PHASE 2
DRAFT ENVIRONMENTAL IMPACT STATEMENT

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document. A detailed glossary of noise-related terminology can be found in Annex A of Appendix V4-3A.

A-weighting — Environmental noise is typically measured and assessed as a sound pressure level, in A-weighted decibels (dBA). The A-weighting is designed to match the average frequency response of the human ear.

Ambient Noise — The average (L_{eq}) and all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far. Noise contributing to ambient levels is characteristically dynamic (all emissions contribute to this average level) and will include sound from wind blowing through trees, wildlife, birdsongs, distant thunder, insects and similar sources if these sounds are a normal feature of the location. Ambient noise is commonly described using the LA_{eq}, T descriptor, where T is the duration of the measurement or assessment period.

Background Noise — The background (L_{90}) and underlying level of noise present in the ambient noise when extraneous noise is removed. Noise contributing to background levels is characteristically continuous or constant but can include sound from wind blowing through trees, wildlife, birdsongs, distant thunder, insects and similar sources if these sounds are a normal feature of the location. Background noise is commonly described using the L_{90}, T descriptor, where T is the duration of the measurement or assessment period.

Baseline or Noise Baseline — In the context of Phase 2, the noise baseline is the existing pre-project acoustic environment unaffected by human (anthropogenic) noise sources. The baseline is considered to consist of only natural noise sources such as wind blowing through trees, wildlife, birdsongs, distant thunder, insects etc.

Decibels — Decibel (dB is the adopted abbreviation for the decibel) is the unit used to describe sound and noise levels. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure.

L_{eq} (dBA) or LA_{eq} — L_{eq} is the continuous equivalent (average) A-weighted sound pressure level in decibels (dB) over a time period. Environmental noise is typically measured and assessed as a sound pressure level, in A-weighted decibels (dBA) hence L_{eq} (dBA) or LA_{eq} being applied.

L_{90} (dBA) or LA_{90}	L_{90} (dBA) or LA90 is the ninetieth percentile exceedance level (the A-weighted sound pressure level that is exceeded 90 percent of the time), over a period of time. For example, L_{90} = 35 dB means that the sound pressure level exceeded 35 dB during 90% of the measurement period. L_{90} is a statistical parameter and is usually regarded as the residual level or the background noise level without discrete or dynamic events (e.g., helicopters, fixed wing aircraft). Environmental noise is typically measured and assessed as a sound pressure level, in A-weighted decibels (dBA) hence L_{90} (dBA) or LA_{90} being applied.
Ld	The average (LAeq) noise level determined over the full daytime 7 am to 10 pm period. For the site under investigation it includes periods of respite and periods of work.
Ln	The average (LAeq) noise level determined over the full night time (10 pm to 7 am) period. For the site under investigation it includes periods of respite and periods of work.
Ldn	A compound parameter that recognises the increased sensitivity of human receptors during the night time (10 pm to 7 am) period by applying a +10 dB penalty to predictions for that period. Ldn is the average (LAeq) noise level determined over a standard 24-hour day period with the +10 dB penalty applied to the Ln value prior to the Ldn average being determined. For the site under investigation it includes periods of respite and periods of work.
Lmax (dBA) or LAmax	Lmax (dBA) or LAmax is the maximum instantaneous noise level recorded during a time period. Environmental noise is typically measured and assessed as a sound pressure level, in A-weighted decibels (dBA) hence Lmax (dBA) or LAmax being applied.
NIRB	Nunavut Impact Review Board
Sound Exposure Level (SEL), dBA	A measure of noise event level, which accounts for both the duration and intensity of noise.
Sound Power Level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.
Sound Pressure Level (LP)	The level of sound pressure, as measured at a distance by a standard sound level meter with a microphone or predicted via modeling. This differs from Sound Power Level (defined above) in that this is the received sound as opposed to the sound 'intensity' at the source.
TK	Traditional Knowledge
TK report	Banci, V. and R. Spicker. 2015. Inuit Traditional Knowledge for TMAC Resources Inc. Proposed Hope Bay Project, Naonaiyaotit Traditional Knowledge Project (NTKP). Prepared for TMAC Resources Inc. Kitikmeot Inuit Association: Kugluktuk, NU.

VEC

Valued Ecosystem Component. Those aspects of the environment considered to be of vital importance to a particular region or community, including:

a) resources that are either legally, politically, publically, or professionally recognized as important, such as parks, land selections, and historical sites;

b) resources that have ecological importance; and

c) resources that have social importance.

3. Noise and Vibration

This chapter presents the baseline noise conditions and noise and vibration assessment of potential effects associated with Phase 2 construction and operation, including consideration of the existing Doris operational noise. The noise and vibration aspects that were warranted for assessment include:

- air-borne noise associated with Phase 2 mine construction;
- air-borne noise associated with Doris and Phase 2 mine operation;
- air-borne noise associated with aircraft;
- air-blast overpressures associated with quarry blasting; and
- ground-borne vibration associated with quarry blasting.

3.1 INCORPORATION OF TRADITIONAL KNOWLEDGE

The Inuit Traditional Knowledge for TMAC Resources Inc. Proposed Hope Bay Project, Naonaiyaotit Traditional Knowledge Project (NTKP) report was reviewed for information related to the current noise environment and baseline noise (Banci and Spicker 2015). There were no direct references relevant to the existing noise environment and noise baseline in the TK report.

3.2 EXISTING ENVIRONMENT AND BASELINE INFORMATION

3.2.1 Data Sources

Noise monitoring was conducted on the Hope Bay Belt in 2007, 2008 (Golder 2007; Annex B of Appendix V4-3A; 2008) and 2010 (Rescan 2010; Annex B of Appendix V4-3A) as part of the required studies for the Doris North Gold Mine Project. Anthropogenic noise was present in the Doris Project area in all monitoring years due to activities associated with exploration and development. To describe baseline noise levels for Phase 2, only data unaffected by anthropogenic noise are referenced herein. This includes data reported in the 2007 Noise Baseline Report (Golder 2007) and the 2010 Noise Compliance Report (Rescan 2010).

3.2.2 Methods

As reported in Golder Associates 2007 and Rescan 2010, noise monitoring surveys performed for the Doris North Mine Project, baseline noise data was collected using Brüel & Kjær Model 2250 sound level meters capable of logging data. Each instrument's microphone was protected by a wind screen/weather shield and bird spikes, and was positioned vertically upward to eliminate the effect of wind directly on the microphone. Each sound level meter was calibrated before sampling.

3.2.2.1 Noise Monitoring in 2007

The July 2007 noise survey (Golder 2007) consisted of monitoring at three sites: NM-1, NM-2/3, and NM-4. The locations were selected to characterize areas potentially affected by Doris Project activity, based on their proximity to proposed infrastructure. The 2007 report excluded the influence of helicopter noise from the calculated hourly daytime and night time noise levels to provide an approximation of natural background conditions. Due to significant levels of construction and helicopter noise, NM-1 was found to be an unsuitable monitoring site for measuring baseline noise and

was excluded from this characterization of baseline noise environment. Figure 3.2-1 is a map of the Doris and Phase 2 projects and the monitoring sites used in the characterization of baseline noise.

3.2.2.2 Noise Monitoring in 2008

Noise monitoring was conducted in 2008 (Golder 2008) at three sites: NM-1, NM-4, and a new site, NM-5, located approximately 1.5 km northwest of NM-2/3. Due to significant anthropogenic noise at all monitoring sites, the 2008 noise survey year did not provide suitable reference sites for baseline noise and all 2008 data were excluded from this baseline characterization.

3.2.2.3 Noise Monitoring in 2010

During May and July of 2010 noise monitoring was conducted at 12 locations within a 15 km radius of the Doris Site (Rescan 2010). These locations were selected to characterize areas potentially affected by Doris Project activity, based on their proximity to proposed infrastructure and sensitive wildlife zones (i.e., caribou and raptor habitats).

Due to anthropogenic noise associated with the construction phase of Doris during the 2010 monitoring program, only sites which were not affected by frequent helicopter traffic (i.e., sites influenced by fewer than three flights during the monitoring period) and construction noise were selected to be included in the baseline. These four sites (S14, S15, S16 and S17) are located 12 to 15 km from the Doris Site (refer Figure 3.2-1) and are included in the noise baseline. Helicopter noise events and noise related to technician deployment at the beginning and end of each monitoring period was excluded from the calculated noise levels at each site. Data recorded at these four locations (S14, S15, S16 and S17) provides an indication of existing noise conditions in the absence of anthropogenic emissions, and in the absence of the Phase 2 site being assessed.

All applicable locations for monitoring conducted on the Hope Bay Belt in 2007, 2008 (Golder 2007; 2008; Annex B of Appendix V4-3A) and 2010 (Rescan 2010; Annex B of Appendix V4-3A) are shown in Figure 3.2-1. A summary of the monitoring sites utilised for characterizing baseline noise is provided in Table 3.2-1.

Table 3.2-1. Summary of Monitoring Sites for Characterizing Baseline Noise

Site ID	Start Date	Start Time	Duration (hours)	Approximate Distance from Doris	Terrain Type	Plate Number
NM-2/3	July 25, 2007	6:00 AM	27	1 km northwest	Rocky with some vegetation	3.2-1
NM-4	July 25, 2007	10:00 AM	20	3 km southeast	Tail Lake and rock outcrops	3.2-2
S14	May 16, 2010	11:46 AM	24	12 km east and downwind	Snow cover	—
S14	July 26, 2010	4:16 AM	20	12 km east and downwind	Vegetation cover	3.2-3
S15	May 22, 2010	6:00 PM	24	15 km east and downwind	Snow cover	—
S15	July 24, 2010	5:00 PM	24	15 km east and downwind	Vegetation cover	3.2-4
S16	July 24. 2010	1:15 PM	24	15 km east and downwind	Vegetation cover	3.2-5
S17	July 24, 2010	3:00 PM	24	12 km east and downwind	Vegetation cover	3.2-6

Figure 3.2-1
Selected Monitoring Sites For Baseline Noise

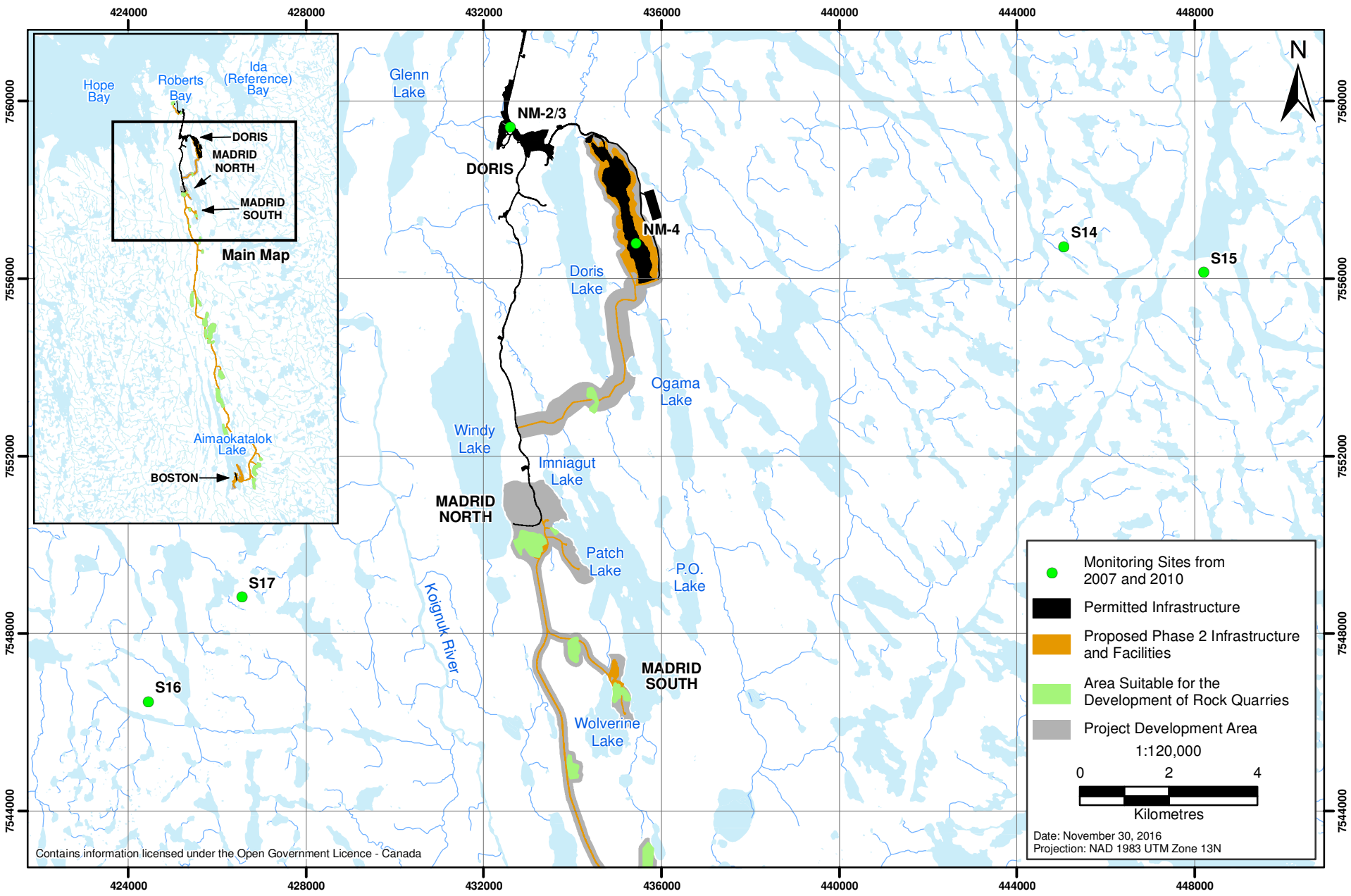


Plate 3.2-1. NM-2/3 Noise Monitoring Station in July, 2007.

Plate 3.2-2. NM-4 Noise Monitoring Station in July, 2007.

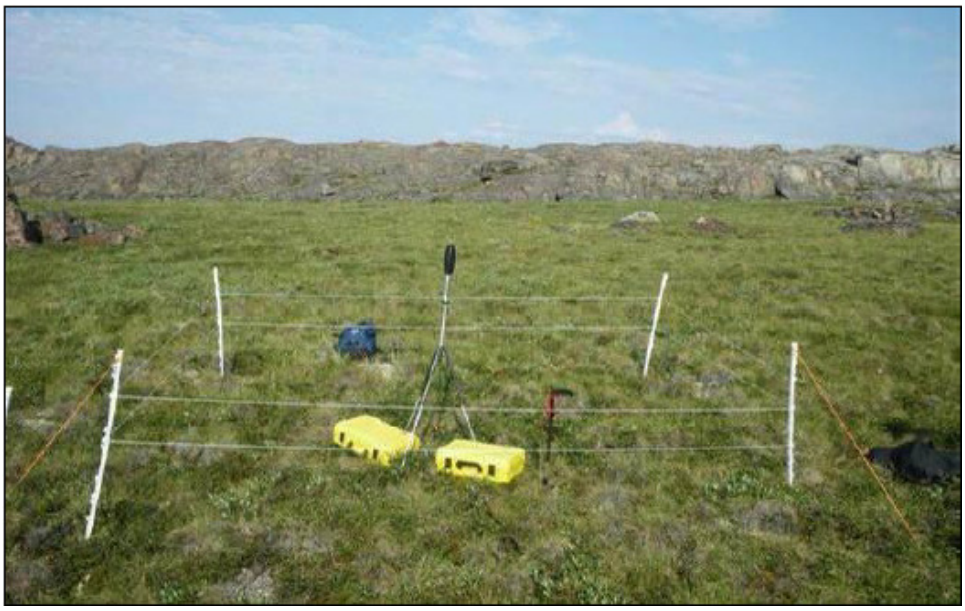


Plate 3.2-3. S14 Noise Monitoring Station in July, 2010.

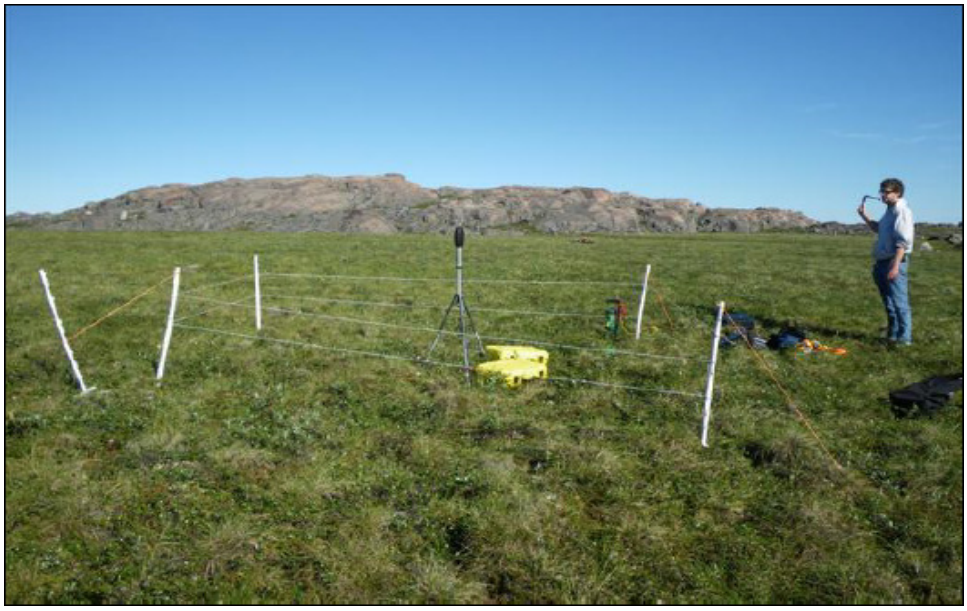


Plate 3.2-4. S15 Noise Monitoring Station in July, 2010.

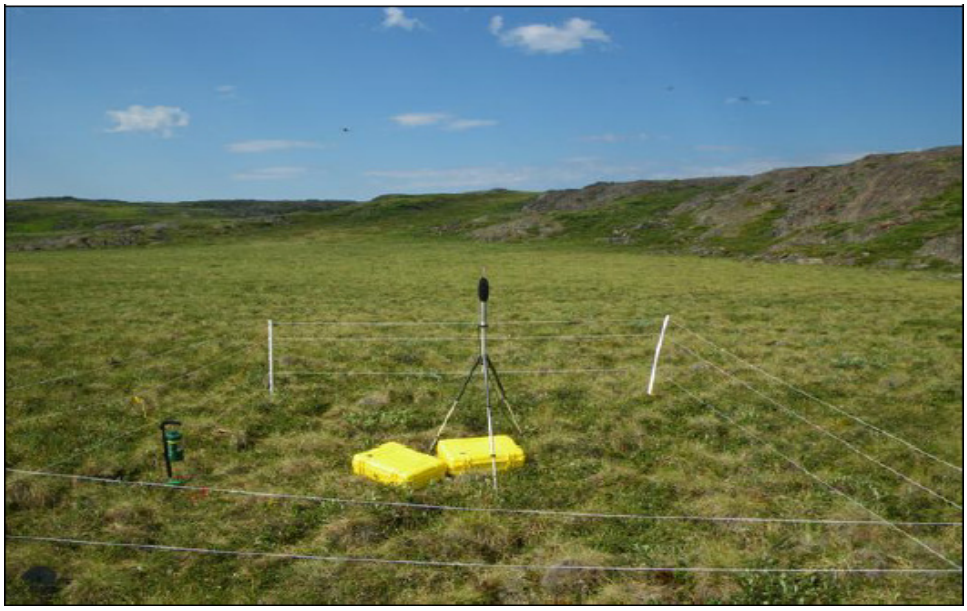


Plate 3.2-5. S16 Noise Monitoring Station in July, 2010.

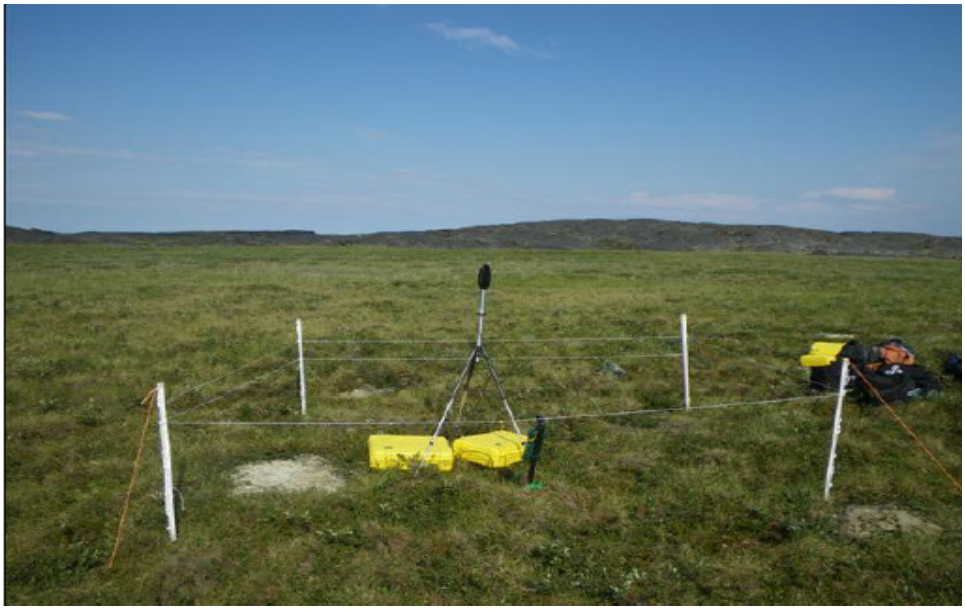


Plate 3.2-6. S17 Noise Monitoring Station in July, 2010.

3.2.3 Baseline Noise Metrics

Noise is typically measured as a sound pressure level, in A-weighted decibels (dBA). The A-weighting is designed to match the average frequency response of the human ear. Measurement parameters (in dBA) reported for both the 2007 and 2010 survey periods included the L_{eq}, L_{90}, and L_{max} values as described below:

- **L_{eq}** is the continuous equivalent (average) A-weighted sound pressure level in decibels (dB) over a time period.

- **L_{90} (dBA) or LA_{90}** is the ninetieth percentile exceedance level (the A-weighted sound pressure level that is exceeded 90 percent of the time), over a period of time. For example, L_{90} = 35 dB means that the sound pressure level exceeded 35 dB during 90% of the measurement period. L_{90} is a statistical parameter and is usually regarded as the residual level or the background noise level without discrete or dynamic events (e.g. helicopters, fixed wing aircraft).
- **L_{max} (dBA) or LA_{max}** is the maximum instantaneous noise level recorded during a time period.

A baseline L_{eq} value for each monitoring site was calculated as the logarithmic average of the recorded hourly L_{eq} values obtained during the survey for the daytime and night time periods. A baseline L_{90} value for each monitoring site was calculated as the lower 10^{th} percentile of the hourly L_{90} values recorded during the survey for the daytime and night time periods.

Specific L_{eq}-based metrics such as L_d, L_n, and L_{dn} were not reported in the noise monitoring studies of 2007 and 2010. The "L_d" (L_{eq} day) metric is the L_{eq} occurring between the hours of 7:00 am and 10:00 pm, while "L_n" (L_{eq} night) describes the L_{eq} occurring between 10:00 pm and 7:00 am. The "L_{dn}" metric is a 24-hour L_{eq} with a 10 dBA weighting applied to the evening hours to account for increased sensitivity to noise at night.

Characterizing noise in terms of L_d, L_n, and L_{dn} is important for assessing noise effects because guidelines for human health the protection of wildlife provide noise thresholds based on these metrics (US EPA 1974; WHO 1999; Environment Canada 2009). To compare baseline noise levels with guidance thresholds, the L_d, L_n, and L_{dn} were calculated from the reported hourly Leq values at each site (Table 3.2-3). A logarithmic average of these site values was calculated to estimate the baseline level for the overall Doris and Phase 2 project areas (Table 3.2-4).

In addition to L_d, L_n, and L_{dn}, the L_{max} metric is also used to assess health effects from noise (WHO 1999). The representative L_{max} (dBA) value for each monitoring site was calculated by determining the upper 10^{th} percentile value. This is considered to be a more conservative approach than taking the average L_{max} value, and was applied to account for the relatively short noise monitoring periods (i.e., 24 hours) undertaken in the area. A baseline L_{max} value representing the overall area was also calculated by averaging the upper 10^{th} percentile L_{max} values from each monitoring site.

3.2.4 Characterization of Baseline Conditions

Eight monitoring events from a total of six monitoring locations were selected from the 2007 and 2010 Doris noise monitoring programs to determine representative baseline noise levels for the Doris and Phase 2 Project areas. Sources of natural noise included animals, waves, and frequent winds. Anthropogenic noise included occasional helicopter traffic, which has been removed from the baseline data. The mean baseline Leq and L_{90} noise levels, and average wind speeds occurring at each site are presented in Table 3.2-2.

Across the monitoring locations, mean ambient L_{eq} noise levels ranged from 22.9 to 53.3 dBA; and background L_{90} noise levels ranged from 18.9 to 41.0 dBA. In some cases, the L_{eq} values observed within the Hope Bay Project area exceeded levels assumed to represent the baseline conditions of rural areas, which are approximately 35 dBA during the nighttime and around 45 dBA during the daytime (Alberta ERCB 2007). However, the 2007 and 2010 monitoring programs reported that wind was a major source of noise in the area, and is likely the cause of relatively high baseline L_{eq} levels (Annex B of Appendix V4-3A).

