APPENDIX 13B

NOISE

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Maps

Tables

Abbreviations

Abbreviation	Definition
AER	Alberta Energy Regulator
CadnaA	Computer Aided Noise Abatement
e.g.	for example
EUB	Alberta Energy and Utilities Board – former name of Alberta Energy Regulator
i.e.	that is
ISO	International Organization for Standardization
L_{eq}	equivalent energy noise level
NIA	noise impact assessment
Project	Jay Project
PSL	permissible sound level
WRSA	waste rock storage area

Units of Measure

Unit	Definition
°	degrees
°C	degrees Celsius
%	percent
+-	plus minus (range)
>	greater than
cm	centimetre
dB	decibel
dBA	A-weighted decibel
Hz	hertz
km	kilometre
km/h	kilometres per hour
m	metre
m/s	metres per second

13B1 NOISE IMPACT ASSESSMENT

13B1.1 Introduction

The environmental assessment (EA) for the Jay Project (Project) was prepared as part of an application by Dominion Diamond Ekati Corporation (Dominion Diamond) to construct and operate the Jay kimberlite pipe and associated mining infrastructure as an extension to the existing Ekati Diamond Mine (Ekati Mine), which is located 300 kilometres (km) northeast of Yellowknife in the Northwest Territories (NWT). This noise impact assessment (NIA) considered potential noise emissions and resulting changes in ambient noise levels occurring during construction and operation of the Project. The NIA focused on Project-related noise sources (e.g., stationary and mobile equipment) and activities (e.g., haul road and winter road traffic, blasting, and material extraction and processing).

The objective of this report was to meet the noise assessment requirements outlined in the Terms of Reference (TOR), which were released on July 17, 2014 by the Mackenzie Valley Review Board (Appendix 1A). Section 5.1 of the TOR requires a description of baseline ambient noise levels throughout the year in the context of a description of the existing biophysical environment. Section 7.3.3 of the TOR requires that effects of noise pollution on caribou habitat be assessed as part of a key line of inquiry dealing with impacts to caribou. Section 7.4.3 of the TOR requires that the potential for sensory disturbance associated with noise be described in the context of a subject of note dealing with impacts to wildlife and wildlife habitat. Section 8.2.1 of the TOR requires that potential sensory impacts associated with noise be described in the context of a subject of note dealing with impacts to cultural aspects.

A baseline noise monitoring program was conducted in response to the requirements presented in Section 5.1 of the TOR. The results of the baseline noise monitoring program are summarized in this report and are described in detail in the Noise Baseline Report (Annex II).

Summaries of noise effects relevant to wildlife and humans are provided in the specific key line of inquiry and subject of note sections in the EA report – Sections 13 and 14, respectively. In particular, assessment of noise effects on valued components and determination of environmental consequences and significance on valued components are provided in the relevant key line of inquiry and subject of note sections of the EA report. This report presents technical information used in the assessment of noise effects and in the determination of environmental consequence and significance.

13B1.1.1 Purpose and Scope

The NIA conducted for the Project summarized the current noise environment within the Project area, and predicted temporal and spatial changes in noise levels due to construction and operation of the Project. Project closure was not assessed because it was assumed that equipment and activities used during this phase will be similar to or less than those identified and assessed for the construction phase. As a result and as a conservative approach to this assessment, the magnitude and extent of noise from the Project during closure is assumed to be comparable to the construction phase.

DOMINION DIAMOND

The purpose of this NIA was to analyze potential effects of the Project on the environment by comparing the noise levels present within the Project area before and after development of the Project. Currently there is no legal framework or guidance related to assessment of noise from industrial developments in effect in the NWT. In the absence of such regulations, potential noise effects from the Project were assessed by adopting noise regulation and guidance described in Alberta Energy Regulator (AER) *Directive 038: Noise Control* (EUB 2007) and Health Canada's *Useful Information for Environmental Assessments* (Health Canada 2010). Directive 038 was used to characterize noise levels resulting from operation of the Project (i.e., open-pit operations), whereas the Health Canada guidance and methodology were used in assessment of noise levels resulting from construction of the Project.

The Project will make use of existing infrastructure associated with the Ekati Mine, including the Ekati camp, processing plant, and airstrip. However, operations at these facilities will not change as a result of the Project – these facilities will continue to operate in the same way that they operate currently. As such, the Ekati Mine was included in the NIA as part of the existing environment, but it was not considered part of the Project.

13B1.1.2 Study Areas and Receptors

Noise emissions from the Project were assessed within a spatial domain comprising two geographical areas: a local study area (LSA) and a regional study area (RSA). Both areas define modelling domains for predictions of spatial and temporal changes in noise levels due to the Project.

The LSA is centred on the Project and covers the entire spatial extent of the Project-related developments such as the mine pit, waste rock storage area (WRSA), mine access roads, and an approximately 8.5-km-long portion of the Misery Road. In accordance with Directive 038, the LSA encompasses an area limited by a 1.5 km AER criteria boundary traced at the distance of 1.5 km from the Project footprint.

The RSA was established to characterize noise emissions from the Project that extend over a larger area. The RSA includes the entire LSA and spans approximately 7 km in each direction from the centre of the Project.

Noise levels from the Project were quantified for the specific geographic locations (i.e., receptors) along the 1.5 km AER criteria boundary that were associated with the highest predicted noise levels from the Project during construction or operations. Receptors identified as Rsouth, Rsouthwest, Rnorth, and Rwest were used to assess noise emissions from Project operations. Receptors CRsouth, CRsouthwest, CRnorth, and CRwest, which are associated with highest predicted noise levels, and a fifth receptor, Camp, which is associated with the Misery camp site, were selected to assess construction noise.
A separate receptor, Rwinter road, was used only for the assessment of the Winter Road. The location of this receptor corresponds to the location 1.5 km from the Winter Road for which the highest noise levels were predicted.

The Project will make use of existing infrastructure associated with the Ekati Mine, including the Ekati camp, processing plant, and airstrip, However, because operations at the Ekati Mine will not be changing as a result of the Project, the Ekati Mine was not considered to be part of the Project. As such, specific receptors associated with the Ekati Mine were not included in the NIA.

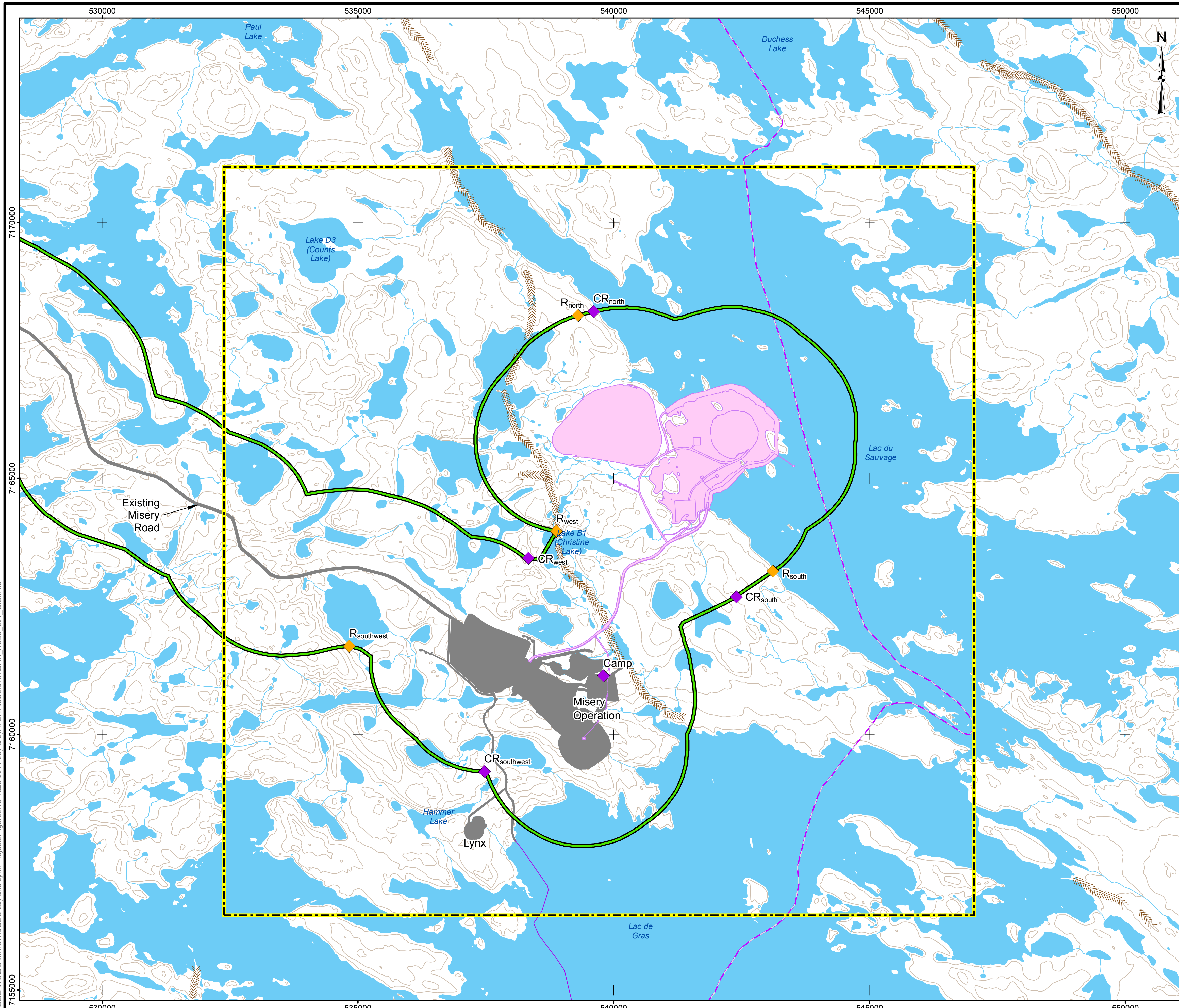
The receptors used in the noise assessment are land-based (i.e., receptors located along portions of the 1.5 km AER criteria boundary that intersect waterbodies were not considered). Considering only land-based receptors is consistent with Directive 038 guidance, which indicates noise assessment should be confined to sites where permanent or seasonal occupancy is likely to occur. Coordinates of the noise receptors that were used in the NIA are presented in Table 13B1.1-1.

Table 13B1.1-1 Receptor Locations

Receptor	Description	Universal Transverse Mercator (Zone 12 W, NAD83)	
		Easting [m]	Northing [m]
Rsouth	Unoccupied site located along southern portion of 1.5 km AER criteria boundary with highest predicted noise contributions from Project operations	543117	7163183
Rsouthwest	Unoccupied site located along south-eastern portion of 1.5 km AER criteria boundary with highest predicted noise contributions from Project operations	534838	7161718
Rnorth	Unoccupied site located along northern portion of 1.5 km AER criteria boundary with highest predicted noise contributions from Project operations	539304	7168184
Rwest	Unoccupied site located along western portion of 1.5 km AER criteria boundary with highest predicted noise contributions from Project operations	538884	7163965
Camp	Receptor located at Misery workers camp, close to workers accommodations.	539800	7161136
CRsouth	Unoccupied site located along southern portion of 1.5 km AER criteria boundary with highest predicted noise contributions from Project construction	542397	7162685
CRsouthwest	Unoccupied site located along south-eastern portion of 1.5 km AER criteria boundary with highest predicted noise contributions from Project construction	537475	7159267
CRnorth	Unoccupied site located along northern portion of 1.5 km AER criteria boundary with highest predicted noise contributions from Project construction	539609	7168260
CRwest	Unoccupied site located along western portion of 1.5 km AER criteria boundary with highest predicted noise contributions from Project construction	538337	7163437
Rwinter road	Unoccupied site located 1.5 km from the Winter Road with the highest predicted noise levels from Winter Road operations	526982	7166970

Rsouth, Rsouthwest, Rnorth, Rwest = operation noise assessment receptors located along the 1.5 km AER criteria boundary; Camp= Receptor associated with Misery camp; CRsouth, CRsouthwest, CRnorth, CRwest = construction noise assessment receptors located along the 1.5 km AER criteria boundary; Rwinter road = Winter Road noise assessment receptor located along the 1.5 km AER criteria boundary; AER = Alberta Energy Regulator; W = west; NAD 83 = North American Datum of 1983; m = metre; km = kilometre.

The Project footprint, LSA, 1.5 km AER criteria boundary, RSA, and location of noise assessment receptors are presented in Map 13B1.1-1.



LEGEND

- EKATI MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (10 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY
- CONSTRUCTION NOISE RECEPTOR
- OPEN PIT OPERATIONS NOISE RECEPTOR
- 1.5 km ALBERTA ENERGY REGULATOR CRITERIA BOUNDARY / LOCAL STUDY AREA
- REGIONAL STUDY AREA

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

1.5 0 1.5
SCALE 1:75,000 KILOMETRES

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

NOISE LOCAL STUDY AREA AND RECEPTOR LOCATIONS

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Noise_001_GIS	
DESIGN	TN	06/08/14	SCALE AS SHOWN	REV 0
GIS	JE	20/10/14	MAP 13B1.1-1	
CHECK	VY	20/10/14		
REVIEW	AF	20/10/14		

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13B1.1.3 Noise Impact Assessment Report Content

This NIA report includes the following sections:

- **Existing Environment –**describes the existing noise levels measured in the LSA and RSA (Section 13B1.2);
- **Pathway Analysis –**describes potential environmental effects of the Project due to noise emissions (Section 13B1.3);
- **Noise Analysis Methods –** describes methods and criteria used in the assessment of noise emissions, the modelling approach used to characterize noise emissions from the Project, and the assessment cases identified for the Project (Section 13B1.4);
- **Noise Assessment Results –** presents the predicted noise levels for construction, operations, blasting, the open-pit mine, and the Winter Road (Section 13B1.5);
- **Conclusions –** describes the conclusions of the Project NIA (Section 13B1.6); and,
- **References –** lists documents and other sources used in preparation of the NIA (Section 13B1.7).

13B1.2 Existing Environment

The current acoustical environment within the RSA is dominated mostly by contributions from naturally occurring noise sources (e.g., wind in vegetation, wildlife) and is also, to a lesser degree, influenced by noise emissions from industrial or man-made sources (e.g., Misery Pit, Misery Road).

