, or convalescent or senior homes, Health Canada suggests that the WHO guideline levels not be exceeded. The WHO's Guidelines for Community Noise (1999) report a threshold for sleep disturbance of an indoor night-time sound level (L_n) of no more than 30 dBA for continuous noise."

Health Canada also quotes the WHO for individual noise events: "For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dBA L_{AFmax} more than 10–15 times per night."

Sound is attenuated as it is transmitted indoors and the amount of reduction mostly depends on whether windows are open or not. Health Canada suggests to assume an outdoor-to-indoor noise reduction of 15 dBA if windows are open and 27 dBA if windows are closed. The actual reduction depends on construction materials, geometry, etc. of the room.

Normally, noise effects are only assessed at human receptors not employed by the Project outside of the Project boundaries. However, Health Canada recommends the assessment of sleep disturbance at onsite mine camps as well.

4.2 Interference with Speech Communication

If continuous project noise indoors or outdoors is high enough, the Projects could interfere with speech communication, such that speakers will need to increase their vocal effort or move closer to each other. Health Canada advises that an indoor level of 40 dBA or an outdoor level of 55 dBA or greater would be required for good speech comprehension.

4.3 Complaints

Health Canada suggests that "The likelihood of a complaint is directly linked to the ability or willingness of an individual to make a complaint and his or her expectation that the complaint will result in noise reduction." Therefore, there is not always a strong link between the disturbance and the complaint. However, Health Canada suggests that "widespread complaints" become more likely above an L_{dn} of 62 dBA and that "several threats of legal action or strong appeals to authorities to stop noise" should be expected if the project L_{dn} is greater than 75 dBA.

4.4 High Annoyance

The response to noise is subjective and is affected by many factors such as the:

- Difference between the Specific Sound (sound from the Projects) and the Residual Sound (noise in the absence of the Specific Sound);
- Characteristics of the sound (e.g. if it contains tones, impulses, etc.);
- Absolute level of sound;
- Time of day;
- Local attitudes to the Project; and
- Expectations for quiet.

Health Canada suggests that the "Percent Highly Annoyed" or "%HA" metric, which is calculated using the adjusted L_{dn} (or Rating Level) – pre- and post-Project, is "an appropriate indicator of noise-induced human health effects for project operational noise and for long-term construction noise exposure".

Health Canada suggests that adjustments should be made to account for more annoying sound characteristics: specifically if the sound at the receiver location can be characterized as having tones, impulses or strong low-frequency content. The penalty for tones and regular impulsive sound is a + 5 dBA adjustment to the sound pressure level. The penalty for highly impulsive noise is a + 12 dBA adjustment. The penalties for high-energy impulsive sound (e.g. blasting) and sound with strong low frequency content are variable and calculated according to the American National Standards Institute (ANSI) standard S12.9-2005/Part 4 (ANSI 2005). The penalty for sound with strong low frequency content should only be considered if the C-weighted sound pressure level is more than 10 dB higher than the A-weighted sound pressure level.

Health Canada advises that "noise mitigation measures be considered when a change in the calculated %HA at any given receptor exceeds 6.5%" or if the Projects L_{dn} exceeds 75 dBA.

4.5 Noise Induced Rattling

Health Canada references the American National Standards Institute (ANSI) standard S12.9-2005/Part 4 (ANSI 2005), stating "To prevent rattles from low-frequency noise and the associated annoyance from this effect, ANSI indicates that the (energy) sum of the sound levels in the 16-, 31.5- and 63-Hz octave bands be less than 70 dB." Health Canada advises implementing feasible mitigation measures if this criterion, based on if the low frequency sound level, or L_{LF}, is exceeded.

4.6 Noise Induced Hearing Loss (NIHL)

Health Canada advises: "When the human ear is exposed to excessive sound levels over long periods of time, permanent damage may occur (WHO 1999). There is no known risk of hearing loss associated with sound levels below 70 dBA regardless of the exposure duration. However, as sound levels increase, the duration of daily exposure becomes an important risk factor for hearing loss."

NIHL concerns are normally most efficiently addressed in the Projects detailed design phase due to the high variation in actual occupational noise exposures depending on design details. Therefore, assessing the potential for NIHL has not been included in this assessment.

4.7 Loss of Wildlife Habitat

The potential effects on wildlife are described in terms of the following responses resulting in "loss of habitat":

- Reduction in biodiversity and population numbers due to 'above threshold' continuous noise levels
- Flight response, freezing or strong startle response due to event noise levels (helicopter and blasting)

Project-related noise was considered and assessed based on noise levels assessed during Construction and Operations. The following limits were identified:

- Continuous Project Noise Project noise during the day (55 dBA),
- Continuous Project Noise Project noise during the night (45 dBA)
- Helicopter overflight A-weighted sound exposure level (LAE) (75 dBA)
- Peak blasting noise levels (108 dB Lpeak).

5 ASSESSMENT CRITERIA

5.1 Noise Impact Criteria

Based on the previous identification of potential effects, six criteria have been chosen to rate potential effects. All of these criteria are for offsite human receptors except for sleep disturbance, where onsite mine camps were assessed with the assumption that windows would be closed. A significant effect is likely to occur if any of the following occur at any receptor outdoors:

Table 5-1 Project Criteria

Project Metric	Description	Limit
L_d	Day-time noise level for assessing speech interference and wildlife habitat loss	55 dBA
L_n	Night-time noise level for assessing sleep disturbance *outside* the Project boundary and wildlife habitat loss	45 dBA
	Night-time noise level for assessing sleep disturbance *inside* the Project boundary	57 dBA
L_{dn}	Assessing the likelihood of complaints	62 dBA
	Legal action / Project noise mitigation required	75 dBA
Δ %HA	Increase in % HA metric before and after Project initiation	6.5%

Project Metric	Description	Limit
L_{LF}	Using the sum of low frequency energy content to assess the likelihood of noise-induced rattling	70 dB
	Assessing low frequency noise annoyance: sum of low frequency energy content > 65 dB	65 dB
	and C-weighted L_{dn} exceeds A-weighted L_{dn} by 10 dB	10 dB
L_{AE}	Sound exposure level for assessing wildlife sensitivity to helicopter noise	75 dBA
L_{peak}	Peak sound pressure level for assessing wildlife sensitivity to impulsive blasting noise	108 dB

The maximum nighttime sound level (L_{AFmax}) was not included because no nighttime blasting, aircraft or road traffic is expected. Therefore, the nighttime equivalent sound level, L_n, should provide a better assessment of sleep disturbance.

5.2 Mitigation Criteria

If the noise impact assessment criteria are exceeded at any receptors, noise mitigation options using the Best Available Techniques Not Entailing Excessive Cost (BATNEEC) approach should be investigated to avoid significant adverse effects. The interpretation of "excessive cost" will depend on the significance of the noise impact. This approach is not to be confused with the approach commonly implemented in industry: the Cheapest Available Technique Not Incurring Prosecution (CATNIP).

6 SPATIAL & TEMPORAL BOUNDARIES

6.1 Spatial Boundaries

The spatial boundary considered in noise modelling includes the area enclosed by Coulter Creek on the west, Highway 37 in the east extending as far north as Teigen Lake, and south as far as Knipple Glacier as shown in below.

PROJECT # 868-022-17 GIS No. KSM-12-071 January 22, 2013

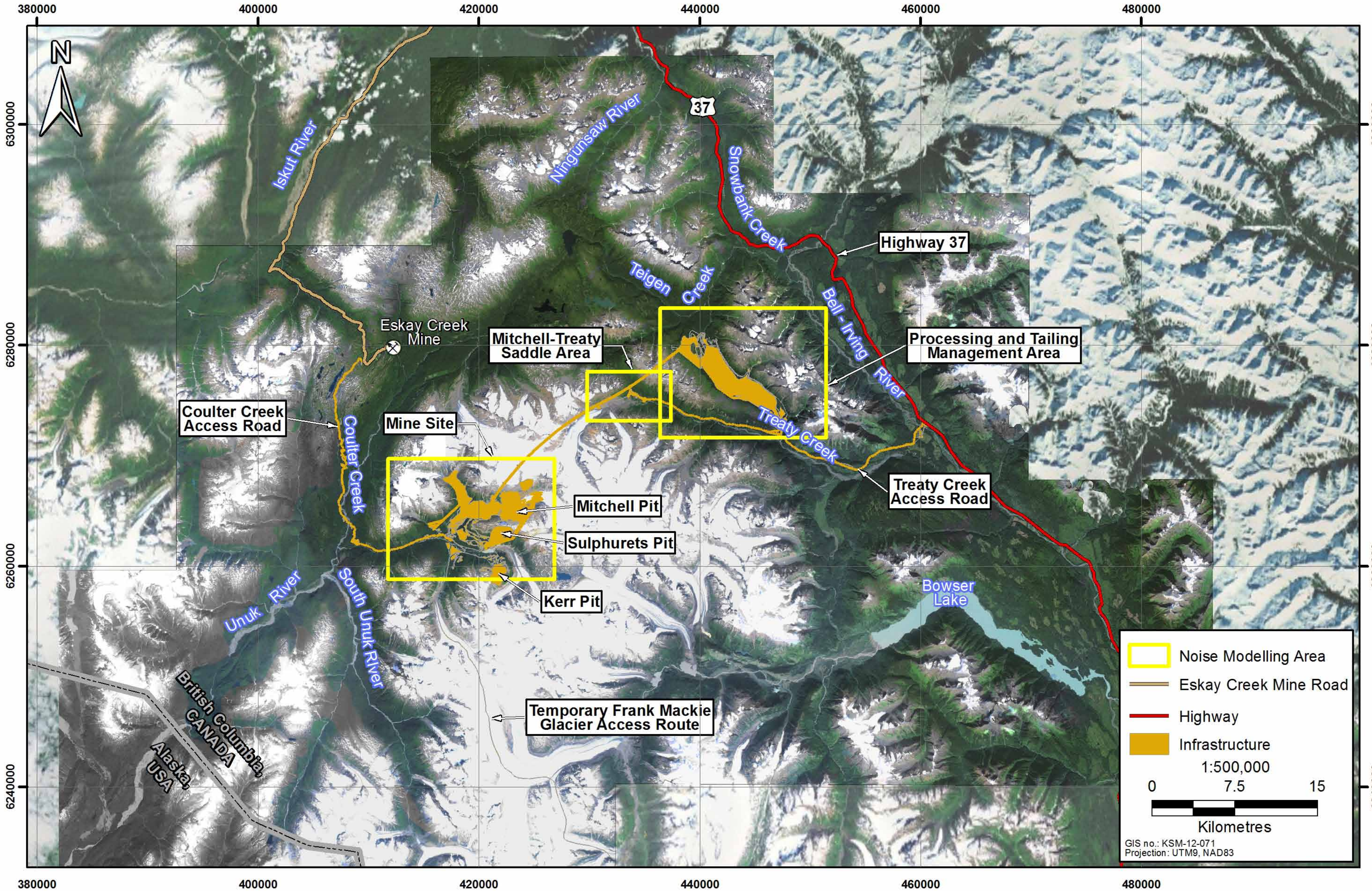

Figure 6-1

Figure 6-1

KSM Site Spatial Boundary of Study Area

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6.2 Temporal Boundaries

This study considers the Project at two points in time representing the estimated worst case scenarios for the both the construction period as well as operations as follows:

- Worst case construction year: Year -1
- Worst case operations year: Year 4

Worst case years were chosen to be those years in which the highest number of mobile and fixed equipment units is in operation.

For the construction phase of the Project, Year -1 will be the most active in terms of total waste moved, total fuel usage (therefore highest diesel equipment activities) and blasting explosives. For these reasons, Year -1 was selected for the assessment as the worst case scenario for the construction phase.

Over the 51.5-year mine life, Year 4 was selected to represent the worst case. In terms of highest amount of waste rock and ore moved, and explosives used, Year 4 is the worst case; in terms of total fuel and electric power consumption, Year 3 is the worst case but only 1% and 4% respectively more than that in Year 4. Therefore, Year 4 was selected to represent the worst case for operations.

7 EXISTING ENVIRONMENTAL CONDITIONS

7.1 Inventory of Noise Sensitive Receptors

Noise levels were predicted at both human and wildlife receptors. The following sections detail the existing and future human and wildlife locations regarded as sensitive to changes in noise levels. Noise levels at these receivers, which were provided by Rescan, were calculated for both years of study. A complete inventory or human and wildlife receptors can be found in Appendix C.