Table 3.2-2. Summary of Baseline Noise Results with Wind Speed

Station	Monitoring Dates	Monitoring Period	Mean L_{eq} (dBA)[1]	L_{90} (dBA)[2]	Mean Wind Speed (km/h)
NM-2/3	July 25 – 26 , 2007	27 h	30.0	24.0	19.1
NM-4	July 26 – 27 , 2007	20 h	47.2	41.0	28
S14	May 15 – 16, 2010	24 h	46.8	30.4	20.3
S14	July 24 – 25, 2010	24 h	50.2	36.9	30.3
S15	May 23 – 24, 2010	24 h	22.9	18.9	11.3
S15	July 24 – 25, 2010	24 h	41.5	31.6	32
S16	July 24 – 25, 2010	24 h	53.3	32.9	27.4
S17	July 24 – 25, 2010	24 h	48.6	39.9	29.2

[1] *L_{eq} values are logarithmic means of hourly levels.*
[2] *L_{90} values represent the 10th percentile of hourly levels.*

In general, mean L_{eq} values increased proportionally with mean wind speed across reference sites (Pearson correlation coefficient: r = 0.79). The lowest mean L_{eq} values were recorded at sites NM-2/3 and S15 (May 2010) and correlate with the lowest mean wind speeds experienced at all sites. In contrast, the highest mean L_{eq} values were observed at sites S14 (July 2010) and S17, which were among the sites that experienced the highest mean wind speeds (Table 3.2-2). These baseline noise levels are considered representative of the baseline noise environment consisting primarily of natural noise sources, as rare anthropogenic noise was removed from the overall noise levels reported.

The baseline L_d, L_n, L_{dn} and L_{max} values calculated for each monitoring station are presented in Table 3.2-3. As shown in Table 3.2-4, the mean baseline L_d, L_n, and L_{dn} values do not exceed recommended noise level thresholds for the assessment of negative effects to humans and wildlife. The calculated baseline L_{max} value does exceed the threshold for human sleep disturbance (Table 3.2-4), which is common for an existing noise environment such as that of the Hope Bay Property. Further information about noise level thresholds and associated assessment criteria (e.g., sleep disturbance, habitat disturbance, likelihood of complaints, and speech interference) can be found in Section 3.3.

Table 3.2-3. Summary of Calculated Baseline L_d, L_n, L_{dn}, and L_{max} Noise Levels

Station	L_d (dBA)	L_n (dBA)	L_{dn} (dBA)	L_{max} (dBA)
NM-2/3	30.3	29.2	35.8	51.8
NM-4	48.3	43.9	51.2	64.2
S14	48.9	28.5	47.0	65.8
S14	51.9	44.2	52.9	70.9
S15	23.9	21.1	28.3	48.4
S15	41.5	31.7	41.6	63.5
S16	46.8	32.9	53.4	68.4
S17	50.7	38.6	50.0	69.5

[1] *Calculated L_{max} values represent the upper 10th percentile of hourly L_{max} levels obtained during the monitoring period of each station.*

Table 3.2-4. Summary of Mean Hope Bay Project Area Baseline Noise with Noise Thresholds

Metric (dBA)	Threshold - Potential Annoyance, or Sleep Disturbance	Threshold - Complaints	Threshold - Wildlife Reaction or Habitat Loss	Hope Bay Project Area Mean (dBA)[1]
Ld	55	-	55	43
Ln	45	-	45	40
Ldn	-	60	-	50
Lmax	60	-	-	63

[1] *Hope Bay Project Area Mean is the logarithmic averages (Ld, Ln, and Ldn), and arithmetic averages (Lmax).*

3.3 VALUED COMPONENTS

3.3.1 Potential Valued Components and Scoping

Noise is an important environmental factor as a change in the noise environment may adversely affect wildlife, workers and local residents. Noise is defined as any undesirable sound that may irritate people, disturb rest or sleep, cause loss of hearing, or otherwise affect the quality of life of affected individuals. Noise can result in psychological and physiological effects (e.g., stress), mental health effects, and effects on residential behaviour (World Health Organization [WHO] 1999).

In addition, noise may negatively affect wildlife causing them to avoid important habitats and/or take time away from their key behaviours such as feeding, breeding or watching for predators, which can ultimately lead to reduced reproduction and increased mortality. Direct effects of high noise levels and shock waves on marine fish include mortality or internal injury (e.g. hearing, bleeding, ruptured swim bladder).

Ground-borne vibration and overpressure generated by blasting events are also important environmental factors as both can cause disturbances to local residents, workers, land users and wildlife. Vibration due to blasting has the potential to generate a risk of structural and cosmetic damage to off-site (non-Project) buildings/structures; however in this circumstance the risk is negligible if any at all. The closest settlement is approximately 70 kilometres (km) from the Doris and Phase 2 sites.

The scope of the assessment was identified based on regulatory considerations and guidance, professional judgment and community-based consultation.

3.3.1.1 TMAC Consultation and Engagement Informing VEC or VSEC Selection

Community meetings for the Phase 2 Project were conducted in each of the five Kitikmeot communities as described in Section 3 of Volume 2. The meetings are a central component of engagement with the public and an opportunity to share information and seek public feedback. Overall, the community meetings were well attended. Public feedback (questions, comments, and concerns) about the proposed Project was obtained through open dialogue during Project presentations, through discussions that arose during the presentation of Project materials and comments provided in feedback forms. No questions, comments, or concerns directly related to construction, operational or aircraft noise, or blasting overpressure and vibration were raised.

3.3.2 Valued Components Included in the Assessment

As a result of the scoping process (Volume 2, Section 4), noise (including overpressure) and vibration has been selected as a Valued Ecosystem Component (VEC). The VEC will be assessed by using modeling and predictions to estimate the noise and vibration levels at nearby relevant receptors. Table 3.3-1 outlines the rationale for including noise and vibration as a VEC in the EIS.

Table 3.3-1. Identification and Rationale for Selecting Noise and Vibration as a VEC

VEC	Identified by		Rationale for Inclusion
	NIRB Guidelines[1]	Government	
Noise and Vibration	X	X	Noise and vibration may negatively affect wildlife, land users, workers and local residents. Measureable parameters are selected to help define the effects and change attribution of the Phase 2 Project activities to the environment, including consideration of the existing Doris operations.

[1] *Nunavut Impact Review Board – Guidelines for the Preparation of an Environmental Impact Statement for Hope Bay Mining Ltd.'s Phase 2 Hope Bay Belt Project (NIRB File No. 12MN001), dated December 2012 (NIRB Guidelines).*

As stated in Section 1.0 of the EIS Guidelines (NIRB), the overall objective of the guidelines is to outline the requirements for the documented evaluation of the project proposal, providing detailed information regarding the proposal's environmental and socio-economic impacts in the form of the EIS. In addition the EIS should include the identification and development of mitigation measures or actions taken to lessen the actual or foreseen adverse environmental impact of a project or activity. As relevant to this chapter and the Environmental Noise and Vibration Study Report (Appendix V4-3A), Section 8.1.3 of the NIRB Guidelines presents the baseline and impact assessment requirements for the EIS. Furthermore, Section 9.4.15 of the NIRB Guidelines presents the requirements for the Proponent to develop a Noise Abatement Plan to provide information on monitoring and mitigating of noise impacts based on the impact assessment conducted to achieve the Section 8.1.3 requirements. These NIRB Guideline requirements validate the rationale for including noise and vibration as a VEC in the EIS. Noise and vibration is specifically addressed in this chapter and the Environmental Noise and Vibration Study Report provided as Appendix V4-3A, with further consideration provided in the Human Health and Environmental Risk Assessment (Volume 6, Section 5) and the Terrestrial Wildlife and Wildlife Habitat chapter (Volume 4, Section 9).

In addition to the regulatory and governmental considerations identified in Table 3.3-1 and summarised above, it is important to recognise the valuable input received during community consultation conducted for Phase 2. This consultation effort has identified noise and vibration as a key consideration for stakeholders, and importantly has highlighted the potential risk of negative wildlife (caribou) effects (disturbance) to occur due to noise associated with Phase 2 mine construction; noise associated with Doris and Phase 2 mine operation; noise associated with aircraft; overpressures associated with quarry blasting; and ground-borne vibration associated with quarry blasting. Each of these important environmental aspects and stakeholder concerns further validate the rationale for including noise and vibration as a VEC in the EIS. Each is addressed in this chapter and the study provided as Appendix V4-3A, with further consideration provided in Human Health and Environmental Risk Assessment (Volume 6, Section 5) and the Terrestrial Wildlife and Wildlife Habitat chapter (Volume 4, Section 9).

3.3.3 Valued Components Excluded from the Assessment

Ground-borne vibration associated with the construction and operation of Phase 2 was excluded from the assessment. ERM has reviewed the proposed construction and operational emission sources associated with the Phase 2 Project to assess any potential effects. This review focused on the location and potential emission of any source, and their proximity to non-Project related receptors. This review has identified that Phase 2 Project activities have limited or no potential to generate off-site vibration levels (other than blasting) that would be perceptible at human and wildlife receptors, and structures. The magnitude and significance of any impacts would be negligible, if any at all. As such a quantitative study was not considered warranted for general vibration aspects of the Phase 2 Project and has been excluded from the Environmental Noise and Vibration Study Report (Appendix V4-3A).

The %HA metric (6.5%) is a measure of a community's reaction to noise (Michaud, Bly, and Keith 2008). The increase in %HA metric applies before and after project initiation for assessing potential community annoyance associated with construction and operational emissions. This threshold only warrants assessment where densely populated areas are identified and is not assessed for low density populations, or temporarily inhabited areas (e.g., hunting camps). Due to the remote location of the Phase 2 Project and the lack of densely populated residential communities in the area, this threshold is not quantified. Assessment of %HA is not considered in the Noise and Vibration Study (Appendix V4-3A) as it is not warranted for the assessment of potential impacts, which are adequately assessed via other thresholds.

3.4 SPATIAL AND TEMPORAL BOUNDARIES

The noise and vibration assessment boundary differs from the baseline study boundaries. This is due to the different nature of the works, one for quantifying existing conditions at accessible locations and two for assessing impacts at receptors following Phase 2 Project initiation. These baseline and assessment boundaries differ from other VECs/VSECs.

The spatial boundaries of the assessment of the Project, and its components, were determined on the basis of the Project's potential impacts on the particular biophysical, social and/or economic environment being addressed. The noise and vibration spatial boundaries considered:

- the physical or socio-economic extent of Phase 2 Project activities;
- the extent of ecosystems potentially affected by the Phase 2 Project; and
- the extent to which traditional and contemporary land and resource use, including protected areas, and other harvesting activities could potentially be affected by the Phase 2 Project.

For noise and vibration, a spatial boundary is defined as the area that could be potentially affected by noise and vibration sources from the Phase 2 Project, including consideration for the existing Doris operational noise. Three general spatial boundaries (identified in Figure 3.4-1) were used in the noise and vibration assessment:

- Proposed Development Area (PDA) — includes the Hope Bay Project Footprint, plus a buffer area.
- Local Study Area (LSA) — the area where there is a reasonable expectation of immediate impacts from the Project activities on valued environmental and socio-economic components.
- Regional Study Area (RSA) — a broader area where there is a potential for direct, indirect or cumulative environmental impacts.

3.4.1 Project Overview

Through a staged approach, the Hope Bay Project is scheduled to achieve mine operations in the Hope Bay Greenstone Belt through mining at Doris, a bulk sample followed by commercial mining at Madrid North and South, and mining of the Boston deposit. To structure the assessment, the Hope Bay Project is broadly divided into: 1) the Approved Projects (Doris and exploration), and 2) the Phase 2 Project (this application).

3.4.1.1 The Approved Projects

The Approved Projects include:

1. the Doris Project (NIRB Project Certificate 003, NWB Type Water Licence Type A Water Licence 2AM-DOH1323);
2. the Hope Bay Regional Exploration Project (NWB Type B Water Licences NWB Type B 2BE-HOP1222);
3. the Boston Advanced Exploration Project (NWB Type B Water Licence 2BB-BOS1217).

The Doris Project

Following acquisition of the Hope Bay Project by TMAC in March of 2013, planning and permitting, advanced exploration and construction activities have focused on bringing Doris into gold production in early 2017. In 2016, the Nunavut Impact Review Board and Nunavut Water Board (NWB) granted an amendment to the Doris Project Certificate and Doris Type A Water Licence respectively, to expand mine operations to 6 years and mine the full Doris deposit. Mining and milling rates were increased to a nominal 1,000 tpd to 2,000 tpd.

The Doris Project includes the following:

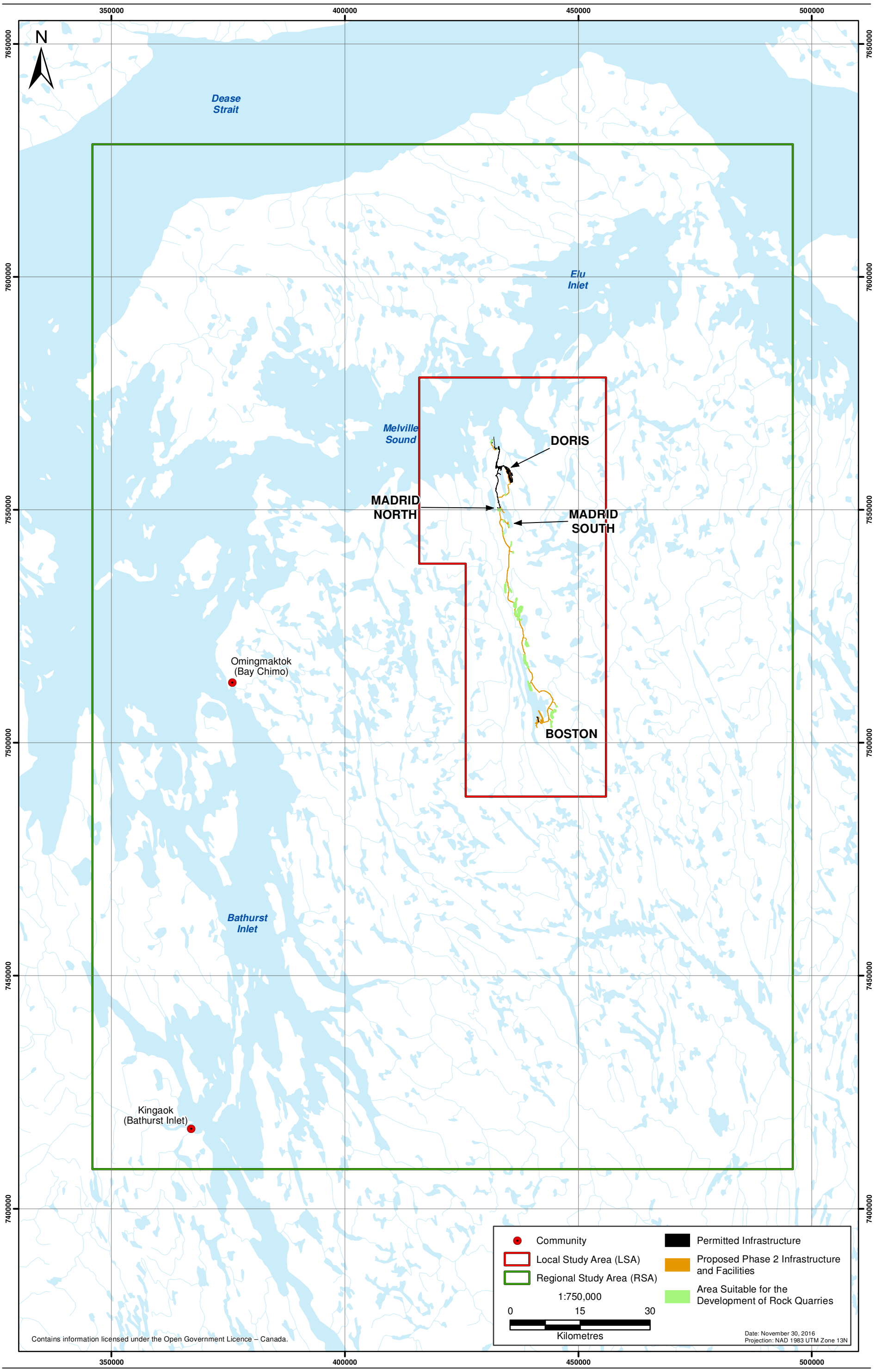
- The Roberts Bay offloading facility: marine jetty, barge landing area, beach and pad laydown areas, fuel tank farm/transfer station, and quarries;
- The Doris site: 280-person accommodation, laydown area, service complex (e.g., workshop, wash bay), quarries, fuel tank farm/transfer station, potable water treatment, waste water treatment, incinerators, explosives storage, and diesel power plant;
- Doris Mine works and processing: underground portal, temporary waste rock pile, ore stockpile, and processing plant;
- Water use for domestic, drilling and industrial uses, and groundwater inflows to underground development;
- Tailings Impoundment Area (TIA): Schedule 2 designation of Tail Lake with two dams (North and South dams), roads, pump house, and quarry;
- All-weather roads and airstrip, winter airstrip, and helicopter pads; and
- water discharge from the TIA will be directed to the outfall in Roberts Bay.

Hope Bay Regional Exploration Project

The Hope Bay Regional Exploration Project has been ongoing since the 1990s. Much of the previous work for the program was based out of the Windy Lake (closed in 2008) and Boston sites (put into care and maintenance in 2011). All exploration activities are currently based from the Doris site with plans for some future exploration at the Boston site. Components and activities for the Hope Bay Regional Exploration Project include:

- staging of drilling activities out or Doris or Boston sites; and
- operation of exploration drills in the Hope Bay Belt area, which are supported by helicopter.

Figure 3.4-1
Noise and Vibration Spatial Boundaries



Boston Advanced Exploration

The Boston Advanced Exploration Project, which operates under a Type B Water Licence, includes:

- the Boston exploration camp, sewage and greywater treatment plant, fuel storage and transfer station, landfarm, and a heli-pad;
- mine works consisting of underground development for exploration drilling and bulk sampling, temporary waste rock pile, and ore stockpile;
- potable water and industrial water taken from Aimaokatalok Lake; and
- treated sewage and greywater discharged to the tundra.

Since the construction of Boston will require the reconfiguration of the entire site, construction and operation of all aspects of the Boston site will be considered as part of the Phase 2 Project for the purposes of the assessment.

3.4.1.2 The Phase 2 Project

The Phase 2 Project includes the Construction and Operation of commercial mining at the Madrid (North and South) and Boston sites, the continued operation of Roberts Bay and the Doris sites to support mining at Madrid and Boston, and the Reclamation and Closure and Post-Closure phases of all sites. Excluded from the Phase 2 project, for the purposes of the assessment, are the Reclamation and Closure and Post-closure of unaltered components of the Doris Project as currently permitted and approved.

Construction

Phase 2 construction will utilize the infrastructure associated with Approved Projects.

Additional infrastructure to be constructed for the proposed Phase 2 Project includes:

- expansion of the Doris TIA (raising of the South Dam, construction of West Dam, and development of a west road to facilitate access);
- construction of an off-loading cargo dock at Roberts Bay (including a fuel pipeline, expansion of the fuel tank farm and laydown area);
- construction of infrastructure at Madrid North and Madrid South to accommodate mining;
- complete development of the Madrid North and Madrid South mine workings;
- construction of a process plant, fuel storage, power plant, and laydown at Madrid North;
- all weather access road (AWR) and tailings line from Madrid North to the south end of the TIA;
- AWR linking Madrid to Boston with associated quarries;
- all infrastructure necessary to support mining activities at Boston including construction of a new 200-person accommodation at Boston and associated support facilities, additional fuel storage, laydown area, ore pad, waste rock pad, process plant, airstrip, diesel power plant, and dry-stack tailings management area (TMA) at Boston; and
- infrastructure necessary to support ongoing exploration activities at both Madrid and Boston.

Operation

Phase 2 Project represents the staged development of the Hope Bay Belt beyond the Doris Project (Phase 1). Phase 2 operations includes:

- mining of the Madrid North, Madrid South, and Boston deposits;
- transportation of ore from Madrid North, Madrid South and Boston to Doris for processing, and transportation of concentrate from process plants at Madrid North and Boston to Doris for final gold refining once the process plants at Madrid North and Boston are constructed;
- use of Roberts Bay and Doris facilities, including processing at Doris and maintaining and operating the Robert's Bay outfall for discharge of water from the TIA;
- operation of a process plant at Madrid North to concentrate ore, and disposal of tailings at the Doris TIA;
- operation of a process plant at Boston to concentrate ore, and disposal of tailings to the Boston TMA; and
- on-going use and maintenance of transportation infrastructure (cargo dock, jetty, roads, and quarries).

Reclamation and Closure

At Reclamation and Closure, all sites will be deactivated and reclaimed in the following manner (see Volume 3, Section 5.5):

- Camps and associated infrastructure, laydown areas and quarries, buildings and physical structures will be decommissioned. All foundations will be re – graded to ensure physical and geotechnical stability and promote free-drainage, and any obstructed drainage patterns will be re – established.
- Using non-hazardous landfill, facilities will receive a final quarry rock cover which will ensure physical and geotechnical stability.
- Mine waste rock will be used as structural mine backfill.
- The Doris TIA surface will be covered rock. Once the water quality in the reclaim pond has reached the required discharge criteria, the North Dam will be breached and the flow returned to Doris Creek.
- The Madrid to Boston All-Weather Road and Boston Airstrip will remain in place after Reclamation and Closure. Peripheral equipment will be removed. Where rock drains, culverts, or bridges have been installed, the roadway or airstrip will be breached and the element removed. The breached opening will be sloped and armoured with rock to ensure that natural drainage can pass without the need for long-term maintenance.
- A low permeability cover, including a geomembrane, will be placed over the Boston TMA. The contact water containment berms will be breached. The balance of the berms will be left in place to prevent localised permafrost degradation.

3.4.2 Spatial Boundaries

3.4.2.1 Project Development Area

The Project Development Area (PDA) is defined as the area which has the potential for infrastructure to be developed as part of the Phase 2 Project. The PDA includes engineering buffers around the footprints of structures. These buffers allow for refinement in the final placement of a structure through detailed design and necessary in-filed modifications during construction phase. Areas with buildings and other infrastructure in close proximity are defined as pads with buffers whereas roads are defined as linear corridors with buffers. The buffers for pads varied depending on the local physiography and other buffered features such as sensitive environments or riparian areas. The average engineering buffer for roads is 100 m on either side.

3.4.3 Local Study Area

The noise and vibration LSA was defined as that area where there exists the reasonable potential for immediate impacts due to Phase 2 Project activities, ongoing normal activities, or to possible abnormal operating conditions. The LSA includes the Hope Bay Project facilities, buildings and infrastructure, and all areas proposed for Phase 2 Project activities. This area was established following preliminary noise modeling, and includes the closest and/or potentially most affected receptors (identified via GIS analysis) and encompasses an area 310,005 hectares (ha) including Doris and Phase 2, and the PDA.

The LSA was established based on a conservatively determined “zone of influence” beyond which the potential effects of the Phase 2 Project are expected to diminish to a negligible state. The expected zone of influence was determined following preliminary noise modeling, with regard to baseline studies, and expert knowledge. The LSA was considered specifically in the construction and operational noise modeling domain which incorporated “tiles” (10 x 10 km areas where noise is predicted, incorporating a 5 km buffer to each) to permit the computation of levels over very large areas.

3.4.4 Regional Study Area

The noise and vibration RSA was defined as the area within which there exists the potential for direct, indirect, and/or cumulative biophysical and socio-economic effects. The noise RSA contains the PDA and LSA. This area was established following preliminary noise modeling, it includes all receptors (identified via GIS analysis) and encompasses an area of 3,300,000 ha.

The RSA considers receptors beyond the “zone of influence” of potential effects of the Phase 2 Project. The RSA was considered specifically in the construction and operational noise modeling (“tiles” described above) to permit the computation of levels over very large areas.

3.4.5 Temporal Boundaries

The Project represents a significant development in the mining of the Hope Bay Greenstone Belt. Even though this Project spans the conventional Construction, Operation, Reclamation and Closure, and Post-closure phases of a mine project, Phase 2 is a continuation of development currently underway. Phase 2 has four separate operational sites: Roberts Bay, Doris, Madrid (North and South), and Boston and three mine sites: Madrid North, Madrid South and Boston. Development, operation and closure of the Phase 2 Project will overlap mining and post-mining activities at the existing Doris mine. As such, the temporal boundaries of this Project overlap with a number of Existing and Approved Authorizations (EAAs) for the Hope Bay Project and the extension of activities during Phase 2.

The Environmental Noise and Vibration Study Report (Appendix V4-3A) considered all phases of the Phase 2 Project, including consideration of existing Doris operation noise. Assessment of the potential effects of the Phase 2 Project includes the following phases:

- Construction phase – 4 years;
- Operation phase – 10 years;
- Reclamation and Closure phase – 3 years; and
- Post-closure phase – 5 years.

All of the Project phases may have interactions with noise; however, only the years with the highest predicted emissions were included in the study.

The Environmental Noise and Vibration Study Report (Appendix V4-3A) was based on the conservative approach of using the 'worst case' assessment scenario for emissions. Construction and quarry noise modeling was focused on discrete areas within the Project design and operational modeling considered years where activity within certain mining areas are scheduled, as follows:

- Year 6 to 10: Phase 2 Cargo Dock, Doris, Madrid North, All-weather Access Road and Boston mine areas are active; and
- Year 11 to 14: as per Year 6 to 10; however, Madrid South mine area becomes active.

If the potential effects of these years are predicted to be not significant then the potential effects for the entirety of the Phase 2 Project should also be not significant.

Noise levels have also been predicted for two scenarios to represent snapshots of the aircraft and helicopter operations using the proposed permanent airstrips at Doris and Boston.

The potential noise effects during Reclamation and Closure, Post-closure and other potential phases, such as Temporary Closure, are expected to be less than during the Construction and Operation phases and, therefore, these phases are not explicitly assessed further.