Noise levels within the RSA were measured during a field survey conducted in summer 2013. The survey methodology was consistent with the approach described in AER Directive 038 (EUB 2007). The data obtained during the baseline noise measurements was considered as the base case for the Project NIA.

13B1.2.1 Methods

The existing noise levels within the RSA were established via a baseline noise survey that took place from July 26 through July 28, 2013. Three monitoring locations were selected to measure existing noise levels within areas to the north, west, and south of the proposed Project (Annex II, Map 1.2-1). Each location was monitored for a minimum duration of 24 hours to characterize variations in noise levels during the daytime and nighttime periods. This survey duration is considered sufficient to capture the variation of noise levels in the area surrounding the monitoring locations.

In addition to noise level measurements, weather parameters were also recorded and used during the data analysis. The validity of data was determined based on the requirements of Directive 038 in conjunction with interpretation of the audio recordings that were collected at each monitoring location. Invalid noise measurement data were removed (e.g., wind speed exceeding 15 kilometres per hour [km/h], periods of heavy precipitation, or presence of non-representative noise sources). The results of the baseline noise program are presented in Annex II.

13B1.2.2 Existing Conditions

The results of the baseline noise survey indicate that the noise levels measured at the three monitoring locations were between 25 A-weighted decibels (dBA) and 28 dBA for the AER-defined daytime period (i.e., 7:00 am to 10:00 pm), and between 21 dBA and 25 dBA for the AER-defined nighttime period (i.e., 10:00 pm to 7:00 am). A small variation of 3 dB between daytime and nighttime noise level was observed during the survey, which is expected to be typical for remote tundra areas with mostly natural noise sources present in the environment.

The relatively low existing noise levels can be attributed to the remoteness of the site (i.e., large distance to industry-based noise sources), and the lack of large trees or other vegetation in the area (i.e., tundra landscape). Directive 038 also requires that only data samples recorded at wind speeds below 15 km/h can be included in the calculation of daytime and nighttime noise levels. Therefore, it can be expected that during periods of increased wind speeds the ambient noise may be substantially higher than 28 dBA. The baseline noise survey results are summarized in Table 13B1.2-1.

Table 13B1.2-1 Baseline Noise Levels

Receptor	Leq, day (dBA)	Leq, night (dBA)
R1	25	25
R2	27	21
R3	28	23

R1, R2, R3 = receptors from the baseline noise survey, Noise Baseline Report (Annex II).

Leq, day = equivalent energy noise level during daytime period (7:00 am to 10:00 pm); Leq, night = equivalent energy noise level during nighttime period (10:00 pm to 7:00 am); dBA = A-weighted decibel; am = ante meridiem; pm = post meridiem.

Directive 038 requires that ambient noise is measured under representative summertime conditions (i.e., no ice or snow ground cover, and temperatures above 0 degrees Celsius [ºC]). Therefore, the noise baseline survey was conducted during the summer. A winter baseline noise survey was not conducted because it would not be in accordance with Directive 038. In addition, the Type I sound level meters that are used for noise monitoring are only accurate at temperatures above –10ºC. However, it is expected that noise levels during the winter should, on average, be higher than those observed during the summer. This assumption takes into consideration lack of noise from wildlife, and increased noise levels due to higher wind speeds and adverse meteorological conditions.

13B1.3 Pathway Analysis

Noise levels, occurring within a specific area, are not considered as a primary environmental effect because typical environmental noise levels do not accumulate enough energy to impact directly the surrounding environment. However, noise may have an environmental effect when considered from a receptor perspective (e.g., wildlife or humans).

The activities related to construction and operation of the Project, including the mine fleet, Winter Road, and blasting, were considered to be noise sources affecting the noise environment within the LSA, and as having the potential to affect the RSA.

Noise as a physical phenomenon propagates within the environment, from a source to a receptor, thorough pathways that are associated with specific transfer mediums (e.g., air, water, and ground). Changes in the existing noise environment can be detected by receptors (e.g., wildlife, people) and cause a specific reaction proportional to the noise level (e.g., avoidance, attraction). The noise component of the EA considers the pathway from the noise source to the receptor, and the overall noise level at various distances from the source.

Potential environmental effects of noise emissions from Project-related activities to the noise levels expected throughout the lifetime of the Project are presented in Table 13B1.3-1.

Table 13B1.3-1 Potential Environmental Effect of the Project

Activity	Potential Environmental Effect
Construction/Closure	Temporal changes in ambient noise levels (Leq, day and Leq, night [dBA]), limited to duration of Project construction activities
Operations (e.g., ore and waste extraction, transportation and processing)	Continuous long-term changes in ambient noise levels (Leq, day and Leq, night [dBA]), limited to duration of Project operations
Blasting	Short-term changes in noise levels (Lmax [dBL]), limited to duration and frequency of blasting operations
Winter Road	Short-term change in noise levels (Leq, day and Leq, night [dBA]), limited to number and duration of each truck passage along the Winter Road

Leq, day = equivalent energy noise level during daytime period (7:00 am to 10:00 pm); Leq, night = equivalent energy noise level during nighttime period (10:00 pm to 7:00 am); dBA = A-weighted decibel; dBL = L-weighted decibel; Lmax = maximum noise level; am = ante meridiem; pm = post meridiem.

13B1.4 Noise Analysis Methods

13B1.4.1 Noise Assessment Criteria

13B1.4.1.1 Construction

The NWT does not have specific noise regulations for assessing noise emissions during construction of the Project. In the absence of specific territorial regulations, and because Directive 038 does not provide assessment methods for construction, Health Canada guidance and benchmarks were used to assess potential environmental effects of the Project construction on humans (Health Canada 2010). The Health Canada noise assessment benchmarks include the following:

- noise-induced hearing loss;
- sleep disturbance;
- interference with speech comprehension;
- complaints; and,
- change in percentage of highly annoyed.

The Health Canada guidance focuses the assessment primarily on human-related receptors (e.g., occupied dwellings, hospitals, schools, workers camps). Only one potential receptor, Misery camp (Camp), can be considered as an occupied receptor under Health Canada guidance. To assess the noise effects in the LSA from Project construction, four additional receptors were included. These receptors were selected following the assessment approach described in Directive 038, which requires noise to be assessed along the 1.5 km AER criteria boundary. Selection of receptors along the 1.5 km AER criteria boundary is not required or recommended by the Health Canada guidance. However, in the absence of other occupied sites, this approach provides information on the spatial extent of noise effects from Project construction.

The Health Canada guidance requires that total noise levels (i.e., the logarithmic sum of measured baseline noise levels and predicted Project contributions) be calculated at each identified receptor. The base case noise levels used in the construction noise assessment for receptors located along the 1.5 km AER criteria boundary were based on the results obtained during the baseline noise survey for receptor R2. This receptor was the only receptor with noticeable noise contributions from the Misery Mine and Misery Road.

The baseline noise level at the Camp receptor was not measured during the baseline noise survey. Therefore, a direct comparison between existing noise levels and contributions from construction noise was not practical. However, it was possible to assess a potential change of noise level at the Camp based on results from model predictions. This approach allowed an assessment as to whether the construction of the Project has potential to affect existing noise levels at the Camp. To evaluate noise effects of the Project construction, the predicted noise levels were compared with the specific noise benchmarks indicated by Health Canada.

The benchmarks for noise levels described in the Health Canada guidance are presented in Table 13B1.4-1.

Table 13B1.4-1 Health Canada Construction Noise Benchmarks

Receptor	Noise-Induced Hearing Loss		Sleep Disturbance	Speech Comprehension		Complaints	Highly Annoyed
	Leq, day [dBA]	Leq, night [dBA]	Leq, night [dBA]	Leq, day [dBA]	Leq, night [dBA]	Leq, dn [dBA]	%HA
Camp	70	70	45	55	55	62	6.5
CRsouth	70	70	45	55	55	62	6.5
CRsouthwest	70	70	45	55	55	62	6.5
CRnorth	70	70	45	55	55	62	6.5
CRwest	70	70	45	55	55	62	6.5

Source: Health Canada (2010).

Leq, day = equivalent energy noise level during daytime period (7:00 am to 10:00 pm); Leq, night = equivalent energy noise level during nighttime period (10:00 pm to 7:00 am); Leq, dn= equivalent energy noise level during 24-hour period with a 10 dB penalty applied to the nighttime period; dBA = A-weighted decibel; Camp = Receptor associated with Misery camp; CRsouth, CRsouthwest, CRnorth, CRwest = noise assessment receptors located along 1.5 km AER criteria boundary; AER = Alberta Energy Regulator decibel; am = ante meridiem; pm = post meridiem;%HA = percentage of highly annoyed population.

13B1.4.1.2 Operations

The NWT does not have environmental noise regulations. Therefore, the assessment of noise from Project operations was based on Directive 038 (EUB 2007). Directive 038 stipulates that noise emissions from facilities under its jurisdiction be controlled to a permissible sound level (PSL) at each dwelling located within the AER 1.5 km criteria boundary. If there are no dwellings within the AER 1.5 km criteria boundary (Directive 038 explicitly excludes worker camps as dwellings), Directive 038 requires noise levels form the Project to not exceed PSL at any point along the AER 1.5 km criteria boundary.

Directive 038 requires that cumulative noise levels be compared to the PSL. Cumulative noise levels include contributions from existing and approved facilitates, a mandated ambient sound level (ASL) that accounts for natural and non-industrial sources, and the Project noise emissions. Directive 038 specifies a daytime and nighttime ASL, as well as the methodology that was used to determine daytime and nighttime PSL values applicable to the Project. Values of ASL and PSL based on Directive 038 and applicable to the Project are presented in Table 13B1.4-2.

Table 13B1.4-2 Mandated Ambient Sound Level and Permissible Sound Levels as per Directive 038

Receptor	Ambient Sound Level[(a)] (ASL) [dBA]		Permissible Sound Level[(b)] (PSL) [dBA]	
	Nighttime	Daytime	Nighttime	Daytime
Rsouth	35	45	40	50
Rsouthwest	35	45	40	50
Rnorth	35	45	40	50
Rwest	35	45	40	50

a) Ambient sound level as per Directive 038 (EUB 2007).

b) Permissible sound levels as per Directive 038 (EUB 2007).

Daytime = daytime period (7:00 am to 10:00 pm); Nighttime = nighttime period (10:00 pm to 7:00 am); dBA = A-weighted decibel; am = ante meridiem; pm = post meridiem; Rsouth, Rsouthwest, Rnorth, Rwest = noise assessment receptors located along the 1.5 km Alberta Energy Regulator criteria boundary.

Directive 038 also provides an approach that can be used to identify potential effects related to low frequency noise (LFN). Using the assessment criteria for LFN described in Directive 038,there is a potential for LFN effects if the following is present:

- the difference between predicted noise levels expressed in C-weighted decibels (dBC) and A-weighted decibels (dBA) is equal to or above 20 dB; and,
- a clear tonal component exists at frequencies below 250 hertz (Hz).

The first condition can be evaluated based on the results of the model predictions. However, the presence of a tonal component can be only confirmed by actual noise measurements. Because the Project is in an early design stage, the potential for LFN issues due to operation of the Project can only be evaluated based on the first condition.

Directive 038 requires that noise is assessed during summertime weather conditions. The weather parameters that Directive 038 considers as representative of these conditions include temperature between 0 to 25ºC, relative humidity between 70 percent (%) and 90%, and wind speeds from 5 km/h to 7 km/h from source to receptor. The ASL values used in the Project NIA were based on average summertime noise levels typically encountered in quiet rural environment without contributions from industrial sources.

Directive 038 allows seasonal adjustment of PSL values to reflect changes in noise levels during the winter. However, this approach is only applicable to noise complaint investigations. It is expected that noise contributions from the Project will increase during the winter due to generally favourable noise propagation conditions (i.e., hard reflective ground coverage and existence of an inversion layer). However, it is also expected that winter will be characterized by higher wind speeds increasing the degree of noise masking by wind-related noise. Therefore, overall wintertime noise effects will be less pronounced when compared to summertime noise effects.

13B1.4.1.3 Blasting

Noise emissions from blasting were assessed as a separate part of the Project, because this type of noise is considered to be short term, and it can be only assessed in the context of maximum noise and vibration levels. The NWT does not have regulatory requirements for assessing environmental noise and vibration from blasting activities. Therefore, in the absence of such regulations, the assessment of noise and vibration from blasting operations was based on limits outlined in the Ontario Ministry of Environment (OMOE) *Noise Pollution Control Publication 119* (NPC-119) (OMOE 1978).

According to NPC-119, the limits of ground vibration peak particle velocity (PPV) expressed in the unit of millimetres per second (mm/s) and air vibration peak pressure level (PPL) expressed in linear decibels (dBL) should not exceed 10 mm/s and 120 dBL, respectively. The assessment of noise and vibration levels from Project blasting activities used engineering formulae to determine noise and vibrations levels at certain distances from the blasting site. The predicted results can be considered as conservative because the calculations do not consider attenuation due to terrain screening nor air absorption. The NPC-119 noise and vibration limits for Project-related blasting operations are presented in Table 13B1.4-3.

Table 13B1.4-3 Limits of Vibration and Noise Levels from Blasting

Vibration Type	Unit	Limits for Blasting Operations
Ground borne	Peak Particle Velocity (mm/s)	10
Air borne	Peak Pressure Level (dBL)	120

Source: Ontario Ministry of Environment (OMOE 1978).
dBL = linear decibel; mm/s = millimetres per second.

Vibration levels from everyday activities are presented in Table 13B1.4-4. Effects of elevated peak pressure levels on structural elements of buildings are described in Table 13B1.4-5. These two tables are presented to provide context to the NPC-119 noise and vibration limits for blasting operations.

Table 13B1.4-4 Vibration Levels from Everyday Activities

Vibration Level (mm/s)	Activity
0.8	walking
0.8	heel drops
7.1	jumping
12.7	doors slams
22.4	pounding nails

Source: Dowding (1985).
mm/s = millimetres per second.

Table 13B1.4-5 Peak Pressure Level Criteria

Peak Pressure Level (dBL)	Damage Measure
180	Some structural damage possible
171	General window breakage
151	Occasional window breakage
140	Long-term history of application as safe project specification
134	United States Bureau of Mines recommended maximum for large-scale surface mine blasting

Source: International Society of Explosive Engineers (ISEE 1998).
dBL = L-weighted decibel; L-weighted = linear scale.