7.1.1 Human Receptors

Human receptors were identified both onsite and offsite as shown in Table 7-1 below. The closest offsite human receptor is 14 km from the centre of the mine site. Major noise sources included in this summary are identified as either the cumulative continuous mine noise, helicopter, access roads and blasting noise.

Table 7-1 Summary of Human Receptors

Receiver Type	Offsite	Onsite	Shortest Distance to Major Noise Source
Cabin	4	0	Trapline cabin 2 – Helicopter flight path (980 m)
Camp	0	14	All camps are close to mine noise sources/ helicopter flight paths
Exploration Camp	0	2	Exploration camp 1 - 250m to Helicopter flight path
Municipal	2	0	Municipality 2 – 120m from Helicopter flight path

7.1.2 Wildlife receptors

Wildlife receptors were distributed throughout the study area and were comprised of locations sensitive to the Mountain Goat, Grizzly Bear and Moose populations of this area as shown in Table 7-2 Summary of Wildlife Receptors below.

Table 7-2 Summary of Wildlife Receptors

Receiver Type	Number of Receivers	Shortest Distance to Major Noise Source
Goat	20	Goat 9 – 2.3km from centre of mine Goat 8 – 900m from helicopter flight path
Grizzly	6	Grizzly 1 – 150m to helicopter flight path Grizzly 4 – 220m from Treaty Creek access road
Moose	11	Moose 2- 360m to Helicopter flight path and Coulter Creek access road Moose 6 – 150m from helicopter flight path Moose 9 – situation on Treaty Creek Access Road

7.2 Baseline Noise

The site is remote and therefore void of significant noise sources prior to construction of the mine. Therefore no baseline noise study was conducted on this site. In cases such as this, Health Canada provides options for estimating baseline noise levels. The most conservative of these options was chosen for a "quiet, rural area" as shown in Table 7-3 below.

Table 7-3 Estimated Baseline Noise Levels

Time Period	Noise Level (dBA)
Day (L_d)	35
Night (L_n)	25
Day-Night (L_{dn})	35

8 NOISE MODELLING METHODOLOGY

8.1 Acoustical Model

Transportation and industrial noise levels have been predicted using the ISO 9613-2:1996 (ISO 1996), NMPB-Routes-2008 (NMPB, 2009a & NMPB, 2009b), ANSI S12.17 (ANSI 1996), ANSI S2.20 (ANSI 1983), ANSI S12.17 (ANSI 1996) and ECAC Doc 29 standards implemented in the outdoor sound propagation software Cadna/A, in-house developed Matlab programs and US Federal Aviation Administration (FAA) INM. Based on our experience, sound reflections were not considered to be significant and were therefore not modelled.

ISO 9613 describes a method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level (as described in ISO 1996) under meteorological conditions. It has been used to predict noise transmission from industrial sources.

NMPB-Routes-2008 is the new version of the current European Union preferred road traffic noise prediction model. It specifies third-octave band sound power levels for roadways, dependant on traffic volumes, average travel speed, percentage of heavy vehicles (i.e. trucks, buses), road gradient and the flow conditions factor (continuous, accelerating, decelerating vehicles). BKL has found that this model provides a high level of agreement with traffic noise measurements conducted in BC.

Blasting was modelled at three different blast sites. ANSI S12.17-1996 and ANSI 12.9 2005 Part 4 as implemented in our in-house Matlab software were used to calculate the blasting parameters. The blast noise level at receivers is dependent on the distance between the blast location and the receiver, the amount of explosive used as well as the depth at which each charge is buried. The relevant diffraction over terrain surrounding the mine site was done using ISO 9613-2 as implemented in Cadna/A. The worst case of three modelled blast events for human and wildlife receptors respectively was used in the results. The worst case for humans is noted to be BLAST1-001 as listed in Table 8-9 for both construction and operations. The worst case for Wildlife is noted to be BLAST2-019 for both construction and operations.

Helicopter noise was modelled as a "worst case day" scenario. The worst case day was defined as the scenario where all modelled routes are flown in the same day such that each nearby receiver will experience two fly-by events. Modelling was performed using Integrated Noise Model (INM) software version 7.0c developed by the Federal Aviation Administration Office of Environment and Energy. It implements the following standards:

- SAE-AIR-1845
- SAE-AIR-5662
- SAE-ARP-866A
- ECAC Doc 29
- ICAO Circular 205

Each of the above modelling techniques for helicopter and blasting noise were able to produce noise contours as an output. Combined noise level contours were then produced using grid arithmetic in Cadna/A.

The acoustic properties of the ground surface can have a considerable effect on the propagation of noise. Flat non-porous surfaces such as concrete, asphalt, buildings, calm water etc. are highly reflective to noise, and according to ISO 9613-2 have a ground constant of G=0. Soft, porous surfaces such as foliage, loam, soft grass, snow etc are highly absorptive to noise, and have a ground constant of G=1. The ISO standard does not use intermediate ground constants.

Model calculations were performed in octave bands, considering ground cover, topography and shielding objects (see following sections). A temperature of 10°C and relative humidity of 80% were used in the model settings. A moderate temperature inversion was assumed to represent typical, but not absolute, worst case conditions. Table 8-1 summarizes the standards and software used. Table 8-2 summarizes the scenarios and sound level outputs.

Table 8-1 Calculation Standards and Software Programs

Sound Source	Calculation Standards	Software Implementation
Mine Site	ISO 9613-2	Cadna/A Version 4.2
Blasting	ANSI S12.17-1996 ANSI S2.20-1983 ISO 9613-2 (diffraction over terrain)	In-house computer programming of ANSI calculation formulas and Cadna/A Version 4.2
Access Road	NMPB 2008	Cadna/A Version 4.2
Aircraft and Helicopter	SAE-AIR-1845 SAE-AIR-5662 SAE-ARP-866A ECAC Doc 29 ICAO Circular 205	US Federal Aviation Administration's (FAA) Integrated Noise Model (INM) Version 7.0

Table 8-2 Noise Modelling Scenarios

Noise Scenario	Intrusive Noise Adjustments	Model Outputs and Assessment Criteria
Construction (Y -1)	Without adjustments applied	L_d & L_n (dBA), L_{LF} (dBZ), L_{dn} (dBA & dBC) L_{peak}, LAE
Operations (Y 4)		
Construction (Y -1)	With adjustments applied*	LN_{dn} (dB), Δ %HA
Operations (Y 4)		

* Adjustments and rationale for adjustments is supplied in section 8.5

8.2 Geometrical Data

8.2.1 Topography

The intervening terrain has been modelled by directly importing ground contours provided by Moose Mountain Technical Services. Contours were imported for Year -1 and Year 4 respectively to incorporate terrain effects due to construction and mining activity already completed at each stage.

8.2.2 Ground Surface

The ground surface has generally been modelled as reflective (G=0) due to predominantly rock and ice surfaces, with the following specific cases:

- Roads and buildings are reflective (G=0)
- Foliage is absorptive (G=1). All areas designated as foliage have an assumed forest height of 35m.

8.2.3 Obstacles

Only Terrain and no buildings were modelled in Year -1. The following buildings as supplied by Bosche Ventures Ltd were modelled in addition to the terrain for Year 4.

Table 8-3 Modelled Buildings

Building	Building Height (m)
Mitchell Course Ore Reclaim baghouse - before MTT	8*
Mitchell Primary Crusher baghouse	8*
Mitchell Coarse Ore Reclaim baghouse - after MTT	50
Cone Crusher Building baghouse	8*
Secondary crusher building	40
HPGR building	27
Fine Ore Stockpile baghouse	8*
Grinding and Flotation building	38
CIL Building	33
Maintenance and Warehouse building shop	8.5
EPCM and medical building	3
Cold Storage	8.3
Concentrate storage & loadout building	16.5
Treaty Operation Camp	6
Admin Building	5
Camp 6	3
Camp 10	6
Camp 11	3
Refinery Building	19

*assumed height

8.3 Noise Sources

The Cadna/A model of the total noise environment considered noise from the following sources:

- Fixed equipment (indoors and outdoors)
- Mobile Equipment
- Road Traffic
- Helicopters
- Blasting

A complete list of modelled sources with assumptions is presented in Appendix D. Fixed equipment, mobile equipment and road traffic was modelled in Cadna/A.

8.3.1 Fixed Equipment

All fixed equipment units operating outdoors were modelled as 'point sources' in Cadna/A. The table below summarises the types of fixed equipment modelled under each acoustic class.

Table 8-4 Fixed Equipment

Source Descriptor	Year -1	Year 4
Intermittent	Hydraulic Shovels, Manlifts, Tower Cranes	Hydraulic Shovels, Crushers and Screens
Continuous	Generators, Ventilation Fans, Light Towers	Baghouses, Generators, Ventilation Fans, Power Plant, Light Towers
Impulsive	N/A	N/A
Tonal	N/A	N/A

All equipment operating indoors was modelled as combined area sources (walls and roof) with the following characteristics of the building as a whole:

- Interior reverberant noise level of combined sources: 85 dBA
- 26 gauge corrugated steel with fibreglass lining facade

8.3.2 Mobile Equipment

This assessment considered mobile equipment to be all wheeled and tracked units that change their position in the mine over the course of 24 hours of typical operation. These were modelled as point sources in Cadna/A dispersed throughout their designated area of use, to represent a typical snapshot in time. Equipment that was assumed to be working underground during tunnel construction was not included. The table below summarises the types of mobile equipment modelled under each acoustic class:

Table 8-5 Mobile Equipment

Source Descriptor	Year -1	Year 4
Intermittent	All wheeled and tracked construction and passenger vehicles	All wheeled and tracked construction and passenger vehicles
Continuous	N/A	N/A
Impulsive	Dump trucks tipping fill	Dump trucks tipping fill
Tonal	Backup alarms	Backup alarms

8.3.3 Road Traffic

8.3.3.1 Haul Road Traffic

Haul road traffic was modelled as a 'line source' in Cadna/A. The amount of traffic on each route was estimated based on the number of haul trucks available and the estimated total hours of operation. A duty cycle suggested by BS5228-1:2009 of 50% was assumed, since when not hauling, these trucks are assumed to be idling for the hours of operation provided by Rescan of 11.8 hrs (day) and 7.1hrs (night). This is a conservative assumption since Air Quality Management requires minimisation of idling wherever possible. 60% of haul trucks were assumed to operate on the route between Mitchell pit and the Mitchell OPC (route 1), whilst 40% were assumed to travel between the Sulphurets pit and the Mitchell OPC (route 2). The following table summarizes the data used:

Table 8-6 Haul Road Traffic

	Year -1	Year 4	
	Route 1	Route 1	Route 2
Number of Units	18	32	22
Total Day Time Operation for all units (mins/day)	6372	11328	7788
Total Night Time Operation for all units (mins/day)	3834	6816	4686

Route 1: between Mitchell pit and the Mitchell OPC

Route 2: between the Sulphurets pit and the Mitchell OPC

8.3.3.2 Access Road Traffic

<u>Construction Phase (Year -1)</u>

During the construction phase of the Project, equipment, materials, and supplies to establish camps, and build roads and infrastructure will be shipped to the Project site via the Eskay Creek Mine/Coulter Creek and the Treaty Creek access roads.

Operations Phase (Year 4)

During Operation, liners, diesel fuel, lubricants, personnel, camp supplies, lime and reagents, and parts/machinery will be shipped to site via Highway 37 and along the Treaty Creek Access Road; Explosives, and major mine equipment (assumed to be replaced every 10 years) required at the Mine site will be routed via Highway 37 to the existing Eskay Creek and proposed Coulter Creek access roads.

Rescan has advised that access to the mine via the Treaty Creek and Coulter Creek access roads occurs only during the day (7am and 10pm). The table below summarizes the traffic volumes on both access roads.

Table 8-7 Access Road Traffic

	Year -1		Year 4	
	Route 1	**Route 2**	**Route 1**	**Route 2**
Vehicles per day	8	22	3	83
Vehicles per hour	1.5	0.5	5.5	0.2
% Heavy Vehicles	98%	98%	98%	98%

Route 1: Treaty Creek Access Road

Route 2: Coulter Creek Access Road

8.3.4 Aircraft

In the early stages of the project, helicopter support would be needed to move equipment, personnel, and the supplies needed for early construction work, on-site electrical generation, and manpower support as well as avalanche control. In addition small amounts of gold will be transported off the site via helicopter. The designated helicopter model is a Eurocopter AS 350 "A Star". The operating noise parameters for this helicopter are not available in the INM model database. As such the next closest model was used (Eurocopter EC-130).