3.5 PROJECT-RELATED EFFECTS ASSESSMENT

3.5.1 Methodology Overview

This noise and vibration assessment was informed by a methodology used to identify and assess the potential environmental effects of the Project. The effects assessment evaluates the potential direct and indirect effects of the Project on the environment and follows the general methodology provided in Volume 2, Section 4 (Effects Assessment Methodology), and comprises a number of steps that collectively assess the manner in which the Project will interact with noise and vibration defined for the assessment (Section 3.3.2).

To provide a comprehensive understanding of the potential effects for the Project, the Phase 2 components and activities are assessed on their own as well as in the context the Approved Projects (Doris and exploration) within the Hope Bay Greenstone Belt. The effects assessment process is summarized as follows:

- identify potential interactions between the Phase 2 Project and the VECs or VSECs;
- identify the resulting potential effects of those interactions;

- identify mitigation or management measures to eliminate or reduce the potential effects;.
- for Phase 2 in isolation of the Existing and Approved Projects, characterize the potential incremental effects;
- for Phase 2 in combination with the Existing and Approved Projects, characterize the potential effects;
- identify residual effects (potential effects that would remain after mitigation and management measures have been applied) for both Phase 2 in isolation;
- identify residual effects of Phase 2 in combination with the residual effects of Approved Projects; and for the entire Hope Bay Development (Phase 2 in combination with the Existing and Approved Projects), characterize any residual effects(potential effects that would remain after mitigation and management measures have been applied); and
- determine the significance of combined residual effects.

Noise and vibration is a fairly broad term and, therefore, it is important to select the correct measurable parameters in order to assess the potential effects of the Phase 2 Project on the receiving environment. The potential effects on the VEC noise and vibration can be broken down into the following indicators:

- effects on humans:
  - sleep disturbance;
  - interference with speech communication;
  - complaints;
  - high annoyance;
  - noise induced rattling;
  - noise induced hearing loss (NIHL); and
  - cosmetic and structural damage to buildings from vibration.
- effects on wildlife:
  - loss of wildlife habitat; and
  - disturbance to wildlife.

All of the above human and wildlife indicators relate to offsite receptors, except for sleep disturbance, where current best practice stipulates that onsite mine camps should also be considered.

This noise and vibration study has been completed with due regard to and in accordance with relevant policy, standards and guidelines. The indicators selected above were selected based on professional judgement, current best practice and the following relevant guidance:

- Alberta Energy and Utility Board – *Alberta Noise Directive 038* (Directive 038), dated 2007;
- Environment Canada – *Environmental Code of Practice for Metal Mines*, dated 2009;
- German Institute for Standardisation – DIN 4150 (1999-02) Part 3 (DIN4150-3) – *Structural Vibration - Effects of Vibration on Structures*;
- Health Canada – *Useful Information for Environmental Assessments*. (Section 6: Noise Effects) Ottawa, Health Canada, dated 2010;

- International Organisation for Standardisation (ISO) 1996-1:2003 (ISO1996:2) – *Description, Measurement and Assessment of Environmental Noise - Part 1: Basic Quantities and Assessment Procedures*;
- International Organisation for Standardisation (ISO) 9613-2:1996 (ISO9613:2) – *Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation*;
- Ollerhead, J.B. et al, 1992, *A Field Study of Aircraft Noise and Sleep Disturbance, Department of Transport, London* (Ollerhead, J.B. et al, 1992);
- Standards Australia AS2187.2-2006™ (AS2187.2) – *Explosives—Storage and Use Part 2: Use of Explosives*;
- United States Environment Protection Agency (US EPA) – *Information on Levels of Environmental Noise Requisite to Protect Public Health* (US EPA, 550/9-74-004), dated March 1974; and
- World Health Organisation, Geneva (WHO 1999) - *Guidelines for Community Noise*, dated 1999.

Potential interactions were identified using professional judgement and experience at other similar projects, and were based on the initial matrix provided in the Project Description (Volume 3). The potential interactions and the characterization of these effects using noise modeling and prediction are discussed in Section 3.5.2. Section 3.6 identifies potential mitigation measures and predicted residual effects.

The significance of residual effects is assessed using the eight attributes defined in Volume 2, Section 4. First, the direction of a residual effect was determined to be positive, neutral or negative. Negative effects were then assessed according to several criteria. The magnitude and extent of the effect were used as the primary criteria; the duration and frequency of the effect as secondary criteria.

Definitions for magnitude of effects are provided in Table 3.5-1. Definitions of significance specific to noise and vibration are included in Table 3.5-2. By combining these with the probability that the effect will occur, the significance of the effect was rated as positive, not significant, or significant. Finally, the degree of uncertainty in the rating was provided as a qualifier.

All potential noise effects are fully reversible and the noise environment will return to background levels once noise sources are removed. The significance of any residual effects is discussed in Section 3.5.

Table 3.5-1. Definitions of Magnitude Ratings for Noise and Vibration Effects

Magnitude	Short term - Descriptor of Magnitude[2]	Long term - Descriptor of Magnitude[2]
Negligible	Project is predicted to increase noise levels by less than 5 dB above the baseline noise levels.	Project is predicted to increase noise levels by less than 5 dB above the baseline noise levels.
Low	Project is predicted to increase noise levels above the baseline by more than 5 dB but noise levels remain below the relevant criteria.	Project is predicted to increase noise levels above the baseline by more than 5 dB but noise levels remain below the relevant criteria.
Moderate	Project is predicted to result in some localised exceedances with noise and vibration levels less than 10 dBA above the relevant threshold.	Project is predicted to result in some localised exceedances with noise and vibration levels less than 5 dBA above the relevant threshold.
High[1]	Project is predicted to result in widespread exceedances with noise and vibration levels more than 10 dB above the relevant criteria.	Project is predicted to result in widespread exceedances with noise and vibration levels more than 5 dB above the relevant criteria.

[1] *Any levels that exceed vibration thresholds are rated as high.*
[2] *Short term applies to construction, blasting, aircraft and maximum noise events. Long term applies to operations.*

Table 3.5-2. Definitions of Significance Ratings for Noise and Vibration Residual Effects

Significance	Descriptor of Significance
Positive	Residual effect results in improvements to the noise environment, i.e., reductions in noise levels near sensitive receptors.
Significant	Residual effects have high or moderate magnitude and occur outside the PDA. Effects may be sporadic or continuous and occur at all frequencies. Probability of the effect occurring is medium or high.
Not Significant	Residual effects have moderate or low magnitude, occur within the PDA and may occur at all frequencies and durations. Probability of the effect occurring may be low, medium or high.

3.5.2 Potential Effects and Interactions with Project

An interaction matrix summarizing the potential interactions with noise and vibration and the Phase 2 Project is provided in Volume 2, Section 4. Table 3.5-3 presents the key components of the Phase 2 Project and the potential interaction with noise and vibration indicators. An overview of each phase as relevant to noise and vibration is also provided below.

The potential effects on humans may include sleep disturbance, interference with speech communication, complaints, high annoyance; noise induced rattling, noise induced hearing loss (NIHL), cosmetic and structural damage to buildings from vibration. The potential effects on wildlife may include loss of wildlife habitat and disturbance to wildlife. Each of these effects is related to human or wildlife reaction to noise and vibration and highlighted in the interactions matrix.

It is reiterated that each is considered in this assessment with regard to noise associated with Phase 2 mine construction; noise associated with Doris and Phase 2 mine operation; noise associated with aircraft; overpressures associated with quarry blasting; and ground-borne vibration associated with quarry blasting. Further consideration provided in the Human Health and Environmental Risk Assessment (Volume 6, Section 5) and the Terrestrial Wildlife and Wildlife Habitat chapter(Volume 4, Section 9).

3.5.2.1 Overview by Project Phase

Site Preparation and Construction

The noise modeling study included a representative worst-case set of construction equipment and machinery, and traffic (road traffic between the key Phase 2 areas, and vessels at the Cargo Dock). A conservative approach was taken so that the highest plausible number of mobile and fixed equipment units expected to be in use at each Project area was considered. This assists to consider all potential effects and interactions with the Phase 2 Project and to determine suitable mitigation and/or management measures, if required.

General construction noise levels were predicted via modeling based on this representative worst-case scenario at all receptors (human and wildlife) within the LSA. The noise levels associated with Reclamation and Closure are expected to be less than those during the Construction phase due to the quantity of plant and the duties performed. It has been assumed that if the effects during Construction are found to be not significant, the potential effects of the Reclamation and Closure phase of the Project should also be not significant.

Potential maximum noise levels (associated with construction) were predicted via spreadsheet calculation and were based on representative worst-case impulsive noise emissions and GIS analysis to establish distance offsets between the closest Phase 2 Project infrastructure and the receptor location.

Table 3.5-3. Potential Phase 2 Project Interactions with the VEC Noise and Vibration

Project Activities		Noise and Vibration Indicators								
		Effects on Humans							Effects on Wildlife	
		Sleep disturbance	Interference with speech communication	Complaints	High annoyance	Noise induced rattling	Noise induced hearing loss	Cosmetic and structural damage to buildings	Loss of wildlife habitat	Disturbance to wildlife
Construction	Surface mine, mill and accommodation facility construction (as applicable to Madrid North and South, Boston)	x	x	x	x				x	x
	Cargo Dock construction at Doris	x	x	x	x				x	x
	Local site roads, Boston airstrip, equipment laydown areas, pad areas construction	x	x	x	X				x	x
	Tailings expansion at Doris	x	x	x	X				x	x
	Road Transport (light and heavy vehicles associated with construction, personnel or goods)	x	x	x	X				x	x
	Air Transport (Doris and Boston Airstrips)	x	x	x	X				x	x
Operation	Surface mine, mill and accommodation facility operation (as applicable to Madrid North and South, Boston)	x	x	x	X				x	x
	Cargo Dock use at Doris	x	x	x	X				x	x
	Quarry use and activity	X	X	X	X				X	X
	Local site roads, equipment laydown areas use and operation	x	x	x					x	x
	Road Transport(light and heavy vehicles associated with construction, personnel or goods)	x	x	x	X				x	x
	Air Transport (Doris and Boston Airstrips)	x	x	x	X				x	x
Reclamation and Closure	Surface mine, mill, tailings and accommodation facility closure (as applicable to Madrid North and South, Boston)	X	X	X	X				X	X
	Cargo Dock closure at Doris	x	x	x	X				x	x
	Local site roads, Boston airstrip, equipment laydown areas, pad areas closure	x	x	x	x				x	x
	Road Transport (light and heavy vehicles associated with closure, personnel or goods)	x	x	x	x				x	x
	Air Transport (Doris and Boston Airstrips)	x	x	x	x				x	x

Operation

The noise modeling study included a representative worst-case set of operational equipment and machinery, and traffic (road traffic between the key Phase 2 areas, and vessels at the Cargo Dock). A conservative approach was taken so that the highest plausible number of mobile and fixed equipment units expected to be in use at each Project area was considered, including consideration for existing Doris operational noise. This assists to consider all potential effects and interactions with the Phase 2 Project and to determine suitable mitigation and/or management measures, if required.

There were two key phase/years assessed: Years 6 to 10 and Years 11 to 14. Noise levels were predicted via modeling based on the representative worst-case scenarios at all receptors (human and wildlife) within the LSA. Noise levels during the Operation phase were calculated using a computational noise model (refer to Appendix V4-3A). The following noise sources were included in the noise model:

- Phase 2 Cargo Dock, near Doris;
- Madrid North fixed infrastructure, such as the processing plant and fans, and mobile equipment such as dozers, haul trucks, forklift, graders, and fuel trucks;
- Madrid South fixed infrastructure and mobile equipment such as dozers, haul trucks, forklift, graders, and fuel trucks;
- Boston fixed plant, such as the processing plant and fans and mobile equipment such as dozers, haul trucks, forklift, graders, and fuel trucks;
- Road traffic between the key Phase 2 areas (Cargo Dock to Roberts Bay, Roberts Bay to Doris, Doris to Madrid North, Madrid North to South and Madrid South to Boston); and
- Doris and Boston airstrip, fixed-wing aircraft and helicopters.

Potential overpressure and ground-borne vibration levels were predicted via spreadsheet calculation (for the five closest quarry sites to any human and/or wildlife receptor) and were based on representative worst-case blasting charges (two charge values were assessed based on historic blasting data at Doris) and GIS analysis to establish distance offsets between each quarry and the receptor location.

Potential maximum noise levels (associated with operation) were also predicted via spreadsheet calculation and were based on representative worst-case impulsive noise emissions and GIS analysis to establish distance offsets between the closest Phase 2 Project infrastructure and the receptor location.

Reclamation and Closure

As discussed above, the noise levels associated with Reclamation and Closure are expected to be less than those during the Construction phase due to the quantity of plant and the duties performed. It has been assumed that if the effects during Construction are found to be not significant, the potential effects of the Reclamation and Closure phase should also be not significant.

3.5.3 Characterization of Potential Project-related Effects

3.5.3.1 Effects on Humans

Noise sources introduced by Phase 2 have the potential to increase noise levels at relevant human receptors and may affect humans through sleep disturbance, interference with speech communications, complaints, and high annoyance.

3.5.3.2 Effects on Wildlife

Noise sources introduced by the Phase 2 Project may also increase noise levels at relevant wildlife receptors and result in loss of habitat and wildlife disturbance. All of the Phase 2 Project activities identified in Section 3.5.2 have the potential to affect wildlife.

3.5.3.3 Characterization of Potential Effects

Noise modeling was conducted to predict construction and operational noise levels (including road and air traffic) at all receptors within the LSA. Spreadsheet calculations were conducted to predict overpressure and vibration levels associated with blasting (select receptors within the LSA) and to predict maximum noise levels at all receptors within the LSA.

The **construction and operational noise modeling** was used to predict noise levels (L_d, L_n and L_{dn}, in dBA) from continuous and intermittent noise sources (fixed and mobile plant, including traffic) during the assessed phase/years.

The **aircraft noise modeling** was used to predict noise levels (SEL, in dBA) from fixed wing arrivals/departures at the Doris and Boston airstrips, and from helicopter arrivals and departures and the helipad near to both Doris and Boston airstrips.

Spreadsheet calculations for **quarry blasting** were used to predict overpressure (L_{peak}, in dBZ) and ground-borne vibration levels (PPV, in mm/s) from blast events. dBZ is relevant to overpressure assessments and is the linear noise level with no weighting applied. Spreadsheet calculations for Construction and Operation were used to predict noise levels (L_{max}, in dBA) from **maximum and impulsive** noise sources. Both spreadsheet calculations utilized GIS analysis of spatial data to establish distance offsets between each quarry or item of infrastructure and the receptor location.

Potential maximum noise levels (associated with operation) were also predicted via spreadsheet calculation and were based on representative worst-case impulsive noise emissions and GIS analysis to establish distance offsets between the closest infrastructure and the receptor location.

The noise and vibration study used the following key methodologies:

- **Construction and Operation Noise:** Brüel & Kjær's Predictor 7810 (Version 11.1) noise modeling software package was utilised to calculate noise levels using the ISO 9613-2:1996 (ISO 1996) noise propagation algorithms for construction and operation, including road traffic.
- **Maximum and Impulsive Noise:** standardised acoustical equations (that account for the attenuation of noise over distance) were used to calculate maximum noise level events.
- **Aircraft Noise:** US Federal Aviation Administration (FAA) Integrated Noise Model (INM) version 7.0d (FAA 2013) was used to calculate flight profiles and noise emission levels.
- **Blasting:** AS2187.2 (Appendix J) was used to predict air-blast overpressure and ground-borne vibration levels. The AS2187.2 equations offer a highly conservative method to estimate levels in the absence of measured site laws.

Full details of the methodologies used in the noise modeling and spreadsheet calculations are included in Appendix V4-3A.

Human and Wildlife Receptors

A key feature of assessing noise and vibration is the prediction of levels at receptors to determine potential effects based on comparison of levels to thresholds. In this case GIS analysis of spatial data (site layout, known dwelling/property boundaries, known habitat regions, etc.) was utilised to establish receptor points. In all cases the GIS analysis considered the closest point at the boundary or region to determine the receptors point for that area, with multiple receptor points selected for some regions or areas to provide results at various points. Based on this analysis, a total of 436 human and wildlife receptor points were established within the RSA, the majority of which are within the LSA.

Table 3.5-4 provides a summary of locations within 500 metres of any Project infrastructure, ranked from closest to farthest. These locations (including any Project or non-Project related points) have been identified as being representative of the closest and/or potentially most affected sensitive receptors (human and wildlife) within the LSA. These receptor locations are also shown on Figures 3.5-1a and 3.5-1b. All 436 receptor locations are presented as a tabulated list in Annex C of Appendix V4-3A.

As is evident in Table 3.5-4, the closest human receptors are Project-related and are situated in close proximity to existing Doris or proposed Phase 2 infrastructure. There are three non-Project related human receptors within 500 metres of any infrastructure, two of which (R_H-F2 and R_H-H1) are associated with seasonal fishing and hunting grounds. R_H012 is the closest human (non-Project receptor) positioned approximately 485 metres from Boston. All other receptors identified in the ranked tabulated list are wildlife receptor points considered representative of potential raptor, waterbird flock, and den locations.

Key Indicators and Thresholds

A complete list of the noise and vibration indicators and thresholds is provided in Table 3.5-5. Predicted values were compared to these thresholds to qualify potential effects, with the results of this comparison being assessed as per the methodology summarised Section 3.5.1. Discussion and justification for these thresholds is provided in the noise and blast study (Appendix V4-3A).

Resultant Levels and Comparison to Thresholds

To reduce the extent of data presented in this section, only values that exceed the applicable thresholds and have the potential for moderate or high magnitude ratings for noise and vibration effects are produced here. The full set of noise and vibration results is presented in Annex D of Appendix V4-3A.

The resultant levels are presented as follows:

- **Table 3.5-6. General Phase 2 construction noise:** predicted values and comparison to the applicable L_d, L_n and L_{dn} thresholds.
- **Table 3.5-7. General Doris operational noise:** predicted values and comparison to the applicable L_d, L_n and L_{dn} thresholds
- **Table 3.5-8. General Phase 2 operational noise (Years 6 to 10):** predicted values and comparison to the applicable L_d, L_n and L_{dn} thresholds.
- **Table 3.5-9. General Phase 2 operational noise (Years 11 to 14):** predicted values and comparison to the applicable L_d, L_n and L_{dn} thresholds.
- **Table 3.5-10. General overall (Doris + Phase 2) operational noise (Years 6 to 10):** predicted values and comparison to the applicable L_d, L_n and L_{dn} thresholds.

- **Table 3.5-11. General overall (Doris + Phase 2) operational noise (Years 11 to 14): predicted values and comparison to the applicable L_d, L_n and L_{dn} thresholds.**
- **Table 3.5-12. General Phase 2 operational noise (Quarries): predicted values and comparison to the applicable L_d, L_n and L_{dn} thresholds.**
- **Table 3.5-13. Construction and operational noise (maximum noise):** predicted values and comparison to the applicable L_{max} thresholds.
- **Table 3.5-14. Aircraft noise (Doris Airstrip):** predicted values and comparison to the applicable SEL thresholds.
- **Table 3.5-15. Aircraft noise (Boston Airstrip):** predicted values and comparison to the applicable SEL thresholds.
- **Table 3.5-16. Blasting overpressure:** predicted values and comparison to the applicable L_{peak} thresholds.
- **Table 3.5-17. Blasting vibration:** predicted values and comparison to the applicable PPV thresholds.

General discussion regarding Low Frequency Noise based on the indicative noise level thresholds (L_{eq}, LF L_d and L_n) is provided with the summary of findings.

Noise Contour Mapping

Due to the characteristics of aircraft operations (fixed-wing and helicopters) and the large spatial area that noise effects could occur, it is prudent and warranted to provide contour mapping of the predicted SEL, dBA levels across the LSA. This contour mapping, although not a mandatory requirement, assists to visually describe the extent of potential noise effects for the purpose of achieving the EIS Guidelines (NIRB) requirement for noise.

These aircraft SEL, dBA levels across the LSA are identified in Figures 3.5-2 to 3.5-7.

Potential noise effects associated with Phase 2 mine construction and potential noise effects associated with Doris and Phase 2 mine operation are limited to the areas immediately surrounding each respective operational site. The tabulated results accurately describe the potential extent of noise effects that are limited to the closest and most affected receptors in the vicinity of the Doris and Phase 2 operational areas. Therefore, it is not warranted or useful to provide contour mapping of the predicted L_d, L_n and L_{dn} (dBA) levels across the LSA. The tabulated results adequately describe the extent of potential noise effects for the purpose of achieving the EIS Guidelines (NIRB) requirement for noise. Suitable recommendations for potential operational noise contour mapping are provided below with regards to the mitigation by project design and the Project-related residual effects that are characterised in this chapter.

Table 3.5-4. Closest Potential Human and Wildlife Receptors

#	Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Closest Project Infrastructure	Distance to Closest Project Infrastructure (m)	Project Area
1	R_W081	Wildlife	Raptor Nest	432990	7550050	Waste Rock Pile	0	Madrid North
2	R_W246	Wildlife	Raptor Nest	435016	7556936	Tailings Impoundment Area	0	Doris
3	R_H-W1	Human (Project related)	Doris Site (active)	432965	7559019	Doris Site (Pads X & Y)	0	Doris
4	R_H-W3	Human (Project related)	Boston Operation site	441091	7504366	Camp	0	Boston
5	R_H-W4	Human (Project related)	Quarry D Camp	432902	7551719	New Windy Camp	0	Doris
6	R_W198	Wildlife	Raptor Nest	432900	7550330	Quarry AH	12	Madrid North
7	R_W027	Wildlife	Waterbird Flock (>100)	438834	7517996	Quarry T	16	Madrid-Boston Road
8	R_W192	Wildlife	Raptor Nest	432893	7556376	Doris-Windy AWR	23	Doris
9	R_H-W2	Human (Project related)	Boston Exploration Camp	441137	7505488	Existing Boston Exploration Camp	36	Existing Boston Exploration Camp
10	R_W049	Wildlife	Raptor Nest	433200	7559350	Doris Water Diversion Berm	36	Doris
11	R_W322	Wildlife	Raptor Nest	441273	7505006	Existing Boston Exploration Camp	61	Existing Boston Exploration Camp
12	R_W304	Wildlife	Raptor Nest	432517	7554837	Doris-Windy AWR	61	Doris
13	R_W056	Wildlife	Raptor Nest	432532	7554865	Doris-Windy AWR	72	Doris
14	R_W176	Wildlife	Raptor Nest	432532	7554850	Doris-Windy AWR	73	Doris
15	R_W140	Wildlife	Raptor Nest	435044	7556747	Tailings Impoundment Area	74	Doris
16	R_W349	Wildlife	Raptor Nest	432530	7554758	Doris-Windy AWR	75	Doris
17	R_W028	Wildlife	Waterbird Flock (>100)	441894	7505738	Airstrip	79	Boston
18	R_W029	Wildlife	Waterbird Flock (>100)	441894	7505738	Airstrip	79	Boston
19	R_W030	Wildlife	Waterbird Flock (>100)	441894	7505738	Airstrip	79	Boston
20	R_W222	Wildlife	Raptor Nest	432543	7554788	Doris-Windy AWR	88	Doris
21	R_W234	Wildlife	Raptor Nest	433453	7559443	Doris Water Diversion Berm	91	Doris
22	R_W142	Wildlife	Raptor Nest	433607	7552649	Madrid North-TIA Road	96	Doris
23	R_W243	Wildlife	Raptor Nest	433546	7552620	Madrid North-TIA Road	98	Doris
24	R_W190	Wildlife	Raptor Nest	433252	7559431	Doris Water Diversion Berm	99	Doris
25	R_W195	Wildlife	Raptor Nest	433546	7552614	Madrid North-TIA Road	103	Doris
26	R_W305	Wildlife	Raptor Nest	433107	7559423	Doris Water Diversion Berm	113	Doris
27	R_W312	Wildlife	Raptor Nest	434706	7532916	Quarry Z	125	Madrid-Boston Road
28	R_W208	Wildlife	Raptor Nest	434711	7532903	Quarry Z	132	Madrid-Boston Road
29	R_W175	Wildlife	Raptor Nest	433049	7559452	Doris Water Diversion Berm	146	Doris
30	R_W204	Wildlife	Raptor Nest	434727	7542318	Madrid-Boston Road	146	Madrid-Boston Road
31	R_W105	Wildlife	Raptor Nest	434722	7532650	Quarry Z	154	Madrid-Boston Road
32	R_W240	Wildlife	Raptor Nest	434720	7532685	Quarry Z	155	Madrid-Boston Road
33	R_H-F2	Human (non-Project related)	Fishing Area	443743	7507934	Madrid-Boston Road	156	Madrid-Boston Road
34	R_W213	Wildlife	Raptor Nest	434729	7532619	Quarry Z	159	Madrid-Boston Road
35	R_W252	Wildlife	Raptor Nest	434755	7532315	Quarry Z	159	Madrid-Boston Road
36	R_W249	Wildlife	Raptor Nest	434941	7542043	Madrid-Boston Road	185	Madrid-Boston Road
37	R_W354	Wildlife	Raptor Nest	432963	7559482	Doris Water Diversion Berm	191	Doris
38	R_W144	Wildlife	Raptor Nest	432755	7559699	Primary Road to Doris Site	196	Doris
39	R_W253	Wildlife	Raptor Nest	433849	7543980	Madrid-Boston Road	198	Madrid-Boston Road
40	R_W220	Wildlife	Raptor Nest	433796	7544106	Madrid-Boston Road	207	Madrid-Boston Road
41	R_W119	Wildlife	Raptor Nest	441374	7503337	Vent Raise	214	Boston
42	R_W181	Wildlife	Raptor Nest	432848	7559593	Primary Road to Doris Site	214	Doris