13B1.4.1.4 Winter Road

Noise emissions from the Winter Road were assessed using the same approach and benchmarks as used in the noise assessment of the Project operations (i.e., noise levels were assessed along the 1.5 km AER criteria boundary traced from the Winter Road). During the lifetime of the Project, noise related to truck traffic along the Winter Road is expected to remain at the current capacity. It is expected that load requirements of current Ekati Mine operations and Project operations will be comparable. Therefore, no net increase in noise emissions from the Winter Road is expected. However, based on available information there will be a slight increase of Winter Road truck traffic (approximately 200 additional trucks per season) during Project construction. Therefore, the NIA analyzed the following two assessment cases:

- Project operations – based on current Ekati Mine truck traffic on the Winter Road of approximately 2,063 trucks per season); and,
- Project construction – based on current Ekati Mine truck traffic on the Winter Road of approximately 2,063 trucks per season plus an additional 200 trucks per season during Project construction.

Trucks traveling along the Winter Road are not considered major noise sources and their noise contributions are spatially limited to the area adjacent to the road. Directive 038 requires that noise assessment is conducted during summertime conditions (i.e., temperature above 0˚C and absence of snow or ice ground cover). Directive 038 allows a seasonal adjustment (i.e., wintertime adjustment of 5 dBA) to be applied to PSL values, but only for situations when a noise complaint is received. The noise assessment for the Winter Road was conducted using computer model calculations configured for wintertime temperature and humidity values. However, no seasonal PSL adjustment was applied. Therefore, the results can be considered conservative (i.e., tending to overestimate potential noise effects associated with the Winter Road).

13B1.4.2 Noise Modelling Methods

13B1.4.2.1 Modelling Software

Noise emissions from Project construction and operations, and from the Winter Road were assessed based on results obtained from computer models that were developed for the specific phases of the Project (e.g., construction, operations) or activity (e.g., truck traffic on Winter Road).

Computer Aided Noise Abatement (CadnaA) version 4.3.143 software, by DataKustik GmbH, was used to develop detailed computer models of the Project phases and activities. CadnaA software uses a calculation algorithm that is consistent with the international standard *ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 1996). The computer model has the ability to simulate noise emissions from stationary and mobile equipment or activities (e.g., haul trucks, excavators, crushers, electrical transformers, and ventilation fans) using point, line and/or area sources, as required.

Each emission source is characterized by specifying either the total sound power level or the octave-band sound power level. Other parameters, such as equipment and building dimensions, hours of operation, and noise controls (e.g., transmission loss and insertion loss), can also be represented by the model, allowing for realistic and accurate treatment of operational parameters and character of noise sources.

The CadnaA model also accounts for noise attenuation related to meteorological conditions, ground cover, and physical barriers, either natural (e.g., terrain-based) or man-made (e.g., screens, barriers, and buildings).

13B1.4.2.2 Model Input Parameters

The configuration parameters that were used during model calculations are listed in Table 13B1.4-6.

Table 13B1.4-6 Model Configuration Parameters

Parameter	Model Setting	Description/Comments
Standards used	ISO 9613-2 (ISO 1996)	All noise sources modelled based on requirements of the standard
Ground absorption	0.0 – waterbodies 0.5 – rest of LSA and RSA	These values represent the acoustic properties of the ground in accordance with ISO 9613-2 (ISO 1996): 0.0 represents hard/reflective ground; 1.0 represents porous/absorptive ground
Temperature/humidity	11˚C/71% summertime[(a)] -25˚C/78% wintertime[(b)]	Average summer conditions within Project area Average wintertime conditions within Project area

Table 13B1.4-6 Model Configuration Parameters

Parameter	Model Setting	Description/Comments
Wind conditions	1 to 5 m/s	Default ISO 9613-2 (ISO 1996) including moderate inversion condition, all receptors downwind from each source
Terrain	Ground elevation lines (5 m[c] to 520 m) at 5 m resolution	Ground elevation lines used to characterize topography of the terrain within the Project area
Order of reflections	1	Maximum of one reflection included in calculations
Source type	Line Point Area	Mobile equipment (e.g., truck) was represented by line source located along equipment movement pattern Stationary sources (e.g., fans, idling trucks) were represented as point sources located in specific areas of the mine Sources that are expected to move or operate with changing pattern (e.g., dozer within pit or WRSA) were represented as area sources with acoustical energy distributed over expected area of operation (e.g., pit)

a) Summertime defined based on Directive 038 (EUB 2007) (temperature above 0˚C and no snow or ice ground cover).

b) Wintertime defined as time for which Winter Road will be operational (e.g., from February to the end of March).

c) Bottom of the pit.

ISO = International Organization for Standardization; LSA = local study area; RSA = regional study area; ˚C = degrees Celsius;% = percentage of relative humidity; m/s = metres per second; m = metre; WRSA = waste rock storage area.

13B1.4.2.3 Model Limitations

Outdoor noise attenuation was predicted using standard algorithms and assumptions that tend to simplify the actual acoustic environment. Noise, whether natural or man-made, is normally variable over time. The algorithms used to calculate equivalent energy noise level (Leq) within the LSA and RSA account for that variability, but are not capable to predict the exact moment of its occurrence.

The quality and relevance of predictions from the noise model are dependent on the data inputs. For the NIA, sound power levels of Project noise sources were established using a combination of acoustical data collected for similar equipment, manufacturer-provided equipment noise data, and noise emission calculations based on widely accepted engineering formulae.

13B1.4.2.4 Model Uncertainty

The ISO 9613-2 standard will predict noise attenuation to within ± 3 dBA for distances up to 1 km (ISO 1996). The prediction accuracy for larger distances is not specified in the standard, although accuracy is expected to decrease with increasing distance.

13B1.4.3 Noise Assessment Cases

13B1.4.3.1 Base Case

The base case characterizes the noise environment that exists within the LSA and RSA. The base case includes noise contributions from sources related to existing industrial developments (e.g., mine sites, roads), non-industrial man-made sources (e.g., aircraft), and natural sources (e.g., wildlife, waves on waterbodies, precipitation, and wind in vegetation). The purpose of the base case is to quantify the existing noise levels before the start of Project construction or operations.

Base case noise levels were used to analyze potential changes in noise levels resulting from development of the Project. The effect of the Project was judged, in part, based on comparison of noise levels existing before the Project (i.e., base case) with the noise levels predicted to exist in the area after the Project becomes operational (i.e., cumulative case).

13B1.4.3.1.1 Pre-Development Noise Levels

Pre-development noise levels refer to noise levels existing within the area of Lac du Sauvage and Lac de Gras before any industrial development. Before the existence of any industrial developments, environmental noise in the LSA and RSA was influenced by naturally occurring sources (e.g., wind in vegetation, wildlife, rain). Acoustical data for this period is not available. However, it can be assumed that noise levels within an area located far from any industrial development should be comparable with noise levels existing across the LSA and RSA before any industrial developments.

During the baseline noise survey in 2013, noise levels measured at one receptor location, R1, were influenced only by noise associated with natural sources (e.g., wind in vegetation, wildlife) (Annex II). Therefore, it can be assumed that the results obtained at receptor R1 provide noise levels that are representative of pre-development noise levels across the LSA and RSA.

13B1.4.3.1.2 Existing Developments

Industrial developments existing in the area of Lac de Gras and Lac du Sauvage include the Ekati Mine (i.e., Ekati camp, processing plant, and airstrip), the Misery Pit, the Misery Road, and the Diavik Diamond Mine (Diavik Mine).

During the baseline monitoring program conducted in summer 2013, noise contributions from the Misery Pit and Misery Road were audible at only one of the three monitoring locations, receptor R2. At the other receptor locations, the noise contributions from the Misery Pit and Misery Road were too low to be identified above the noise contributions from natural sources. The noise contributions from the other existing industrial developments (i.e., Ekati Mine and Diavik Mine) were too low to be identified above the noise contributions from natural sources at any of the three baseline monitoring receptors. To be clear, the baseline monitoring conducted in summer 2013 captured the contributions from all the exiting industrial developments (Misery Pit, Misery Road, Ekati Mine, and Diavik Mine), but in most cases these contributions were too small to be identified above the contribution from natural sources.

The Lynx Pit was not considered as part of baseline because it will be located at the distance of 7 km from the Project and, therefore, it is assumed that noise emissions from Lynx Pit will attenuate to a level well-below ambient before reaching receptors relevant to the Project NIA.

13B1.4.3.1.3 Winter Road

The noise from existing traffic on the Winter Road was quantified using a CadnaA model developed for the Project. The noise levels resulting from operation of the Winter Road were evaluated along the entire length of the Winter Road. The spatial extent of the Winter Road assessment area comprised a 3-km-wide band centred on the road (i.e., a 1.5 km AER criteria boundary surrounding the Winter Road).

During normal operations of the Ekati Mine an average of 2,063 trucks are expected to arrive at the Ekati Mine each season. It is expected that the same number of loads will be required to support Project operations, and so there will be no net increase in Winter Road traffic associated with Project operations.

The modelling parameters that were used to represent the existing traffic on the Winter Road are presented in Table 13B1.4-7.

Table 13B1.4-7 Noise Modelling Parameters for Winter Road Supply Truck

Equipment Type	Acoustical Usage Factor (%)	Overall Sound Power Level [dBA]	Source Type[a]
Supply Truck	100	114	Line

a) Model setting for source type is described in Table 13B1.4-6.
dBA = A-weighted decibel;% = percentage of operating time.

13B1.4.3.2 Application Case

13B1.4.3.2.1 Construction

Project construction noise was assessed for the specific period of time characterized by the highest amount of equipment used and the most intensive operations. Based on analysis of the construction schedule, the summer 2017 construction period, during which the highest number of equipment including excavators, dozers, and transport trucks will be operating, was selected for assessment.

Using a conservative approach, all Project construction activities were modelled as occurring for 24-hours every day. Each piece of equipment was modelled as operating for a percentage of each 24-hour period. This percentage is referred to as the acoustical usage factor. In other words, the acoustical usage factor specifies the percentage of the 24-hour period (both daytime and nighttime) during which the equipment is continuously emitting noise. For example, a dozer at 40% acoustical factor will emit noise for 6.0 hours during each 15-hour daytime period and 3.6 hours during each 9-hour nighttime period.

Acoustical usage factors and sound power levels used to model each piece of major construction equipment are presented in Table 13B1.4-8.

Table 13B1.4-8 Noise Modelling Parameters for Construction Equipment

Equipment Type	Acoustical Usage Factor[d] (%)	Overall Sound Power Level [dBA]	Equipment Quantity	Source Type[e]
Dozer CAT D8[a]	39	108	4	Line
Dozer CATD10R[a]	46	111	5	Line
Excavator CAT 345[a]	4	110	4	Line
Excavator CAT 375[a]	55	112	12	Line
Komatsu 125 t excavator	13	113	4	Line
200 tonne transport truck (CAT789)[a]	47	115	25	Line
200 tonne transport truck (CAT789)[a]	47	115	25	Area
CAT777 transport truck	46	109	16	Line
CAT777 transport truck	46	109	16	Area
Water truck (CAT777)[a]	40	109	1	Line

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Table 13B1.4-8 Noise Modelling Parameters for Construction Equipment

Equipment Type	Acoustical Usage Factor[d] (%)	Overall Sound Power Level [dBA]	Equipment Quantity	Source Type[e]
Loader CAT992[a]	47	113	6	Line
Loader CAT992[a]	47	113	1	Area
Mobile crane 150t[b]	6	105	4	Line
Temporary crusher[c]	83	125	1	Point
Clamshell Dredge	42	108	4	Point

a) Based on measurements of similar equipment.
b) Calculated based on values published by Department for Environment Food and Rural Affairs (DEFRA 2007).
c) Assumed identical to the equipment assessed in the Ekati Mine Environmental Impact Statement (BHP 1995).
d) Estimated based on conceptual design of Project construction phase.
e) Model setting for source type is described in Table 13B1.4-6.
dBA = A-weighted decibel;% = percentage of operating time.

13B1.4.3.2.2 Operations

The Project will be operating as an open-pit mine in which kimberlite will be blasted, loaded onto transport trucks, and hauled to a kimberlite transfer pad. Within the transfer pad, kimberlite will be transferred to longer-haul trucks and hauled to the Ekati processing plant. It is expected that noise emissions from open-pit operations will not remain at the same level over the lifetime of the Project but will diminish as pit depth increases and equipment moves farther and farther below ground surface. The NIA assessed Project operations for the first year in the operational life of the mine when equipment is located close to the surface.

During operations, noise sources associated with the Project equipment will be spatially distributed within four main areas including the pit, kimberlite storage pad, haul road, and WRSA. The footprint of the Project (e.g., location and layout of roads, pit, WRSA, kimberlite storage area) will remain the same during the entire lifetime of the Project.

13B1.4.3.2.3 Open-Pit Mine

During open-pit operations for the Project, the following types of noise sources associated with mine equipment and activities were considered in the NIA:

- waste rock and ore extraction:
  - pit shovels;
  - excavators;
  - drills; and,
  - loaders.

- waste rock and ore handling:
  - dozers; and,
  - loaders.
- waste rock and ore transport:
  - pit trucks;
  - haul trucks; and,
  - water trucks.

In addition, four areas where most of the noise-emitting equipment will be operating were identified for the Project:

- pit area:
  - pit shovels;
  - excavators;
  - dozers;
  - graders;
  - drills; and,
  - ore and waste rock transport trucks.
- Jay WRSA:
  - loaders; and,
  - dozers.
- kimberlite storage pad:
  - loaders; and,
  - dozer.
- haul road:
  - ore transport trucks; and,
  - water trucks.

To quantify noise emissions from Project operations, source information including sound power level and operation time (i.e., acoustical usage factor) was assigned to each of the major noise sources. The sound power levels were obtained based on field measurement of similar equipment, manufacturer-supplied noise data, or calculated using widely accepted engineering formulae. Acoustic usage factors were determined based on the annual equipment usage data provided by Dominion Diamond for the Ekati Mine.