Six flight tracks were chosen out of all available routes to be those that were closest to receivers. The chosen flight tracks are shown in Figure 8 1. Two flyby events per day were modelled to simulate a return-trip for each track.

Each flight was designated a flight profile: "approach", "departure" or "overflight". Each profile was modified from standard profiles (default in INM software) according to the given cruising altitude, speed as supplied by Bosche Venture Ltd. and track lengths as supplied by Rescan. It should be noted that an "overflight" profile starts in mid-air and ends in mid-air in order to model a section of a flight path that is nearest the applicable receiver. For detailed description of flight profiles refer to Appendix E.7.

A cruising speed of 180 km/h supplied by Rescan was translated to a true airspeed of approximately 104 knots for use in the INM model (Csgnetwork 2012).

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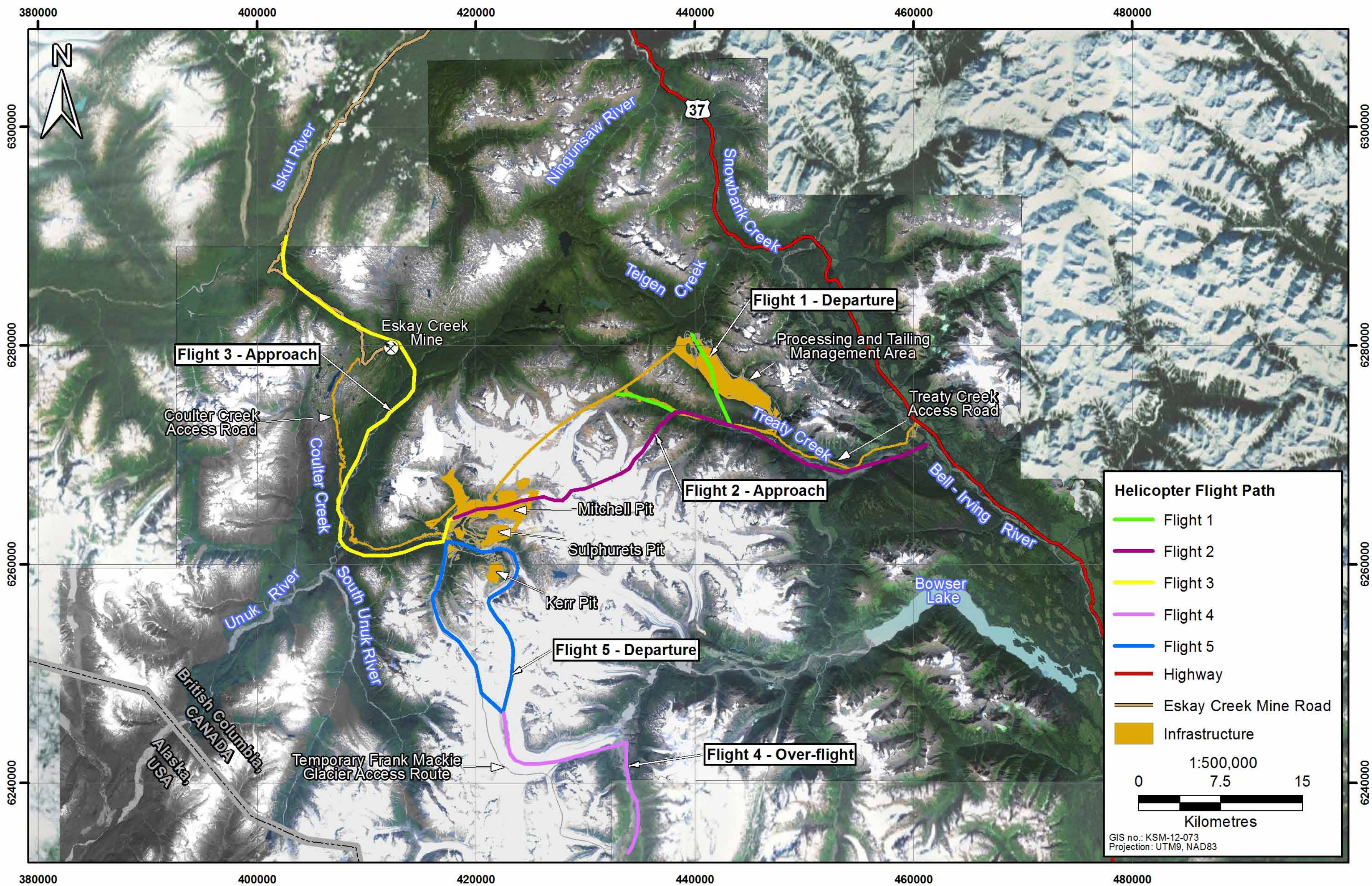

Figure 8-1

Figure 8-1

Modelled Helicopter Flight Paths

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KSM PROJECT

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Table 8-8 Flight Paths Modelled

Flight #	Origin	Destination	Type	Overflights / Day
1	Treaty OPC Helipad	Towards saddle area	Departure	2
2	Camp 11- Treaty Creek Marshalling Camp	Mitchell Camp Helipad	Approach	2
3	Eskay Mine	Mitchell Camp Helipad	Approach	2
4	Camp 1- Granduc Camp	Towards the northeast	Over-flight	2
5	Mitchell Camp Helipad	Round trip to Mitchell Camp Helipad for avalanche control	Departure	2

8.3.5 Blasting

ANSI 12.9 2005 Part 4 was used to calculate the adjusted sound exposure from C-weighted sound exposure level, which was in turn used to calculate the adjusted L_{dn} to be used in conjunction with Health Canada's approach to calculating %HA in the presence of high energy impulsive types of noise. These calculation steps are shown in Appendix B.1.

Three blast locations were modelled and the worst case was used in calculations. The co-ordinates below represent the centre of the blast-hole pattern for each blast:

Table 8-9 Blast Locations

Blast Number	Co-ordinates of blast		
	X (m)	Y (m)	Z
BLAST1-001	421482.9	6263023	According to digital terrain model
BLAST1-012	422737	6263054	
BLAST2-019	424016.4	6264817	

8.3.5.1 Sound Exposure Levels

The C-weighted sound exposure level (LCE) was used to assess the impact on humans and was calculated using section 4.3 of ANSI 12.17 – 1996 as shown in Appendix E.8. LCE calculates the total sound exposure over the time for the blast event to occur using the total mass of explosives used per blast, and the burial depth of the each charge.

The explosive to be used is ANFO. ANSI S12.17 – 1996 requires explosive mass to be a TNT equivalent. The table below summarises the TNT equivalents used and other input data used to calculate blasting noise levels at receiver locations.

Table 8-10 Blasting Input Data

Input	Year -1	Year 4
ANFO per hole	1046 kg	1046 kg
TNT mass equivalent per hole	844.5 kg	844.5 kg
Blasts per day	1	1
Holes per blast	58	150
Charge burial depth (m)	11.5	11.5

8.3.5.2 Peak Sound Pressure Levels

Peak sound pressure levels (Lpeak) were used to assess Wildlife effects in accordance with ANSI S2.20 - 1983. Adjustments for burial depth were made in accordance with ANSI S12.17 – 1996. Lpeak calculations require mass of explosive per delay. The estimated maximum number of holes per delay for use in this calculation was 10.

8.4 Receivers

Calculations were performed for assumed receiver heights of 4m above the ground in order to minimize the direct ground effect close to receivers. In addition, sound contours were calculated on 100 m by 100 m grids for the full study area inclusive.

8.5 Sound Source Adjustments

Health Canada's approach to calculating human annoyance is to apply adjustments to sound sources depending on their relative annoyance (e.g. helicopter noise may be more annoying than traffic noise). Additionally, adjustments are applied to the sound character of the source if it is impulsive, tonal or has significant low-frequency content. Appendix B describes these adjustments in detail. The below table summarises the adjustments used in the Project.

Table 8-11 Adjustments Applied to Sources

Source	Penalty	Adjustment Type
Air Traffic (Helicopter)	+5 dBA	Sound source adjustment
Dump Trucks Tipping Load	+5 dBA	Regular Impulsive
Backup beepers	+5 dBA	Tonal
Blasting	Calculated as per ANSI S12.9-2005 part 4	High Energy Impulsive
Baseline noise	+10 dBA	Rural Area Adjustment*
Total continuous Project noise	+10 dBA	

* see Appendix B.3 for explanation

8.6 Limitations

For sound calculated using the ISO 9613 standard, the indicated accuracy is ± 3 dBA at source to receiver distances of up to 1000 m and unknown at distances above 1000 m.

The estimated sound power levels for mobile equipment are generally based on new, well-maintained equipment. Older pieces of mobile equipment would likely produce higher noise emissions. For individually modelled noise sources (fixed and mobile equipment and roads), the estimated accuracy of the sound power levels is ± 5 dBA.

The Cadna/A noise model was used to predict receiver noise levels for both construction and operations phases.

ANSI S12.17-1996 limits the applicability of results to distances ≤ 30km and total explosive mass in TNT equivalent of 50g to 1000 kg. Each blast hole has either 844.5 kg (Year -1) or 1031.8 kg (Year 4) of TNT mass equivalent and the total explosive mass is multiplied by the number of holes (58 and 150 respectively). This standard will not provide accurate estimates of the total explosive mass since this is greater than 1000 kg. In order to preserve the applicability of the equations set forth in this standard, LCE values for blasting were calculated on a single blast basis. The additional holes (57 and 149 respectively) were accounted for on an energy basis by adding an adjustment factor of 10*log(h) where 'h' is the total number of holes per blast event.

9 POTENTIAL EFFECTS AND MITIGATION

9.1 Predicted Noise

The below sections detail the predicted day and night noise levels from the Cadna/A noise model as well as from INM and Matlab as previously mentioned.

Total Continuous Noise: This is all project related activity excluding helicopter and blasting noise to approximate the continuous sound level at the receptors. No penalties or adjustments are included. Baseline noise levels of 35 dB (day) and 25 dB (night) are included.

Adjusted Total Noise: This is the adjusted L_{dn} metric calculated according to Appendix D of the Health Canada Guideline. This includes all penalties and adjustments to source noise as well as baseline noise levels with associated adjustments as detailed in section 8.5 and Appendix B of this document.

9.1.1 Total Continuous Noise

It can be seen from Table 9 1 that offsite human receptors are not affected by Project noise. These receivers are expected to experience noise levels equivalent to the assumed baseline noise levels (L_d 35 dBA and L_n 25 dBA). Predicted noise levels were not increased above baseline at any Grizzly receptors. An increase in noise above baseline is expected for some Moose receiver locations, with Mountain Goats receiving the highest noise dose of 62 dBA during the day for both phases of the project.

Table 9-1 Total continuous Project noise levels summary

Receiver Type	Construction		Operations	
	Ld (dBA)	Ln (dBA)	Ld (dBA)	Ln (dBA)
Cabin	0	0	0	0
Camp	67	62	63	62
Exploration camp	31	24	34	33
Goat	62	60	62	63
Grizzly	0	0	25	22
Moose	47	0	52	16
Municipal	0	0	0	0

The noise levels at the loudest receivers are noted below for each phase of the Project. Both receivers are on the Project site, and in close proximity to the modelled noise sources. The position of these sources will vary with time since they are mobile.

Construction Phase

Camp 5 has the highest predicted noise level for the construction phase of the Project.

L_{dn} = 70 dBA;

L_d = 67 dBA;

L_n = 62 dBA;

For this receiver location the predicted top noise contributors within the Project are presented in Table 9-2. These sources have the biggest contribution due to their assumed proximity to the nearest receptor (Camp 5).

Table 9-2 Top 5 Discreet Sources for Noise Contribution at Camp 5

Noise Source	Ldn (dBA)	Ld (dBA)	Ln (dBA)
12-ton High Boy	68	65	61
12-ton High Boy	59	55	52
Flat Decks	57	53	51
777 Heavy lift Crane	56	53	49
Pick-ups	52	51	44

Operations Phase

Treaty Operating Camp has the highest predicted noise level for the operations phase of the Project.

L_{dn} = 67 dBA;

L_d = 63 dBA;

L_n = 60 dBA;

For this receiver location the predicted top noise contributors within the Project are presented in Table 9-3 These sources have the biggest contribution due to their assumed proximity to the nearest receptor (Treaty Operating Camp).

Table 9-3 Top 5 Discreet Sources for Noise Contribution at Treaty Operating Camp

Noise Source	Ldn (dBA)	Ld (dBA)	Ln (dBA)
Dump Truck (20 tonne capacity) – two units	58	55	51
Forklift (1,800 kg capacity)	57	54	50
Excavator – two units	48	50	0
Cone Crusher Building Baghouse 1	55	49	49
Treaty Operating Camp Generator (250 person)	55	49	49

9.1.2 Adjusted Total Noise

Using all applicable adjustments as detailed in section 8.5, the following table summarises the highest adjusted noise levels, or "rated" noise level at each human receiver type.