#	Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Closest Project Infrastructure	Distance to Closest Project Infrastructure (m)	Project Area
43	R_W098	Wildlife	Raptor Nest	435050	7541740	Madrid-Boston Road	219	Madrid-Boston Road
44	R_W307	Wildlife	Raptor Nest	433795	7544069	Madrid-Boston Road	220	Madrid-Boston Road
45	R_W050	Wildlife	Raptor Nest	432961	7559514	Doris Water Diversion Berm	222	Doris
46	R_W282	Wildlife	Raptor Nest	432961	7559514	Doris Water Diversion Berm	222	Doris
47	R_W166	Wildlife	Raptor Nest	433788	7544081	Madrid-Boston Road	223	Madrid-Boston Road
48	R_W216	Wildlife	Raptor Nest	432850	7559607	Primary Road to Doris Site	226	Doris
49	R_W262	Wildlife	Raptor Nest	434419	7542593	Madrid-Boston Road	229	Madrid-Boston Road
50	R_W151	Wildlife	Raptor Nest	433745	7544174	Madrid-Boston Road	230	Madrid-Boston Road
51	R_W203	Wildlife	Raptor Nest	434024	7543375	Madrid-Boston Road	231	Madrid-Boston Road
52	R_W173	Wildlife	Raptor Nest	433918	7543677	Madrid-Boston Road	233	Madrid-Boston Road
53	R_W393	Wildlife	Raptor Nest	433801	7544011	Madrid-Boston Road	234	Madrid-Boston Road
54	R_W168	Wildlife	Raptor Nest	432407	7553346	Doris-Windy AWR	236	Doris
55	R_W078	Wildlife	Raptor Nest	432470	7552810	Doris-Windy AWR	240	Doris
56	R_W309	Wildlife	Raptor Nest	434010	7543375	Madrid-Boston Road	245	Madrid-Boston Road
57	R_W095	Wildlife	Raptor Nest	434000	7543360	Madrid-Boston Road	259	Madrid-Boston Road
58	R_W194	Wildlife	Raptor Nest	432379	7553340	Doris-Windy AWR	264	Doris
59	R_W339	Wildlife	Raptor Nest	433567	7544981	Madrid-Boston Road	278	Madrid-Boston Road
60	R_W306	Wildlife	Raptor Nest	433350	7546300	Madrid-Boston Road	279	Madrid-Boston Road
61	R_W251	Wildlife	Raptor Nest	434212	7542817	Madrid-Boston Road	286	Madrid-Boston Road
62	R_W285	Wildlife	Raptor Nest	432855	7559927	Primary Road to Doris Site	289	Doris
63	R_W314	Wildlife	Raptor Nest	436249	7556391	Secondary Road	300	Doris
64	R_W403	Wildlife	Common Eider	432374	7563735	Roberts Bay Discharge Access Road	327	Doris
65	R_W290	Wildlife	Raptor Nest	432999	7546821	Madrid-Boston Road	339	Madrid-Boston Road
66	R_W211	Wildlife	Raptor Nest	433059	7546699	Madrid-Boston Road	343	Madrid-Boston Road
67	R_W202	Wildlife	Raptor Nest	433108	7546596	Madrid-Boston Road	347	Madrid-Boston Road
68	R_W088	Wildlife	Raptor Nest	433059	7546650	Madrid-Boston Road	367	Madrid-Boston Road
69	R_W378	Wildlife	Raptor Nest	433507	7551283	Doris-Windy AWR	384	Doris
70	R_W167	Wildlife	Raptor Nest	431976	7554832	Quarry	385	Doris
71	R_W382	Wildlife	Raptor Nest	431964	7554822	Quarry	392	Doris
72	R_W334	Wildlife	Raptor Nest	434552	7544979	Quarry X	414	Madrid-Boston Road
73	R_W376	Wildlife	Raptor Nest	432554	7549455	Quarry AH	416	Madrid North
74	R_W159	Wildlife	Raptor Nest	437815	7518709	Quarry T	420	Madrid-Boston Road
75	R_W242	Wildlife	Raptor Nest	431954	7554874	Quarry	423	Doris
76	R_H-H1	Human (non-Project related)	Hunting and Fishing	443076	7504032	Madrid-Boston Road	424	Madrid-Boston Road
77	R_W186	Wildlife	Raptor Nest	433335	7545766	Madrid-Boston Road	437	Madrid-Boston Road
78	R_W196	Wildlife	Raptor Nest	433566	7551278	Doris-Windy AWR	439	Doris
79	R_W153	Wildlife	Raptor Nest	432538	7549437	Quarry AH	441	Madrid North
80	R_W079	Wildlife	Raptor Nest	433586	7551259	Doris-Windy AWR	454	Doris
81	R_W230	Wildlife	Raptor Nest	433622	7551128	Doris-Windy AWR	478	Doris
82	R_W375	Wildlife	Raptor Nest	432568	7549367	Quarry AH	480	Madrid North
83	R_W363	Wildlife	Raptor Nest	440912	7510837	Madrid-Boston Road	484	Madrid-Boston Road
84	R_H012	Human (non-Project related)	Potential Human Receptor	440418	7503938	Camp and Mill Site	485	Boston
85	R_W394	Wildlife	Den	432422	7550901	Doris-Windy AWR	490	Doris

Figure 3.5-1a
Noise and Vibration Receptors in the Local Study Area

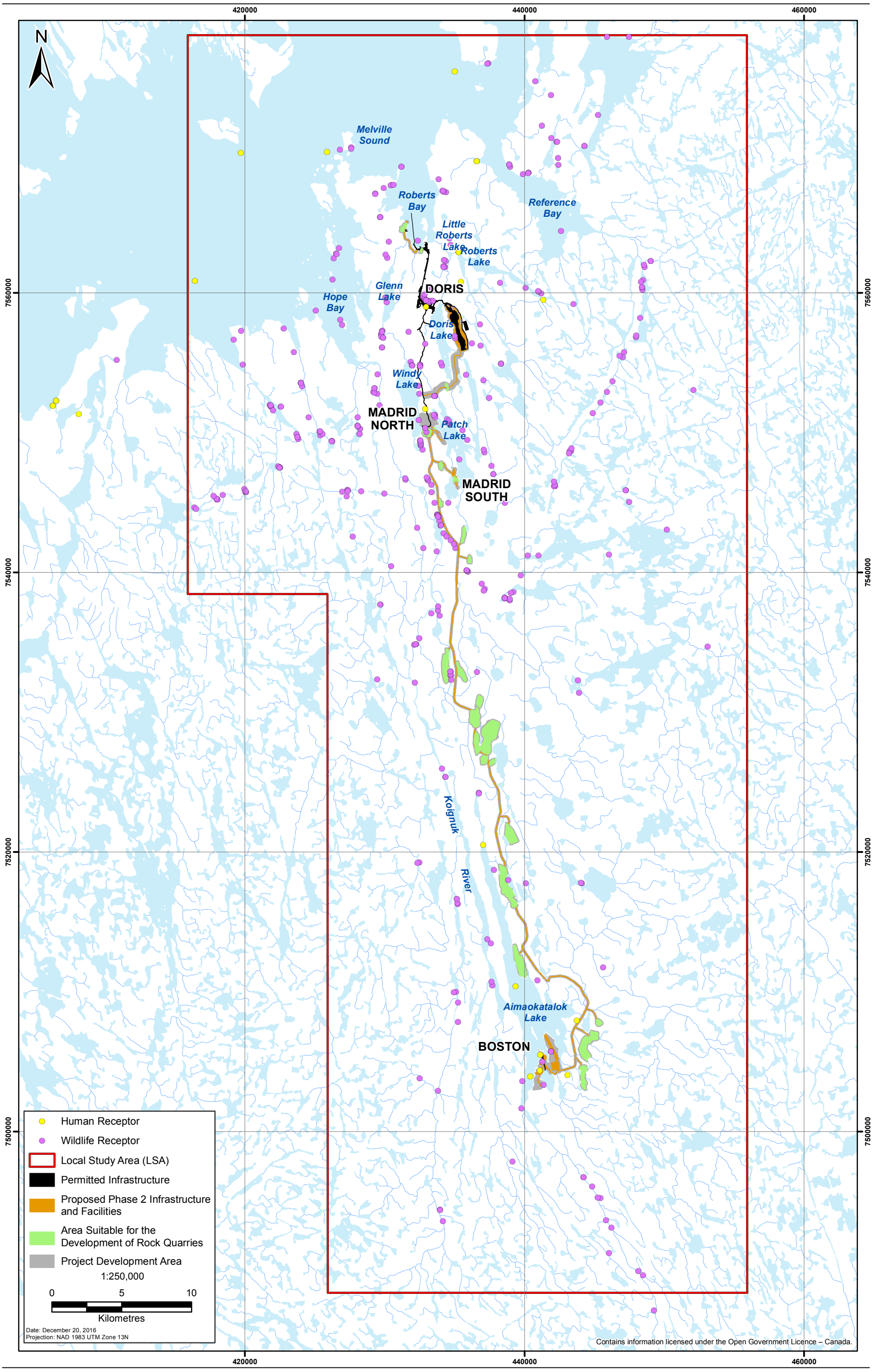


Figure 3.5-1b
Noise and Vibration Receptors in the Regional Study Area

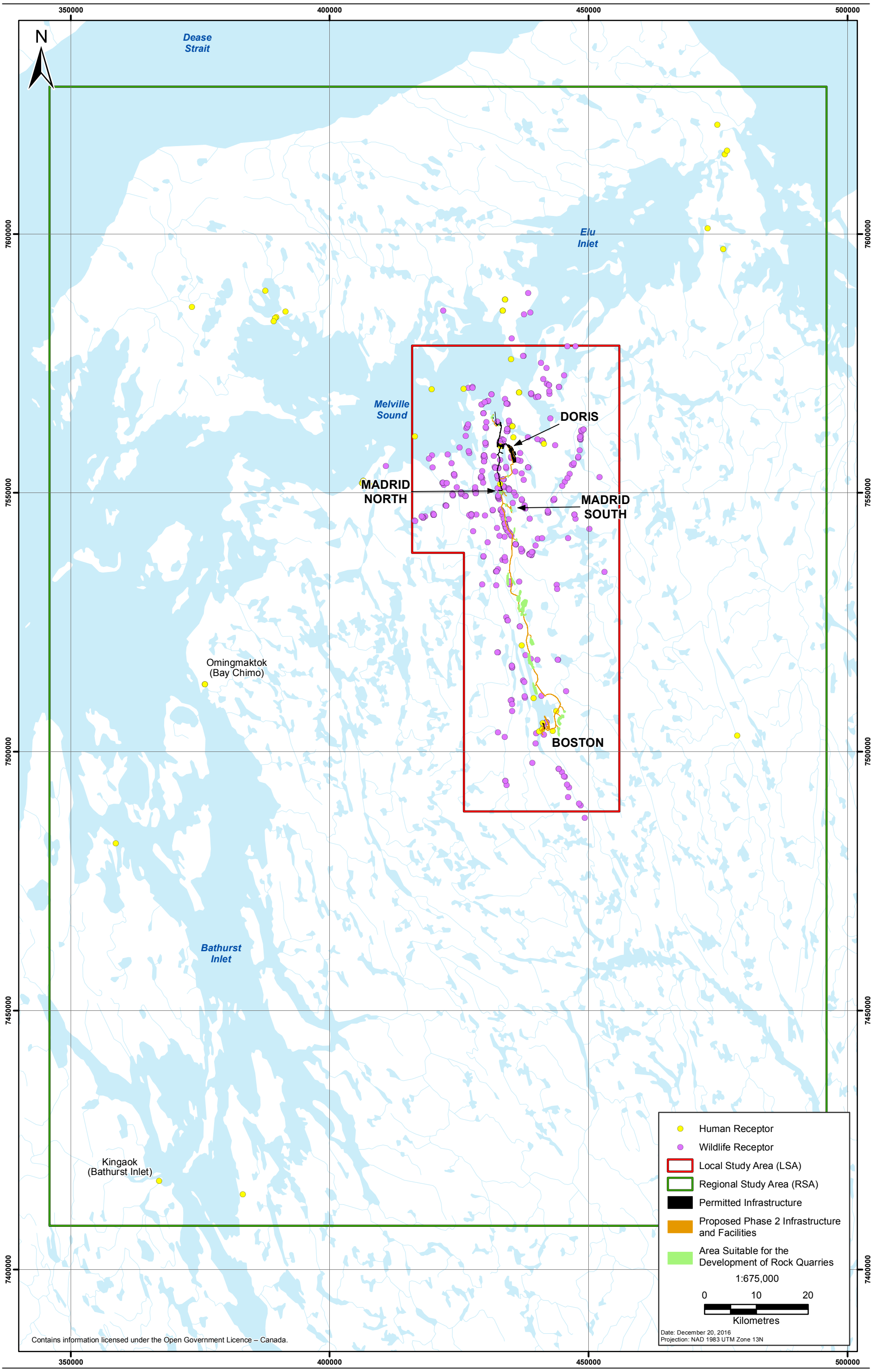


Table 3.5-5. Indicators and Thresholds

Phase	Factor	Receptor Type	Indicator	Applicable Period	Description	Indicator / Threshold
Construction and Operation	General Noise	Human (non-Project related)	L_{eq}, L_d	Daytime (7am to 10pm)	Noise level threshold for assessing potential annoyance, or interference with speech communication, associated with Project Construction and Operational emissions.	55 dBA
			L_{eq}, L_n	Night time (10pm to 7am)	Noise level threshold for assessing potential annoyance, or sleep disturbance associated with Project Construction and Operational emissions.	45 dBA
			L_{eq}, L_{dn}	24 hour Equivalent Period	Day and night time combined (24 hour equivalent) noise level threshold for assessing potential annoyance, or the likelihood of complaints associated with Project Construction and Operational emissions.	55 dBA
			L_{max}	Night time (10pm to 7am)	Maximum noise level not to be exceeded more than 10 times per night for assessing potential annoyance, or sleep disturbance associated with Project Construction and Operational emissions.	60 dBA
			L_{eq}, LF L_d and L_n	Daytime (7am to 10pm)	Indicative noise level threshold for assessing potential annoyance, due to low frequency noise, associated with Project Construction and Operational emissions. This threshold is based on L_d and L_n + 15 dB which is commonly recognised as the typical noise level difference between dBA and dB(C) noise parameters.	70 dB(C)
				Night time (10pm to 7am)		60 dB(C)
		Human (Project related)	L_{eq}, L_d	Daytime (7am to 10pm)	Noise level threshold for assessing potential annoyance, or sleep disturbance associated with Project Construction and Operational emissions. This threshold is adopted for both daytime (L_d) and night time (L_n) periods to account for potential shift workers, where sleep may be required during the daytime period.	57 dBA
			L_{eq}, L_n	Night time (10pm to 7am)		57 dBA
			L_{eq}, L_{dn}	24 hour Equivalent Period	Day and night combined (24 hour equivalent) noise level for assessing the likelihood of complaints associated with on-site Project Construction and Operational emissions.	60 dBA
			L_{max}	Any time	Maximum noise level not to be exceeded more than 10 times per sleeping period for assessing sleep disturbance associated with on-site Project Construction and Operational emissions.	72 dBA
			L_{eq}, LF L_d and L_n	Daytime (7am to 10pm)	Indicative noise level threshold for assessing potential annoyance, due to low frequency noise, associated with Project Construction and Operational emissions. This threshold is based on L_d and L_n + 15 dB which is commonly recognised as the typical noise level difference between dBA and dB(C) noise parameters.	72 dB(C)
				Night time (10pm to 7am)		72 dB(C)
		Wildlife	L_{eq}, L_d	Daytime (7am to 10pm)	Indicative noise level threshold for assessing potential wildlife habitat loss associated with Project Construction and Operational emissions.	55 dBA
			L_{eq}, L_n	Night time (10pm to 7am)	Indicative noise level threshold for assessing potential wildlife habitat loss associated with Project Construction and Operational emissions.	45 dBA

Phase	Factor	Receptor Type	Indicator	Applicable Period	Description	Indicator / Threshold
Operation	Aircraft Noise	Human (non-Project related)	SEL	Daytime (7am to 10pm)	Noise exposure threshold for assessing potential annoyance, or sleep disturbance associated with Project Operational aircraft emissions.	90 dBA
				Night time (10pm to 7am)		
		Human (Project related)		Daytime (7am to 10pm)		120 dBA
				Night time (10pm to 7am)		
		Wildlife		Daytime (7am to 10pm)	Noise exposure threshold for assessing wildlife sensitivity (highly sensitive wildlife, birds etc.) to Project Operational aircraft emissions.	90 dBA[1]
				Night time (10pm to 7am)		
Quarry Blasting	Overpressure	Human (non-Project related)	L_{peak}	Any time	Overpressure threshold for assessing potential annoyance due to blasting, applicable to 95% of blasts in any calendar year.	115 dBZ
					Overpressure threshold for assessing potential annoyance due to blasting, applicable to 5% of blasts in any calendar year.	120 dBZ
		Human (Project related)			Overpressure threshold for assessing potential annoyance due to blasting at occupied non-sensitive receptors, applicable to 100% of blasts.	125 dBZ
		Wildlife			Overpressure threshold for assessing potential wildlife sensitivity due to blasting, applicable to 100% of blasts in any calendar year.	96 dBZ
	Ground-borne Vibration	Human (non-Project related)	PPV	Any time	Ground-borne vibration threshold for assessing potential annoyance (or structural damage/cosmetic issues) due to blasting at highly sensitive receptors (or buildings), applicable to 100% of blasts in any calendar year.	3 mm/s
					Ground-borne vibration threshold for assessing potential annoyance due to blasting, applicable to 95% of blasts in any calendar year.	5 mm/s
					Ground-borne vibration threshold for assessing potential annoyance due to blasting, applicable to 5% of blasts in any calendar year.	10 mm/s
		Human (Project related)			Ground-borne vibration level for assessing potential annoyance due to blasting at occupied non-sensitive receptors, applicable to 100% of blasts in any calendar year.	25 mm/s

Phase	Factor	Receptor Type	Indicator	Applicable Period	Description	Indicator / Threshold
Quarry Blasting	Ground-borne Vibration	Wildlife			Indicative ground-borne vibration threshold for assessing wildlife sensitivity (highly sensitive wildlife, birds etc.) due to blasting, applicable to 100% of blasts in any calendar year.	3 mm/s
					Indicative ground-borne vibration level for assessing potential wildlife sensitivity (less sensitive wildlife, all other wildlife) due to blasting, applicable to 95% of blasts in any calendar year.	5 mm/s
					Indicative ground-borne vibration level for assessing potential wildlife sensitivity (less sensitive wildlife, all other wildlife) due to blasting, applicable to 5% of blasts in any calendar year.	10 mm/s

Table 3.5-6. General Phase 2 Construction Noise

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W081	Wildlife	Raptor Nest	432990	7550050	74	74	81	55	45	-	19	29	n/a
R_W322	Wildlife	Raptor Nest	441273	7505006	67	67	73	55	45	-	12	22	n/a
R_W028	Wildlife	Waterbird Flock (>100)	441894	7505738	60	60	66	55	45	-	5	15	n/a
R_W029	Wildlife	Waterbird Flock (>100)	441894	7505738	60	60	66	55	45	-	5	15	n/a
R_W030	Wildlife	Waterbird Flock (>100)	441894	7505738	60	60	66	55	45	-	5	15	n/a
R_W198	Wildlife	Raptor Nest	432900	7550330	60	60	66	55	45	-	5	15	n/a
R_W246	Wildlife	Raptor Nest	435016	7556936	59	59	66	55	45	-	4	14	n/a
R_W140	Wildlife	Raptor Nest	435044	7556747	57	57	64	55	45	-	2	12	n/a
R_H-W3	Human Receptor (Project Related)	Boston Operation site	441091	7504366	68	68	74	57	57	60	11	11	14
R_W376	Wildlife	Raptor Nest	432554	7549455	52	52	59	55	45	-	-3	7	n/a
R_W153	Wildlife	Raptor Nest	432538	7549437	52	52	58	55	45	-	-3	7	n/a
R_W375	Wildlife	Raptor Nest	432568	7549367	52	52	58	55	45	-	-3	7	n/a
R_W247	Wildlife	Raptor Nest	432566	7549321	51	51	58	55	45	-	-4	6	n/a
R_W345	Wildlife	Raptor Nest	432585	7549236	51	51	57	55	45	-	-4	6	n/a
R_W171	Wildlife	Raptor Nest	432562	7549225	51	51	57	55	45	-	-4	6	n/a
R_W314	Wildlife	Raptor Nest	436249	7556391	51	51	57	55	45	-	-4	6	n/a
R_W230	Wildlife	Raptor Nest	433622	7551128	50	50	57	55	45	-	-5	5	n/a
R_W201	Wildlife	Raptor Nest	432578	7549152	50	50	57	55	45	-	-5	5	n/a

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W119	Wildlife	Raptor Nest	441374	7503337	50	50	57	55	45	-	-5	5	n/a
R_W154	Wildlife	Raptor Nest	432578	7549081	50	50	56	55	45	-	-5	5	n/a
R_W079	Wildlife	Raptor Nest	433586	7551259	49	49	55	55	45	-	-6	4	n/a
R_W196	Wildlife	Raptor Nest	433566	7551278	49	49	55	55	45	-	-6	4	n/a
R_W086	Wildlife	Raptor Nest	435325	7548102	49	49	55	55	45	-	-6	4	n/a
R_W192	Wildlife	Raptor Nest	432893	7556376	47	49	55	55	45	-	-8	4	n/a
R_W378	Wildlife	Raptor Nest	433507	7551283	49	49	55	55	45	-	-6	4	n/a
R_W083	Wildlife	Raptor Nest	432700	7548800	48	48	55	55	45	-	-7	3	n/a
R_H012	Human Receptor (non-Project Related)	Potential Human Receptor	440418	7503938	47	47	53	55	45	55	-8	2	-2
R_W394	Wildlife	Den	432422	7550901	47	47	53	55	45	-	-8	2	n/a
R_H-H1	Human Receptor (non-Project Related)	Hunting and Fishing	443076	7504032	46	46	52	55	45	55	-9	1	-3

[1] Potential Phase 2 noise emissions sources were placed at representative locations within the PDA based on the (07.11.16) Phase 2 Project design. Levels were predicted via 3D modelling based on significant source emissions deemed representative of the plant, equipment, machinery or activity proposed to be undertaken. The resultant noise levels are presented in this table.