The Project will be operated as open pit. During its production lifespan, noise emissions from sources associated with pit equipment and activities are expected to progressively decrease since over time the equipment will be located deeper below the ground surface and thus will be effectively screened by the wall of the pit. Following a conservative approach, open-pit operations were modelled based on equipment and pit development stage corresponding to the first year of production. It is expected that during the first year of production most of the equipment will be located close to the surface and, therefore, noise screening by pit walls will be minimal.

Overall sound power levels and acoustical usage factors used for modelling the operation phase of the Project are presented in Table 13B1.4-9.

Table 13B1.4-9 Noise Modelling Parameters for Operation Equipment

Equipment Type	Acoustical Usage Factor (%)	Overall Sound Power Level [dBA]	Source Type[j]	Equipment Quantity	Equipment Location
Pit shove CAT6040I[a]	75[b]	119	Area	3	Jay Pit
Pit shove CAT6018I[a]	75[b]	117	Area	1	Jay Pit
Dozer CATD10R[a]	72[b]	111	Area	1	Jay Pit
Loader CAT992[a]	80[b]	113	Area	3	Jay Pit
Driltech D90KS[a]	65[b]	116	Area	2	Jay Pit
Ingersoll Rand DM45HP[a]	65[b]	116	Area	1	Jay Pit
Grader CAT16H[a]	60[b]	104	Area	1	Jay Pit
CAT IT28 Toll Carrier	35[b]	104	Area	1	Jay Pit
CAT777[a]	9	109	Area	6	Jay Pit
CAT789[a]	10	116	Area	19	Jay Pit
CAT777[a]	48[f]	109	Line	6	Jay Pit to Kimberlite storage pad
CAT789[a]	52[f]	116	Line	19	Jay Pit to WRSA
CAT IT28 Toll Carrier	35[b]	104	Area	1	Jay Pit
Dozer CATD10R[a]	72[b]	119	Area	1	WRSA
Excavator CAT 375[a]	30[b]	112	Area	1	WRSA
CAT789[a]	4[e]	116	Area	19	WRSA
Loader CAT992[a]	80[b]	113	Area	1	Kimberlite storage pad
Dozer CATD10R[a]	72[b]	119	Area	1	Kimberlite storage pad
CAT777	4	109	Area	6	Kimberlite storage pad
Pit hauler[c]	4[e]	121	Area	6	Kimberlite storage pad
Pit hauler[c]	67[f]	121	Line	6	Misery Road
Water truck (CAT777)[a]	40[b]	109	Line	1	Jay access road/ Misery Road

Table 13B1.4-9 Noise Modelling Parameters for Operation Equipment

Equipment Type	Acoustical Usage Factor (%)	Overall Sound Power Level [dBA]	Source Type[j]	Equipment Quantity	Equipment Location
Lake dewatering pump 460 kW[d][i]	100	91	Point	1	Lac du Sauvage
Lake dewatering pump 480 kW[d]	100	91	Point	1	Lac du Sauvage
Lake dewatering pump transformer[d][h]	100	77	Point	2	Lac du Sauvage

a) Based on measurements of similar equipment.
b) Operation time based on data provided by Dominion Diamond for the Ekati Mine.
c) Noise emissions calculated based on data for similar equipment
d) Calculated based on engineering formulae (Bies and Hansen 2003).
e) Equipment idling.
f) Based on optimal operational time, including loading and unloading, trip to and back.
g) Calculated based on values published by Department for Environment Food and Rural Affairs (DEFRA 2007).
h) Transformer suitable for 460 kilowatt (kW) and 480 kW pumps.
i) Pumps enclosed in weather protective casing.
j) Model setting for source type is described in Table 13B1.4-6.
dBA = A-weighted decibel;% = percentage of operating time; WRSA = waste rock storage area.

13B1.4.3.2.4 Blasting

In addition to continuous noise emissions from Project operations, short-duration high-magnitude noise and vibration emissions associated with mine blasting operations were also assessed. These short events will have a temporal effect on noise levels within the LSA and RSA.

During mine operations three types of blasting activities can be conducted: pre-split; trim and waste rock; and ore production blasting. The magnitude of noise and vibrations resulting from blasting strongly depends on the amount of explosives loaded per blast hole. It was assumed that the higher amount of explosives per each blasting hole will be used during production blasting. Therefore, the calculations of noise and vibration from basting activities will be based on the amount of explosives used in production blasting.

Noise and vibration from blasting were assessed for two high-level scenarios:

- An average blasting scenario consisting of 538 kilograms (kg) of explosives per single hole. This average value was estimated based on the total amount explosives used per year at the Ekati Mine.
- A maximum blasting scenario consisting of 775 kg of explosives per hole. This maximum value was estimated based on the maximum amount of explosives per hole that is used during normal blasting operations at the Ekati Mine (Tannant and Peterson 2001).

A 6.5 metre (m) by 7.5 m equilateral pattern with 270 millimetre (mm) diameter production holes drilled to the depth of 10 m is modelled as a typical production blast layout. A 70/30 mixture of emulsion and ammonium nitrate fuel oil (ANFO) explosives is assumed based on long-standing operating practice at the Ekati Mine. Based on the current blasting practice it is expected that a single hole will be detonated per delay.

The effect of mine blasting was determined by analyzing two forms of vibrations released during blasting:

- ground borne vibrations; and,
- air borne vibrations.

Ground vibrations created by blasting activities propagate within the ground in the form of waves that attenuate with increased distance from the blast site. Ground vibrations are characterized by PPV expressed in mm/s. Attenuation of ground vibration due to propagation through rock and soil is expressed by the scaled distance and defined as:

- Scaled distance

$$SD = {}^{D}/_{\sqrt{W}}$$

where:

D = distance (m) between a blast site and a receptor; and,

W = maximum weight of explosives in kilograms detonated per delay period.

The predicted peak particle velocity at a distance from the blast can be found using the following equation published in *Blaster's Handbook of International Society of Explosive Engineers* (ISEE 1998):

- PPV (mm/s)

$$PPV = 1725 * (SD)^{-1.6}$$

where:

SD=scaled distance $({}^{m}/_{kg}{}^{0.5})$.

Air borne vibrations created by blasting activities propagate within air in the form of waves that attenuate with increased distance from the blast site. Air vibrations in the form of sound waves attenuate at a slower rate than the ground borne vibrations. Attenuation of air borne vibrations depends on local weather conditions (e.g., temperature, humidity, wind direction), terrain features (e.g., noise screening by terrain), and surface absorption (e.g., soft ground or hard ground). The rate at which air vibrations attenuate due to distance travelled is expressed by the scaled distance and defined as:

- Scaled distance

$$SD = {}^{D}/_{\sqrt[3]{W}}$$

where:

D = distance (m) between the blast and receptor; and,

W = maximum weight of explosives in kilograms detonated per delay period.

The predicted maximum noise level can be found based on the following equation published in *Blaster's Handbook of International Society of Explosive Engineers* (ISEE 1998):

- Maximum noise level (dBL)

$$L_{peak} = 20 * \log_{10}(SD^{-1.1}) + 170.75$$

where:

Lpeak = peak pressure level (dBL); and,

SD=scaled distance ($\left.{}^{ft}/_{lb}\right.^{0.33}$).

13B1.5 Noise Assessment Results

13B1.5.1 Base Case

Results measured at receptor R2 were considered a valid representation of the base case (Section 13B1.4.3). The noise levels considered representative for the Project base case are presented in Table 13B1.5-1.

Table 13B1.5-1 Base Case Noise Levels

Receptor	Base Case Noise Levels [dBA]	
	Daytime	Nighttime
CRsouthwest	27	21
CRnorth	27	21
CRwest	27	21
CRsouth	27	21

Daytime = daytime period (7:00 am to 10:00 pm); Nighttime = nighttime period (10:00 pm to 7:00 am); dBA = A-weighted decibel; am = ante meridiem; pm = post meridiem; CRsouth, CRsouthwest, CRnorth, CRwest = noise assessment receptors located along 1.5 km AER criteria boundary; AER = Alberta Energy Regulator.

13B1.5.2 Application Case

13B1.5.2.1 Construction

13B1.5.2.1.1 Winter Road

Predicted daytime and nighttime noise levels due to Winter Road usage associated with Project operations are presented in Table 13B1.5-2 and Table 13B1.5-3. Winter Road traffic required for Project operations is expected to be the same as Winter Road traffic associated with operation of the current Ekati Mine (Section 13B1.4.1). As such, the noise level predictions presented in Table 13B1.5-2 and Table 13B1.5-3 are consistent with current noise levels associated with the Winter Road.

Table 13B1.5-2 Project Operation – Predicted Daytime Noise Levels from the Winter Road

Receptor	ASL [dBA][b]	Operations Winter Road Noise Contribution [dBA][c]	Operations Cumulative Noise Level [dBA][d]	PSL [dBA][e]	Margin of Compliance [dB][f]
Rwinter road[a]	45	33	45	50	5

a) Location 1.5 kilometres (km) from Winter Road with highest predicted noise levels.
b) Alberta Energy Regulator (AER) mandated daytime ambient sound level (ASL) (EUB 2007).
c) Daytime noise contribution from Winter Road.
d) Logarithmic sum of ASL and Winter Road noise contributions.
e) AER mandated daytime permissible sound level (PSL) (EUB 2007).
f) Result of arithmetic subtraction of cumulative noise levels from PSL.
dBA = A-weighted decibel; PSL = Permissible Sound Level; ASL = Ambient Sound Level, Rwinter road = noise assessment receptor.

Table 13B1.5-3 Project Operation – Predicted Nighttime Noise Levels from the Winter Road

Receptor	ASL [dBA][b]	Operations Winter Road Noise Contribution [dBA][c]	Operations Cumulative Noise Level [dBA][d]	PSL[e]	Margin of Compliance [dB][f]
Rwinter road[a]	35	33	37	40	3

a) Location 1.5 kilometres (km) from Winter Road with highest predicted noise levels.
b) Alberta Energy Regulator (AER) mandated daytime ambient sound level (ASL) (EUB 2007).
c) Daytime noise contribution from Winter Road.
d) Logarithmic sum of ASL and Winter Road noise contributions.
e) AER mandated daytime permissible sound level (PSL) (EUB 2007).
f) Result of arithmetic subtraction of cumulative noise levels from PSL.
dBA = A-weighted decibel; PSL = Permissible Sound Level; ASL = Ambient Sound Level, Rwinter road = noise assessment receptor.

The construction phase of the Project will require a small increase in traffic on the Winter Road over and above the level of traffic required for Project operation (Section 13B1.4.1). This small increase in traffic on the Winter Road is a small increase over and above the level of traffic currently using the Winter Road as a result of Ekati Mine operations. Predicted daytime and nighttime noise levels associated with this additional Winter Road traffic are shown in Table 13B1.5-4 and Table 13B1.5-5, which present noise levels for the additional Project construction traffic in isolation, and cumulative noise levels obtained by summing the contribution from the additional traffic with the Winter Road noise levels associated with Project operations (or with current Ekati Mine operations).

Table 13B1.5-4 Project Construction – Predicted Daytime Noise Levels from the Winter Road

Receptor	Construction Phase Winter Road Noise Contribution [dBA][b]	Operations Cumulative Noise Level [dBA]	Construction + Operations Cumulative Noise Level [dBA][c]	Noise Level Change [dBA][d]	PSL [dBA][e]	Margin of Compliance [dB][f]
Rwinter road[a]	27	45	45	0	50	5

a) Location 1.5 kilometres (km) from Winter Road with highest predicted noise levels.
b) Alberta Energy Regulator (AER) mandated daytime ambient sound level (ASL) (EUB 2007).
c) Daytime noise contribution from Winter Road.
d) Logarithmic sum of ASL and Winter Road noise contributions.
e) AER mandated daytime permissible sound level (PSL) (EUB 2007).
f) Result of arithmetic subtraction of cumulative noise levels from PSL.
dBA = A-weighted decibel; PSL = Permissible Sound Level; Rwinter road = noise assessment receptor.

Table 13B1.5-5 Project Construction – Predicted Nighttime Noise Levels from the Winter Road

Receptor	Construction Phase Winter Road Noise Contribution [dBA] [b]	Operations Cumulative Noise Level [dBA]	Construction + Operations Cumulative Noise Level [dBA] [c]	Noise Level Change [d] [dB]	PSL [dBA] [e]	Margin of Compliance [dB] [f]
Rwinter road[a]	27	37	37	0	40	3

a) Location 1.5 kilometres (km) from Winter Road with highest predicted noise levels.
b) Alberta Energy Regulator (AER) mandated daytime ambient sound level (ASL) (EUB 2007).
c) Daytime noise contribution from Winter Road.
d) Logarithmic sum of ASL and Winter Road noise contributions.
e) AER mandated daytime permissible sound level (PSL) (EUB 2007).
f) Result of arithmetic subtraction of cumulative noise levels from PSL.
dBA = A-weighted decibel; PSL = Permissible Sound Level; Rwinter road = noise assessment receptor.

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13B1.5.2.1.2 Project Construction

Predicted daytime and nighttime noise levels from the Project construction phase are presented in Table 13B1.5-6.

Table 13B1.5-6 Predicted Daytime and Nighttime Noise Levels from the Project Construction Phase

Noise Receptor	Base Case Noise Level [dBA]			Predicted Project Construction Noise Level [dBA]			Total Application Case Noise Level [dBA][a]		
	Leq, night	Leq, day	Leq, dn	Leq, night	Leq, day	Leq, dn	Leq, night	Leq, day	Leq, dn
Camp	n/a	n/a	n/a	47.5	47.5	53.9	47.5[b]	47.5[b]	53.9[b]
CRsouth	21	27	29	39.4	39.4	45.8	39.5	39.6	45.9
CRsouthwest	21	27	29	35.4	35.4	41.8	35.6	36.0	42.0
CRnorth	21	27	29	35.1	35.1	41.5	35.3	35.7	41.7
CRwest	21	27	29	42.1	42.1	48.5	42.1	42.2	48.6

a) Logarithmic sum of noise contributions from the Base Case and the Project.

b) Noise levels due to contributions from Project construction sources only (i.e., baseline sources are not included).

Leq, day = equivalent energy noise level over the daytime period (7:00 am to 10:00 pm); Leq, night = equivalent energy noise level during nighttime period (10:00 pm to 7:00 am); Leq, dn = equivalent energy noise level during 24-hour period with a 10 dB penalty added to the nighttime; dBA = A-weighted decibel; am = ante meridiem; pm = post meridiem; n/a = noise data not available; Camp = receptor associated with Misery camp; CRsouth, CRsouthwest, CRnorth, CRwest = noise assessment receptors located along 1.5 kilometre (km) Alberta Energy Regulator criteria boundary .