Table 9-4 Highest Adjusted Noise Levels (all sources) Summary

Human Receiver Type	Adjusted Ldn (dBA)	
	Construction	Operations
Cabin	47	49
Camp	80	78
Exploration camp	62	74
Municipal	52	52

9.1.3 Event Noise

The effect of event noise on human receptors is accounted for as part of the %HA calculation. Wildlife peak sound pressure levels have thus been presented separately from that of human receptors. Maximum Helicopter A-weighted sound exposure and blasting Lpeak event noise levels at wildlife receptors are summarised in Table 9-5 below. Details on noise levels for these events can be found in Appendix F.4. The worst case blasting event for wildlife receptors was chosen to be Blast2-019 as listed in Table 8-9.

Table 9-5 Highest Sound Exposure and Peak Levels Summary

Noise Source	Helicopter LAE	Blasting Lpeak
Goat	72	119
Grizzly	85	96
Moose	86	96

9.2 Effects Assessment

A count of receptors exceeding each of the assessment criteria, for the project phases, has been completed and is presented in

Table 9-6. The noise impact regarding each of the assessment criteria is explained in the following sub-sections. All of the receivers showing exceedence levels in the table below were located onsite.

Table 9-6 Count of Receptors in Exceedence

Criteria	Impact	Approximate number of receivers exceeding criteria	
		Y -1	Y 4
Ld > 55 dBA	Interference with speech*	0	0
	Wildlife habitat lost	1	1
Ln > 45 dBA	Sleep disturbance at offsite human receptors	0	0
	Wildlife habitat lost	1	1
Ln > 57 dBA	Sleep disturbance at onsite human receptors	1	2
Ldn > 62 dBA	Widespread complaints*	0	0
Ldn > 75 dBA	Potential legal action*	0	0
Δ %HA > 6.5%	Percentage highly annoyed*	0	0
LLF > 70 dB	Low frequency noise induced rattles*	0	0

*only applicable to offsite human receptors

9.2.1 Human Receptors

9.2.1.1 Ld > 55 dBA

The Ld level presented herein account for total continuous project noise, and exclude helicopter and blasting contributions. The predicted human receivers that are above L_d 55 dBA are onsite camps. Some degree of outdoor speech interference is expected to occur at the camps listed in Table 9-7 below.

Table 9-7 Camps with Ld > 55 dBA

Receiver	Ld (dBA)	Phase
Camp 5	67	Construction
Camp 6	62	Construction
Camp #4 Mitchell North Camp	58	Construction
Camp #9 Mitchell Initial Camp	56	Construction
Camp 5	58	Operations
Camp 6	62	Operations
Treaty operating camp	63	Operations

9.2.1.2 Ln > 45 dBA at Offsite Human Receptors

The Ln levels presented herein account for total continuous project noise. No helicopter and blasting events are expected to occur at night. It is predicted that no offsite human receivers will be above the L_n 45 dBA criteria in both the construction and operations phases. No increases above baseline are anticipated.

9.2.1.3 Ln > 57 dBA at Onsite Human Receptors

The Ln levels presented herein account for total continuous project noise. No helicopter and blasting events are expected to occur at night. There are three onsite camps that are above the L_n 57 dBA criteria for sleep disturbance. Health Canada mentions that noise experienced by off-duty workers who reside on or near the project site need to be considered.

Table 9-8 Receivers with L_n > 57 dBA

Receiver	L_n (dBA)	Phase
Camp 5	67	Construction
Camp 6	62	Operations
Treaty operating camp	63	Operations

9.2.1.4 Ldn > 62 dBA

The Ldn levels presented herein account for total continuous project noise, and exclude helicopter and blasting contributions. Only onsite camps are predicted to experience L_{dn} > 62 dBA, which is unlikely to cause complaint as these camps are part of the Project. The levels experienced at these locations are shown in Table 9-9 below:

Table 9-9 Receivers with Ld_n>62 dBA

Receiver	Adjusted Ldn with baseline (dBA)	Phase
Existing Exploration Camp 1	62	Construction
Camp 5	80	
Camp 6	71	
Camp 10	65	
Camp #4 Mitchell North Camp	69	
Camp #9 Mitchell Initial Camp	66	
Existing Exploration Camp 1	74	Operations
Camp 5	72	
Camp 6	78	
Camp #4 Mitchell North Camp	62	
Camp #2 Ted Morris Staging Camp	68	

9.2.1.5 Ldn > 75 dBA

The L_{dn} levels presented used in this calculation account for total continuous project noise, and exclude helicopter and blasting contributions. It is predicted that no offsite receivers will be above the L_{dn} 75 dBA criteria in both the construction and operations phases. The highest predicted adjusted L_{dn} is 48 dBA.

9.2.1.6 Δ %HA > 6.5%

The Δ %HA levels presented herein account for total continuous project noise, helicopter and blasting contributions as well as baseline noise levels. The Health Canada Guideline does not include onsite camps as part of the affected receivers in the % HA calculation. None of the offsite receivers in this study exceeded this limit. The average offsite human receptors %HA increase was predicted to be less than 1%. This is due to the large distance between these receivers and the mine site.

9.2.1.7 L_{LF} > 70 dB

The L_{LF} levels used in this calculation account for total continuous project noise, and exclude helicopter and blasting contributions. None of the receivers are predicted to be exposed to low-frequency noise above the "rattle criterion" of 70 dB. In addition of those receivers that show a 10dB or more difference between their A-weighted and C-weighted values, none have low frequency components above 65 dB.

9.2.1.8 Potential Mitigation

Sleep disturbance at onsite camps is the only potential adverse effect identified. In order to mitigate this potential effect, the following should be considered during the detailed design phase:

- Maximize distances from major noise sources to sleeping quarters minimize noise; and
- Calculate building façade insulation and improve so that predicted indoor L_{eq} are 30 dBA or less at night.

9.2.2 Wildlife Receptors

The following sections detail the total continuous noise and event noise levels received by wildlife receptors for continuous project noise, blasting and helicopter overflights.

9.2.2.1 L_d > 55 dBA

The Ld level presented herein account for total continuous project noise, and exclude helicopter and blasting contributions. The predicted wildlife receiver that is above L_d 55 dBA is located in close proximity to the mine site.

Table 9-10 Wildlife Receivers with L_d>55 dBA

Receiver	Ld (dBA)	Phase
Goat Receptor 9	62	Construction
Goat Receptor 9	62	Operations

9.2.2.2 L_n > 45 dBA

The Ln levels presented herein account for total continuous project noise. No helicopter and blasting events are expected to occur at night. The predicted wildlife receiver that is above L_n= 45 dBA is located in close proximity to the mine site and thus levels received at this location are variable and highly dependent on which equipment is operating nearby.

Table 9-11 Wildlife Receivers with L_n>45 dBA

Receiver	Ld (dBA)	Phase
Goat Receptor 9	60	Construction
Goat Receptor 9	63	Operations

9.2.2.3 L_{AE} > 75 dBA

The L_{AE} levels presented herein account for event noise exposure levels for helicopter overflights. As per wildlife assessment, only mountain goats are regarded as sensitive to helicopter disturbance. As shown in Table 9-12 Wildlife Receivers with LAE>75 dBA no mountain goat receivers modelled were above the threshold.

Table 9-12 Wildlife Receivers with LAE>75 dBA

Receiver	Helicopter LAE (dBA)
Grizzly Receptor Point 1	85
Grizzly Receptor Point 2	76
Grizzly Receptor Point 4	83
Moose Receptor Point 2	86
Moose Receptor Point 6	86

9.2.2.4 L_{peak} > 108 dB

The L_{peak} levels presented herein account for instantaneous sound pressure levels from blasting activities. The predicted wildlife receiver that is above L_{peak} 108 dB is located in close proximity to the mine site.

Table 9-13 Wildlife Receivers with L_{peak}> 108 dB

Receiver	L_{peak} (dB)	Phase
Goat Receptor 9	117	Construction
Goat Receptor 9	119	Operations

10 RESIDUAL EFFECTS ASSESSMENT

Noise mitigation should be provided at onsite camps to eliminate potential sleep disturbance. If recommendations for mitigation are followed the residual effects of the Project will be insignificant.

11 CUMULATIVE EFFECTS ASSESSMENT

Projects that have been identified within close proximity to the KSM project include:

- Past Producing Eskay Creek mine
- Snowfield Project
- Brucejack Project
- IITL and Forest Kerr Hydroelectric construction
- Traffic using the Eskay Creek Mine Road and Highway 37

Each of the above projects will have their own potential effects on their immediate surroundings. The potential of cumulative effects relating to noise are limited to those receivers within approximately 1km of the area where the KSM project and the Snowfield and Brucejack Projects are immediately adjacent to each other. Assuming the Snowfield and Brucejack Projects produce an equivalent amount of noise to the KSM project, receivers in this vicinity will experience a maximum 3 dB cumulative effect.

12 NOISE MANAGEMENT PLANNING

12.1 Construction and Operation Noise Management Plan

No significant adverse effects were identified for either the construction or operation phases of the Project if mitigation options for sleep disturbance at worker camps are followed. However, it is important that noise levels are monitored to ensure that operational project requirements do not result in noise levels that are higher than estimated in this study.

12.1.1 Objective

The objectives of this Noise Management Plan are to:

- Ensure all relevant regulatory requirements and published best practice recommendations are met;
- Manage and minimise the impact of noise from mining operations on the community and environment;
- Maintain an effective response mechanism to deal with issues and complaints; and
- Ensure the results of noise monitoring comply with applicable criteria.

12.1.2 Targets

Noise levels at sensitive receptors identified in section 7.1 will be controlled to comply with those limits identified in section 5.1.

Essentially, there are three main mitigation strategies for noise control. These noise mitigation strategies will follow a hierarchy of control, with source control always being the preferred option where reasonable and feasible, and control at the receiver the least favourable option:

1. Controlling noise at the source.

   There are two approaches:

   - Best Management Practice (BMP) and
   - Best Available Technique Not Entailing Excessive Cost (BATNEEC).

2. Controlling the transmission of noise.

   There are two approaches:

   - The use of barriers and
   - Land-use controls—which attenuate noise by increasing the distance between source and receiver.

3. Controlling noise at the receiver.

This is the least preferred control option, and is applied when all other methods of noise control have been evaluated and implemented, and further improvements are still required for the receptor. If further modifications are required, the options should be evaluated by a noise specialist in order to maximise the effectiveness of mitigation. This would be undertaken on an as needs basis and could include noise mitigation measures such as increasing the thickness of window glazing, review of HVAC systems and improving the construction of exterior facades.

Implementation of each of the three strategies for the Project is addressed in the following sections.

12.1.3 Actions to Avoid, Control and Mitigate

The BATNEEC approach involves the assessment of all factors that contribute to the resulting noise impact. The major noise sources contributing to levels at or near the thresholds identified include blasting activities and various stationary and mobile equipment. The most sensitive receptors within the mining area are the worker camps and goat population points. The following factors identified using the BATNEEC approach will be considered during detailed design and operation for the most affected receivers.

12.1.3.1 Mobile Equipment

The following recommendations will be followed concerning mobile equipment operating nearby worker camps during sleeping hours. Sleeping hours are defined as any time workers are sleeping, and are not limited to night time due to the continuous production nature of the mine.

- Use of the quietest available equipment;
- Maintain equipment well to minimise noise;
- Optimise the site layout to minimize noise impact, e.g. through the use of natural screens such as buildings, open doors facing away from noise sources etc;
- Maximise the distance between roads servicing mobile equipment and worker camps;
- Optimise site procedures to minimize the noise impact, e.g. keeping doors closed, conducting noisy procedures indoors;
- Optimisation of hours of operation for noisy procedures to minimize the noise impact and/or restricted to specific hours so that the workers know when to expect particularly annoying noise events during sleeping hours;
- Conscious application of other site operations to minimise noise; and
- Use of barriers to minimize the noise impact.

12.1.3.2 Stationary Equipment

- Ensure that stationary equipment such as generators, light plants, power plants, incinerators etc are not placed in close proximity to worker camps.;
- Generators will be contained within a noise enclosure where possible;

- Cladding of bins, crushers, and conveyors is recommended; and
- Low noise conveyors will be utilized throughout.