Table 3.5-7. General Doris Operational Noise

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Doris			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W049	Wildlife	Raptor Nest	433200	7559350	70	70	76	55	45	-	15	25	n/a
R_W305	Wildlife	Raptor Nest	433107	7559423	67	67	73	55	45	-	12	22	n/a
R_W144	Wildlife	Raptor Nest	432755	7559699	67	67	73	55	45	-	12	22	n/a
R_W175	Wildlife	Raptor Nest	433049	7559452	66	66	73	55	45	-	11	21	n/a
R_W354	Wildlife	Raptor Nest	432963	7559482	66	66	73	55	45	-	11	21	n/a
R_W181	Wildlife	Raptor Nest	432848	7559593	66	66	72	55	45	-	11	21	n/a
R_W216	Wildlife	Raptor Nest	432850	7559607	66	66	72	55	45	-	11	21	n/a
R_W050	Wildlife	Raptor Nest	432961	7559514	66	66	72	55	45	-	11	21	n/a
R_W282	Wildlife	Raptor Nest	432961	7559514	66	66	72	55	45	-	11	21	n/a
R_W190	Wildlife	Raptor Nest	433252	7559431	65	65	72	55	45	-	10	20	n/a
R_H-W1	Human (Project related)	Doris Site (active)	432965	7559019	77	77	84	57	57	60	20	20	24

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Doris			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W234	Wildlife	Raptor Nest	433453	7559443	64	64	71	55	45	-	9	19	n/a
R_W285	Wildlife	Raptor Nest	432855	7559927	62	62	68	55	45	-	7	17	n/a
R_W048	Wildlife	Raptor Nest	433323	7560393	54	54	61	55	45	-	-1	9	n/a
R_W233	Wildlife	Raptor Nest	433604	7560209	53	53	59	55	45	-	-2	8	n/a
R_W163	Wildlife	Raptor Nest	433416	7560355	52	52	58	55	45	-	-3	7	n/a
R_W051	Wildlife	Raptor Nest	430150	7559359	50	50	56	55	45	-	-5	5	n/a
R_W396	Wildlife	Den	431711	7557205	49	49	55	55	45	-	-6	4	n/a
R_W192	Wildlife	Raptor Nest	432893	7556376	48	48	54	55	45	-	-7	3	n/a
R_W281	Wildlife	Raptor Nest	434212	7561864	48	48	54	55	45	-	-8	3	n/a
R_W280	Wildlife	Raptor Nest	434219	7561931	47	47	54	55	45	-	-8	2	n/a
R_W047	Wildlife	Raptor Nest	434309	7561882	47	47	54	55	45	-	-8	2	n/a
R_W311	Wildlife	Raptor Nest	434350	7562300	46	46	53	55	45	-	-9	1	n/a
R_W246	Wildlife	Raptor Nest	435016	7556936	46	46	53	55	45	-	-9	1	n/a
R_W052	Wildlife	Raptor Nest	429900	7556800	46	46	53	55	45	-	-9	1	n/a
R_W283	Wildlife	Raptor Nest	429900	7556800	46	46	53	55	45	-	-9	1	n/a
R_W310	Wildlife	Raptor Nest	434255	7562364	46	46	52	55	45	-	-9	1	n/a
R_W327	Wildlife	Raptor Nest	434249	7562367	46	46	52	55	45	-	-9	1	n/a
R_W403	Wildlife	Common Eider	432374	7563735	46	46	52	55	45	-	-9	1	n/a
R_W140	Wildlife	Raptor Nest	435044	7556747	46	46	52	55	45	-	-9	1	n/a

[1] *Known existing Doris noise emissions sources were placed at their general location within the PDA based on the (07.11.16) Project design. Levels were predicted via 3D modelling based on significant source emissions deemed representative of the plant, equipment, machinery or activity undertaken. The resultant noise levels are presented in this table.*

Table 3.5-8. General Phase 2 Operational Noise (Years 6 to 10)

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W081	Wildlife	Raptor Nest	432990	7550050	80	80	86	55	45	-	25	35	n/a
R_H-W3	Human Receptor (Project Related)	Boston Operation site	441091	7504366	82	82	89	57	57	60	25	25	29
R_W198	Wildlife	Raptor Nest	432900	7550330	64	64	71	55	45	-	9	19	n/a
R_W322	Wildlife	Raptor Nest	441273	7505006	59	59	66	55	45	-	4	14	n/a
R_W376	Wildlife	Raptor Nest	432554	7549455	58	58	64	55	45	-	3	13	n/a
R_W153	Wildlife	Raptor Nest	432538	7549437	57	57	64	55	45	-	2	12	n/a
R_W375	Wildlife	Raptor Nest	432568	7549367	57	57	63	55	45	-	2	12	n/a
R_H012	Human Receptor (non-Project Related)	Potential Human Receptor	440418	7503938	57	57	63	55	45	55	2	12	8
R_W247	Wildlife	Raptor Nest	432566	7549321	57	57	63	55	45	-	2	12	n/a
R_W345	Wildlife	Raptor Nest	432585	7549236	56	56	63	55	45	-	1	11	n/a
R_W119	Wildlife	Raptor Nest	441374	7503337	56	56	63	55	45	-	1	11	n/a
R_W171	Wildlife	Raptor Nest	432562	7549225	56	56	62	55	45	-	1	11	n/a
R_W201	Wildlife	Raptor Nest	432578	7549152	56	56	62	55	45	-	1	11	n/a
R_W154	Wildlife	Raptor Nest	432578	7549081	55	55	61	55	45	-	0	10	n/a
R_W083	Wildlife	Raptor Nest	432700	7548800	53	53	60	55	45	-	-2	8	n/a
R_W394	Wildlife	Den	432422	7550901	53	53	59	55	45	-	-2	8	n/a
R_W378	Wildlife	Raptor Nest	433507	7551283	50	50	57	55	45	-	-5	5	n/a
R_W230	Wildlife	Raptor Nest	433622	7551128	50	50	57	55	45	-	-5	5	n/a
R_W079	Wildlife	Raptor Nest	433586	7551259	50	50	56	55	45	-	-5	5	n/a
R_W196	Wildlife	Raptor Nest	433566	7551278	50	50	56	55	45	-	-5	5	n/a
R_W028	Wildlife	Waterbird Flock (>100)	441894	7505738	49	49	56	55	45	-	-6	4	n/a
R_W029	Wildlife	Waterbird Flock (>100)	441894	7505738	49	49	56	55	45	-	-6	4	n/a
R_W030	Wildlife	Waterbird Flock (>100)	441894	7505738	49	49	56	55	45	-	-6	4	n/a
R_W192	Wildlife	Raptor Nest	432893	7556376	47	49	55	55	45	-	-8	4	n/a
R_H-H1	Human Receptor (non-Project Related)	Hunting and Fishing	443076	7504032	48	48	54	55	45	55	-7	3	-1
R_W019	Wildlife	Waterbird Flock (>100)	439844	7503589	46	46	53	55	45	-	-9	1	n/a
R_W304	Wildlife	Raptor Nest	432517	7554837	44	46	52	55	45	-	-11	1	n/a
R_W056	Wildlife	Raptor Nest	432532	7554865	44	45	52	55	45	-	-11	0	n/a

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W078	Wildlife	Raptor Nest	432470	7552810	45	45	52	55	45	-	-10	0	n/a
R_W218	Wildlife	Raptor Nest	434479	7550822	45	45	52	55	45	-	-10	0	n/a
R_W176	Wildlife	Raptor Nest	432532	7554850	44	45	52	55	45	-	-11	0	n/a
R_W243	Wildlife	Raptor Nest	433546	7552620	45	45	52	55	45	-	-10	0	n/a
R_W195	Wildlife	Raptor Nest	433546	7552614	45	45	52	55	45	-	-10	0	n/a
R_W349	Wildlife	Raptor Nest	432530	7554758	44	45	51	55	45	-	-11	0	n/a

[1] Potential Phase 2 noise emissions sources were placed at representative locations within the PDA based on the (07.11.16) Phase 2 Project design. Levels were predicted via 3D modelling based on significant source emissions deemed representative of the plant, equipment, machinery or activity proposed to be undertaken. The resultant noise levels are presented in this table.

Table 3.5-9. General Phase 2 Operational Noise (Years 11 to 14)

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W081	Wildlife	Raptor Nest	432990	7550050	80	80	86	55	45	-	25	35	n/a
R_H-W3	Human Receptor (Project Related)	Boston Operation site	441091	7504366	82	82	89	57	57	60	25	25	29
R_W198	Wildlife	Raptor Nest	432900	7550330	64	64	71	55	45	-	9	19	n/a
R_W322	Wildlife	Raptor Nest	441273	7505006	59	59	66	55	45	-	4	14	n/a
R_W376	Wildlife	Raptor Nest	432554	7549455	58	58	64	55	45	-	3	13	n/a
R_W153	Wildlife	Raptor Nest	432538	7549437	57	57	64	55	45	-	2	12	n/a
R_W375	Wildlife	Raptor Nest	432568	7549367	57	57	63	55	45	-	2	12	n/a
R_H012	Human Receptor (non-Project Related)	Potential Human Receptor	440418	7503938	57	57	63	55	45	55	2	12	8
R_W247	Wildlife	Raptor Nest	432566	7549321	57	57	63	55	45	-	2	12	n/a
R_W345	Wildlife	Raptor Nest	432585	7549236	56	56	63	55	45	-	1	11	n/a
R_W119	Wildlife	Raptor Nest	441374	7503337	56	56	63	55	45	-	1	11	n/a
R_W171	Wildlife	Raptor Nest	432562	7549225	56	56	62	55	45	-	1	11	n/a
R_W201	Wildlife	Raptor Nest	432578	7549152	56	56	62	55	45	-	1	11	n/a
R_W154	Wildlife	Raptor Nest	432578	7549081	55	55	61	55	45	-	0	10	n/a
R_W086	Wildlife	Raptor Nest	435325	7548102	54	54	60	55	45	-	-1	9	n/a
R_W083	Wildlife	Raptor Nest	432700	7548800	54	54	60	55	45	-	-1	9	n/a

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W394	Wildlife	Den	432422	7550901	53	53	59	55	45	-	-2	8	n/a
R_W230	Wildlife	Raptor Nest	433622	7551128	51	51	57	55	45	-	-4	6	n/a
R_W378	Wildlife	Raptor Nest	433507	7551283	51	51	57	55	45	-	-4	6	n/a
R_W079	Wildlife	Raptor Nest	433586	7551259	50	50	57	55	45	-	-5	5	n/a
R_W196	Wildlife	Raptor Nest	433566	7551278	50	50	56	55	45	-	-5	5	n/a
R_W028	Wildlife	Waterbird Flock (>100)	441894	7505738	49	49	56	55	45	-	-6	4	n/a
R_W029	Wildlife	Waterbird Flock (>100)	441894	7505738	49	49	56	55	45	-	-6	4	n/a
R_W030	Wildlife	Waterbird Flock (>100)	441894	7505738	49	49	56	55	45	-	-6	4	n/a
R_W192	Wildlife	Raptor Nest	432893	7556376	47	49	55	55	45	-	-8	4	n/a
R_H-H1	Human Receptor (non-Project Related)	Hunting and Fishing	443076	7504032	48	48	54	55	45	55	-7	3	-1
R_W290	Wildlife	Raptor Nest	432999	7546821	48	48	54	55	45	-	-7	3	n/a
R_W306	Wildlife	Raptor Nest	433350	7546300	48	48	54	55	45	-	-7	3	n/a
R_W211	Wildlife	Raptor Nest	433059	7546699	48	48	54	55	45	-	-7	3	n/a
R_W088	Wildlife	Raptor Nest	433059	7546650	47	47	54	55	45	-	-8	2	n/a
R_W202	Wildlife	Raptor Nest	433108	7546596	47	47	54	55	45	-	-8	2	n/a
R_W218	Wildlife	Raptor Nest	434479	7550822	47	47	53	55	45	-	-8	2	n/a
R_W082	Wildlife	Raptor Nest	434650	7550600	47	47	53	55	45	-	-8	2	n/a
R_W381	Wildlife	Raptor Nest	434650	7550600	47	47	53	55	45	-	-8	2	n/a
R_W084	Wildlife	Raptor Nest	435910	7549480	47	47	53	55	45	-	-8	2	n/a
R_W237	Wildlife	Raptor Nest	434466	7550962	46	46	53	55	45	-	-9	1	n/a
R_W358	Wildlife	Raptor Nest	434596	7550841	46	46	53	55	45	-	-9	1	n/a
R_W019	Wildlife	Waterbird Flock (>100)	439844	7503589	46	46	53	55	45	-	-9	1	n/a
R_W304	Wildlife	Raptor Nest	432517	7554837	45	46	52	55	45	-	-10	1	n/a
R_W085	Wildlife	Raptor Nest	437131	7548597	46	46	52	55	45	-	-9	1	n/a
R_W243	Wildlife	Raptor Nest	433546	7552620	46	46	52	55	45	-	-9	1	n/a
R_W195	Wildlife	Raptor Nest	433546	7552614	46	46	52	55	45	-	-9	1	n/a
R_W056	Wildlife	Raptor Nest	432532	7554865	44	46	52	55	45	-	-11	1	n/a
R_W199	Wildlife	Raptor Nest	435564	7550169	46	46	52	55	45	-	-9	1	n/a
R_W142	Wildlife	Raptor Nest	433607	7552649	45	46	52	55	45	-	-10	1	n/a

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W176	Wildlife	Raptor Nest	432532	7554850	44	46	52	55	45	-	-11	1	n/a
R_W078	Wildlife	Raptor Nest	432470	7552810	45	46	52	55	45	-	-10	1	n/a
R_W349	Wildlife	Raptor Nest	432530	7554758	44	45	52	55	45	-	-11	0	n/a
R_W186	Wildlife	Raptor Nest	433335	7545766	45	45	51	55	45	-	-10	0	n/a

[1] *Potential Phase 2 noise emissions sources were placed at representative locations within the PDA based on the (07.11.16) Phase 2 Project design. Levels were predicted via 3D modelling based on significant source emissions deemed representative of the plant, equipment, machinery or activity proposed to be undertaken. The resultant noise levels are presented in this table.*

Table 3.5-10. General Overall (Doris + Phase 2) Operational Noise (Years 6 to 10)

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W081	Wildlife	Raptor Nest	432990	7550050	80	80	86	55	45	-	25	35	n/a
R_H-W3	Human (Project related)	Boston Operation site	441091	7504366	82	82	89	57	57	60	25	25	29
R_W049	Wildlife	Raptor Nest	433200	7559350	70	70	76	55	45	-	15	25	n/a
R_W305	Wildlife	Raptor Nest	433107	7559423	67	67	73	55	45	-	12	22	n/a
R_W144	Wildlife	Raptor Nest	432755	7559699	67	67	73	55	45	-	12	22	n/a
R_W175	Wildlife	Raptor Nest	433049	7559452	66	66	73	55	45	-	11	21	n/a
R_W354	Wildlife	Raptor Nest	432963	7559482	66	66	73	55	45	-	11	21	n/a
R_W181	Wildlife	Raptor Nest	432848	7559593	66	66	72	55	45	-	11	21	n/a
R_W216	Wildlife	Raptor Nest	432850	7559607	66	66	72	55	45	-	11	21	n/a
R_W050	Wildlife	Raptor Nest	432961	7559514	66	66	72	55	45	-	11	21	n/a
R_W282	Wildlife	Raptor Nest	432961	7559514	66	66	72	55	45	-	11	21	n/a
R_W190	Wildlife	Raptor Nest	433252	7559431	65	65	72	55	45	-	10	20	n/a
R_H-W1	Human (Project related)	Doris Site (active)	432965	7559019	77	77	84	57	57	60	20	20	24
R_W198	Wildlife	Raptor Nest	432900	7550330	64	64	71	55	45	-	9	19	n/a
R_W234	Wildlife	Raptor Nest	433453	7559443	64	64	71	55	45	-	9	19	n/a
R_W285	Wildlife	Raptor Nest	432855	7559927	62	62	68	55	45	-	7	17	n/a
R_W322	Wildlife	Raptor Nest	441273	7505006	59	59	66	55	45	-	4	14	n/a

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W376	Wildlife	Raptor Nest	432554	7549455	58	58	64	55	45	-	3	13	n/a
R_W153	Wildlife	Raptor Nest	432538	7549437	57	57	64	55	45	-	2	12	n/a
R_W375	Wildlife	Raptor Nest	432568	7549367	57	57	63	55	45	-	2	12	n/a
R_H012	Human (non-Project related)	Potential Human Receptor	440418	7503938	57	57	63	55	45	55	2	12	8
R_W247	Wildlife	Raptor Nest	432566	7549321	57	57	63	55	45	-	2	12	n/a
R_W345	Wildlife	Raptor Nest	432585	7549236	56	56	63	55	45	-	1	11	n/a
R_W119	Wildlife	Raptor Nest	441374	7503337	56	56	63	55	45	-	1	11	n/a
R_W171	Wildlife	Raptor Nest	432562	7549225	56	56	62	55	45	-	1	11	n/a
R_W201	Wildlife	Raptor Nest	432578	7549152	56	56	62	55	45	-	1	11	n/a
R_W154	Wildlife	Raptor Nest	432578	7549081	55	55	61	55	45	-	0	10	n/a
R_W048	Wildlife	Raptor Nest	433323	7560393	54	54	61	55	45	-	-1	9	n/a
R_W083	Wildlife	Raptor Nest	432700	7548800	53	53	60	55	45	-	-2	8	n/a
R_W233	Wildlife	Raptor Nest	433604	7560209	53	53	59	55	45	-	-2	8	n/a
R_W394	Wildlife	Den	432422	7550901	53	53	59	55	45	-	-2	8	n/a
R_W163	Wildlife	Raptor Nest	433416	7560355	52	52	58	55	45	-	-3	7	n/a
R_W192	Wildlife	Raptor Nest	432893	7556376	50	52	58	55	45	-	-5	7	n/a
R_W378	Wildlife	Raptor Nest	433507	7551283	50	50	57	55	45	-	-5	5	n/a
R_W230	Wildlife	Raptor Nest	433622	7551128	50	50	57	55	45	-	-5	5	n/a
R_W051	Wildlife	Raptor Nest	430150	7559359	50	50	56	55	45	-	-5	5	n/a
R_W079	Wildlife	Raptor Nest	433586	7551259	50	50	56	55	45	-	-5	5	n/a
R_W196	Wildlife	Raptor Nest	433566	7551278	50	50	56	55	45	-	-5	5	n/a
R_W028	Wildlife	Waterbird Flock (>100)	441894	7505738	49	49	56	55	45	-	-6	4	n/a
R_W029	Wildlife	Waterbird Flock (>100)	441894	7505738	49	49	56	55	45	-	-6	4	n/a
R_W030	Wildlife	Waterbird Flock (>100)	441894	7505738	49	49	56	55	45	-	-6	4	n/a
R_W396	Wildlife	Den	431711	7557205	49	49	55	55	45	-	-6	4	n/a
R_H-H1	Human (non-Project related)	Hunting and Fishing	443076	7504032	48	48	54	55	45	55	-7	3	-1
R_W281	Wildlife	Raptor Nest	434212	7561864	48	48	54	55	45	-	-7	3	n/a
R_W280	Wildlife	Raptor Nest	434219	7561931	47	47	54	55	45	-	-8	2	n/a
R_W047	Wildlife	Raptor Nest	434309	7561882	47	47	54	55	45	-	-8	2	n/a

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W304	Wildlife	Raptor Nest	432517	7554837	46	47	53	55	45	-	-9	2	n/a
R_W056	Wildlife	Raptor Nest	432532	7554865	46	47	53	55	45	-	-9	2	n/a
R_W176	Wildlife	Raptor Nest	432532	7554850	45	47	53	55	45	-	-10	2	n/a
R_W246	Wildlife	Raptor Nest	435016	7556936	46	46	53	55	45	-	-9	1	n/a
R_W019	Wildlife	Waterbird Flock (>100)	439844	7503589	46	46	53	55	45	-	-9	1	n/a
R_W311	Wildlife	Raptor Nest	434350	7562300	46	46	53	55	45	-	-9	1	n/a
R_W349	Wildlife	Raptor Nest	432530	7554758	45	46	53	55	45	-	-10	1	n/a
R_W052	Wildlife	Raptor Nest	429900	7556800	46	46	53	55	45	-	-9	1	n/a
R_W283	Wildlife	Raptor Nest	429900	7556800	46	46	53	55	45	-	-9	1	n/a
R_W222	Wildlife	Raptor Nest	432543	7554788	45	46	53	55	45	-	-10	1	n/a
R_W310	Wildlife	Raptor Nest	434255	7562364	46	46	52	55	45	-	-9	1	n/a
R_W327	Wildlife	Raptor Nest	434249	7562367	46	46	52	55	45	-	-9	1	n/a
R_W403	Wildlife	Common Eider	432374	7563735	46	46	52	55	45	-	-9	1	n/a
R_W140	Wildlife	Raptor Nest	435044	7556747	46	46	52	55	45	-	-9	1	n/a
R_W078	Wildlife	Raptor Nest	432470	7552810	45	46	52	55	45	-	-10	1	n/a
R_W242	Wildlife	Raptor Nest	431954	7554874	45	46	52	55	45	-	-10	1	n/a
R_W167	Wildlife	Raptor Nest	431976	7554832	45	45	52	55	45	-	-10	0	n/a
R_W382	Wildlife	Raptor Nest	431964	7554822	45	45	52	55	45	-	-10	0	n/a
R_W243	Wildlife	Raptor Nest	433546	7552620	45	45	52	55	45	-	-10	0	n/a
R_W195	Wildlife	Raptor Nest	433546	7552614	45	45	52	55	45	-	-10	0	n/a
R_W218	Wildlife	Raptor Nest	434479	7550822	45	45	52	55	45	-	-10	0	n/a
R_W193	Wildlife	Raptor Nest	431855	7555068	45	45	52	55	45	-	-10	0	n/a
R_W142	Wildlife	Raptor Nest	433607	7552649	45	45	52	55	45	-	-10	0	n/a

[1] *Known existing Doris noise emissions sources were placed at their general location within the PDA based on the (07.11.16) Project design. Potential Phase 2 noise emissions sources were placed at representative locations within the PDA based on the (07.11.16) Phase 2 Project design. Levels were predicted via 3D modelling based on significant source emissions deemed representative of the plant, equipment, machinery or activity undertaken or proposed to be undertaken. The resultant noise levels are presented in this table.*

Table 3.5-11. General Overall (Doris + Phase 2) Operational Noise (Years 11 to 14)

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W081	Wildlife	Raptor Nest	432990	7550050	80	80	86	55	45	-	25	35	n/a
R_H-W3	Human (Project related)	Boston Operation site	441091	7504366	82	82	89	57	57	60	25	25	29
R_W049	Wildlife	Raptor Nest	433200	7559350	70	70	76	55	45	-	15	25	n/a
R_W305	Wildlife	Raptor Nest	433107	7559423	67	67	73	55	45	-	12	22	n/a
R_W144	Wildlife	Raptor Nest	432755	7559699	67	67	73	55	45	-	12	22	n/a
R_W175	Wildlife	Raptor Nest	433049	7559452	66	66	73	55	45	-	11	21	n/a
R_W354	Wildlife	Raptor Nest	432963	7559482	66	66	73	55	45	-	11	21	n/a
R_W181	Wildlife	Raptor Nest	432848	7559593	66	66	72	55	45	-	11	21	n/a
R_W216	Wildlife	Raptor Nest	432850	7559607	66	66	72	55	45	-	11	21	n/a
R_W050	Wildlife	Raptor Nest	432961	7559514	66	66	72	55	45	-	11	21	n/a
R_W282	Wildlife	Raptor Nest	432961	7559514	66	66	72	55	45	-	11	21	n/a
R_W190	Wildlife	Raptor Nest	433252	7559431	65	65	72	55	45	-	10	20	n/a
R_H-W1	Human (Project related)	Doris Site (active)	432965	7559019	77	77	84	57	57	60	20	20	24
R_W198	Wildlife	Raptor Nest	432900	7550330	64	64	71	55	45	-	9	19	n/a
R_W234	Wildlife	Raptor Nest	433453	7559443	64	64	71	55	45	-	9	19	n/a
R_W285	Wildlife	Raptor Nest	432855	7559927	62	62	68	55	45	-	7	17	n/a
R_W322	Wildlife	Raptor Nest	441273	7505006	59	59	66	55	45	-	4	14	n/a
R_W376	Wildlife	Raptor Nest	432554	7549455	58	58	64	55	45	-	3	13	n/a
R_W153	Wildlife	Raptor Nest	432538	7549437	57	57	64	55	45	-	2	12	n/a
R_W375	Wildlife	Raptor Nest	432568	7549367	57	57	63	55	45	-	2	12	n/a
R_H012	Human (non-Project related)	Potential Human Receptor	440418	7503938	57	57	63	55	45	55	2	12	8
R_W247	Wildlife	Raptor Nest	432566	7549321	57	57	63	55	45	-	2	12	n/a
R_W345	Wildlife	Raptor Nest	432585	7549236	56	56	63	55	45	-	1	11	n/a
R_W119	Wildlife	Raptor Nest	441374	7503337	56	56	63	55	45	-	1	11	n/a
R_W171	Wildlife	Raptor Nest	432562	7549225	56	56	62	55	45	-	1	11	n/a
R_W201	Wildlife	Raptor Nest	432578	7549152	56	56	62	55	45	-	1	11	n/a
R_W154	Wildlife	Raptor Nest	432578	7549081	55	55	61	55	45	-	0	10	n/a
R_W048	Wildlife	Raptor Nest	433323	7560393	54	54	61	55	45	-	-1	9	n/a

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W086	Wildlife	Raptor Nest	435325	7548102	54	54	60	55	45	-	-1	9	n/a
R_W083	Wildlife	Raptor Nest	432700	7548800	54	54	60	55	45	-	-1	9	n/a
R_W233	Wildlife	Raptor Nest	433604	7560209	53	53	59	55	45	-	-2	8	n/a
R_W394	Wildlife	Den	432422	7550901	53	53	59	55	45	-	-2	8	n/a
R_W163	Wildlife	Raptor Nest	433416	7560355	52	52	58	55	45	-	-3	7	n/a
R_W192	Wildlife	Raptor Nest	432893	7556376	50	52	58	55	45	-	-5	7	n/a
R_W230	Wildlife	Raptor Nest	433622	7551128	51	51	57	55	45	-	-4	6	n/a
R_W378	Wildlife	Raptor Nest	433507	7551283	51	51	57	55	45	-	-4	6	n/a
R_W079	Wildlife	Raptor Nest	433586	7551259	50	50	57	55	45	-	-5	5	n/a
R_W196	Wildlife	Raptor Nest	433566	7551278	50	50	56	55	45	-	-5	5	n/a
R_W051	Wildlife	Raptor Nest	430150	7559359	50	50	56	55	45	-	-5	5	n/a
R_W028	Wildlife	Waterbird Flock (>100)	441894	7505738	49	49	56	55	45	-	-6	4	n/a
R_W029	Wildlife	Waterbird Flock (>100)	441894	7505738	49	49	56	55	45	-	-6	4	n/a
R_W030	Wildlife	Waterbird Flock (>100)	441894	7505738	49	49	56	55	45	-	-6	4	n/a
R_W396	Wildlife	Den	431711	7557205	49	49	55	55	45	-	-6	4	n/a
R_H-H1	Human (non-Project related)	Hunting and Fishing	443076	7504032	48	48	54	55	45	55	-7	3	-1
R_W290	Wildlife	Raptor Nest	432999	7546821	48	48	54	55	45	-	-7	3	n/a
R_W306	Wildlife	Raptor Nest	433350	7546300	48	48	54	55	45	-	-7	3	n/a
R_W211	Wildlife	Raptor Nest	433059	7546699	48	48	54	55	45	-	-7	3	n/a
R_W281	Wildlife	Raptor Nest	434212	7561864	48	48	54	55	45	-	-7	3	n/a
R_W088	Wildlife	Raptor Nest	433059	7546650	47	47	54	55	45	-	-8	2	n/a
R_W280	Wildlife	Raptor Nest	434219	7561931	47	47	54	55	45	-	-8	2	n/a
R_W047	Wildlife	Raptor Nest	434309	7561882	47	47	54	55	45	-	-8	2	n/a
R_W304	Wildlife	Raptor Nest	432517	7554837	46	47	53	55	45	-	-9	2	n/a
R_W202	Wildlife	Raptor Nest	433108	7546596	47	47	54	55	45	-	-8	2	n/a
R_W218	Wildlife	Raptor Nest	434479	7550822	47	47	53	55	45	-	-8	2	n/a
R_W056	Wildlife	Raptor Nest	432532	7554865	46	47	53	55	45	-	-9	2	n/a
R_W082	Wildlife	Raptor Nest	434650	7550600	47	47	53	55	45	-	-8	2	n/a
R_W381	Wildlife	Raptor Nest	434650	7550600	47	47	53	55	45	-	-8	2	n/a