Results of the construction noise assessment based on Health Canada guidance and benchmarks (Health Canada 2010) are presented in Table 13B1.5-7 and Table 13B1.5-8.

Table 13B1.5-7 Assessment of Construction Noise

Receptor	Noise-Induced Hearing Loss			Sleep Disturbance		Speech Comprehension			Complaints	
	Leq, day [dBA]	Leq, night [dBA]	Threshold Value[a] [dBA]	Leq, night [dBA]	Threshold Value[a] [dBA]	Leq, day [dBA]	Leq, night [dBA]	Threshold Value[a] [dBA]	Leq, dn [dBA]	Threshold Value[a] [dBA]
Camp	47.5	47.5	70	47.5	45	47.5	47.5	55	53.9	62
CRsouth	39.6	39.5	70	39.5	45	39.6	39.5	55	45.9	62
CRsouthwest	36.0	35.6	70	35.6	45	36.0	35.6	55	42.0	62
CRnorth	35.7	35.3	70	35.3	45	35.7	35.3	55	41.7	62
CRwest	42.2	42.1	70	42.1	45	42.2	42.1	55	48.6	62

a) Health Canada (2010).

Leq, day = equivalent energy noise level over the daytime period (7:00 am to 10:00 pm); Leq, night = equivalent energy noise level during nighttime period (10:00 pm to 7:00 am); Leq, dn = equivalent energy noise level during 24-hour period with a 10 dB penalty added to the nighttime; dBA = A-weighted decibel; am = ante meridiem; pm = post meridiem; Camp = Receptor associated with Misery camp; CRsouth, CRsouthwest, CRnorth, CRwest = noise assessment receptors located along 1.5 kilometre (km) Alberta Energy Regulator criteria boundary.

Table 13B1.5-8 Assessment of Change in Percentage Highly Annoyed due to Construction Noise

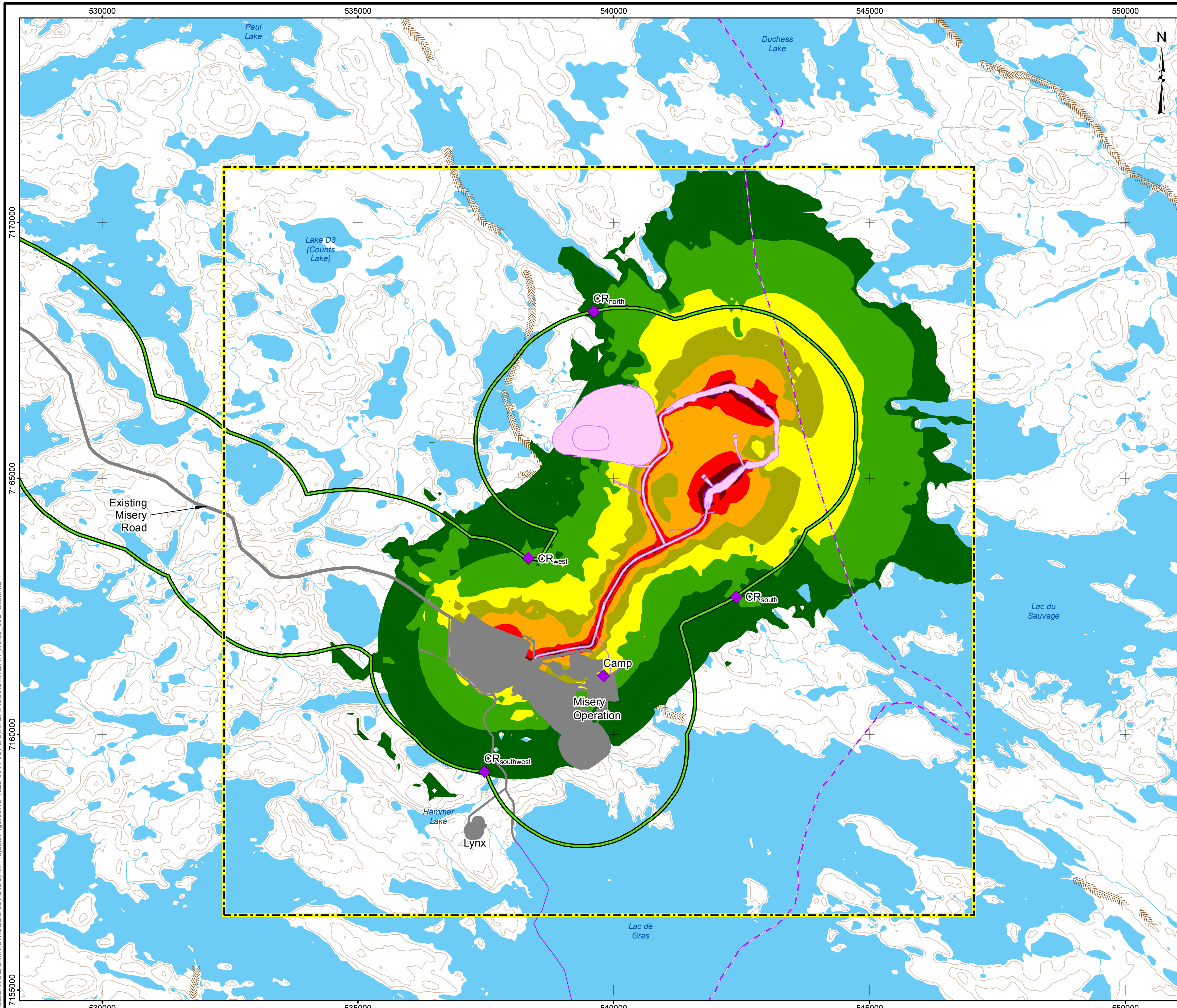
Receptor	Base Case%HA	Application Case%HA	Change in%HA	Threshold Value[c]
Camp	n/a	3.6[b]	n/a	6.5
CRsouth	0.5[a]	4.6	4.1	6.5
CRsouthwest	0.5[a]	2.8	2.3	6.5
CRnorth	0.5[a]	2.7	2.2	6.5
CRwest	0.5[a]	6.5	6.0	6.5

a) Including 10 decibel (dB) adjustment for quiet rural area.
b) Project only contributions; no 10 dB adjustment for existing baseline noise level.
c) Health Canada (2010).
%HA = percentage highly annoyed; Camp = receptor associated with Misery camp; CRsouth, CRsouthwest, CRnorth, CRwest = noise assessment receptors located along 1.5 kilometre (km) Alberta Energy Regulator criteria boundary; n/a = not applicable.

Based on the results presented in Table 13B1.5-7 and Table 13B1.5-8, the total noise from the Project construction phase will not exceed Health Canada benchmarks for noise-induced hearing loss, sleep disturbance, interference with speech comprehension, complaints, or change in percentage highly annoyed, with the exception of an exceedance of the sleep disturbance criterion for the Camp receptor.

Because baseline noise levels at the Camp receptor are not available, a direct assessment of noise effects from construction noise at this receptor is not practical. However, results present in Table 13B1.5-7 and Table 13B1.5-8 indicate that noise contributions from construction will be minimal at this receptor compared to noise levels that likely exist currently. Therefore, Project construction noise is not expected to cause any perceptible difference in the acoustic environment at the Camp receptor (i.e., in and around the Misery camp). In addition, it is expected that noise levels due to contributions from camp-related noise sources (e.g., ventilation fans, electrical transformers, and site-specific traffic) are dominant at the Camp receptor and will remain dominant throughout the Project construction phase.

Nighttime noise contours for the Project construction phase are presented in Map 13B1.5-1.



LEGEND

- EKATI MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (10 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY
- CONSTRUCTION NOISE RECEPTOR
- 1.5 km ALBERTA ENERGY REGULATOR CRITERIA BOUNDARY / LOCAL STUDY AREA
- REGIONAL STUDY AREA

NOISE CONTOUR

- 35-40 dBA
- 40-45 dBA
- 45-50 dBA
- 50-55 dBA
- 55-60 dBA
- 60-65 dBA
- 65-70 dBA
- 70-75 dBA
- 75-80 dBA
- 80-85 dBA
- >85 dBA

REFERENCE

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NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

1.5 0 1.5
SCALE 1:75,000 KILOMETRES

PROJECT
DOMINION DIAMOND
JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

JAY CONSTRUCTION PROJECT ONLY NIGHTTIME NOISE CONTOURS

Golder Associates

PROJECT		13-1328-0041	FILE No. DAR_Noise_002_GIS	
DESIGN	TN	06/08/14	SCALE AS SHOWN	REV 0
GIS	JE	20/10/14	MAP 13B1.5-1	
CHECK	VY	20/10/14		
REVIEW	AF	20/10/14		

13B1.5.2.2 Operations

13B1.5.2.2.1 Open-Pit Mine

Broadband

Predicted daytime and nighttime broadband noise levels for Project operations are presented in Table 13B1.5-9 and Table 13B1.5-10.

Table 13B1.5-9 Predicted Daytime Broadband Noise Levels from the Project Operations Phase

Receptor	Base Case [dBA][(a)]	ASL [dBA][(b)]	Project Operations Noise Contribution [dBA]	Application Case Cumulative Noise Level [dBA][(c)]	PSL[(d)]	Margin of Compliance [dB][(e)]
Rsouth	27	45	37.4	45.8	50	4.2
Rsouthwest	27	45	36.3	45.6	50	4.4
Rnorth	27	45	35.2	45.5	50	4.5
Rwest	27	45	38.1	45.9	50	4.1

a) Based on baseline noise measurement (Annex II).
b) Daytime ambient sound level (ASL) as per Directive 038 (EUB 2007).
c) Logarithmic sum of noise contributions from the Base Case, ASL, and the Project.
d) Daytime permissible sound level (PSL) as per Directive 038 (EUB 2007).
e) Arithmetic difference between PSL and Application Case cumulative noise levels.
dBA = A-weighted decibel; dB = unweighted decibel; ASL = Ambient Sound Level; PSL = Permissible Sound Level; Rsouth, Rsouthwest, Rnorth, Rwest = noise assessment receptors located along 1.5 kilometre (km) Alberta Energy Regulator criteria boundary.

Table 13B1.5-10 Predicted Nighttime Broadband Noise Levels from the Project Operations Phase

Receptor	Base Case [dBA][(a)]	ASL [dBA][(b)]	Project Operations Noise Level [dBA]	Application Case Cumulative Noise Level [dBA][(c)]	PSL[(d)]	Margin of Compliance [dB][(e)]
Rsouth	21	35	37.4	39.4	40	0.6
Rsouthwest	21	35	36.3	38.8	40	1.2
Rnorth	21	35	35.2	38.2	40	1.8
Rwest	21	35	38.1	39.9	40	0.1

a) Based on baseline noise measurement (Annex II).
b) Nighttime ambient sound level (ASL) as per Directive 038 (EUB 2007).
c) Logarithmic sum of noise contributions from the Base Case, ASL, and the Project.
d) Nighttime permissible sound level (PSL) as per Directive 038 (EUB 2007).
e) Arithmetic difference between PSL and Application Case cumulative noise levels.
dBA = A-weighted decibel; dB = unweighted decibel; ASL = ambient sound level; PSL = permissible sound level; Rsouth, Rsouthwest, Rnorth, Rwest = noise assessment receptors located along 1.5 kilometre (km) Alberta Energy Regulator criteria boundary.

The results presented in Table 13B1.5-9 and Table 13B1.5-10 show that the noise levels related to Project operations are predicted to comply with daytime and nighttime PSL values mandated by Directive 038. The predicted Project cumulative noise levels are between 38.2 dBA (Rnorth) and 39.9 dBA (Rwest).

Nighttime noise contours for Project operations are presented in Map 13B1.5-2.

Low Frequency Noise

The results of the LFN assessment for Project operations for daytime and nighttime periods are presented in Table 13B1.5-11 and Table 13B1.5-12.

Table 13B1.5-11 Assessment of Daytime Low Frequency Noise for Project Operations

Receptor	Application Case [dBA][(a)]	Application Case [dBC][(a)]	dBC-dBA	LFN Threshold [dB]	Potential for LFN Issue[(b)]
Rsouth	38	57	19	20	no
Rsouthwest	37	56	19	20	no
Rnorth	36	56	20	20	yes
Rwest	38	57	19	20	no