12.1.3.3 Blasting

- Avoid blasting configurations which could result in more than seven holes detonating simultaneously.;
- Ensure blast holes are stemmed to at least 6 m; and
- Publish blasting schedule so ear plugs may be worn if this coincides with sleep times.

12.1.3.4 Indoor Equipment

All equipment located indoors, such as in the Ore Processing Complex, should not exceed an interior reverberant level of 85 dBA or as specified by occupational noise limits.

12.1.4 Mitigation Plans

Operational Noise Mitigation plans will be identified based on the above best-practice guidelines. These will be triggered if the noise monitoring program records levels that exceed the relevant criteria, or if complaints have been received from the community or stakeholders.

12.1.5 Monitoring

The objective of the noise monitoring is to ensure that noise levels propagated from the Project will meet human health and wildlife standards as well as guidelines as identified in section 5.1. They will also provide relevant stakeholders with timely and concise information that indicates whether or not the environmental management plans developed to mitigate any negative effects are on track to achieve their stated objectives. Periodic noise monitoring will be performed to assess noise levels at sensitive receptor locations.

12.1.5.1 Noise Monitoring Locations

12.1.5.1.1 Night Time Mine Noise at Worker Camps

Overnight noise monitoring will be periodically conducted at worker camps to ensure limits for sleep disturbance are not exceeded.

12.1.5.1.2 Blasting Noise Monitoring

Instantaneous noise levels as a result of blasting activities will be monitored at a position anywhere along the 108 dB L_{peak} contour line as per the wildlife assessment located in Section 7.3 of Chapter 18. Monitoring instrumentation will be placed in an exposed area such that local shielding effects of noise are minimised.

12.1.5.1.3 Helicopter Noise Monitoring

Sound exposure levels as a result of helicopter overflights will be monitored at a position representative of mountain goat habitat as per the wildlife assessment located in Section 7.3 of

Chapter 18. Monitoring instrumentation will be placed in an exposed area such that local shielding effects of noise are minimised, where there is direct line of site to the helicopter flight track.

12.1.5.1.4 Interior Noise Levels at Production Facilities

Noise monitoring will be conducted indoors to ensure occupational noise limits are met.

12.1.5.2 Sampling Techniques

The internationally recognized ISO 1996-2:2007 standard provides guidelines for the measurement of environmental sound and encompasses the following aspects:

- instrumentation system;
- calibration;
- monitoring locations;
- evaluation of measurement results;
- measurement uncertainty; and
- documentation.

Noise monitoring measurements will be performed in compliance with this standard. Noise monitoring will be coordinated so that measurements can be conducted during representative conditions. Noise monitoring may be attended or unattended if over a longer period. Representative conditions include source operating conditions and weather conditions. Noise monitoring would be conducted at least once a year during active construction and operations and significant blasts (great than ten tonnes of TNT equivalent).

12.1.5.3 Noise Monitoring Equipment

The acoustic instrumentation system, comprised of a microphone, wind screen, cable and recorder, will conform to class 1 or class 2 requirements as defined by the International Electrotechnical Commission (IEC) method IEC 61672-1 (IEC 2002). The sound level meters will be field calibrated immediately before and after each measurement, with a class 1 calibrator in accordance with IEC 60942:2003.

Windscreens will always be used during outdoor measurements and will be clean, dry and in good condition.

12.1.5.4 Placement of Monitoring Equipment

The number of monitoring locations will be chosen to adequately assess the varying noise environment of the human and wildlife receptors within the study area.

Microphones will normally be located outdoors, approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface (e.g., wall). Night time monitoring at worker camps will be performed indoors to compare with the recommended WHO indoor noise criteria. The microphone location will represent where a person’s head would be while sleeping.

12.1.5.5 Safe Work Procedures

Personnel performing the noise monitoring will follow Health and Safety guidelines for KSM.

Personnel will:

- Prepare a site workplan, emergency response plan and identify hazards prior to each monitoring program;
- Wear personal protective equipment (eye protection, hard hat and steal toe boots);
- Make sure to have stable footing on steep slopes;
- Be aware of loose branches, falling branches, shrubs when working in the woods;
- Be prohibited from working alone;
- Stay on a scheduled communication with the designated Site Environmental Officer;
- Avoid excess exposure to sun;
- Wear insect repellent;
- Reduce or avoid monitoring during lightning and thunderstorms; and
- Wear flotation devices when near water bodies.

12.1.6 Documentation and Record Keeping

Records of noise monitoring activities and associated management actions, including operational controls and mitigation, shall be retained to ensure the continued safe and economical management of noise-generating activities.

Data to be collected during monitoring will be as described in the reporting section below.

12.1.6.1 Complaints Procedure

Upon receipt of a complaint from the community, preliminary investigations will commence as soon as practicable to determine the likely causes of the complaint using information such as the prevailing climatic conditions, the nature of activities taking place and recent monitoring results. A response will be provided as soon as practicable, which may include the provision of relevant monitoring data if requested.

Where specific complaints are received in relation to noise at a particular residence, attended noise monitoring may be undertaken at or near the complainant's residence if the Environmental Manager deems the complaint likely to be valid.

Every effort will be made to ensure that concerns are addressed in a manner that facilitates a mutually acceptable outcome for both the complainant and the Project.

12.1.6.2 Complaints Register:

The Environmental Manager will record all community complaints into a site event management database. The database will be maintained to include reporting, incident/event notification, close out action tracking, risk management, inspection, audits and document management.

The following information related to noise complaints from the public will be recorded:

- name
- address
- contact telephone number
- date and time of registering complaint
- date and time when noise occurred
- subjective assessment of magnitude, and
- detailed description of noise.

12.1.6.3 Noise Monitoring Exceedence

In situations where attended noise results are identified as exceeding the impact assessment criteria, the following actions will be undertaken:

- The Environmental Coordinator must be notified as soon as practicable of any exceedence identified during noise monitoring;
- The Environmental Coordinator, and noise consultants will investigate the results of the noise monitoring for the potential causes for the exceedence;
- Stakeholders will be notified as soon as possible when an exceedence is identified;
- The Environmental Manager will initiate investigations as to the cause of the exceedence and prepare a detailed report of the incident;
- The Environmental Manager will prepare a detailed report as a result of the investigation and provide stakeholders and any other relevant agencies, with the report within a respectable timeframe of not more than 10 days;
- If no recognisable causes can be identified further investigations maybe undertaken to identify the cause e.g. specific weather or atmospheric conditions;
- Where the cause is identified, additional controls will be implemented or the operational method will be altered;
- Additional monitoring may be required as a follow up to determine the effectiveness of any corrective actions implemented;
- Any corrective action will be recorded and reported to the Environmental Coordinator who will keep a record of all significant proactive and reactive actions; and
- The Environmental Coordinator will be informed of any complaint and details must be recorded in the site event management database in addition to response and actions taken.

12.1.7 Reporting

An appropriate measurement report will be used to:

- demonstrate compliance with the noise management plan;
- demonstrate compliance with calibration standards in case the measurement is challenged by an external party;

- permit repeating the measurement in the future, to evaluate a change in source or propagation conditions or in case the measurement is challenged by an external party;
- permit comparison with similar situations; and
- permit an external party to perform more detailed measurements and/or analyses without needing to repeat the original measurement.

12.1.7.1 Measurement Reports

Measurement reports will be completed after each monitoring session. Templates will be created for the different measurement scenarios in order to provide a method for producing reports efficiently and consistently. Templates may be useful in word processing and measurement analysis software.

The measurement report contents will minimally include:

- the relevant noise limit (if applicable);
- the reference time interval(s), e.g. 8 hour period - as per the criteria;
- a description of the sound source(s) included in the reference time intervals;
- a description of the operating conditions of the sound sources;
- a description of the assessment site including the topography, the building geometry, the ground cover and condition and locations, including height above ground, of the microphone(s) and source(s);
- the time, day, year and place for the measurements;
- the instrumentation used (i.e. models and serial numbers) and calibration results;
- the measurement time intervals;
- a description of the weather conditions during the measurements, particularly the wind direction and speed, the cloud cover and whether precipitation was present, but also temperature, barometric pressure, humidity and the location of the weather instrumentation;
- a description of the residual sound;
- a description of any procedures used to correct for contamination by residual sound, including a description of any noise modelling performed including prediction standard and calculation settings;
- the rating level and the components, including acoustic levels contributing to the rating level;
- whether or not the measurement demonstrates compliance with the noise limit (if applicable);
- figure showing measurement positions on a map;
- figure showing photograph of microphones as set up;
    - Many of these items can be recorded while at the site on a field data sheet.

- All measurement data, photographs and field data sheets will be stored electronically to permit future access as required.

12.1.7.1.1 Blasting

The following records for each significant blast event shall be recorded:

- date and time of blast;
- name and signature of Certified Blasting Engineer supervising the event;
- environmental conditions (e.g., temperature, cloud conditions, wind speed and direction) that may affect the noise/vibration characteristics of the blast;
- location of blast (mine co-ordinates, elevation, and description);
- sketch of blast pattern, including depth and diameter of holes, number of holes in blast and holes per delay, spacing of holes, burden on rows and direction of throw, and the type and dimensions of decking and stemming in blastholes;
- type, product name, package dimensions, and density of explosives;
- distribution and weight of explosive per hole;
- maximum weight of explosive per delay;
- delay type, sequence, pattern, and timing;
- initiation system description; and
- mats, padding, or other mitigation measures employed.

12.1.7.2 Evaluation of Measurement Results

There is the chance that atypical events will be captured during the monitoring period, which can then reduce the overall validity of the monitoring program. Atypical events are not representative of the wide-area noise environment being assessed. The risk of capturing these occurrences is increased when the noise environment is relatively quiet. These events typically result from sound created close to the microphone by humans, plants/trees (due to wind), rain or animals.

In order to reduce the chance of including atypical events in the measurement results, use class 1 sound level meters that simultaneously record audio files. Once the measurement data is downloaded to the computer and exported to the post-processing software, suspect noise events can be quickly reviewed and listened to in order to determine whether or not they should be included in the measurement results.

A noise model can also be used to estimate the baseline noise level at other locations, based on the results of the monitoring program, if discrete sound sources and setback distances have been identified (e.g. roadways).

12.1.7.3 Measurement Uncertainty

Measurement uncertainty can be attributed to instrumentation, sound source operating conditions and weather and ground conditions. These will be assessed and summarized.

12.1.7.4 Quarterly and Annual Reports

Quarterly reports will be submitted to the Environmental Manager using a consistent template for the first year of construction. An annual report will be circulated at the end of the first year to relevant stakeholders for review and comment. A meeting will follow, at which time recommendations for the revision and refinement of management plans will be made.

The quarterly and annual reports will include:

- Noise monitoring results and comparison to performance criteria;
- Noise related complaints and management/mitigation measures undertaken;
- Management/mitigation measures undertaken in the event of any confirmed exceedence of performance criteria; and
- Review of the performance of management/mitigation measures and the monitoring program.

The Environmental Manager will perform routine inspections and audits to document compliance with the Noise Environmental Management Plan. Should non-compliance be observed, a corrective action notification that outlines what measures will need to be undertaken within a given timeframe to bring the work back into compliance with this plan will be created.

12.1.7.5 Review

This Noise Management Plan will be reviewed, and if necessary revised to the satisfaction of Stakeholders and regulatory authorities within 3 months of the following:

- Submission of the annual report:
- Modification to the conditions of the original Project approval;
- When there are changes to project approval or license conditions relating to noise management or monitoring;
- Following significant incidents at the Project relating to noise;
- Following the conduct of an independent environmental audit which requires changes to the Noise Management Plan or to the Noise monitoring practices; or
- If there is a relevant change in technology or legislation.

13 CONCLUSIONS

Predictions using detailed noise modelling have shown that the Total Continuous Project Noise is contained largely within the Project boundary, with the most affected receivers being worker camps onsite. Health Canada exempts these receptors from noise level criteria stipulated to prevent human health effects, with the exception of sleep disturbance. In order to mitigate this potential effect, the following will be considered during the detailed design phase:

- Maximize distances from major noise sources to sleeping quarters to minimize noise; and
- Calculate building façade insulation and improve so that predicted indoor L_{eq} are 30 dBA or less.

Event noise levels associated with blasting and helicopter overflights were not shown to significantly increase the noise levels when combined with the Total Continuous Project Noise to the extent that offsite human receptors are likely to become annoyed or complain.

Only Wildlife receptors in close proximity (<2km) from the centre of mining activities are predicted to receive continuous levels in excess of those suggested by Environment Canada.