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W176	Wildlife	Raptor Nest	432532	7554850	46	47	53	55	45	-	-9	2	n/a
R_W084	Wildlife	Raptor Nest	435910	7549480	47	47	53	55	45	-	-8	2	n/a
R_W349	Wildlife	Raptor Nest	432530	7554758	46	47	53	55	45	-	-9	2	n/a
R_W237	Wildlife	Raptor Nest	434466	7550962	47	47	53	55	45	-	-8	2	n/a
R_W246	Wildlife	Raptor Nest	435016	7556936	47	47	53	55	45	-	-8	2	n/a
R_W358	Wildlife	Raptor Nest	434596	7550841	46	46	53	55	45	-	-9	1	n/a
R_W222	Wildlife	Raptor Nest	432543	7554788	46	46	53	55	45	-	-9	1	n/a
R_W019	Wildlife	Waterbird Flock (>100)	439844	7503589	46	46	53	55	45	-	-9	1	n/a
R_W311	Wildlife	Raptor Nest	434350	7562300	46	46	53	55	45	-	-9	1	n/a
R_W052	Wildlife	Raptor Nest	429900	7556800	46	46	53	55	45	-	-9	1	n/a
R_W283	Wildlife	Raptor Nest	429900	7556800	46	46	53	55	45	-	-9	1	n/a
R_W243	Wildlife	Raptor Nest	433546	7552620	46	46	52	55	45	-	-9	1	n/a
R_W195	Wildlife	Raptor Nest	433546	7552614	46	46	52	55	45	-	-9	1	n/a
R_W310	Wildlife	Raptor Nest	434255	7562364	46	46	52	55	45	-	-9	1	n/a
R_W327	Wildlife	Raptor Nest	434249	7562367	46	46	52	55	45	-	-9	1	n/a
R_W085	Wildlife	Raptor Nest	437131	7548597	46	46	52	55	45	-	-9	1	n/a
R_W140	Wildlife	Raptor Nest	435044	7556747	46	46	52	55	45	-	-9	1	n/a
R_W142	Wildlife	Raptor Nest	433607	7552649	46	46	52	55	45	-	-9	1	n/a
R_W199	Wildlife	Raptor Nest	435564	7550169	46	46	52	55	45	-	-9	1	n/a
R_W078	Wildlife	Raptor Nest	432470	7552810	46	46	52	55	45	-	-9	1	n/a
R_W403	Wildlife	Common Eider	432374	7563735	46	46	52	55	45	-	-9	1	n/a
R_W242	Wildlife	Raptor Nest	431954	7554874	46	46	52	55	45	-	-9	1	n/a
R_W167	Wildlife	Raptor Nest	431976	7554832	46	46	52	55	45	-	-9	1	n/a
R_W382	Wildlife	Raptor Nest	431964	7554822	46	46	52	55	45	-	-9	1	n/a
R_W193	Wildlife	Raptor Nest	431855	7555068	45	45	52	55	45	-	-10	0	n/a
R_W186	Wildlife	Raptor Nest	433335	7545766	45	45	51	55	45	-	-10	0	n/a

[1] *Known existing Doris noise emissions sources were placed at their general location within the PDA based on the (07.11.16) Project design. Potential Phase 2 noise emissions sources were placed at representative locations within the PDA based on the (07.11.16) Phase 2 Project design. Levels were predicted via 3D modelling based on significant source emissions deemed representative of the plant, equipment, machinery or activity undertaken or proposed to be undertaken. The resultant noise levels are presented in this table.*

Table 3.5-12. General Phase 2 Operational Noise (Quarries)

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W081	Wildlife	Raptor Nest	432990	7550050	73	73	80	55	45	-	18	28	n/a
R_W198	Wildlife	Raptor Nest	432900	7550330	68	68	75	55	45	-	13	23	n/a
R_W226	Wildlife	Raptor Nest	433928	7536920	64	64	70	55	45	-	9	19	n/a
R_W027	Wildlife	Waterbird Flock (>100)	438834	7517996	62	62	68	55	45	-	7	17	n/a
R_W221	Wildlife	Raptor Nest	433816	7537299	61	61	67	55	45	-	6	16	n/a
R_W312	Wildlife	Raptor Nest	434706	7532916	59	59	66	55	45	-	4	14	n/a
R_W208	Wildlife	Raptor Nest	434711	7532903	59	59	66	55	45	-	4	14	n/a
R_W339	Wildlife	Raptor Nest	433567	7544981	59	59	66	55	45	-	4	14	n/a
R_W240	Wildlife	Raptor Nest	434720	7532685	59	59	65	55	45	-	4	14	n/a
R_W105	Wildlife	Raptor Nest	434722	7532650	59	59	65	55	45	-	4	14	n/a
R_W213	Wildlife	Raptor Nest	434729	7532619	59	59	65	55	45	-	4	14	n/a
R_W252	Wildlife	Raptor Nest	434755	7532315	58	58	64	55	45	-	3	13	n/a
R_W334	Wildlife	Raptor Nest	434552	7544979	57	57	63	55	45	-	2	12	n/a
R_W350	Wildlife	Raptor Nest	433820	7537574	56	56	63	55	45	-	1	11	n/a
R_W376	Wildlife	Raptor Nest	432554	7549455	54	54	60	55	45	-	-1	9	n/a
R_W375	Wildlife	Raptor Nest	432568	7549367	54	54	60	55	45	-	-1	9	n/a
R_W153	Wildlife	Raptor Nest	432538	7549437	54	54	60	55	45	-	-1	9	n/a
R_W225	Wildlife	Raptor Nest	435852	7540160	53	53	60	55	45	-	-2	8	n/a
R_W230	Wildlife	Raptor Nest	433622	7551128	53	53	60	55	45	-	-2	8	n/a
R_W370	Wildlife	Raptor Nest	435866	7540144	53	53	60	55	45	-	-2	8	n/a
R_W178	Wildlife	Raptor Nest	435879	7540130	53	53	60	55	45	-	-2	8	n/a
R_W247	Wildlife	Raptor Nest	432566	7549321	53	53	60	55	45	-	-2	8	n/a
R_W099	Wildlife	Raptor Nest	435857	7540133	53	53	60	55	45	-	-2	8	n/a
R_W151	Wildlife	Raptor Nest	433745	7544174	53	53	59	55	45	-	-2	8	n/a
R_W403	Wildlife	Common Eider	432374	7563735	53	53	59	55	45	-	-2	8	n/a
R_W345	Wildlife	Raptor Nest	432585	7549236	53	53	59	55	45	-	-2	8	n/a
R_W249	Wildlife	Raptor Nest	434941	7542043	52	52	59	55	45	-	-3	7	n/a
R_W171	Wildlife	Raptor Nest	432562	7549225	52	52	59	55	45	-	-3	7	n/a

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W220	Wildlife	Raptor Nest	433796	7544106	52	52	59	55	45	-	-3	7	n/a
R_W150	Wildlife	Raptor Nest	433349	7537073	52	52	59	55	45	-	-3	7	n/a
R_W079	Wildlife	Raptor Nest	433586	7551259	52	52	59	55	45	-	-3	7	n/a
R_W148	Wildlife	Raptor Nest	435960	7540040	52	52	59	55	45	-	-3	7	n/a
R_W378	Wildlife	Raptor Nest	433507	7551283	52	52	58	55	45	-	-3	7	n/a
R_W098	Wildlife	Raptor Nest	435050	7541740	52	52	58	55	45	-	-3	7	n/a
R_W196	Wildlife	Raptor Nest	433566	7551278	52	52	58	55	45	-	-3	7	n/a
R_W166	Wildlife	Raptor Nest	433788	7544081	52	52	58	55	45	-	-3	7	n/a
R_W201	Wildlife	Raptor Nest	432578	7549152	52	52	58	55	45	-	-3	7	n/a
R_W307	Wildlife	Raptor Nest	433795	7544069	52	52	58	55	45	-	-3	7	n/a
R_W154	Wildlife	Raptor Nest	432578	7549081	51	51	58	55	45	-	-4	6	n/a
R_W393	Wildlife	Raptor Nest	433801	7544011	51	51	58	55	45	-	-4	6	n/a
R_W253	Wildlife	Raptor Nest	433849	7543980	51	51	58	55	45	-	-4	6	n/a
R_W186	Wildlife	Raptor Nest	433335	7545766	50	50	57	55	45	-	-5	5	n/a
R_W142	Wildlife	Raptor Nest	433607	7552649	50	50	57	55	45	-	-5	5	n/a
R_W083	Wildlife	Raptor Nest	432700	7548800	50	50	57	55	45	-	-5	5	n/a
R_W159	Wildlife	Raptor Nest	437815	7518709	50	50	57	55	45	-	-5	5	n/a
R_W204	Wildlife	Raptor Nest	434727	7542318	50	50	56	55	45	-	-5	5	n/a
R_W306	Wildlife	Raptor Nest	433350	7546300	50	50	56	55	45	-	-5	5	n/a
R_W243	Wildlife	Raptor Nest	433546	7552620	50	50	56	55	45	-	-5	5	n/a
R_W195	Wildlife	Raptor Nest	433546	7552614	50	50	56	55	45	-	-5	5	n/a
R_W237	Wildlife	Raptor Nest	434466	7550962	50	50	56	55	45	-	-5	5	n/a
R_W394	Wildlife	Den	432422	7550901	50	50	56	55	45	-	-5	5	n/a
R_W218	Wildlife	Raptor Nest	434479	7550822	50	50	56	55	45	-	-5	5	n/a
R_W388	Wildlife	Raptor Nest	436601	7532890	50	50	56	55	45	-	-5	5	n/a
R_W086	Wildlife	Raptor Nest	435325	7548102	49	49	56	55	45	-	-6	4	n/a
R_W290	Wildlife	Raptor Nest	432999	7546821	49	49	55	55	45	-	-6	4	n/a
R_W358	Wildlife	Raptor Nest	434596	7550841	49	49	55	55	45	-	-6	4	n/a
R_W211	Wildlife	Raptor Nest	433059	7546699	49	49	55	55	45	-	-6	4	n/a

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dBA			Threshold, dBA			Comparison, dBA (Predicted - Threshold)		
					L_d	L_n	L_{dn}	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
R_W088	Wildlife	Raptor Nest	433059	7546650	49	49	55	55	45	-	-6	4	n/a
R_W202	Wildlife	Raptor Nest	433108	7546596	49	49	55	55	45	-	-6	4	n/a
R_W262	Wildlife	Raptor Nest	434419	7542593	49	49	55	55	45	-	-6	4	n/a
R_W173	Wildlife	Raptor Nest	433918	7543677	49	49	55	55	45	-	-6	4	n/a
R_W251	Wildlife	Raptor Nest	434212	7542817	47	47	54	55	45	-	-8	2	n/a
R_W082	Wildlife	Raptor Nest	434650	7550600	47	47	54	55	45	-	-8	2	n/a
R_W381	Wildlife	Raptor Nest	434650	7550600	47	47	54	55	45	-	-8	2	n/a
R_W203	Wildlife	Raptor Nest	434024	7543375	47	47	54	55	45	-	-8	2	n/a
R_W309	Wildlife	Raptor Nest	434010	7543375	47	47	54	55	45	-	-8	2	n/a
R_W095	Wildlife	Raptor Nest	434000	7543360	47	47	53	55	45	-	-8	2	n/a
R_H-H1	Human Receptor (non-Project Related)	Hunting and Fishing	443076	7504032	47	47	53	55	45	55	-8	2	-2
R_W141	Wildlife	Raptor Nest	434113	7554804	46	46	52	55	45	-	-9	1	n/a
R_H-F2	Human Receptor (non-Project Related)	Fishing Area	443743	7507934	45	45	52	55	45	55	-10	0	-3

[1] *Potential Phase 2 quarry noise emissions sources were placed at each quarry location considered within the PDA based on the (07.11.16) Phase 2 Project design. Levels were predicted via 3D modelling based on significant source emissions deemed representative of the plant, equipment, machinery or activity proposed to be undertaken. \The resultant noise levels are presented in this table.*

Table 3.5-13. Construction and Operational Noise (maximum noise)

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Closest Project Infrastructure	Predicted Noise Level, dBA		Threshold, dBA	Comparison, dBA (Predicted - Threshold)	
						Lower, L_{max}	Upper, L_{max}	Lmax	Lower, L_{max}	Upper, L_{max}
R_H-W1	Human (Project related)	Doris Site (active)	432965	7559019	Doris Site (Pads X & Y)[1]	47	102	72	-25	30
R_H-W3	Human (Project related)	Boston Operation site	441091	7504366	Camp[1]	47	102	72	-25	30
R_H-W4	Human (Project related)	Quarry D Camp	432902	7551719	New Windy Camp[1]	47	102	72	-25	30
R_H-W2	Human (Project related)	Boston Exploration Camp	441137	7505488	Existing Boston Exploration Camp	36	91	72	-36	19
R_H-F2	Human (non-Project related)	Fishing Area	443743	7507934	Madrid-Boston Road	23	78	60	-37	18
R_H-H1	Human (non-Project related)	Hunting and Fishing	443076	7504032	Madrid-Boston Road	14	69	60	-46	9
R_H012	Human (non-Project related)	Potential Human Receptor	440418	7503938	Camp and Mill Site	13	68	60	-47	8

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Closest Project Infrastructure	Predicted Noise Level, dBA		Threshold, dBA	Comparison, dBA (Predicted - Threshold)	
						Lower, L_{max}	Upper, L_{max}	L_{max}	Lower, L_{max}	Upper, L_{max}
R_H011	Human (non-Project related)	Potential Human Receptor	439356	7510386	Quarry U	9	64	60	-51	4
R_H010	Human (non-Project related)	Potential Human Receptor	437052	7520536	Madrid-Boston Road	7	62	60	-53	2

[1] Potential Phase 2 maximum noise levels were predicted based on distance offsets established via GIS analysis and based on all potential sources of noise within the PDA (07.11.16 Phase 2 Project design). Levels were predicted via spreadsheet calculation. The resultant noise levels are presented in this table.
[2] To predict noise levels a nominal distance of 10 metres was adopted.
[3] An upper and lower Lmax range is presented to identify the extent of potential maximum noise levels, which vary depending on the source emission of the event.
[4] The noise and blast study does not delineate between different maximum noise level events that could occur during construction or operation as these types of impulsive noise events could occur during either phase.

Table 3.5-14. Aircraft Noise (Doris Airstrip)

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dB(A)			Threshold, dBA	Comparison, dBA (Predicted - Threshold)		
					Helicopter (SEL), dBA	Fixed Wing (SEL), dBA - Opt 1	Fixed Wing (SEL), dBA - Opt 2	SEL	Helicopter (SEL), dBA	Fixed Wing (SEL), dBA - Opt 1	Fixed Wing (SEL), dBA - Opt 2
R_W285	Wildlife	Raptor Nest	432855	7559927	69	105	79	90	-21	15	-11
R_W144	Wildlife	Raptor Nest	432755	7559699	72	105	78	90	-18	15	-12
R_W216	Wildlife	Raptor Nest	432850	7559607	74	104	77	90	-16	14	-13
R_W181	Wildlife	Raptor Nest	432848	7559593	74	104	77	90	-16	14	-14
R_W050	Wildlife	Raptor Nest	432961	7559514	76	102	75	90	-14	12	-15
R_W282	Wildlife	Raptor Nest	432961	7559514	76	102	75	90	-14	12	-15
R_W354	Wildlife	Raptor Nest	432963	7559482	76	102	75	90	-14	12	-16
R_W048	Wildlife	Raptor Nest	433323	7560393	65	101	77	90	-25	11	-13
R_W175	Wildlife	Raptor Nest	433049	7559452	77	101	73	90	-13	11	-17
R_W305	Wildlife	Raptor Nest	433107	7559423	77	100	73	90	-13	10	-17
R_H-W1	Human (Project related)	Doris Site (active)	432965	7559019	92	100	72	90	2	10	-18
R_W163	Wildlife	Raptor Nest	433416	7560355	66	100	76	90	-24	10	-14
R_W049	Wildlife	Raptor Nest	433200	7559350	78	99	72	90	-12	9	-18

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dB(A)			Threshold, dBA	Comparison, dBA (Predicted - Threshold)		
					Helicopter (SEL), dBA	Fixed Wing (SEL), dBA - Opt 1	Fixed Wing (SEL), dBA - Opt 2	SEL	Helicopter (SEL), dBA	Fixed Wing (SEL), dBA - Opt 1	Fixed Wing (SEL), dBA - Opt 2
R_W190	Wildlife	Raptor Nest	433252	7559431	76	99	72	90	-14	9	-18
R_W233	Wildlife	Raptor Nest	433604	7560209	76	97	71	90	-14	7	-19
R_W234	Wildlife	Raptor Nest	433453	7559443	76	97	71	90	-14	7	-19
R_W396	Wildlife	Den	431711	7557205	69	97	74	90	-21	7	-16
R_W033	Wildlife	Raptor Nest	434227	7567253	45	96	75	90	-45	6	-16
R_W328	Wildlife	Raptor Nest	434201	7567260	45	96	75	90	-45	6	-16
R_W034	Wildlife	Raptor Nest	434157	7567315	45	96	74	90	-45	6	-16
R_W162	Wildlife	Raptor Nest	434202	7567286	45	96	75	90	-45	6	-16
R_W338	Wildlife	Raptor Nest	434165	7567306	45	96	75	90	-45	6	-16
R_W183	Wildlife	Raptor Nest	434387	7567203	45	95	74	90	-45	5	-16
R_W327	Wildlife	Raptor Nest	434249	7562367	56	95	73	90	-34	5	-17
R_W310	Wildlife	Raptor Nest	434255	7562364	56	94	73	90	-34	4	-17
R_W235	Wildlife	Raptor Nest	434637	7563901	52	94	68	90	-38	4	-22
R_W133	Wildlife	Raptor Nest	434713	7563468	53	93	69	90	-37	3	-21
R_W311	Wildlife	Raptor Nest	434350	7562300	57	93	72	90	-33	3	-18
R_W280	Wildlife	Raptor Nest	434219	7561931	58	93	72	90	-32	3	-18
R_W281	Wildlife	Raptor Nest	434212	7561864	58	92	71	90	-32	2	-19
R_W047	Wildlife	Raptor Nest	434309	7561882	58	92	71	90	-32	2	-19
R_W192	Wildlife	Raptor Nest	432893	7556376	85	91	68	90	-5	1	-22
R_H006	Human (non-Project related)	Potential Human Receptor	435299	7562924	42	90	69	90	-48	0	-21

[1] Predictions are provided for two aircraft (fixed wing) options. Option 1 (Opt 1) utilises a mix of Smaller aircraft (Dash 8) and jets (J737) whereas Option 2 (Opt 2) is limited to smaller aircraft (Dash 8) only. Option 2 generates lower noise emissions (due to the small aircraft being used, no jets) however an increased number of flights will be required annually. Both options consider two arrivals and departures at the airstrip.

[2] A nominal helicopter (Bell 206 Long Ranger) flight path to and from the Doris helipad towards key Phase 2 areas was adopted for the aircraft noise assessment. It is not plausible or warranted to assess every permutation of potential flight paths associated with helicopter use.

Table 3.5-15. Aircraft Noise (Boston Airstrip)

Receptor ID	Receptor Type	Description	GPS (Easting)	GPS (Northing)	Predicted Noise Level, dB(A)			Threshold, dBA	Comparison, dBA (Predicted - Threshold)		
					Helicopter (SEL), dBA	Fixed Wing (SEL), dBA - Opt 1	Fixed Wing (SEL), dBA - Opt 2	SEL	Helicopter (SEL), dBA	Fixed Wing (SEL), dBA - Opt 1	Fixed Wing (SEL), dBA - Opt 2
R_W028	Wildlife	Waterbird Flock (>100)	441894	7505738	71	110	85	90	-19	20	-5
R_H-H1	Human (non-Project related)	Hunting and Fishing	443076	7504032	63	102	76	90	-27	12	-14
R_H011	Human (non-Project related)	Potential Human Receptor	439356	7510386	68	93	71	90	-22	3	-20
R_W322	Wildlife	Raptor Nest	441273	7505006	95	92	70	90	5	2	-20

[1] Predictions are provided for two aircraft (fixed wing) options. Option 1 (Opt 1) utilises a mix of Smaller aircraft (Dash 8) and jets (J737) whereas Option 2 (Opt 2) is limited to smaller aircraft (Dash 8) only. Option 2 generates lower noise emissions (due to the small aircraft being used, no jets) however an increased number of flights will be required annually. Both options consider one arrival and departure at the airstrip.

[2] A nominal helicopter (Bell 206 Long Ranger) flight path to and from the Doris helipad towards key Phase 2 areas was adopted for the aircraft noise assessment. It is not plausible or warranted to assess every permutation of potential flight paths associated with helicopter use.

Table 3.5-16. Blasting Overpressure

Quarry			Receptor ID / Ranked for Distance (one to five)					Ranked Receptor Distance, m (one to five)					Predicted Overpressure Level, dBZ: Lpeak (one to five)					Limiting Threshold, dBZ	Comparison, dBZ (Predicted - Threshold): Lpeak (one to five)				
ID	Blast Location	Charge	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	Lpeak	1	2	3	4	5
Quarry W	CENTROID	90	R_H-H1	R_H-W3	R_H-W2	R_H012	R_H-F2	1142	3151	3436	3798	4000	107	95	94	92	92	115	-8	-20	-21	-23	-23
Quarry AI	CENTROID	90	R_H-W4	R_H-W1	R_H-F3	R_H008	R_H006	1576	8739	10666	12046	12736	103	82	79	78	77	115	-12	-33	-36	-37	-38
Quarry AB	CENTROID	90	R_H-F2	R_H-H1	R_H-W2	R_H-W3	R_H012	1582	4377	4774	5441	6234	103	91	89	88	86	115	-12	-24	-26	-27	-29
Quarry AH	CENTROID	90	R_H-W4	R_H-W1	R_H-F3	R_H008	R_H006	1690	8985	11036	12604	13084	103	81	79	77	77	115	-12	-34	-36	-38	-38
Quarry U	CENTROID	90	R_H011	R_H-F2	R_H-W2	R_H-W3	R_H012	1704	5808	6739	7829	8160	102	87	85	83	83	115	-13	-28	-30	-32	-32
Quarry U	BOUNDARY	90	R_H011	R_H-F2	R_H-W2	R_H-W3	R_H012	826	4778	5643	6742	7102	112	89	87	85	84	115	-3	-26	-28	-30	-31
Quarry W	BOUNDARY	90	R_H-H1	R_H-W3	R_H-W2	R_H-F2	R_H012	940	2855	2957	3248	3572	110	96	95	94	93	115	-5	-19	-20	-21	-22
Quarry V	BOUNDARY	90	R_H-F2	R_H-H1	R_H-W2	R_H-W3	R_H012	1251	1651	2791	3166	3952	106	103	96	95	92	115	-9	-12	-19	-20	-23
Quarry AB	BOUNDARY	90	R_H-F2	R_H-H1	R_H-W2	R_H-W3	R_H012	1384	4153	4586	5244	6038	105	91	90	88	86	115	-10	-24	-25	-27	-29
Quarry AH	BOUNDARY	90	R_H-W4	R_H-W1	R_H-F3	R_H008	R_H006	1388	8687	10783	12300	12827	105	82	79	78	77	115	-10	-33	-36	-37	-38
Quarry W	CENTROID	162	R_H-H1	R_H-W3	R_H-W2	R_H012	R_H-F2	1142	3151	3436	3798	4000	110	97	96	95	94	115	-5	-18	-19	-20	-21
Quarry AI	CENTROID	162	R_H-W4	R_H-W1	R_H-F3	R_H008	R_H006	1576	8739	10666	12046	12736	106	84	82	80	80	115	-9	-31	-33	-35	-35
Quarry AB	CENTROID	162	R_H-F2	R_H-H1	R_H-W2	R_H-W3	R_H012	1582	4377	4774	5441	6234	106	93	92	90	89	115	-9	-22	-23	-25	-26
Quarry AH	CENTROID	162	R_H-W4	R_H-W1	R_H-F3	R_H008	R_H006	1690	8985	11036	12604	13084	105	84	81	80	79	115	-10	-31	-34	-35	-36
Quarry U	CENTROID	162	R_H011	R_H-F2	R_H-W2	R_H-W3	R_H012	1704	5808	6739	7829	8160	105	89	88	86	85	115	-10	-26	-27	-29	-30
Quarry U	BOUNDARY	162	R_H011	R_H-F2	R_H-W2	R_H-W3	R_H012	826	4778	5643	6742	7102	114	92	90	88	87	115	-1	-23	-25	-27	-28
Quarry W	BOUNDARY	162	R_H-H1	R_H-W3	R_H-W2	R_H-F2	R_H012	940	2855	2957	3248	3572	112	98	98	97	96	115	-3	-17	-17	-18	-19
Quarry V	BOUNDARY	162	R_H-F2	R_H-H1	R_H-W2	R_H-W3	R_H012	1251	1651	2791	3166	3952	109	105	99	97	94	115	-6	-10	-16	-18	-21
Quarry AB	BOUNDARY	162	R_H-F2	R_H-H1	R_H-W2	R_H-W3	R_H012	1384	4153	4586	5244	6038	108	94	92	91	89	115	-7	-21	-23	-24	-26
Quarry AH	BOUNDARY	162	R_H-W4	R_H-W1	R_H-F3	R_H008	R_H006	1388	8687	10783	12300	12827	107	84	82	80	79	115	-8	-31	-33	-35	-36
Quarry AH	CENTROID	90	R_W081	R_W198	R_W376	R_W153	R_W375	59	330	761	785	822	145	123	113	112	112	96	49	27	17	16	16
Quarry AH	BOUNDARY	90	R_W081	R_W198	R_W376	R_W153	R_W375	59	330	761	785	822	145	123	113	112	112	96	49	27	17	16	16
Quarry X	CENTROID	90	R_W339	R_W334	R_W151	R_W220	R_W166	429	557	819	872	898	120	117	112	111	110	96	24	21	16	15	14
Quarry T	CENTROID	90	R_W027	R_W112	R_W159	R_W111	R_W373	467	1386	1483	3674	3674	119	105	104	93	93	96	23	9	8	-3	-3
Quarry Z	CENTROID	90	R_W312	R_W208	R_W240	R_W105	R_W213	476	489	670	701	732	118	118	114	114	113	96	22	22	18	18	17
Quarry AI	CENTROID	90	R_W081	R_W198	R_W230	R_W079	R_W196	653	693	826	956	976	115	114	112	110	109	96	19	18	16	14	13
Quarry AH	BOUNDARY	90	R_W081	R_W198	R_W376	R_W153	R_W375	0	12	416	441	480	>150	>150	120	119	118	96	>54	>54	24	23	22
Quarry T	BOUNDARY	90	R_W027	R_W159	R_W112	R_W020	R_W315	16	420	1090	2884	3017	>150	120	108	96	95	96	>54	24	12	0	-1
Quarry Z	BOUNDARY	90	R_W312	R_W208	R_W105	R_W240	R_W213	125	132	154	155	159	135	135	133	133	132	96	39	39	37	37	36
Quarry X	BOUNDARY	90	R_W339	R_W334	R_W151	R_W220	R_W166	318	414	585	635	661	124	120	116	115	114	96	28	24	20	19	18
Quarry L	BOUNDARY	90	R_W249	R_W098	R_W204	R_W262	R_W251	518	540	753	1096	1345	117	117	113	108	105	96	21	21	17	12	9
Quarry AH	CENTROID	162	R_W081	R_W198	R_W376	R_W153	R_W375	59	330	761	785	822	147	126	115	115	114	96	51	30	19	19	18
Quarry X	CENTROID	162	R_W339	R_W334	R_W151	R_W220	R_W166	429	557	819	872	898	122	119	114	113	113	96	26	23	18	17	17
Quarry T	CENTROID	162	R_W027	R_W112	R_W159	R_W111	R_W373	467	1386	1483	3674	3674	121	107	107	95	95	96	25	11	11	-1	-1
Quarry Z	CENTROID	162	R_W312	R_W208	R_W240	R_W105	R_W213	476	489	670	701	732	121	121	117	116	116	96	25	25	21	20	20
Quarry AI	CENTROID	162	R_W081	R_W198	R_W230	R_W079	R_W196	653	693	826	956	976	117	116	114	112	112	96	21	20	18	16	16
Quarry AH	BOUNDARY	162	R_W081	R_W198	R_W376	R_W153	R_W375	0	12	416	441	480	>150	>150	123	122	121	96	>54	>54	27	26	25
Quarry T	BOUNDARY	162	R_W027	R_W159	R_W112	R_W020	R_W315	16	420	1090	2884	3017	>150	123	111	98	98	96	>54	27	15	2	2
Quarry Z	BOUNDARY	162	R_W312	R_W208	R_W105	R_W240	R_W213	125	132	154	155	159	138	137	135	135	135	96	42	41	39	39	39
Quarry X	BOUNDARY	162	R_W339	R_W334	R_W151	R_W220	R_W166	318	414	585	635	661	126	123	118	117	117	96	30	27	22	21	21
Quarry L	BOUNDARY	162	R_W249	R_W098	R_W204	R_W262	R_W251	518	540	753	1096	1345	120	119	115	110	108	96	24	23	19	14	12