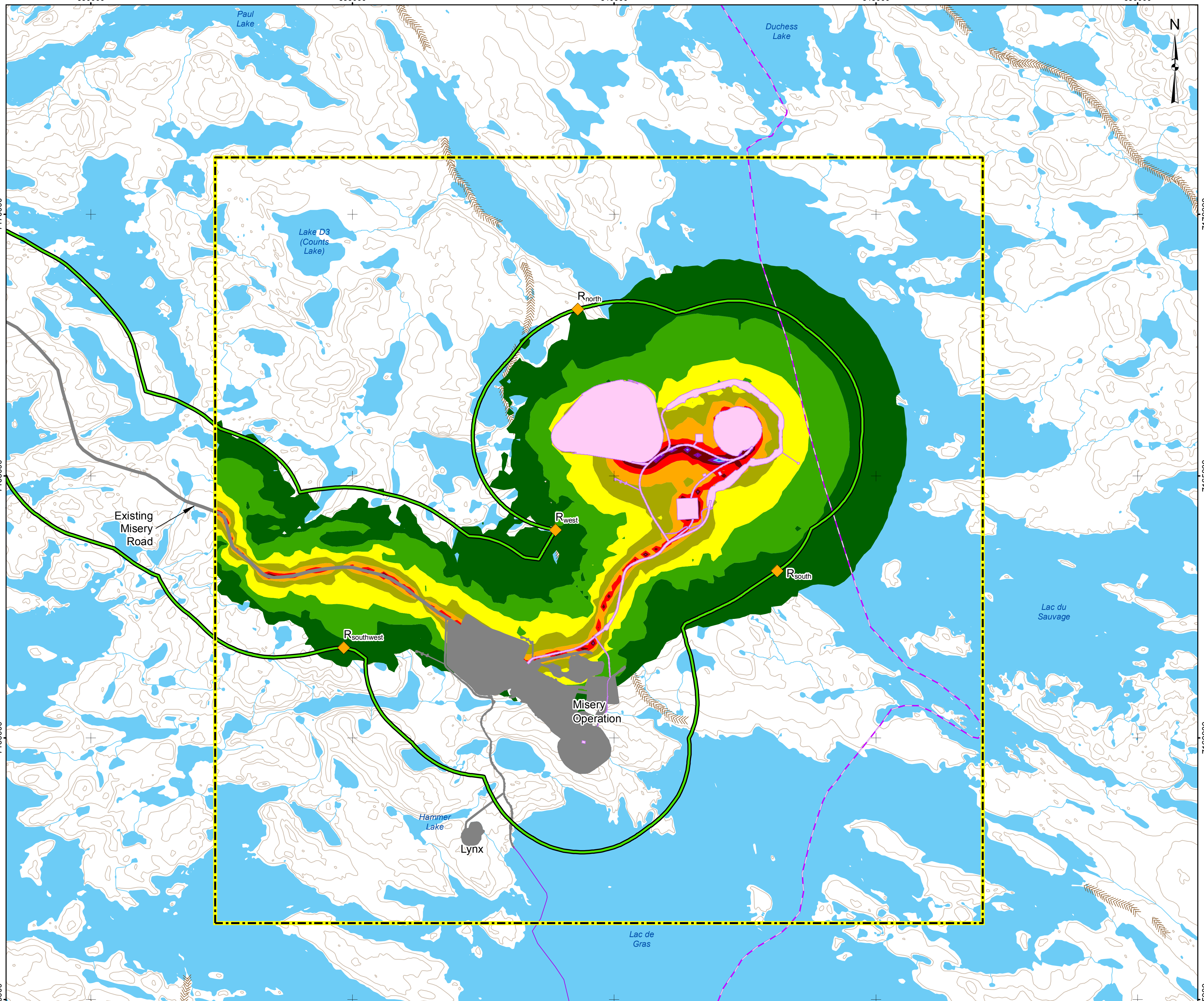
a) Base Case + Project (ASL had to be excluded because Directive 038 [EUB 2007] does not provide ASL values in dBC).
b) dBC-dBA equal to or higher than 20 dB.
dBA = A-weighted decibel; dB = unweighted decibel; dBC = C-weighted decibel; ASL = ambient sound level; Rsouth, Rsouthwest, Rnorth, Rwest = noise assessment receptors located along 1.5 kilometre (km) Alberta Energy Regulator criteria boundary.

Table 13B1.5-12 Assessment of Nighttime Low Frequency Noise for Project Operations

Receptor	Application Case [dBA][(a)]	Application Case [dBC][(a)]	dBC-dBA	LFN Threshold	Potential for LFN Issue[(b)]
Rsouth	38	51	13	20	no
Rsouthwest	36	46	10	20	no
Rnorth	35	49	14	20	no
Rwest	38	50	12	20	no

a) Base Case + Project (ASL had to be excluded because Directive 038 [EUB 2007] does not provide ASL values in dBC).
b) dBC-dBA equal to or higher than 20 dB.
dBA = A-weighted decibel; dB = unweighted decibel; dBC = C-weighted decibel; LFN = low frequency noise; ASL = ambient sound level; Rsouth, Rsouthwest, Rnorth, Rwest = noise assessment receptors located along 1.5 kilometre (km) Alberta Energy Regulator criteria boundary.

The LFN assessment results presented in Table 13B1.5-11 indicate that there is the potential for LFN effects at one receptor (Rnorth) during the daytime period. However, the potential is a small one, because the dBC – dBA difference is equal to the 20 dB threshold values. In any case, at the current stage of Project design the second LFN criterion cannot be assessed because the high-resolution spectral data that is needed to identify tones is not available from a standard computer model. It is likely that there is no LFN effect at receptor Rsouthwest because there is no reason to believe that a tonal component would be observed at this location. The results presented in Table 13B1.5-11 and Table 13B1.5-12 indicate that there is no potential for LFN effects at any other receptors during either the daytime or nighttime periods.



LEGEND

- EKATI MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
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- WATERCOURSE
- WATERBODY
- OPEN PIT OPERATIONS NOISE RECEPTOR
- 1.5 km ALBERTA ENERGY REGULATOR CRITERIA BOUNDARY / LOCAL STUDY AREA
- REGIONAL STUDY AREA

NOISE CONTOUR

- 35-40 dBA
- 40-45 dBA
- 45-50 dBA
- 50-55 dBA
- 55-60 dBA
- 60-65 dBA
- 65-70 dBA
- 70-75 dBA
- 75-80 dBA
- 80-85 dBA

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
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DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DEVELOPER'S ASSESSMENT REPORT

1.5 0 1.5
SCALE 1:75,000 KILOMETRES

PROJECT
DOMINION DIAMOND
JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE
JAY OPEN PIT OPERATIONS PROJECT ONLY NIGHTTIME NOISE CONTOURS

Golder Associates

PROJECT	13-1328-0041		FILE No. DAR_Noise_003_GIS
DESIGN	TN	06/08/14	SCALE AS SHOWN REV 0
GIS	JE	20/10/14	MAP 13B1.5-2
CHECK	VY	20/10/14	
REVIEW	AF	20/10/14	

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13B1.5.2.2.2 Blasting

The results of the noise and vibration assessment for Project blasting operations are presented in Table 13B1.5-13.

Table 13B1.5-13 Peak Particle Velocity and Maximum Noise Levels from Project Blasting Operations

Distance from Blasting[a] [m]	Peak Particle Velocity [mm/s]			Maximum Noise Level [dBL]		
	553 [kg/hole]	775 [kg/hole]	NPC-119 Limit[b]	553 [kg/hole]	775 [kg/hole]	NPC-119 Limit[b]
100	170	223	10	138	139	120
200	56	74	10	131	132	120
400	19	24	10	125	126	120
800	6	8	10	118	119	120
1,600	2	3	10	112	113	120
3,200	1	1	10	105	106	120
5,200[a]	0	0	10	100	101	120

a) Distance between Jay pit and Misery workers camp.
b) *Noise Pollution Control Publication 119* (OMOE 1978).
dBL = L-weighted decibel; kg/hole = kilograms per hole; mm/s = millimetres per second; m = metre.

The results presented in Table 13B1.5-13 indicate that blasting operations are expected to comply with maximum permissible values suggested by NPC-119 (OMOE 1978) at all locations 800 m and farther from the Jay Pit. In particular, at the Misery worker camp noise and vibration levels associated with blasting will be well-below mandated maximum values.

13B1.6 Conclusions

13B1.6.1 Construction

13B1.6.1.1 Winter Road

Results obtained for assessment of noise emissions from Winter Road usage during Project construction indicate that the increase in truck traffic required to accommodate construction demand will not cause a quantifiable increase in noise levels along its length. The model predicts that along the length of the Winter Road the highest noise levels at the 1.5 km AER criteria boundary resulting from Project construction traffic will be equal to 27 dBA.

13B1.6.1.2 Project Construction

Results obtained for assessment of Project construction noise associated with the highest intensity of construction activities (i.e., summer 2017) indicate that noise levels will meet Health Canada noise benchmarks at all identified receptors, with the exception of a small exceedance of the sleep disturbance criterion for the receptor corresponding to the Misery worker camp. A high-level assessment of noise from Project construction in the context of existing noise levels suggest that Project construction will not substantially change noise levels currently existing around Misery camp.

The results presented for remaining receptors located along the 1.5 km AER criteria boundary provide indication of noise levels within the LSA. These receptors are not strictly applicable to the Health Canada assessment methodology and assessment benchmarks. However, the assessment of noise at these receptors provides indication of noise environment within the LSA since there are no other locations of human occupancy. The results presented in Tables 13B1.5-6 and 13B1.5-7 indicate that all Health Canada noise criteria including noise-induced hearing loss, sleep disturbance, interference with speech comprehension, complaints, or change in percentage highly annoyed will be met at all receptors located along the 1.5 km AER criteria boundary.

13B1.6.2 Operations

13B1.6.2.1 Winter Road

Traffic levels on the Winter Road that are associated with Project operations are expected to be consistent with current traffic levels required to support operations at the Ekati Mine. In other words, during Project operations there will be no net increase in noise levels associated with the Winter Road over and above the current noise levels.

Results obtained for assessment of noise emissions from Winter Road usage during Project operations presented in Tables 13B1.5-2 and 13B1.5-3 indicate that the maximum noise level predicted at a distance of 1.5 km from the road is equal to 33 dBA. At this low level, it can be expected that under most circumstances noise from the Winter Road will be masked by noise resulting from natural sources.

13B1.6.2.2 Open-Pit Mine

The noise assessment conducted for Project operations focused on the first year of operations when in-pit equipment will be closest to the surface and thus the potential for noise effects is greatest.
The results presented in Tables 13B1.5-8 and 13B1.5-9 indicate that the Project will comply with the PSL values mandated by Directive 038 at all receptors located along 1.5 km AER criteria boundary for both daytime and nighttime. The predicted cumulative noise levels including Project noise contributions, existing noise levels, and the ASL mandated by Directive 038 are between 45.8 dBA and 45.9 dBA during the daytime period, and between 38.8 dBA and 39.9 dBA during the nighttime period. In addition, the results shown in Tables 13B1.5-11 and 13B1.5-12 indicate that based on Directive 038 there is no potential for LFN at three receptors: Rsouth, Rwest , and Rsouthwest. At the fourth receptor, Rnorth, there is a small potential for LFN effects. However, this prediction is believed to be the result of conservatism in the modelling and not something that would actually be observed in the field since there is no reason to believe that noise emissions from the Project will have a distinct low frequency tonal component.

13B1.6.2.3 Blasting

Noise and vibrations emissions from mine blasting operations were assessed using guidance and vibration limits outlined in NPC-119 (OMOE 1978) and an assumed range of explosive weights from 553 kg/hole to 775 kg/hole. The assessment of noise and vibration effects associated with blasting concluded that airborne noise and ground borne vibrations will meet the noise and peak particle velocity limits at the Misery camp and at all locations 800 m or farther from the Jay Pit.

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13B2 NOISE MODELLING

13B2.1 Introduction

This appendix is structured as follows:

- Section 13B2.2 provides an introduction to the concepts and theories used in the assessment of outdoor acoustics;
- Section 13B2.3 describes noise modelling in general and the specifics of the noise modelling for the Jay Project (Project);
- Section 13B2.4 describes the specifics of the sources modelled for the Project;
- Section 13B2.5 gives an overview of the noise level contributions of the various sources at the receptor locations; and,
- Section 13B2.6 describes the permissible sound level (PSL) calculations for the receptor locations.

13B2.2 Basics of Acoustics

This section provides basic insights into the mechanisms of outdoor acoustics, which are aimed to help the reader to better understand the noise impact assessment (NIA) for the Project.

13B2.2.1 Noise Levels

Noise levels from common sources are listed in Table 13B2.2-1 to provide a reference when comparing the noise levels predicted for the Project. The noise levels listed in the table represent average values and may vary from one situation to the next.

Table 13B2.2-1 Noise Levels of Common Sources

Activity	Noise Level [dBA]
lawnmower	88 to 93 at 152 cm
portable hair dryer	77 to 86 at 30 cm
vacuum cleaner	78 to 85 at 152 cm
food blender	76 to 81 at 91 cm
microwave oven	56 to 58 at 91 cm
schools, libraries, churches, hospitals, nursing homes	60 to 65
dehumidifier	58 to 60 at 152 cm
rustling leaves in wind	55 to 58
summer nighttime insects	50 to 54 in open field
whispered speech	40
average rural sound level at night	35

Source: Cowan (1994).
cm = centimetre; dBA= A-weighted decibel.

13B2.2.2 Noise Prediction Methods

Two basic acoustic concepts are the key in evaluation of noise levels expected from the Project. The first concept deals with the addition of multiple noise sources. The second concept deals with the attenuation of noise levels in the environment.

13B2.2.2.1 Addition of Noise Levels

Noise is generated by fluctuations of pressure in a medium. For outdoor noise propagation the medium is air. The differences in pressure that humans can hear are very large. However, quantifying noise in pressure units results in very large numbers, which is not very practical. Therefore, a logarithmic scale has been introduced to keep the numbers manageable. Because noise levels are measured on a logarithmic scale, the combined effect of multiple sources is calculated accordingly.

The following formula is used to combine multiple sources:

$$dBA = 10 \times \log\left(10^{\frac{dBA_1}{10}} + 10^{\frac{dBA_2}{10}} + 10^{\frac{dBA_3}{10}} + \ldots + 10^{\frac{dBA_n}{10}}\right)$$

If the sound emitted from a single facility results in a noise level of 40 A-weighted decibels (dBA), then the emissions from two facilities with the same noise level will result in a noise level of 43 dBA. Therefore, a doubling of the sound emissions will result in a 3 dBA increase in noise level. When the emissions from a third similar facility are added, the noise level increases to 44.8 dBA.

13B2.2.2.2 Attenuation of Noise in the Environment

Several factors can mitigate noise emissions in the environment. These mitigating factors are referred to as noise attenuation. The most important factor for noise attenuation is the distance between the source and the receptor.

As distance increases, noise levels decrease. For facilities, noise levels at increased distances can be calculated using the following formula (EUB 2007):

L(R2) = L(R1) – 20 Log10(R2/R1),

where L(R) represents the noise level at distance R from a noise-emitting facility, and R1 and R2 represent two different distances. A doubling of the distance from a facility results in a 6 dBA reduction in noise level. Therefore, increasing the distance from 500 to 1,000 metres (m) will drop the noise level from 40 to 34 dBA. Increasing the distance by another 1,000 m from 1,000 to 2,000 m will decrease the noise level from 34 to 28 dBA.

Several other environmental factors will result in attenuation of emitted sounds. These include the absorption of sound by air, the effect of barriers or hills on noise levels, and the effect of trees and ground on the emitted noise.

As sound passes through the atmosphere it collides with air molecules, converting some of the energy into heat. This transfer of energy results in a decrease in the sound energy. The amount of energy that the atmosphere absorbs varies with weather conditions and the sound frequency. Low frequency sounds (those not readily detected by the human ear) are relatively unaffected by the atmosphere. The mid-range frequency sounds, which are most readily detected by the human ear, can lose substantial energy to the atmosphere.