The only wildlife receptor that was shown to have any adverse effects to event noise levels from blasting is the mountain goat habitat in close proximity to the mine (< 5km). Mountain goat populations occurring within approximately 300m (slant distance) of helicopter flight tracks may suffer adverse effects.

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APPENDIX A - GLOSSARY

A-weighting (dBA) – A standardized filter used to alter the sensitivity of a sound level meter with respect to frequency so that the instrument is less sensitive at low and high frequencies where the human ear is less sensitive.

Acoustics – The science of sound, including its production, transmission, and effects.

Background sound level (LAF90) – The A-frequency-weighted, fast-time-weighted, sound pressure level of the residual sound at the assessment position that is exceeded for 90% of a given time interval.

Baseline noise level - The pre-project noise level.

C-weighting (dBC) – The C-weighting provides a more discriminating measure of the low frequency sound pressures associated with high-energy impulsive sounds such as blasting than provided by A-weighting. Measurement of high-energy impulsive sounds such as blasting in terms of C-weighted sound levels provides better correlation with human response than does A-weighted sound levels. Also written as dBC.

Calculation standard – A set of standard algorithms to calculate the sound pressure level at arbitrary locations from measured or predicted sound emission and sound attenuation data

Continuous Sound Level – The A-weighted sound level, for any sound occurring for a duration of more than three minutes in a fifteen minute period.

Day-night equivalent sound level (Ldn) – The sound exposure level for a 24-hour day calculated by adding the sound exposure level obtained during the daytime (7:00 am to 10:00 pm) to 10 times the sound exposure level obtained during the nighttime (10:00 pm to 7:00 am) to account for greater human sensitivity to nighttime noise.

Daytime equivalent sound level (Ld) – The equivalent sound level over the daytime hours (07:00 to 22:00).

Decibel (dB) – The standard unit of measurement for sound pressure and sound power levels. It is the unit of level which denotes the ratio between two quantities that are proportional to pressure or power. The decibel is 10 times the logarithm of this ration.

Equivalent sound level (Leq) – The value of the sound pressure level of a continuous, steady sound that, within a specified time interval, has the same energy as the actual time-varying sound level, and is expressed in decibels (dB), e.g. the LAeq,1h is the A-frequency-weighted equivalent sound level for a 1 hour time interval. Although it is, in a sense, an “average”, it is strongly influenced by the loudest events because they contain the majority of the sound energy.

Façade –The outside face of the exterior wall of a building.

Fluctuating sound – Continuous sound whose sound pressure level varies significantly, but not in an impulsive manner, during observation.

Frequency – Analogous to musical pitch, the basic unit for measuring frequency is the number of cycles per second, or Hertz (Hz), where bass tones are low frequency/low Hertz values and treble tones are high frequency/high Hertz values. Audible sound occurs over a wide frequency range, from approximately 15 Hz to 20,000 Hz.

Frequency spectrum – Distribution of frequency components of a noise or vibration signal.

Hertz – The unit of frequency measurement, representing the number of cycles per second.

Impulsive Sound – Non-continuous sound characterised by brief bursts of sound pressure. The duration of a single burst of sound is usually less than one second.

Infrasound – Sound at frequencies below the audible range, below about 15 Hz.

Intermittent Sound – Non-continuous sounds that are present at the observer only during certain time periods that occur at regular or irregular time intervals and are such that the duration of each occurrence is more than about five seconds, e.g. train noise, air-compressor noise.

Intervening terrain – The terrain in between the noise/vibration source and sensitive receiver.

Loudness – The intensive attribute of sound by which sounds are classified from quiet to loud.

Low Frequency Noise (LFN) – Sound containing frequencies of interest within the range covering the one-third octave bands from 10 Hz to 200 Hz.

Maximum sound level – The highest exponential time-averaged sound level, in decibels, that occurs during a stated time period. The standardized time periods are 1 second for "slow" and 0.125 seconds for "fast" exponential weightings.

Metric – Measurement parameter or descriptor.

N percent exceedance level – Time-weighted and frequency-weighted sound pressure level that is exceeded for N% of the time interval considered and expressed in decibels (dB), e.g. the LAF90,1h is the A-frequency-weighted, F-time-weighted sound pressure level exceeded for 90% of 1 hour.

Nighttime equivalent sound level (Ln) – The equivalent sound level over the nighttime hours (22:00 to 07:00).

Non-Continuous Sound Level - The maximum A-weighted sound level using the “slow” time constant.

Noise - Noise is unwanted sound, which carries no useful information and tends to interfere with the ability to receive and interpret useful sound.

Octave band – A standardized division of a frequency spectrum in which the interval between two divisions is a frequency ratio of 2.

Percent heavy vehicles– The percentage of vehicles, out of the total number of vehicles, with weight greater than 3500 kg

Percent highly annoyed (%HA) – A descriptor for noise annoyance in a population derived from a dose-response relationship between the percentage of a population expressing high annoyance to long-term noise exposure and the corresponding A-weighted day-night sound level (Ldn).

Prediction method – Subset of a calculation method, intended for the calculation of future noise levels.

Rating level – Any predicted or measured acoustic level to which an adjustment has been added, e.g. the Ldn is the measured LAeq,24h with an adjustment to account for increased sensitivity to noise in the nighttime period.

Receiver/Receptor – A stationary far-field position at which noise or vibration levels are specified.

Residual sound – The Total Sound remaining at a given position in a given situation when the Specific Sounds under consideration are suppressed, see below figure.

Slant distance - The straight-line distance between two points not at the same elevation

Sound – The fluctuating motion of air or other elastic medium which can produce the sensation of sound when incident upon the ear.

Sound exposure level (LAE, LCE) – The equivalent sound level for an event that has been normalized to a one second time interval, for comparison of the total sound energy exposure to different events. The use of sound exposure level also meets the need to include a measure of signal duration, since the annoyance of unwanted sounds increases with signal duration.

Sound level – The level of sound pressure measured with a sound level meter and one of its weighting networks. When A-weighting is used, the sound level is given in dBA.

Sound level meter – An electronic instrument for measuring the sound level in accordance with accepted national or international standards.

Sound power – The total sound energy radiated by a source per unit time.

Sound power level (Lw) – The fundamental measure of sound power. Defined as: $Lw = 10 \log W/W_o$ dB, where W is the RMS value of sound power in watts, and W_o is 1 pW.

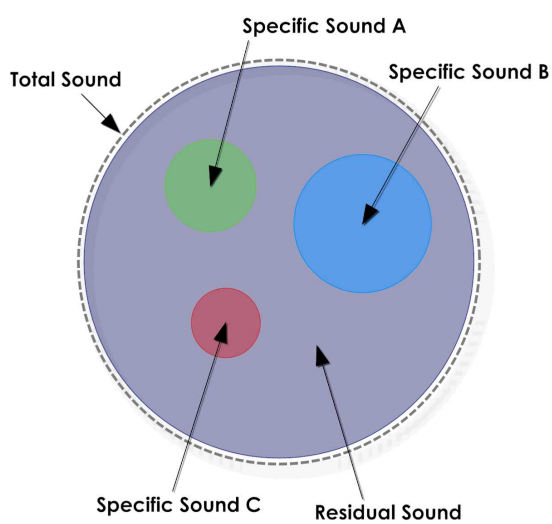
Sound source – The means by which a sound is produced through the vibration of a physical object.

Specific sound - The component of the Total Sound that can be specifically identified and which is associated with a specific source, see below figure.

Time constant (slow, fast) – Used to describe the exponential time weighting of a signal. The standardised time periods are 1 second for “slow” and 0.125 seconds for “fast” exponential weightings.

Tonal sound – Sound characterized by a single frequency component or multiple distinct frequency components that are perceptually distinct from the total sound.

Total sound – Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far. The figure below illustrates the relationship between Total, Specific and Residual Sound.



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APPENDIX B – INTRODUCTION TO SOUND AND ENVIRONMENTAL NOISE ASSESSMENT

The two principle components used to characterize sound are loudness (magnitude) and pitch (frequency). The basic unit for measuring magnitude is the decibel (dB), which represents a logarithmic ratio of the pressure fluctuations in air relative to a reference pressure. The basic unit for measuring pitch is the number of cycles per second, or Hertz (Hz). Bass tones are low frequency and treble tones are high frequency. Audible sound occurs over a wide frequency range, from approximately 20 Hz to 20,000 Hz, but the human ear is less sensitive to low and very high frequency sounds than to sounds in the mid frequency range (500 to 4,000 Hz). "A-weighting" networks are commonly employed in sound level meters to simulate the frequency response of human hearing, and A-weighted sound levels are often designated "dBA" rather than "dB".

If a continuous sound has an abrupt change in level of 3 dB it will generally be noticed while the same change in level over an extended period of time will probably go unnoticed. A change of 6 dB is clearly noticeable subjectively and an increase of 10 dB is generally perceived as being twice as loud.

While the decibel or A-weighted decibel is the basic unit used for noise measurement, other indices are also used to describe environmental noise. The Equivalent Sound Level, abbreviated L_{eq}, is commonly used to indicate the average sound level over a period of time. The L_{eq} represents the steady level of sound which would contain the same amount of sound energy as the actual time-varying sound level. Although the L_{eq} is an average, it is strongly influenced by the loudest events occurring during the time period, because these loudest events contain most of the sound energy. Another common metric used is the L_{90}, which represents the sound level exceeded for 90% of a time interval and is typically referred to as the background noise level.

The L_{eq} can be measured over any period of time using an integrating sound level meter. Some common time periods used are 24 hours, noted as the L_{eq24}, daytime hours (07:00 to 22:00), noted as the L_d, and nighttime hours (22:00 to 07:00), noted as the L_n. As the impact of noise on people is judged differently during the day and during the night, 24 hour noise metrics have been developed that reflect this. The day-night equivalent sound level (L_{dn}) is one metric commonly used to represent community noise levels. It is derived from the L_d and the L_n with a 10 dB penalty applied to the L_n to account for increased sensitivity to nighttime noise.

B.1 Sound Source Adjustments

Helicopter

$$LN_{dn\_heli} = \mathrm{L}_{dn\_heli} + 5$$

B.2 Sound Character Adjustments

Tonal

Tonal penalty was added to all mobile sources containing a backup beeper as follows:

$$LN_{dn\_tonal} = \mathrm{L}_{dn\_tonal} + 5$$

Regular Impulsive

Impulsive adjustment was added to all dump trucks tipping their load as follows:

$$LN_{dn\_impulse} = \mathrm{L}_{dn\_impulse} + 5$$

Blasting (High Energy Impulsive):

The C-weighted sound exposure level (LCE) was calculated as shown in Appendix E.8. ANSI 12.9 2005 Part 4, equation B.3, was used to calculate the adjusted sound exposure from C-weighted sound exposure level as follows:

$$LCE_{adj} = 10^{0.1(2LCE-187)} \qquad for\ LCE \geq 100$$

$$LCE_{adj} = 10^{0.1(1.18LCE-105)} \qquad for\ LCE < 100$$

The adjusted L_{dn} for blasting was then calculated from the adjusted sound exposure from equation 7a (ANSI S12.9 – 2005 Part 4) as follows:

$$LN_{dn\_blast} = 10 * \log\left(LCE_{adj}\right) + 44.6$$

B.3 Rating Level

The overall energy summed result of all adjusted noise was summated as follows:

$$LN_{dn\_project} = 10 * \log\left(10^{\frac{LN_{dn\_heli}}{10}} + 10^{\frac{LN_{dn\_tonal}}{10}} + 10^{\frac{LN_{dn\_impulse}}{10}} + 10^{\frac{LN_{dn\_blast}}{10}} + 10^{\frac{LN_{dn\_continuous}}{10}}\right)$$

Rural Area Adjustment

Both baseline and project noise receive a 10dB adjustment in order to shift the relative position on the %HA curve to be more representative of complaints statistics.

$$LN_{dn\_baseline} = L_{dn\_baseline} + 10$$

$$LN_{dn\_project\_adj} = LN_{dn\_project} + 10$$

$$LN_{dn} = 10 * \log\left(10^{\frac{LN_{dn\_baseline}}{10}} + 10^{\frac{LN_{dn\_project\_adj}}{10}}\right)$$