[1] Blasting levels were predicted via spreadsheet calculations to estimate levels at receptors. Two "Maximum Instantaneous Charges" (MIC) in kilograms (kg) were established based on historic blasting data provided by TMAC. The two values 90 and 162 provide an indicative range of potential levels, and based on experience with other mines are MIC that could occur. Representative blast locations based on a centroid quarry position and a boundary quarry position (closest point to each receptor) were adopted to predict representative worst-case levels.

Table 3.5-17. Blasting Vibration

Quarry			Receptor ID / Ranked Distance					Distance, m					Predicted Vibration Level, mm/s: PPV (one to five)					Limiting Threshold, mm/s	Comparison, mm/s (Predicted - Threshold): PPV (one to five)				
ID	Blast Location	Charge	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	PPV	1	2	3	4	5
Quarry W	CENTROID	90	R_H-H1	R_H-W3	R_H-W2	R_H012	R_H-F2	1142	3151	3436	3798	4000	1	0	0	0	0	3	-2	-3	-3	-3	-3
Quarry AI	CENTROID	90	R_H-W4	R_H-W1	R_H-F3	R_H008	R_H006	1576	8739	10666	12046	12736	0	0	0	0	0	3	-3	-3	-3	-3	-3
Quarry AB	CENTROID	90	R_H-F2	R_H-H1	R_H-W2	R_H-W3	R_H012	1582	4377	4774	5441	6234	0	0	0	0	0	3	-3	-3	-3	-3	-3
Quarry AH	CENTROID	90	R_H-W4	R_H-W1	R_H-F3	R_H008	R_H006	1690	8985	11036	12604	13084	0	0	0	0	0	3	-3	-3	-3	-3	-3
Quarry U	CENTROID	90	R_H011	R_H-F2	R_H-W2	R_H-W3	R_H012	1704	5808	6739	7829	8160	0	0	0	0	0	3	-3	-3	-3	-3	-3
Quarry U	BOUNDARY	90	R_H011	R_H-F2	R_H-W2	R_H-W3	R_H012	826	4778	5643	6742	7102	1	0	0	0	0	3	-2	-3	-3	-3	-3
Quarry W	BOUNDARY	90	R_H-H1	R_H-W3	R_H-W2	R_H-F2	R_H012	940	2855	2957	3248	3572	1	0	0	0	0	3	-2	-3	-3	-3	-3
Quarry V	BOUNDARY	90	R_H-F2	R_H-H1	R_H-W2	R_H-W3	R_H012	1251	1651	2791	3166	3952	0	0	0	0	0	3	-3	-3	-3	-3	-3
Quarry AB	BOUNDARY	90	R_H-F2	R_H-H1	R_H-W2	R_H-W3	R_H012	1384	4153	4586	5244	6038	0	0	0	0	0	3	-3	-3	-3	-3	-3
Quarry AH	BOUNDARY	90	R_H-W4	R_H-W1	R_H-F3	R_H008	R_H006	1388	8687	10783	12300	12827	0	0	0	0	0	3	-3	-3	-3	-3	-3
Quarry W	CENTROID	162	R_H-H1	R_H-W3	R_H-W2	R_H012	R_H-F2	1142	3151	3436	3798	4000	1	0	0	0	0	3	-2	-3	-3	-3	-3
Quarry AI	CENTROID	162	R_H-W4	R_H-W1	R_H-F3	R_H008	R_H006	1576	8739	10666	12046	12736	1	0	0	0	0	3	-2	-3	-3	-3	-3
Quarry AB	CENTROID	162	R_H-F2	R_H-H1	R_H-W2	R_H-W3	R_H012	1582	4377	4774	5441	6234	1	0	0	0	0	3	-2	-3	-3	-3	-3
Quarry AH	CENTROID	162	R_H-W4	R_H-W1	R_H-F3	R_H008	R_H006	1690	8985	11036	12604	13084	0	0	0	0	0	3	-3	-3	-3	-3	-3
Quarry U	CENTROID	162	R_H011	R_H-F2	R_H-W2	R_H-W3	R_H012	1704	5808	6739	7829	8160	0	0	0	0	0	3	-3	-3	-3	-3	-3
Quarry U	BOUNDARY	162	R_H011	R_H-F2	R_H-W2	R_H-W3	R_H012	826	4778	5643	6742	7102	1	0	0	0	0	3	-2	-3	-3	-3	-3
Quarry W	BOUNDARY	162	R_H-H1	R_H-W3	R_H-W2	R_H-F2	R_H012	940	2855	2957	3248	3572	1	0	0	0	0	3	-2	-3	-3	-3	-3
Quarry V	BOUNDARY	162	R_H-F2	R_H-H1	R_H-W2	R_H-W3	R_H012	1251	1651	2791	3166	3952	1	0	0	0	0	3	-2	-3	-3	-3	-3
Quarry AB	BOUNDARY	162	R_H-F2	R_H-H1	R_H-W2	R_H-W3	R_H012	1384	4153	4586	5244	6038	1	0	0	0	0	3	-2	-3	-3	-3	-3
Quarry AH	BOUNDARY	162	R_H-W4	R_H-W1	R_H-F3	R_H008	R_H006	1388	8687	10783	12300	12827	1	0	0	0	0	3	-2	-3	-3	-3	-3
Quarry AH	CENTROID	90	R_W081	R_W198	R_W376	R_W153	R_W375	59	330	761	785	822	>25	4	1	1	1	3	>23	1	-2	-2	-2
Quarry X	CENTROID	90	R_W339	R_W334	R_W151	R_W220	R_W166	429	557	819	872	898	3	2	1	1	1	3	0	-1	-2	-2	-2
Quarry T	CENTROID	90	R_W027	R_W112	R_W159	R_W111	R_W373	467	1386	1483	3674	3674	2	0	0	0	0	3	-1	-3	-3	-3	-3
Quarry Z	CENTROID	90	R_W312	R_W208	R_W240	R_W105	R_W213	476	489	670	701	732	2	2	1	1	1	3	-1	-1	-2	-2	-2
Quarry AI	CENTROID	90	R_W081	R_W198	R_W230	R_W079	R_W196	653	693	826	956	976	1	1	1	1	1	3	-2	-2	-2	-2	-2
Quarry AH	BOUNDARY	90	R_W081	R_W198	R_W376	R_W153	R_W375	0	12	416	441	480	>25	>25	3	2	2	3	>23	>23	0	-1	-1
Quarry T	BOUNDARY	90	R_W027	R_W159	R_W112	R_W020	R_W315	16	420	1090	2884	3017	>25	3	1	0	0	3	>23	0	-2	-3	-3
Quarry Z	BOUNDARY	90	R_W312	R_W208	R_W105	R_W240	R_W213	125	132	154	155	159	18	17	13	13	13	3	15	14	10	10	10
Quarry X	BOUNDARY	90	R_W339	R_W334	R_W151	R_W220	R_W166	318	414	585	635	661	4	3	2	1	1	3	1	0	-1	-2	-2
Quarry L	BOUNDARY	90	R_W249	R_W098	R_W204	R_W262	R_W251	518	540	753	1096	1345	2	2	1	1	0	3	-1	-1	-2	-2	-3
Quarry AH	CENTROID	162	R_W081	R_W198	R_W376	R_W153	R_W375	59	330	761	785	822	>25	6	2	2	1	3	>23	3	-1	-1	-2
Quarry X	CENTROID	162	R_W339	R_W334	R_W151	R_W220	R_W166	429	557	819	872	898	4	3	1	1	1	3	1	0	-2	-2	-2
Quarry T	CENTROID	162	R_W027	R_W112	R_W159	R_W111	R_W373	467	1386	1483	3674	3674	4	1	1	0	0	3	1	-2	-2	-3	-3
Quarry Z	CENTROID	162	R_W312	R_W208	R_W240	R_W105	R_W213	476	489	670	701	732	3	3	2	2	2	3	0	0	-1	-1	-1
Quarry AI	CENTROID	162	R_W081	R_W198	R_W230	R_W079	R_W196	653	693	826	956	976	2	2	1	1	1	3	-1	-1	-2	-2	-2
Quarry AH	BOUNDARY	162	R_W081	R_W198	R_W376	R_W153	R_W375	0	12	416	441	480	>25	>25	4	4	3	3	>23	>23	1	1	0
Quarry T	BOUNDARY	162	R_W027	R_W159	R_W112	R_W020	R_W315	16	420	1090	2884	3017	>25	4	1	0	0	3	>23	1	-2	-3	-3
Quarry Z	BOUNDARY	162	R_W312	R_W208	R_W105	R_W240	R_W213	125	132	154	155	159	>25	>25	21	21	20	3	26	24	18	18	17
Quarry X	BOUNDARY	162	R_W339	R_W334	R_W151	R_W220	R_W166	318	414	585	635	661	7	4	2	2	2	3	4	1	-1	-1	-1
Quarry L	BOUNDARY	162	R_W249	R_W098	R_W204	R_W262	R_W251	518	540	753	1096	1345	3	3	2	1	1	3	0	0	-1	-2	-2

[1] Blasting levels were predicted via spreadsheet calculations to estimate levels at receptors. Two "Maximum Instantaneous Charges" (MIC) in kilograms (kg) were established based on historic blasting data provided by TMAC. The two values 90 and 162 provide an indicative range of potential levels, and based on experience with other mines are MIC that could occur. Representative blast locations based on a centroid quarry position and a boundary quarry position (closest point to each receptor) were adopted to predict representative worst-case levels.