Barriers and hills can also attenuate sound in the environment. As the sound waves "bend" around obstructions, they lose a great deal of energy. This phenomenon explains the use of barriers along major highways in urban areas. This phenomenon also explains why people do not usually hear sounds from sources that are behind hills. The amount of attenuation afforded by an obstruction is a function of the amount the sound waves bend. Therefore, the attenuation is greatest close to the source, and is less effective at greater distances.

The final method of environmental attenuation deals with the interaction of sounds with the ground. The degree of attenuation varies with the weather conditions and the ground absorption. This attenuation has been incorporated in the model used to calculate the attenuation for all sources of noise for the Project.

In addition to environmental attenuation from distance, ground obstructions, trees and other natural features, anthropogenic (man-made) features can also reduce sound levels. Project buildings, weather enclosures, exhaust mufflers, and other similar components reduce the amount of noise effects from facilities. Noise-reducing components can be designed to increase reductions in noise emissions beyond what would otherwise result (e.g., addition of extra insulation to structures).

13B2.3 Noise Modelling

13B2.3.1 Model Selection

In selecting a prediction model to evaluate potential environmental effects of noise emissions from the Project, the following key conditions were taken into consideration:

- can the model evaluate the various source types present at the site;
- can the model predict the necessary environmental noise indicators;
- does the model have a basis that is scientifically sound, and is in keeping with the current standards regarding environmental noise; and,
- is the model suitable to predict noise in accordance with Alberta Energy Regulator (AER) Directive 038: Noise Control (EUB 2007).

The computer noise model used for the Project NIA was developed using Computer Aided Noise Abatement (CadnaA), version 4.3.143 acoustic modelling software (developed by DataKustic GmbH). As required by Directive 038, the CadnaA software uses a calculation algorithm consistent with the international standard ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors. Part 2: General method of calculation (ISO 1996).

CadnaA has the ability to simulate noise emission from stationary and mobile sources (e.g., haul trucks, excavators, crushers, electrical transformers, and ventilation fans) by representing the equipment/activity as a point, line and/or area source, as required. Each emission source is characterized by specifying either the total sound power level or the octave-band sound power level. Other parameters, such as source dimensions, hours of operation, and noise controls like transmission loss and insertion loss, can also be represented in the model allowing for realistic and accurate description of operational parameters and character of noise sources. The CadnaA model also accounts for noise attenuation related to meteorological conditions, ground cover, and physical barriers that are either natural (e.g., terrain-based) or man-made (e.g., screens, barriers and buildings).

13B2.3.2 Noise Modelling Limitations

Outdoor noise attenuation is modelled using standard algorithms and assumptions that tend to simplify the acoustic environment. Noise, whether natural or anthropogenic (man-made), is normally variable over time. The algorithms and the equivalent energy noise level (Leq) indicator account for this variability, but do not predict it. The variation of noise sources over time can be addressed in the CadnaA model using sound power level or time usage adjustments, depending on the noise source being assessed and the level of detail required.

The quality and relevance of predictions from the noise model are dependent on the data inputs. For the assessment, noise sources were established with field measurements of similar equipment, vendor noise emission data, and widely accepted engineering formulae.

According to the relevant standard, the overall accuracy of the calculation algorithm is +/- 3 decibels (dB) for distances between source and receptor up to 1 kilometre (km) (ISO 1996); the accuracy for larger propagation distances is not stated. Model accuracy will also depend on the accuracy of the supplied acoustic sound power levels, which is often +/- 2 dB for measured sources and even larger for engineering formulae. Considering these uncertainties, the accuracy of the predictions presented in this noise assessment is expected to be +/- 5 dB.

Conservative assumptions regarding the Project have been made, where practical, to account for the level of uncertainty inherent in the noise predictions. In particular, the calculation standard used in the development of the noise model assumes that every receptor is downwind from every source 100 percent (%) of the time (ISO 1996). Because downwind conditions tend to enhance noise propagation, the model is expected to overestimate noise levels compared to noise levels that would be observed under typically existing wind conditions.

13B2.3.3 Scientific Uncertainty

As indicated in Section 13B2.3.2, outdoor noise attenuation is modelled using standard algorithms and assumptions that tend to simplify the acoustic environment. Normal variation of noise sources is addressed in the modelling depending on the noise source being assessed and the level of detail required.

The quality and relevance of predictions from the noise model is dependent on the data inputs. Noise emissions and site data used for the assessment were established with a high level of professional care to provide simulations that were representative of the site, yet conservative. The conservatism helps address uncertainties in the data and predictions.

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13B2.3.4 Model Configuration

The configuration of the calculation parameters used to complete noise modelling for the Project is listed in Table 13B2.3-1.

Directive 038 lists meteorological parameter ranges to use for noise modelling (EUB 2007). These include temperatures between 0 degrees Celsius (°C) to 25°C, relative humidity between 70% to 90%, and wind speeds between 5.0 to 7.5 kilometres per hour (km/hr). Wind directions and ground cover as noted by Directive 038 are consistent with site conditions entered into the model.

Table 13B2.3-1 Noise Model Configuration Parameters

Parameter	Model Setting	Description/Comments
Standards used	ISO 9613-2 (ISO 1996)	All noise sources modelled based on requirements of the standard
Ground absorption	0.0 – waterbodies 0.5 – noise study area	These values represent the acoustic properties of the ground in accordance with ISO 9613-2 (ISO 1996): 0.0 represents hard/reflective ground; 1.0 represents porous/reflective ground
Temperature/humidity	11˚C/71% summertime[a] -25˚C/78% wintertime[b]	• Average summer conditions within Project area. • Average wintertime conditions within Project area.
Wind conditions	1 to 5 m/s	Default ISO 9613-2 (ISO 1996) including moderate inversion condition, all receptors downwind from each source
Terrain	Ground elevation lines (5 m[c] to 520 m) at 5 m resolution	Ground elevation lines used to characterize topography of the terrain within the Project area
Order of reflections	1	Maximum of one reflection included in calculations
Source type	• Line • Point • Area	• Mobile equipment (e.g., truck) was represented by line source located along equipment movement pattern. • Stationary sources (e.g., fans, idling trucks) were represented as point sources located in specific areas of the mine. • Sources that are expected to move or operate with changing pattern (e.g., dozer within pit or WRSA) were represented as area sources with acoustical energy distributed over expected area of operation (e.g., pit).

a) Summertime defined based on Directive 038 (temperature above 0˚C and no snow or ice ground cover) (EUB 2007).

b) Wintertime defined as time for which Winter Road will be operational (e.g., from February to the end of March).

c) Bottom of the pit.

ISO = International Organization for Standardization; ˚C = degrees Celsius;% = percentage of relative humidity; m/s = metres per second; m = metre; WRSA = waste rock storage area.

13B2.4 Source-Specific Model Data

The sound power level spectra for the noise sources associated with the Project construction are listed in Table 13B2.4-1. The sound power level spectra associated with equipment used during Project operations are listed in Table 13B2.4-2.

Table 13B2.4-1 Octave Band Sound Power Levels for Project Construction Noise Sources

Equipment Type	Octave Band Sound Power Level [dBA]									Overall	
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz	8,000 Hz	[dBA]	[dB]
CATD8 Dozer	56.0	72.0	100.0	98.0	101.0	102.0	101.0	95.0	84.0	107.9	117.1
CATD10R Dozer	59.0	75.0	103.0	100.0	104.0	105.0	104.0	98.0	87.0	110.8	120.1
CAT345 Excavator	62.9	75.3	98.3	95.3	103.3	105.3	104.3	98.3	91.3	110.0	116.4
CAT375 Excavator	65.0	77.0	100.0	97.0	105.0	107.0	106.0	100.0	93.0	111.7	118.1
Komatsu 125t Excavator	65.9	78.3	101.3	98.3	106.3	108.3	107.3	101.3	94.3	113.0	119.4
CAT789	66.0	81.0	98.0	101.0	108.0	111.0	110.0	104.0	94.0	115.3	119.0
CAT777	67.0	84.0	101.0	99.0	100.0	103.0	102.0	99.0	92.0	108.9	118.9
Water Truck (CAT777)	67.0	84.0	101.0	99.0	100.0	103.0	102.0	99.0	92.0	108.9	118.9
CAT992 Loader	63.0	78.0	102.0	107.0	104.0	106.0	106.0	99.0	89.0	112.5	120.7
Mobile Crane 150t	75.6	88.8	93.9	97.4	98.8	99.0	96.2	89.0	78.9	104.7	119.3
Temporary Crusher	82.1	95.3	105.4	109.9	121.3	120.5	114.7	106.5	104.4	124.7	129.6
Clamshell Dredge	84.1	91.2	88.9	97.9	104.3	101.5	100.4	96.4	94.4	108.3	124.7

dB= unweighted decibel; dBA = A-weighted decibel; Hz = hertz.

Table 13B2.4-2 Octave Band Sound Power Levels for Project Operations Noise Sources

Equipment Type	Octave Band Sound Power Level [dBA]									Overall	
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz	8,000 Hz	[dBA]	[dB]
CAT6040 Pit Shovel	86.0	95.0	106.0	111.0	114.0	114.0	111.0	102.0	94.0	119.1	129.1
CAT6018 Pit Shovel	83.0	93.0	103.0	108.0	111.0	112.0	108.0	99.0	91.0	116.6	126.6
Driltech D90KS	80.0	97.0	101.0	109.0	112.0	110.0	99.0	83.0	83.0	115.5	126.5
Ingersoll Rand DM45HP	80.0	97.0	101.0	109.0	112.0	110.0	99.0	83.0	83.0	115.5	126.5
CAT16H Grader	76.0	84.0	93.0	97.0	99.0	99.0	90.0	78.0	78.0	103.8	117.7

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Table 13B2.4-2 Octave Band Sound Power Levels for Project Operations Noise Sources

Equipment Type	Octave Band Sound Power Level [dBA]									Overall	
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz	8,000 Hz	[dBA]	[dB]
CATIT28 Toll Carrier	85.0	88.0	94.0	96.0	99.0	98.0	95.0	91.0	82.0	104.2	125.0
CATD10R Dozer	59.0	75.0	103.0	100.0	104.0	105.0	104.0	98.0	87.0	110.8	120.1
CAT 375 Excavator	65.0	77.0	100.0	97.0	105.0	107.0	106.0	100.0	93.0	111.7	118.1
CAT789	66.0	81.0	98.0	101.0	108.0	111.0	110.0	104.0	94.0	115.3	119.0
CAT777	67.0	84.0	101.0	99.0	100.0	103.0	102.0	99.0	92.0	108.9	118.9
Water truck (CAT777)	67.0	84.0	101.0	99.0	100.0	103.0	102.0	99.0	92.0	108.9	118.9
Loader CAT992 Loader	63.0	78.0	102.0	107.0	104.0	106.0	106.0	99.0	89.0	112.5	120.7
Pit Hauler	71.3	86.7	103.7	106.7	113.7	116.7	115.7	109.7	99.7	121.0	124.7
Dewatering Pump Transformer	34.0	53.0	66.0	68.0	73.0	71.0	67.0	62.0	55.0	77.0	85.7
Dewatering Pump 460 kW	55.0	63.0	69.0	74.0	75.0	75.0	68.0	57.0	48.0	80.3	96.2
Dewatering Pump 480 kW	55.0	63.0	69.0	74.0	75.0	75.0	68.0	57.0	48.0	80.3	96.2
Transport Truck[a]	72.0	85.0	97.0	104.0	108.0	111.0	106.0	100.0	100.0	114.0	119.8

a) Used in assessment of winter road noise emissions.

dB= unweighted decibel; dBA = A-weighted decibel; Hz = hertz.

13B2.5 Noise Level Predictions

13B2.5.1 Project Construction

The predicted Project construction noise levels at each of the noise receptors identified in the Project NIA are presented in Tables 13B2.5-1 through 13B2.5-5. The results are ranked in descending order for the highest contributing sources.

Table 13B2.5-1 Noise Source Ranking at Camp Receptor

Noise Source Ranking	Equipment Type	Overall Noise Level [dBA]	Activity/Location
1	CAT789	42.8	Transport of construction material to south dike
2	Temporary Crusher	42.4	Crusher
3	CAT789	41.5	Transport of construction material to north dike
4	CAT777	33.8	Transport of construction material to south dike

Table 13B2.5-1 Noise Source Ranking at Camp Receptor

Noise Source Ranking	Equipment Type	Overall Noise Level [dBA]	Activity/Location
5	CAT777	32.3	Transport of construction material to north dike
6	CAT789	27.1	Crusher area
7	CAT992	22.7	Crusher area
8	CAT777	20.8	Crusher area
9	CAT375	18.1	South dike
10	CAT992	18.0	South dike
11	CATD10	16.0	South dike
12	Remaining noise sources	19.8	Jay construction equipment

dBA = A-weighted decibel.

Table 13B2.5-2 Noise Source Ranking at CR_{south} Receptor

Noise Source Ranking	Equipment Type	Overall Noise Level [dBA]	Activity/Location
1	CAT789	33.0	Transport of construction material to south dike
2	CAT375	31.5	South dike
3	CAT992	30.1	South dike
4	CAT789	29.4	Transport of construction material to north dike
5	CATD10	28.1	South dike
6	CAT375	26.7	South dike
7	CAT777	26.7	Transport of construction material to south dike
8	CAT992	25.3	North dike
9	Temporary Crusher	23.9	Crusher
10	CAT777	23.8	Transport of construction material to north dike
11	CATD8	22.9	North dike
12	CATD10	22.4	North dike
13	Dredge	22.2	South dike
14	Komatsu 125t excavator	21.7	South dike
15	CATD8	18.8	North dike
16	Dredge	16.8	South dike
17	Komatsu 125t excavator	16.8	North dike
18	Dredge	16.6	South dike
19	Dredge	15.8	North dike
20	Remaining noise sources	20.6	Jay construction equipment

dBA = A-weighted decibel.

Table 13B2.5-3 Noise Source Ranking at $CR_{southwest}$ Receptor

Noise Source Ranking	Equipment type	Overall Noise Level [dBA]	Activity/Location
1	Temporary Crusher	33.7	Crusher
2	CAT789	24.9	Transport of construction material to south dike
3	CAT789	24.2	Crusher area
4	CAT789	23.7	Transport of construction material to north dike
5	CAT992	20.2	Crusher area
6	CAT777	19.8	Transport of construction material to south dike
7	CAT777	18.4	Transport of construction material to north dike
8	CAT777	18.4	Crusher area
9	Remaining noise sources	11.3	Jay construction equipment

dBA = A-weighted decibel.