B.4 %HA

$$\%HA = \frac{100}{(1 + e^{10.4-0.132*LN_{dn}})}$$

APPENDIX C : FIGURES

APPENDIX D: RECEIVERS

Table D-1 Inventory of Human Receptors

Location	Receiver	Co-ordinates		
		X (m)	Y (m)	Z (m)
Offsite	Municipality 1	423930.22	6314787.66	28.89
	Municipality 2	451409	6289221	944
	Trapline Cabin 1	400816.74	6256126.46	719.42
	Trapline Cabin 2	407402.26	6260839.63	484
	Trapline Cabin 3	408209.31	6251639.27	484
	Trapline Cabin 4	412405.96	6244472.67	944
Onsite	Existing Exploration Camp 1	419683.27	6261175.92	584
	Existing Exploration Camp 2	440661.13	6283755.55	944
	Camp 1 Granduc Camp	435034.05	6235950.42	940.85
	Camp 2 Ted Morris Staging Camp	418366.81	6261261.78	554.34
	Camp 3 Eskay Camp	409353.66	6278285.79	1064
	Camp 4 Mitchell North Camp	418883.71	6265246.37	719.76
	Camp 5 – Treaty Plant	439269	6279138	1114.78
	Camp 6 – Treaty Saddle	434229	6275296	969.07
	Camp 7 Unuk North Camp	407700.41	6264260.61	484
	Camp 8 Unuk South Camp	408490.59	6263415.67	484
	Camp 9 Mitchell Initial Camp	418211.26	6263802.45	777.16
	Camp 10 – Treaty Saddle	418037	6263502	787.53
	Camp 11 – Treaty Creek Marshalling Camp	460032	6272001	944
	Camp 12 Temporary Road Access Camp	460287.97	6272805.88	944
	Mitchell operating camp	415327.51	6262814.32	518.36
	Treaty operating camp	439129.96	6279349.2	1108.92

Table D-2 Inventory of Wildlife Receptors

Receiver	Co-ordinates		
	X (m)	Y (m)	Z (m)
Mountain Goats (20)	398463	6262914	1275
	403189	6275607	1283
	412361	6262821	1409
	413102	6269214	1542
	414955	6256614	1479
	417364	6269029	1422
	419495	6257170	1929
	420700	6273291	1656
	421534	6266157	1066
	425796	6245310	2083
	427093	6262914	2023
	432837	6281167	1501
	438674	6270048	1299
	440898	6290154	1086
	443122	6284502	1609
	445438	6253556	1548
	444419	6267639	1276
	446828	6284595	1141
	447384	6275885	1629
	452572	6271345	1304
Grizzly Bears (6)	407258	6262442	484
	409932	6269098	484
	441782	6286968	944
	446068	6271833	944
	451690	6263475	944
	452936	6279097	944
Moose (11)	403281	6257170	522
	407729	6265508	484
	413380	6237898	944
	425147	6282927	1071
	431725	6279591	944
	437562	6274403	944
	445901	6288115	944
	452201	6280425	944
	455352	6269770	944
	474160	6260227	944
	479719	6247719	714

APPENDIX E : NOISE SOURCE TABLES

E.1 Construction – Total Continuous Noise Sources

Equipment	Lw	Day (min)	Night (min)	Number of Units
Plant Site Mobile Equipment	**127**	**65100**	**3060**	**222**
Intermittent				
44 person bus	120	720	120	4
Articulated dump truck *,240 kW, 35t	123	2880	0	11
Asphalt paver (+ tipper lorry), 112kW, 12t	110	600	0	1
Diesel water pump, 300 kPa/1645 rpm	113	2400	0	4
Dump truck *, 746 kW, 90t	126	3360	0	14
forklift, 2t or 5t	127	72	24	1
Grader, 205 kW, 25t, Lmax	120	1344	48	6
Lorry * 160 kW, 18t	120	96	48	1
Lorry * 250kW, 36t	121	1944	468	10
Lorry with lifting boom, 50kW, 6t	113	480	120	2
Lorry-Lorries being loaded from silo - 32 t to 36 t	113	480	0	1
Pickup Truck, Passby Lmax	114	10092	480	45
Rigid dump truck *, 517kW, 63t	124	1200	0	5
Tracked hydraulic drilling rig, 100mm bore	122	600	0	1
Tracked hydraulic excavator (mainly engine noise)-82 t	120	600	0	1
Tractor (towing equipment), 100kW	112	1008	192	9
Wheeled loader	120	720	120	2
Wheeled loader (loading lorry), 190kW, 25t	121	1200	0	2
Wheeled mobile crane, 275kW, 35t	110	480	120	2
Tonal				
Backup Beeper	115	26424	1320	86
Impulsive				
Dump truck (tipping fill) 306 kW, 29t	115	8400	0	14
Mine Site Non Road Equipment	**124**	**6605**	**1503**	**17**
Continuous				
Diesel generator	108	600	0	1
Generator for Signage (<25KVA, VMS Signs)	119	3317	910	7
Intermittent				
P&H Shovel 4100 XPB Combined	124	287	172	2

Equipment	Lw	Day (min)	Night (min)	Number of Units
Site lift for workers	100	2040	360	6
Tower crane, 88kW, 22t	117	360	60	1
Mine Site Mobile Equipment	**143**	**74182**	**25171**	**282**
Intermittent				
44 person bus	120	444	86	4
Articulated dump truck *,240 kW, 35t	123	1200	0	5
Articulated dump truck, 250 kW, 51t	111	426	256	1
Asphalt paver (+ tipper lorry), 112kW, 12t	110	600	0	1
Crawler mounted dozer	116	2488	1493	5
Diesel water pump, 300 kPa/1645 rpm	113	4706	1024	8
Dump truck *, 1417kW, 160t	129	61	36	1
Dump truck *, 746 kW, 90t	126	1200	0	5
forklift, 2t or 5t	127	285	152	4
Grader, 205 kW, 25t, Lmax	120	1597	632	11
Lorry * 160 kW, 18t	120	96	48	1
Lorry * 250kW, 36t	121	1488	408	9
Lorry * 298 kW, 44t	124	96	57	1
Lorry with lifting boom, 50kW, 6t	113	2277	1198	5
Lorry-Lorries being loaded from silo - 32 t to 36 t	113	480	0	1
Pickup Truck, Passby Lmax	114	4676	1495	28
Rigid dump truck *, 517kW, 63t	124	240	0	1
Rigid dump truck *, 699kW, 90t	123	171	102	1
Road lorry (full) *,270 kW, 39t	124	1052	631	6
Rotary Drill, 311mm, BE 49R/47R	124	340	204	3
Track Dozer, 425 kW, CAT D10L	124	1208	725	6
Tracked excavator, 228kW, 45t	112	1990	1194	4
Tracked excavator, 380 kW, 90t	123	1054	633	2
Tracked hydraulic drilling rig, 100mm bore	122	1200	0	2
Tracked hydraulic excavator (mainly engine noise)-82 t	120	600	0	1
Tracked mobile crane,132kW, 55t	143	240	144	1
Tracked mobile drilling rig, 317 kW, 20t / 125 mm dia.	123	1006	604	4
Tractor (towing equipment), 100kW	112	912	216	9
Wheel Dozer, 235 kW	127	201	121	1
Wheeled loader	120	720	120	2

Equipment	Lw	Day (min)	Night (min)	Number of Units
Wheeled loader (loading lorry), 190kW, 25t	121	600	0	1
Wheeled loader, 184 kW, 23t	114	711	426	2
Wheeled loader, 320 kW, 45t	122	1259	755	3
Wheeled mobile crane, 275kW, 35t	110	639	360	3
Wheeled mobile telescopic crane, 610kW, 400t	112	142	85	1
Tonal				
Backup Beeper	115	33579	11966	132
Impulsive				
Dump truck (tipping fill) 306 kW, 29t	115	4200	0	7
Plant Site Non Road Equipment	**119**	**5280**	**300**	**15**
Continuous				
Diesel generator	108	1800	0	3
Generator for Signage (<25KVA, VMS Signs)	119	1200	0	5
Intermittent				
Site lift for workers	100	1920	240	6
Tower crane, 88kW, 22t	117	360	60	1
Tunnel Construction Equipment	**114**	**3600**	**2160**	**1**
Continuous				
Tunnel Ventilation Fan	114	3600	2160	1
Tunnel Construction Equipment Mobile	**121**	**28080**	**0**	**40**
Intermittent				
Lorry * 250kW, 36t	121	8640	0	8
Lorry with lifting boom, 50kW, 6t	113	1080	0	4
Wheeled loader (loading lorry), 190kW, 25t	121	3240	0	4
Wheeled loader, 184 kW, 23t	114	1080	0	4
Tonal				
Backup Beeper	115	14040	0	20

E.2 Operations – Total Continuous Noise Sources

Equipment	Lw	Day (min)	Night (min)	Number of Units
Plant Site Mobile Equipment	**143**	**20760**	**4704**	**100**
Intermittent				
44 person bus	120	96	48	2
Backhoe, wheeled, 62kW, 9t	98	360	360	3
Dump truck *, 746 kW, 90t	126	96	24	1
Dump truck, 783 kW, 158t	118	1200	240	4
forklift, 2t or 5t	127	240	96	8
Grader, 205 kW, 25t, Lmax	120	288	144	2
Lorry with lifting boom, 50kW, 6t	113	360	180	1
Pickup Truck, Passby Lmax	114	1080	540	10
Tracked mobile crane,132kW, 55t	143	120	60	1
Wheeled backhoe loader (idling), 62 kW, 8t	90	300	180	3
Wheeled backhoe loader, 62 Kw, 8t	104	1560	360	6
Wheeled loader	120	480	120	2
Tonal				
Backup Beeper	115	6180	2352	43
Impulsive				
Dump truck (tipping fill) 306 kW, 29t	115	8400	0	14
Mine Site Non Road Equipment	**131**	**5254**	**2432**	**15**
Continuous				
Generator for Signage (<25KVA, VMS Signs)	119	2276	1366	6
Main Powerplant	131	900	540	1
Intermittent				
Crusher	129	1200	0	2
P&H Shovel 4100 XPB Combined	124	718	431	5
Screen stockpiler	116	160	96	1
Mine Site Mobile Equipment	**143**	**61853**	**32224**	**268**
Intermittent				
44 person bus	120	336	163	6
Articulated dump truck, 250 kW, 51t	111	1279	768	3
Average Haul Truck Dumping Level	131	624	376	2
Average Shovel Horn	126	16	9	2

Equipment	Lw	Day (min)	Night (min)	Number of Units
Backhoe, wheeled, 62kW, 9t	98	120	120	1
Crawler mounted dozer	116	2985	1791	6
Diesel water pump, 300 kPa/1645 rpm	113	3412	2047	6
Dump truck *, 1417kW, 160t	129	61	36	1
Dump truck *, 746 kW, 90t	126	288	48	2
Dump truck, 783 kW, 158t	118	600	120	2
forklift, 2t or 5t	127	429	200	9
Grader, 205 kW, 25t, Lmax	120	1994	1182	16
Lorry * 298 kW, 44t	124	192	115	2
Lorry with lifting boom, 50kW, 6t	113	3355	1977	6
Pickup Truck, Passby Lmax	114	3423	1727	26
Rigid dump truck *, 699kW, 90t	123	341	205	2
Road lorry (full) *,270 kW, 39t	124	2146	1288	11
Rotary Drill, 311mm, BE 49R/47R	124	344	410	6
Track Dozer, 425 kW, CAT D10L	124	1208	725	6
Tracked excavator, 228kW, 45t	112	1990	1194	4
Tracked excavator, 380 kW, 90t	123	1054	633	2
Tracked mobile crane,132kW, 55t	143	599	347	3
Tracked mobile drilling rig, 317 kW, 20t / 125 mm dia.	123	1006	604	4
Wheel Dozer, 235 kW	127	604	362	3
Wheeled backhoe loader (idling), 62 kW, 8t	90	300	180	3
Wheeled backhoe loader, 62 Kw, 8t	104	960	240	4
Wheeled loader	120	480	120	2
Wheeled loader, 184 kW, 23t	114	711	426	2
Wheeled loader, 320 kW, 45t	122	2693	1616	6
Wheeled mobile crane, 275kW, 35t	110	399	240	2
Wheeled mobile telescopic crane, 610kW, 400t	112	284	171	2
Tonal				
Backup Beeper	115	23421	12785	109
Impulsive				
Dump truck (tipping fill) 306 kW, 29t	115	4200	0	7
Plant Site Non Road Equipment	**124**	**5400**	**3240**	**13**
Continuous				
Baghouse	124			7

Equipment	Lw	Day (min)	Night (min)	Number of Units
Diesel generator - power for site cabins 150 kVA, 1 500 rpm	109	3600	2160	4
Tunnel Ventilation Fan	114	1800	1080	2
Tailing Management Facility Mobile	**126**	**16500**	**840**	**62**
Intermittent				
Dump truck *, 746 kW, 90t	126	480	0	3
Grader, 205 kW, 25t, Lmax	120	840	0	4
Lorry * 250kW, 36t	121	240	0	2
Pickup Truck, Passby Lmax	114	360	120	5
Roller, 145kW, 18t	111	360	0	3
Tracked excavator, 380 kW, 90t	123	1950	0	4
Tractor (towing equipment), 100kW	112	1620	300	6
Wheeled loader, 184 kW, 23t	114	1200	0	2
Tonal				
Backup Beeper	115	9450	420	33
Tailing Management Facility Non Road	**119**	**2400**	**0**	**4**
Continuous				
Generator for Signage (<25KVA, VMS Signs)	119	2400	0	4

E.3 Helicopter Flight Profiles

Typical Approach

- Start Altitude – 304.8m, True Airspeed=104.1 knots
- Level Fly – distance of flight track before descent
- Horizontal deceleration for 1.5km to 80 knots
- Fly constant speed at altitude 152m
- Decelerate whilst descending to attitude 4.6m and 1 knots
- 3 second vertical approach
- 30 seconds flight idle
- 30 seconds ground idle

Typical Departure

- 30 seconds ground idle
- 30 seconds flight idle
- 3 second vertical departure to attitude 4.6m
- Accelerate whilst ascending for 31 m at 55 knots
- Horizontal acceleration for 150m to 80 knots at altitude 9m
- Fly constant speed at altitude 304.8m
- Horizontal acceleration over 850m to 104.1 knots
- Level Fly – distance of flight track before descent

Typical Over-flight

- Start altitude 305 m at 104 knots
- Level Fly – distance of flight track

E.4 Blasting Calculations

The C-weighted sound exposure level (LCE) was calculated using section 4.3 of ANSI 12.17 – 1996 by using the following formula:

$$LCE = 99.1 - 29 * \log\left(\frac{S}{1}\right) - 0.025 * S - Cb$$

$Where$

$$S = \frac{d}{\sqrt[3]{m}}$$

$d = distance\ in\ km\ to\ receiver$

$m = mass, kg\ TNT\ equivalent$

APPENDIX F : RESULTS TABLES

F.1 Human Receptors - Construction Phase

Receiver	Ld – Total Continuous noise (dBA)	Ln - Total Continuous noise (dBA)	Adjusted Ldn with Baseline	Speech interference outdoors	Sleep Disturbance Indoors	Complaints Likely?	Low Freq Noise Annoyance?	Rattle Noise?	Δ %HA	Δ %HA > 6.5
Existing Exploration Camp 1	0	24	62	n/a	No	n/a	n/a	No	9.3	n/a
Existing Exploration Camp 2	31	18	46	n/a	No	n/a	No	No	0.2	n/a
Municipality 1	0	0	45	No	No	No	n/a	No	0.0	No
Municipality 2	0	0	52	No	No	No	n/a	No	1.9	No
Trapline Cabin 1	0	0	45	No	No	No	n/a	No	0.1	No
Trapline Cabin 2	0	0	47	No	No	No	n/a	No	0.3	No
Trapline Cabin 3	0	0	46	No	No	No	n/a	No	0.1	No
Trapline Cabin 4	0	0	45	No	No	No	n/a	No	0.1	No
Camp 5 – Treaty Plant	67	62	80	n/a	Yes	n/a	n/a	No	52.2	n/a
Camp 6– Treaty Saddle	62	49	71	n/a	No	n/a	n/a	No	25.5	n/a
Camp 10– Mitchell Secondary	53	47	65	n/a	No	n/a	n/a	No	12.6	n/a
Camp 11– Treaty Creek Marshalling Camp	0	0	45	n/a	No	n/a	n/a	No	0.0	n/a
Camp 3 Eskay Camp	0	0	45	n/a	No	n/a	n/a	No	0.1	n/a
Camp 7 Unuk North Camp	0	0	61	n/a	No	n/a	n/a	No	7.8	n/a
Camp 8 Unuk South Camp	0	0	48	n/a	No	n/a	n/a	No	0.5	n/a
Camp 4 Mitchell North Camp	58	49	69	n/a	No	n/a	n/a	No	19.8	n/a
Camp 9 Mitchell Initial Camp	56	45	66	n/a	No	n/a	n/a	No	13.7	n/a
Camp 2 Ted Morris Staging Camp	26	26	58	n/a	No	n/a	No	No	4.9	n/a
Camp 12 Temporary Road Access Camp	27	0	45	n/a	No	n/a	n/a	No	0.1	n/a
Camp 1 Granduc Camp	0	0	50	n/a	No	n/a	n/a	No	1.0	n/a
Existing Exploration Camp 1	0	0	51	n/a	No	n/a	n/a	No	1.2	n/a
Treaty operating camp	0	0	46	n/a	No	n/a	n/a	No	0.2	n/a

F.2 Human Receptors - Operations Phase

Receiver	Ld – Total Continuous noise (dBA)	Ln - Total Continuous noise (dBA)	Adjusted Ldn with Baseline	Speech interference outdoors	Sleep Disturbance Indoors	Complaints Likely?	Low Freq Noise Annoyance?	Rattle Noise?	Δ %HA	Δ %HA > 6.5
Existing Exploration Camp 1	34	33	74	n/a	No	n/a	No	No	32.9	n/a
Existing Exploration Camp 2	29	25	47	n/a	No	n/a	No	No	0.3	n/a
Municipality 1	0	0	45	No	No	No	n/a	No	0.0	No
Municipality 2	0	0	52	No	No	No	n/a	No	1.9	No
Trapline Cabin 1	0	0	46	No	No	No	n/a	No	0.2	No
Trapline Cabin 2	0	0	49	No	No	No	n/a	No	0.8	No
Trapline Cabin 3	0	0	48	No	No	No	n/a	No	0.4	No
Trapline Cabin 4	0	0	47	No	No	No	n/a	No	0.3	No
Camp 5 – Treaty Plant	58	55	72	n/a	No	n/a	n/a	No	27.6	n/a
Camp 6– Treaty Saddle	62	62	78	n/a	Yes	n/a	n/a	No	47.3	n/a
Camp 10– Mitchell Secondary	45	38	58	n/a	No	n/a	n/a	No	4.9	n/a
Camp 11 – Treaty Creek Marshalling Camp	25	0	45	n/a	No	n/a	n/a	No	0.1	n/a
Camp 3 Eskay Camp	0	0	47	n/a	No	n/a	n/a	No	0.3	n/a
Camp 7 Unuk North Camp	0	0	61	n/a	No	n/a	n/a	No	8.0	n/a
Camp 8 Unuk South Camp	0	0	50	n/a	No	n/a	n/a	No	1.1	n/a
Camp 4 Mitchell North Camp	51	43	62	n/a	No	n/a	n/a	No	8.7	n/a
Camp 9 Mitchell Initial Camp	49	39	60	n/a	No	n/a	n/a	No	6.3	n/a
Camp 2 Ted Morris Staging Camp	34	33	68	n/a	No	n/a	No	No	17.6	n/a
Camp 12 Temporary Road Access Camp	33	0	46	n/a	No	n/a	n/a	No	0.2	n/a
Camp 1 Granduc Camp	0	0	50	n/a	No	n/a	n/a	No	1.0	n/a
Mitchell operating camp	42	42	60	n/a	No	n/a	No	No	7.0	n/a
Treaty operating camp	63	60	77	n/a	Yes	n/a	n/a	No	42.7	n/a

F.3 Human Receptors - Blasting Noise

	Construction			Operations			Construction			Operations			Construction			Operations		
	Lpeak			Lpeak			LCE			LCE			LNdn (ANSI S 12.9-2005)			LNdn (ANSI S 12.9-2005)		
	Blast 1-001	Blast 1-012	Blast 2-019	Blast 1-001	Blast 1-012	Blast 2-019	Blast 1-001	Blast 1-012	Blast 2-019	Blast 1-001	Blast 1-012	Blast 2-019	Blast 1-001	Blast 1-012	Blast 2-019	Blast 1-001	Blast 1-012	Blast 2-019
Existing Exploration Camp 1	108	106	83	109	108	88	92	90	65	98	96	75	52	47	22	64	58	32
Existing Exploration Camp 2	82	74	91	79	72	71	60	51	69	61	53	53	13	4	22	15	7	7
Municipality 1	85	79	85	86	81	86	60	55	61	66	61	66	11	6	12	18	13	19
Municipality 2	83	73	88	81	68	70	59	50	64	61	49	51	11	2	17	14	2	4
Trapline Cabin 1	93	92	92	94	94	93	71	70	69	77	76	75	24	24	22	31	30	29
Trapline Cabin 2	96	96	95	97	97	96	75	75	74	81	80	79	30	29	28	36	35	34
Trapline Cabin 3	94	94	83	96	95	94	73	73	62	79	79	77	27	26	15	34	33	31
Trapline Cabin 4	93	93	83	95	95	73	72	71	61	78	77	56	25	25	15	32	32	10
Camp 5	73	72	93	75	73	74	51	50	72	57	56	57	4	3	25	11	10	11
Camp 6	77	75	97	78	77	78	56	54	76	62	60	62	10	8	30	16	15	17
Camp 10	88	104	98	89	106	101	72	87	80	78	93	87	29	44	37	40	51	44
Camp 11	83	74	88	73	70	69	60	50	64	53	50	50	11	2	17	6	4	4
Camp #3 Eskay Camp	93	94	94	94	95	95	71	72	72	77	78	78	25	26	26	32	32	33
Camp #7 Unuk North	96	95	95	97	97	96	76	75	74	81	80	80	30	29	28	37	36	35
Camp #8 Unuk South	96	96	95	98	97	96	76	75	74	82	81	80	31	30	28	38	36	35
Camp #4 Mitchell North	89	104	107	90	106	108	73	87	89	78	93	95	30	44	46	41	52	53
Camp #9 Mitchell Initial	85	95	98	87	96	101	69	78	81	75	84	87	27	35	37	38	42	44
Camp #2 Ted Morris Staging Camp	106	109	99	108	111	101	90	92	81	96	98	87	47	49	37	58	56	44
Camp #12 Temporary Road Access Camp	74	70	88	72	69	69	51	46	64	53	50	50	3	0	16	6	3	3
Camp #1 Granduc Camp	77	90	90	71	90	71	54	67	67	53	72	52	7	20	19	6	25	6
Mitchell operating camp	100	99	97	102	100	99	82	81	78	88	86	84	38	36	34	46	43	40
Treaty operating camp	73	72	93	75	74	74	51	50	72	57	56	57	4	3	25	11	10	12

F.4 Wildlife Receptors – Event Sound Exposure and Peak Levels

Receiver	Construction		Operations	
	Helicopter LAE	Blasting Lpeak	Helicopter LAE	Blasting Lpeak
Goat Receptor Points 1	41	91	41	93
Goat Receptor Points 2	42	92	42	94
Goat Receptor Points 3	64	99	64	100
Goat Receptor Points 4	55	99	55	100
Goat Receptor Points 5	67	98	67	100
Goat Receptor Points 6	58	103	58	104
Goat Receptor Points 7	61	81	61	82
Goat Receptor Points 8	50	88	50	89
Goat Receptor Points 9	72	117	72	119
Goat Receptor Points 10	52	74	52	75
Goat Receptor Points 11	57	92	57	92
Goat Receptor Points 12	51	94	51	96
Goat Receptor Points 13	60	81	60	77
Goat Receptor Points 14	43	89	43	90
Goat Receptor Points 15	52	91	52	82
Goat Receptor Points 17	53	84	53	75
Goat Receptor Points 16	43	92	43	73
Goat Receptor Points 18	46	72	46	71
Goat Receptor Points 19	53	91	53	79
Goat Receptor Points 20	57	90	57	75
Grizzly Receptor Points 1	85	94	85	96
Grizzly Receptor Points 2	76	96	76	81
Grizzly Receptor Points 3	49	90	49	71
Grizzly Receptor Points 4	83	92	83	73
Grizzly Receptor Points 5	49	90	49	72
Grizzly Receptor Points 6	41	89	41	70
Moose Receptor Points 1	45	93	45	94
Moose Receptor Points 2	86	95	86	96
Moose Receptor Points 3	38	88	38	73
Moose Receptor Points 4	42	94	42	96
Moose Receptor Points 5	50	95	50	96
Moose Receptor Points 6	86	95	86	76
Moose Receptor Points 7	43	89	43	70
Moose Receptor Points 8	41	89	41	70
Moose Receptor Points 9	75	89	75	73
Moose Receptor Points 10	30	85	30	67