Table 13B2.5-4 Noise Source Ranking at CR_{north} Receptor

Noise Source Ranking	Equipment type	Overall Noise Level [dBA]	Activity/Location
1	CAT375	29.2	North dike
2	CAT789	28.3	Transport of construction material to north dike
3	CAT992	27.1	North dike
4	CATD10	24.8	North dike
5	CAT777	22.7	Transport of construction material to north dike
6	CATD8	21.2	North dike
7	Komatsu 125t excavator	19.5	North dike
8	CAT789	18.9	Transport of construction material to south dike
9	Dredge	18.5	North dike
10	CAT375	18.5	South dike
11	CAT992	18.4	South dike
12	Temporary Crusher	16.9	Crusher
13	CATD10	16.4	South dike
14	Dredge	16.3	North dike
15	CAT777	15.6	Transport of construction material to south dike
16	CAT345	11.6	South dike
17	CATD8	11.1	South dike
18	Remaining noise sources	16.9	Jay construction equipment

dBA = A-weighted decibel.

Table 13B2.5-5 Noise Source Ranking at CR_{west} Receptor

Noise Source Ranking	Equipment Type	Overall Noise Level [dBA]	Activity/Location
1	Temporary Crusher	38.1	Crusher
2	CAT789	35.2	Transport of construction material to south dike
3	CAT789	34.2	Transport of construction material to north dike
4	CAT789	29.0	Crusher area
5	CAT777	28.2	Transport of construction material to south dike
6	CAT777	26.7	Transport of construction material to north dike
7	CAT375	26.0	South dike
8	CAT992	25.3	South dike
9	CAT992	24.3	Crusher area
10	CATD10	23.5	South dike
11	CAT777	22.4	Crusher area
12	CATD8	18.3	South dike
13	Dredge	16.7	South dike
14	Komatsu 125t excavator	16.1	South dike
15	CAT992	15.6	North dike
16	CAT375	15.5	North dike
17	Remaining noise sources	19.6	Jay construction equipment

dBA = A-weighted decibel.

13B2.5.2 Project Operations

The predicted Project operations noise levels at each of the noise receptors identified in the Project NIA are presented in Tables 13B2.5-6 through 13B2.5-9. The results are ranked in descending order for the highest contributing sources.

Table 13B2.5-6 Noise Source Ranking at R_{south} Receptor

Noise Source Ranking	Equipment Type	Overall Noise Level [dBA]	Activity/Location
1	CAT6040	31.6	Pit
2	CAT789	31.4	Waste transport to WRSA
3	CAT992	25.9	Pit
4	CAT777	25.8	Ore transport to storage pad
5	Pit Hauler	25.6	Kimberlite storage pad
6	CAT789	25.1	Pit
7	CAT6018	24.3	Pit
8	RandDM45	23.7	Pit
9	DK90KSDrill	23.5	Pit
10	Pit hauler	22.1	Misery Road
11	CAT992	19.1	Kimberlite storage pad

Table 13B2.5-6 Noise Source Ranking at R_{south} Receptor

Noise Source Ranking	Equipment Type	Overall Noise Level [dBA]	Activity/Location
12	CATD10	18.6	Pit
13	CATD10	17.0	Kimberlite storage pad
14	CAT789	16.4	WRSA
15	CAT777	15.3	Pit
16	CAT777	15.1	Kimberlite storage pad
17	Remaining noise sources	17.8	Jay construction equipment

dBA = A-weighted decibel; WRSA = waste rock storage area.

Table 13B2.5-7 Noise Source Ranking at $R_{southwest}$ Receptor

Noise Source Ranking	Equipment Type	Overall Noise Level [dBA]	Activity/Location
1	Pit hauler	36.2	Misery Road
2	Water truck (CAT777)	15.7	Jay access roads
3	CAT789	12.3	Waste transport to WRSA
4	CATD10	7.6	WRSA
5	CAT789	7.2	WRSA
6	Remaining noise sources	9.4	Jay equipment

dBA = A-weighted decibel; WRSA = waste rock storage area.

Table 13B2.5-8 Noise Source Ranking at R_{north} Receptor

Noise Source Ranking	Equipment Type	Overall Noise Level [dBA]	Activity/Location
1	CAT789	29.8	WRSA
2	CAT789	27.9	Waste transport to WRSA
3	CAT6040	27.4	Pit shovel
4	CATD10	24.8	WRSA
5	CAT992	22.1	Pit
6	CAT375	21.2	WRSA
7	CAT789	20.5	Pit
8	CAT6018	20.1	Pit shovel
9	RandDM45	19.5	Pit
10	DK90KSDrill	19.4	Pit
11	CAT777_	17.6	Ore transport to storage pad
12	CATD10	14.9	Pit
13	Pit hauler	14.6	Misery Road

Table 13B2.5-8 Noise Source Ranking at R_{north} Receptor

Noise Source Ranking	Equipment Type	Overall Noise Level [dBA]	Activity/Location
14	Pit Hauler	14.2	Kimberlite storage pad
15	CAT777	11.7	Pit
16	Remaining noise sources	14.9	Jay equipment

dBA = A-weighted decibel; WRSA = waste rock storage area.

Table 13B2.5-9 Noise Source Ranking at R_{west} Receptor

Noise Source Ranking	Equipment Type	Overall Noise Level [dBA]	Activity/Location
1	Pit hauler	33.9	Misery Road
2	CAT789	32.5	Waste transport to WRSA
3	CAT6040	26.9	Pit shovel
4	Pit Hauler	25.6	Kimberlite storage pad
5	CAT789	24.6	WRSA
6	CAT992Loader	21.6	Pit
7	CAT777	21.3	Ore transport to storage pad
8	CATD10	21.2	WRSA
9	CAT789	19.9	Pit
10	CAT6018	19.6	Pit shovel
11	RandDM45	19	Pit
12	DK90KSDrill	18.9	Pit
13	CAT992	18.3	Kimberlite storage pad
14	CAT375	16.8	WRSA
15	Water truck (CAT777)	15.1	Jay access roads
16	CATD10	14.5	Pit
17	CATD10	14.2	Kimberlite storage pad
18	Remaining noise sources	15.9	Jay equipment

dBA = A-weighted decibel; WRSA = waste rock storage area.

13B2.6 Permissible Sound Level Calculations

The PSL criteria for the Project operations noise receptors were calculated using Directive 038 methodology (EUB 2007). The PSL calculations for the Project are detailed in Table13B2.6-1.

Table 13B2.6-1 Permissible Sound Levels at Receptors: R_{south}, $R_{southwest}$, R_{north}, R_{west}

Basic Nighttime Sound Level [dBA]				Nighttime [dBA]	Daytime [dBA]
Proximity to Transportation	Dwelling Unit Density (# per ¼ section of land): 1 to 8 Dwellings	9 to 160 Dwellings	>160 Dwellings		
Category 1	40	43	46	40	40
Category 2	45	48	61	n/a	n/a
Category 3	50	53	56	n/a	n/a
Basic Sound Level (BSL)				40	40
Daytime Adjustment					
Reason for Adjustment			**Value [dBA L_{eq}]**	**Nighttime**	**Daytime**
Adjustment for nighttime hours (22:00 to 07:00)			0	0	n/a
Adjustment for daytime hours (07:00 to 22:00)			+10	n/a	10
Nighttime/daytime adjustment				0	10
Class A Adjustment					
Class	**Reason for Adjustment**		**Value [dBA L_{eq}]**	**Nighttime**	**Daytime**
A1	Seasonal adjustment (November 1 to March 31)		+5	n/a	n/a
A2	Absence of both tonal and impulse/impact components		+5	n/a	n/a
A3	Ambient monitoring adjustment depending on the difference between the BSL and the measured L_{eq}		-10 to +10	0	0
Class adjustment = sum of A1, A2 and A3 (as applicable), but is not to exceed a maximum of 10 dBA L_{eq}					
Total Class A Adjustments				**0**	**0**
Class B Adjustment					
Class	**Duration of Activity**		**Value [dBA L_{eq}]**	**Nighttime**	**Daytime**
B1	1 day		+15	n/a	n/a
B2	1 week		+10	n/a	n/a
B3	≤2 months		+5	n/a	n/a
B4	>2 months		0	0	0
Class B adjustment = one of B1, B2, B3 or B4				n/a	n/a
Class B adjustment				0	0
Permissible Sound Level (PSL) (dBA)				40	50

Note: Shaded fields are selected values used in the permissible sound level (PSL) calculation.

n/a = Not applicable; Leq = equivalent energy noise level; dBA = A-weighted decibel; - = minus; += plus; >= greater than; ≤ = less than or equal to; # = number.

In summary, for all receptors located along the 1.5 km AER criteria boundary (i.e., located at 1.5 km from the Project boundary) the daytime PSL is 50 dBA and the nighttime PSL is 40 dBA.

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13B2.7 References

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13B2.8 Glossary

Term	Definition
Alberta Energy Regulator (AER)	An independent provincial body responsible for regulation of oil, oil sands, natural gas, and coal mining projects in Alberta. In the Northwest Territories (and other jurisdictions that lack specific environmental noise regulations), AER noise regulations are often used to guide noise assessments.
All-season road	A road that is motorable all year by the prevailing means of rural transport.
Ambient	The conditions surrounding an organism or area.
Anthropogenic	Caused by human activity.
Attenuation	The process by which a compound is reduced in concentration over time, through adsorption, degradation, dilution and/or transformation.
A-weighting	A spectral or frequency weighting scheme applied to noise measurements to replicate the frequency response of the human auditory system.
Base Case	The Environmental Assessment (EA) case that includes existing environmental conditions as well as existing and approved projects or activities.
Baseline noise	Current environmental noise levels, against which changes in the environment from the Dominion Diamonds Jay Project could be assessed; the base case focuses on summarizing the noise monitoring data gathered during the recent noise survey.
Broadband noise	Noise measured over the entire audible spectrum; for the average human the audible spectrum extends from approximately 20 Hz to approximately 20,000 Hz.
C-weighting	A spectral or frequency weighting scheme that emphasizes low frequency content.
Daytime	The hours between 7:00 am and 10:00 pm.
dBA	Decibel value obtained using A-weighting.
dBC	Decibel value obtained using C-weighting.
Decibel (dB)	The decibel (dB) is a measure, on a logarithmic scale, of the magnitude of a particular quantity (such as sound pressure level or sound power level) with respect to a standard reference value.
Directive 038	The regulation that applies to environmental noise from oil, oil sands, natural gas, and coal mining projects in Alberta. In the Northwest Territories (and other jurisdictions that lack specific environmental noise regulations), Directive 038 is often used to guide noise assessments. Directive 038 provides guidance regarding the approach used in preparation of noise assessments, including noise measurement techniques and methodology for identifying and addressing adverse noise effects.
Equivalent noise level L_{eq}	Continuous equivalent sound level, defined as the sound pressure level that, if constant over the stated measurement period, would contain the same sound energy as the actual monitored sound that is fluctuating in level over the measurement period. This type of average takes into account the natural variability of sound.
Esker	An esker is a long, winding ridge of stratified sand and gravel believed to form in ice-walled tunnels by streams which flowed within and under glaciers. After the retaining ice walls melt away, stream deposits remain as long winding ridges.
Footprint	The proposed development area that directly affects the soil and vegetation components of the landscape.
Frequency	The number of cycles of a periodic phenomenon per unit time interval. It is used to quantify the periodic oscillation nature of air molecules in a propagation of sound wave.
Hertz (Hz)	Physical unit describing the frequency of occurrence of a certain process expressed in number of cycles per second (e.g., 20 Hz is twenty cycles per second).
ISO 9613-2	ISO 9613: Acoustics – Attenuation of Sound During Propagation Outdoors is a technical standard describing the methodology used in calculation of attenuation of sound during propagation outdoors and determination of environmental noise levels at a distance from the source.

Term	Definition
Kimberlite	Igneous rocks that originate deep in the earth's mantle and intrude the earth's crust. These rocks typically form narrow pipe-like deposits that sometimes contain diamonds.
Kimberlite pipe	A more or less vertical, cylindrical body of kimberlite that resulted from the forcing of the kimberlite material to the Earth's surface. Typically vertical structures of volcanic rock in the Earth's crust that can contain diamonds.
Low frequency noise	Noise containing a clear tonal component at a frequency below 250Hz and for which the difference between the overall C-weighted sound level and the overall A-weighted sound level exceeds 20 dB.
Nighttime	The hours between 10:00 pm and 7:00 am.
Noise	Unwanted sound or sound levels that can be heard or measured at a receptor.
Noise level	Describes magnitude of sound measured using the logarithmic dB scale.
Permissible Sound Level (PSL)	The allowable overall A-weighted sound level of noise from energy industry sources, as specified by the EUB Noise Control Directive, which may contribute to the sound environment of a residential location.
Receptor (Noise)	A location where measurements or predictions of noise levels are made.
Relative Humidity	The ratio of the amount of water vapour in the atmosphere to the amount necessary for saturation at the same temperature. Relative humidity is expressed in terms of percent and measures the percentage of saturation.
Sound	The acoustic energy generated by natural or anthropogenic sources, including Project activities
Sound level meter	A device used to measure, record, and report sound pressure levels.
Sound Power Level (L_w)	The level of sound power, expressed in decibel (dB) relative to a stated reference value of 10^{-12} watts.
Treeline	An area of transition between the tundra and boreal forest to the south.
Tundra	An area between the polar ice cap and taiga that is characterized by a lack of trees and permanently frozen subsoil.
Waste rock	Rock moved and discarded in order to access resources.
Waste rock storage area	Engineered landforms in which waste rock from mining activities is stored.
Waterbody	An area of water such as a river, stream, lake or sea.
Watercourse	Riverine systems such as creeks, brooks, streams and rivers.
Wildlife	Under the Species at Risk Act, wildlife is defined as a species, subspecies, variety or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus that is wild by nature and is native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Winter road	Roads which are built over frozen lakes and tundra. Compacted snow and/or ice is used for embankment construction.