Figure 3.5-2
Boston Airstrip Fixed Wing Operations - Option 1

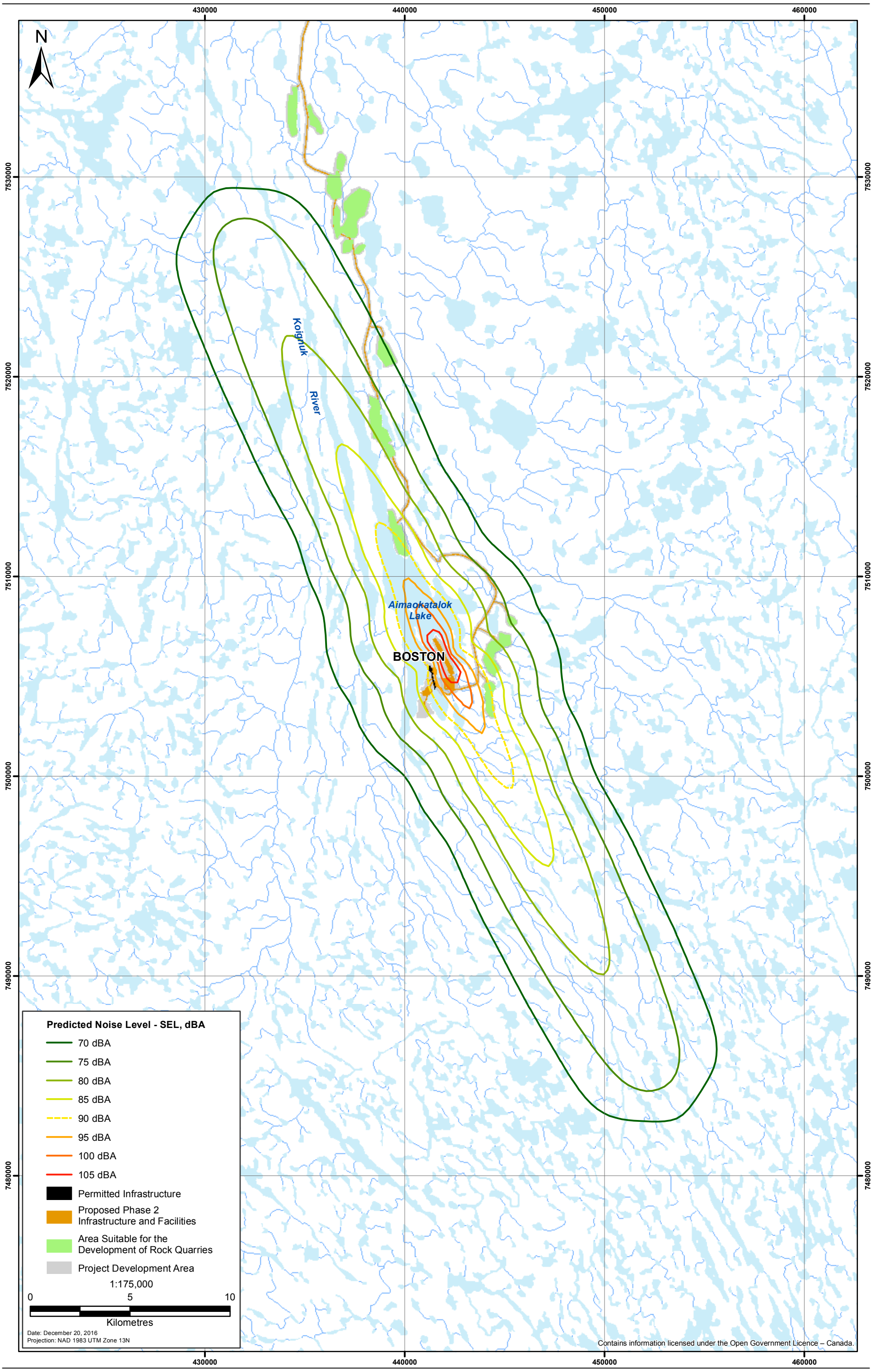


Figure 3.5-3
Boston Airstrip Fixed Wing Operations - Option 2

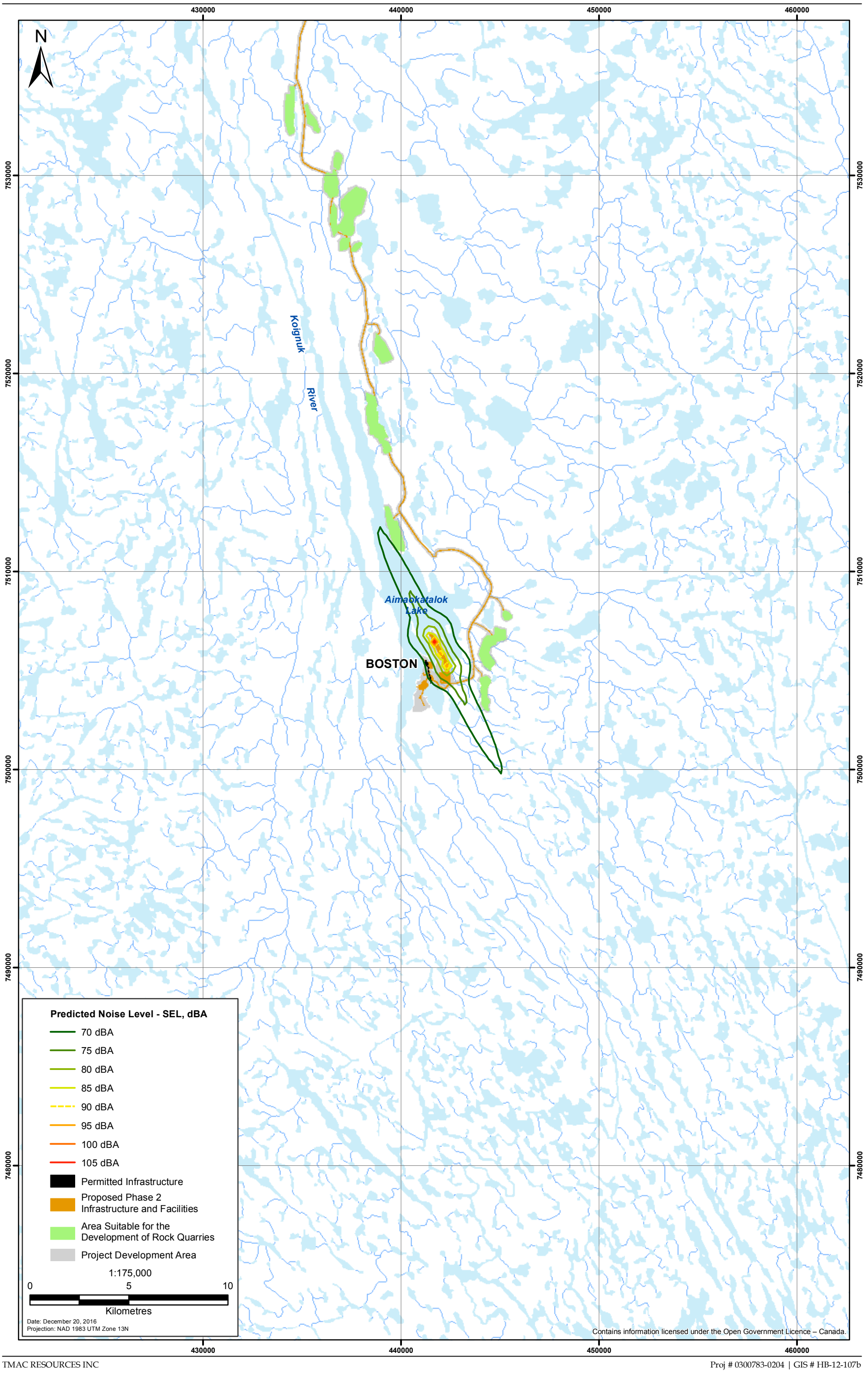


Figure 3.5-4
Boston Airstrip Helicopter Operations

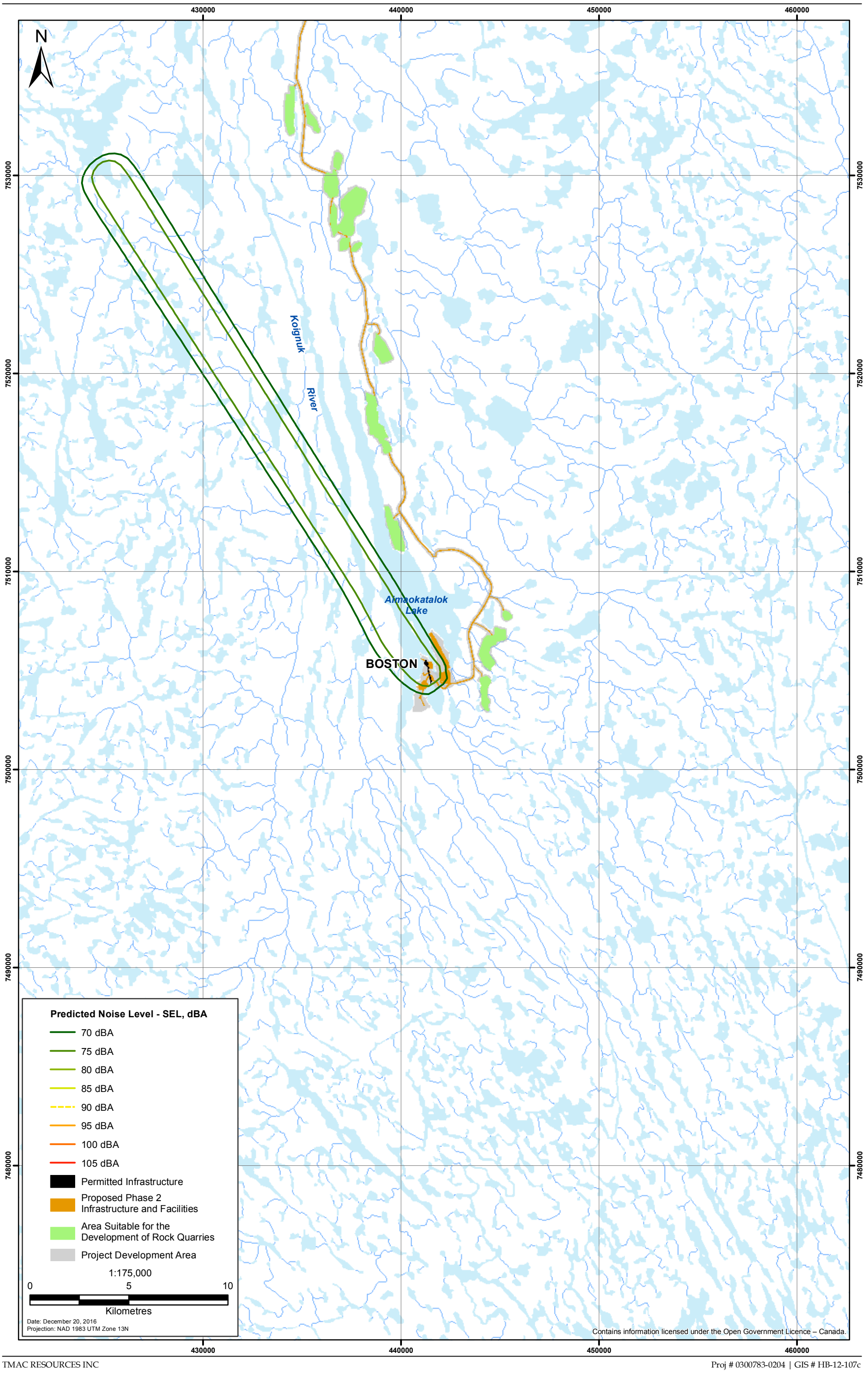


Figure 3.5-5
Doris Airstrip Fixed Wing Operations - Option 1

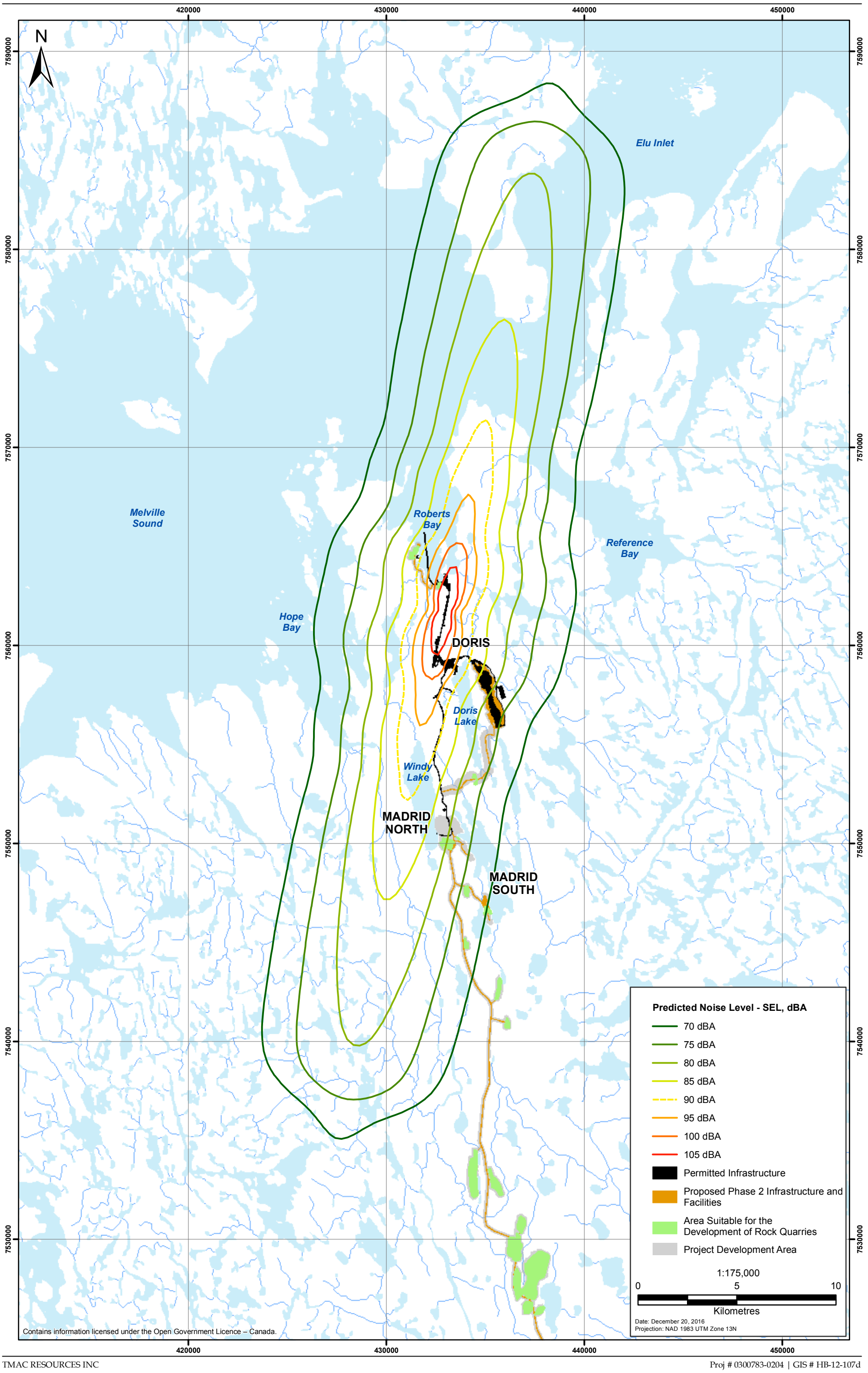


Figure 3.5-6
Doris Airstrip Fixed Wing Operations - Option 2

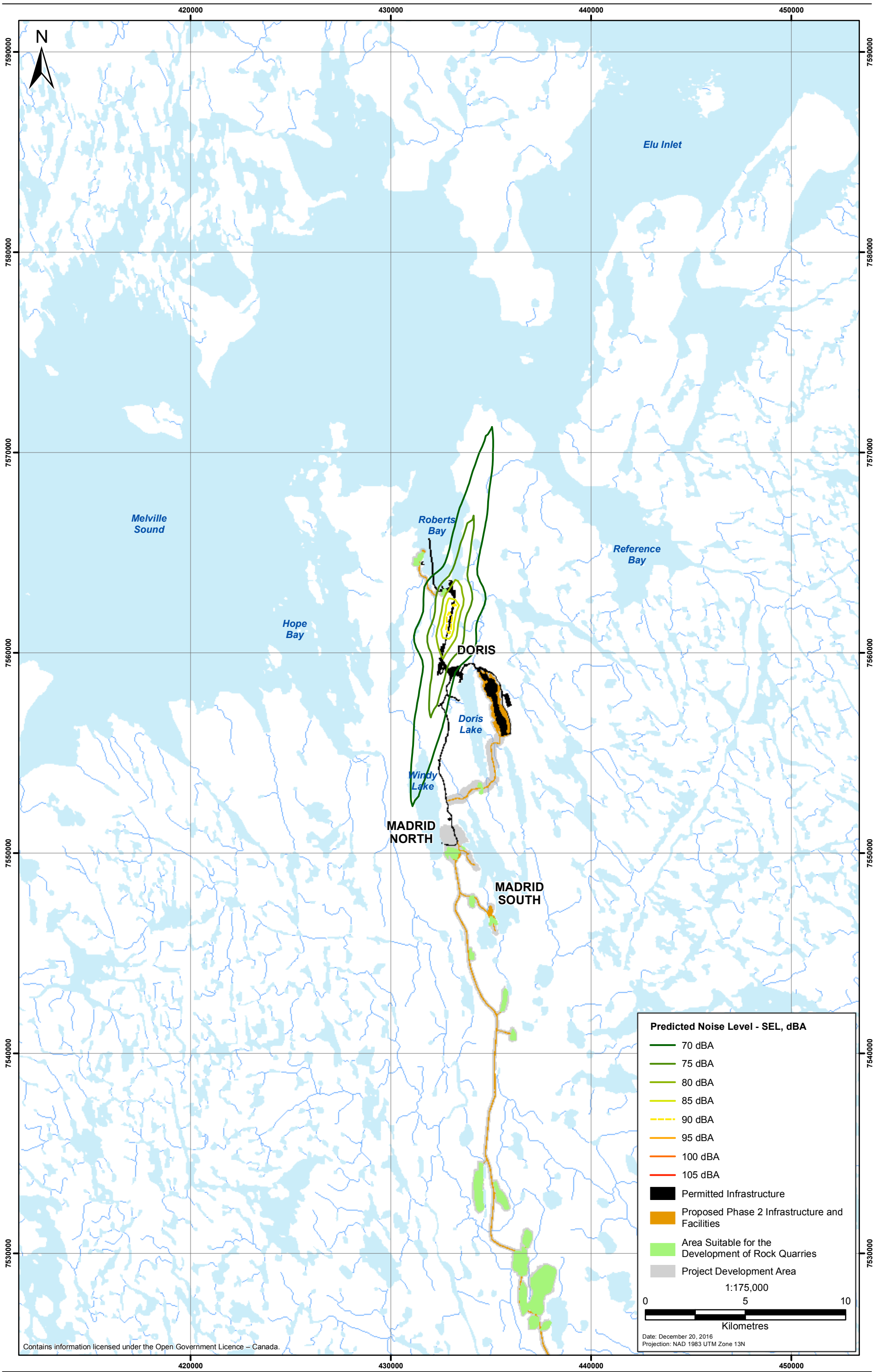
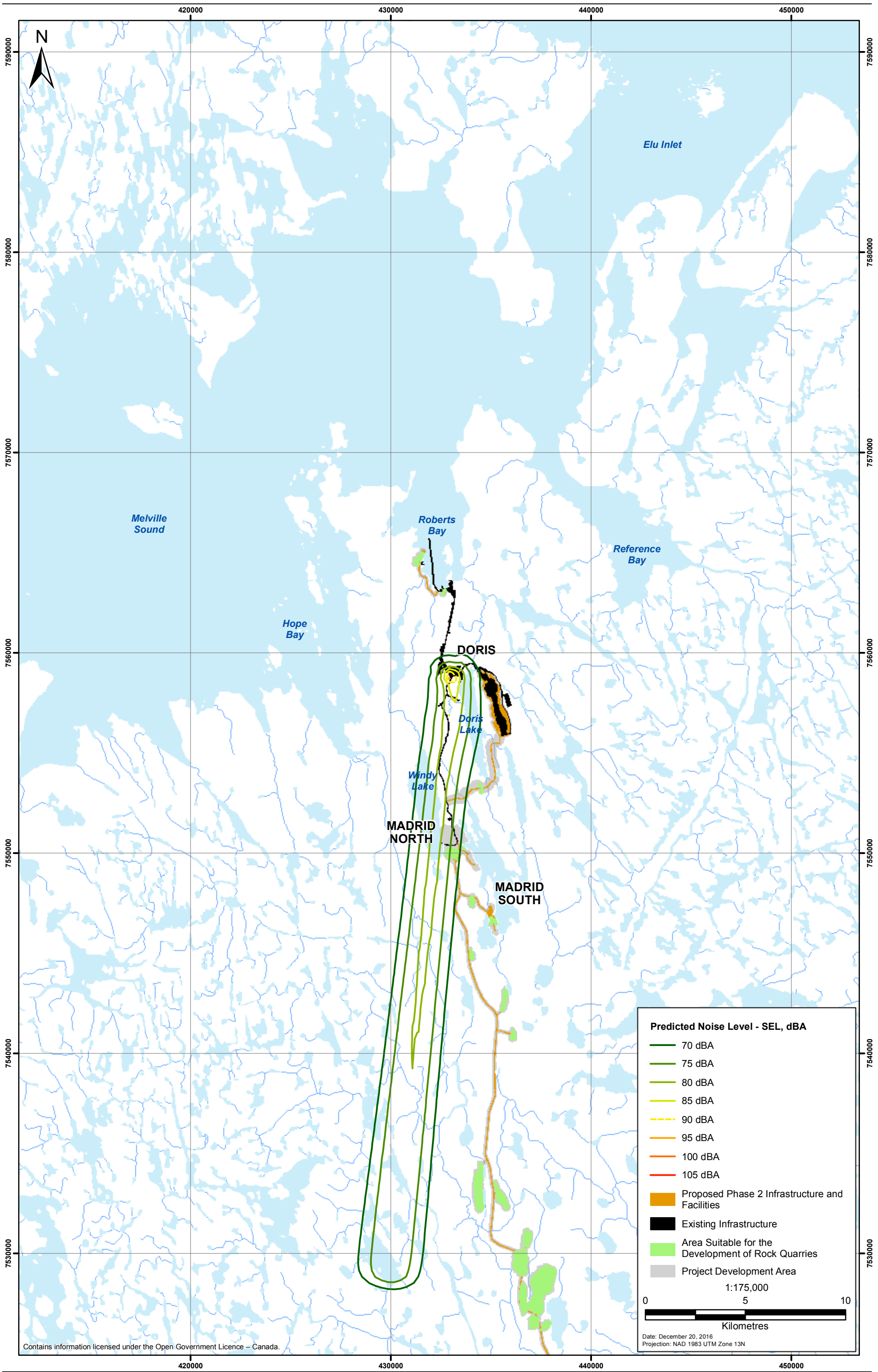


Figure 3.5-7
Doris Airstrip Helicopter Operations



Potential overpressure and ground-borne vibration effects associated with quarry blasting are highly contingent on the blast location and the size of charge that is required. At this stage the actual quarries that will be necessary during Phase 2 operations are yet to be determined such that contour mapping that accurately describes the potential effects cannot to be generated at this stage. The blasting assessment has considered the five closest quarries to any receptor, and then the five closest receptors to each to provide indicative worst-case levels to inform future blasting designs. The tabulated results accurately describe the potential worst-case overpressure and vibration effects that are limited to the closest and most affected wildlife receptors in the vicinity of the five quarry areas. Therefore, it is not warranted or useful to provide contour mapping of the predicted L_{peak}, dBZ and PPV, mm/s levels across the LSA. The tabulated results adequately describe the extent of potential effects for the purpose of achieving the EIS Guidelines (NIRB) requirement. Suitable recommendations for potential blasting overpressure and vibration contour mapping are provided below with regards to the mitigation by project design and the Project-related residual effects that are characterised in this chapter.

Summary of Findings

General construction noise: the findings of the construction noise assessment indicate that noise effects rated as moderate and high are limited to a small number of human and wildlife receptors. For the majority of human and wildlife receptors assessed within the LSA, noise effects rated as negligible and low are anticipated. Noise effects rated as high are limited to nine of the 436 human and wildlife receptors assessed. Noise effects based on the L_{dn} (24-hour) threshold and rated as high are limited to one human receptor (R_H-W3), which is a Project-related receptor. The predicted noise levels (L_d, L_n and L_{dn}), and the magnitude and extent that they exceed the applicable thresholds, is typical of construction works associated with a mining project of this scale. It is reiterated that noise emissions and potential impacts associated with Reclamation and Closure and other less significant works or activities not directly assessed by the Environmental Noise and Vibration Study Report (Appendix V4-3A), are expected to be lower than those identified here. These findings indicate that noise mitigation and management measures are warranted in select construction circumstances to assist reduce impacts to acceptable levels. Suitable recommendations based on the magnitude and extent of potential noise effects are provided below.

General operational noise (Years 6 to 10): the findings of the operational noise assessment indicate that noise effects rated as moderate and high are limited to a small number of human and wildlife receptors. For the majority of human and wildlife receptors assessed within the LSA, noise effects rated as negligible and low are anticipated. Noise effects rated as high are limited to 18 of the 436 human and wildlife receptors assessed. Noise effects based on the L_{dn} (24 hour) threshold and rated as high are limited to two human receptors (R_H-W3 and R_H012). R_H-W3 is a Project-related receptor and R_H012 is a non-Project related receptor. The predicted noise levels (L_d, L_n and L_{dn}), and the magnitude and extent that they exceed the applicable thresholds, is typical of a mining project of this scale. These findings indicate that noise mitigation and management measures are warranted in select operational circumstances to assist reduce impacts to acceptable levels. Suitable recommendations based on the magnitude and extent of potential noise effects are provided below.

For the overall (Doris and Phase 2) scenario, there is an increased number of receptors in the tabulated list of results where noise effects rated as moderate and high are predicted to occur. The increased number of receptors is due to the spatial distribution of Doris and Phase 2 within the LSA, and their respective proximity to receptors. Significantly increased Project noise levels and potential noise effects due to the combined operation of Doris and Phase 2 areas are not anticipated at the most affected receptors, due to this spatial distribution. The majority of receptors that are potentially affected by Doris operations will not be affected by Phase 2 operations. This feature is particularly relevant for receptors in the southern portion of the LSA (south of Madrid North and South) and towards Boston which are a significant distance from Doris operational noise emissions.

General operational noise (Years 11 to 14): the findings for operational Years 11 to 14 are broadly similar to those summarised above for Years 6 to 10). However the introduction of the Madrid South operations will increase the number of receptors where noise effects are rated as high to 20 of the 436 human and wildlife receptors assessed.

General operational noise (Quarries): the findings of the quarry noise assessment indicate that noise effects rated as moderate and high are limited to a small number of human and wildlife receptors. For the majority of human and wildlife receptors assessed within the LSA, noise effects rated as negligible and low are anticipated. Noise effects rated as high are limited to 45 of the 436 human and wildlife receptors assessed. The increased number of receptors where noise effects are rated as high (when compared to construction and operation) is due to the number of quarries being considered at this time (25) and their spatial distribution within the LSA. Under normal mining and quarry circumstances it is envisaged that between three and five quarries could be active at any one time such that the extent of potential impacts is significantly reduced. Noise effects based on the L_{dn} (24 hour) threshold and rated as moderate are limited to two human receptors (R_H-H1 and R_H-F2), both of which are non-Project related receptors. Noise effects based on the L_{dn} (24 hour) threshold and rated as high are not anticipated at any human receptor. The predicted noise levels (L_d, L_n and L_{dn}), and the magnitude and extent that they exceed the applicable thresholds, is typical of a quarry activities of this scale. These findings indicate that noise mitigation and management measures are warranted in select quarrying circumstances to assist reduce impacts to acceptable levels. Suitable recommendations based on the magnitude and extent of potential noise effects are provided below.

Construction and operational noise (maximum noise): the findings of the construction and operational maximum noise assessment indicate that noise effects (upper range of L_{max} levels) rated as moderate and high are limited to 9 of 45 human receptors. For 36 (the majority) of the human receptors assessed within the LSA, noise effects rated as negligible and low are anticipated. Noise effects rated as high are limited to 5 of the 45 human receptors assessed, being: R_H-W1, R_H-W3, R_H-W4, R_H-W2 and R_H-F2. Four of the five listed receptors are Project related and one R_H-F2 is non-Project related. Construction and operational maximum no3-ise effects based on the lower range of L_{max} levels and rated as moderate or high are not anticipated at any human receptor. The predicted noise levels (L_{max}), and the magnitude and extent that they exceed the applicable thresholds, is typical of a mining project of this scale. It is reiterated that the Environmental Noise and Vibration Study Report (Appendix V4-3A) does not delineate between different maximum noise level events that could occur during construction or operation as these types of impulsive noise events (e.g., noise generated by metal on metal contact) could occur during either phase. These findings indicate that noise mitigation and management measures are warranted in select quarrying circumstances to assist reduce impacts to acceptable levels. Suitable recommendations based on the magnitude and extent of potential noise effects are provided below.

Aircraft Noise (Doris Airstrip): the findings of the aircraft noise assessment indicate that noise effects rated as moderate and high are limited to a small number of human and wildlife receptors. For the majority of human and wildlife receptors assessed within the LSA, noise effects rated as negligible and low are anticipated. Noise effects rated as high are identified for 10 of the 62 human and wildlife receptors assessed. Noise effects rated as high are not anticipated for human receptors but one human receptor, R_H-W1, which is a non-Project related receptor (rated as moderate) is near to the high rating threshold. The worst-case noise effects are associated with the Option 1 scenario that includes the arrival and departure of the J737 jet. It is reiterated that a nominal helicopter flight path to and from the Doris helipad towards key Phase 2 areas was adopted for the aircraft noise assessment. It is not plausible or warranted to assess every permutation of potential flight paths associated with helicopter use. The helicopter noise results indicate that noise effects rated as high will not occur at any receptor however this could change if the helicopter flight path varies significantly to that assessed and encounters other receptors in closer proximity to those considered in the Environmental Noise and

Vibration Study Report (Appendix V4-3A). The predicted noise levels (SEL), and the magnitude and extent that they exceed the applicable thresholds, is typical of a mining project of this scale. These findings indicate that noise mitigation and management measures are warranted in select aircraft circumstances to assist reduce impacts to acceptable levels. Suitable recommendations based on the magnitude and extent of potential noise effects are provided below.

Aircraft Noise (Boston Airstrip): the findings for the Boston airstrip aircraft noise assessment are broadly similar to those summarised above for the Doris airstrip. However noise effects rated as high are identified for two of the 21 human and wildlife receptors assessed. Noise effects rated as high are limited to one human receptor, R_H-H1, which is a non-Project related receptor. The worst-case noise effects are again associated with the Option 1 scenario that includes the arrival and departure of the J737 jet.

Blasting overpressure: the findings of the quarry blasting overpressure assessment indicate that overpressure effects rated as moderate and high are limited to the closest and/or potentially most affected wildlife receptors. For all human receptors assessed within the LSA, overpressure effects rated as negligible and low are anticipated. The blasting assessment has considered the five closest quarries to any receptor, and then the five closest receptors to each. For wildlife receptors overpressure effects rated as moderate or high could, therefore, occur at other receptor locations but this is contingent on the blast event location and the charge used, both of which are easily managed by good blasting practices. Further guidance regarding blasting overpressure levels for a range of charge values and at a range of distances is provided in the Environmental Noise and Vibration Study Report (Appendix V4-3A). These findings indicate that blasting mitigation and management measures are warranted in select quarry blasting circumstances to assist reduce impacts to acceptable levels. Suitable recommendations based on the magnitude and extent of potential noise effects are provided below.

Blasting vibration: the findings for the quarry blasting vibration assessment are broadly similar to those summarised above for overpressure. Similar blasting mitigation and management measures are warranted in select quarry blasting circumstances to assist reduce impacts to acceptable levels. Suitable recommendations based on the magnitude and extent of potential noise effects are provided below.

Low Frequency Noise: an indicative noise level threshold (L_{eq}, LF L_d and L_n) was established for assessing potential annoyance, due to low frequency noise, associated with Construction and Operation emissions. This threshold is based on L_d and L_n + 15 dB which is commonly recognised as the typical noise level difference between dBA and dBC noise parameters. Applying this same noise level difference to the predicted values for general construction noise, general operational noise and quarry noise identifies that a similar potential for noise effects rated as moderate or high exists. As such mitigation and management measures are warranted in select circumstances to assist reduce impacts to acceptable levels. Suitable recommendations based on the magnitude and extent of potential low frequency noise effects are provided below.

Change in Acoustics Environment

In accordance with Section 8.1.3.2 of the NIRB Guidelines it is necessary to consider the potential change in noise due to the Project activities at different project stages. This is achievable by comparing the predicted general construction noise levels (Table 3.5-6) and the general operational noise levels (Table 3.5-7 to Table 3.5-12) to the mean Hope Bay Project Area Baseline presented in Table 3.2-4. For this analysis the Ln (night time) and Ldn (24 hour) parameters provide the most conservative comparison and have been adopted here to represent the worst-case change in noise levels.

As per Annex A of Appendix V4-3A:

- Differences in noise levels of less than approximately 2 dBA are generally imperceptible in practice, an increase of 2 dB is hardly perceivable.
- Differences in noise levels of around 5 dBA are considered to be significant.
- Differences in noise levels of around 10 dBA are generally perceived to be a doubling (or halving) of the perceived loudness of the noise. An increase of 10 dB is perceived as twice as loud. Therefore an increase of 20 dB is four times as loud and an increase of 30 dB is eight times as loud etc.

The comparison and evaluation via the indicative noise level difference thresholds above identifies that for the majority of the receptors assessed there will be no significant change in average noise levels based on the introduction of the Phase 2 construction, and Doris and Phase 2 operations.

For non-Project receptors identified in Table 3.5-6, a temporary short-term increase in noise could occur and would be more than 5 dB and the most affected locations. This increase in noise would be reduced with the successful implementation of the noise reducing measures agreed by TMAC and presented in this chapter such that a significant change in noise environment would only occur at the very closest receptors that are listed in Section 3.5.5 of this chapter, each of which are typically within the PDA.

For non-Project receptors identified in Table 3.5-7 to Table 3.5-12 a temporary medium-term increase in noise could also occur and would be more than 5 dB and the most affected locations. This increase in noise would be reduced with the successful implementation of the noise reducing measures agreed by TMAC and presented in this chapter such that a significant change in noise environment would only occur at the very closest receptors. The receptors listed in Section 3.5.5 of this chapter (each of which are typically within the PDA) are expected experience an increase of 10 dB or greater that may be perceived as twice as loud, or more. For Project receptors a significant change is likely in all cases however this is to be expected due to their Project involvement and close proximity to noise emission sources.

Any change in the acoustic environment due to aircraft noise, maximum noise events or due to blasting will be very short-term (noise, overpressure and vibration levels will immediately return to baseline levels after the event) and no further assessment is warranted.

3.5.4 Mitigation and Adaptive Management

The following section details mitigation and management measures designed to enhance Phase 2 Project benefits and reduce or eliminate negative effects. Mitigation measures involve taking a tangible action to avoid, minimize, or restore on-site or offset Phase 2 Project effects. Mitigation measures that are recommended to reduce an adverse effect are technically, environmentally, and economically feasible and aim to avoid, reduce, control, eliminate, offset, or compensate potential project effects. Consideration for noise and vibration effects has not yet been incorporated into the Phase 2 Project design such that the recommendations here are intended to provide guidance to assist minimise, mitigate, and/or manage potential adverse effects on the environment while systematically seeking to enhance positive effects. These recommended measures have been reviewed and confirmed acceptable by TMAC and will be incorporated into the Phase 2 Project design subsequent to this EIS.

The mitigation and management measures provided below are designed to reduce the noise and vibration levels generated by the Phase 2 Project and the overall noise footprint from the Hope Bay Project. As such, the measures are identical for each of the potential interaction and effect and are therefore presented by phase, rather than potential effect.

3.5.4.1 Mitigation by Project Design

Construction Phase Noise Mitigation and Management

Noise mitigation and management during the Construction phase should be focused on material handling sources, and on equipment or activities that are expected to generate the highest noise levels. Based on experience from other mine projects the following noise mitigation is defined, where feasible and reasonable to implement and enforce on site:

- Ensure equipment is fitted with appropriate mufflers and silencers.
- Use enclosures, berms, acoustic screening and shrouding where stationary sources requiring control are identified.
- Ensure equipment is well maintained.

With the successful implementation of these recommended mitigation and management measures a noise level reduction of 10 dBA (including low frequency noise emissions) may be achieved. This reduction applies to general construction noise assessed via the L_d, L_n and L_{dn} thresholds; however, a similar reduction may also be achieved for maximum (L_{max}) construction noise events. With the successful management of potential impulsive noise events, emissions that generate maximum noise levels can be avoided completely such that no adverse effects occur.

Operation Phase Noise, Blasting and Aircraft Mitigation and Management

Noise mitigation and management during the Operation phase should be focused on surface equipment associated with Phase 2 (i.e., mobile equipment such as dozers and excavators etc.), and fixed infrastructure for mining, milling, power generation, processing, and material handling (e.g., crushing) and transportation sources. Based on experience from other mine projects the following noise mitigation is defined, where feasible and reasonable to implement and enforce on site:

- Ensure equipment is fitted with appropriate mufflers and silencers;
- Use enclosures, berms, acoustic screening and shrouding where stationary sources requiring control (noise reduction at the source) are identified.
- Consider strategic placement of waste rock piles etc. to block plant sources.
- Optimise equipment placement within the underground mining areas as this can result in significant noise reductions, including low frequency noise emissions, for surface mining equipment e.g. for excavating and hauling waste rock, due to the shielding provided.
- Ensure equipment is well maintained.
- House stationary high noise emitting sources in buildings. This will target fixed milling, power generation, processing, and material handling (i.e., crushing) infrastructure and will consider potential low frequency noise emissions.
- Design haul roads to optimise the haulage route to avoid receptors, and to minimise the distance travelled which will reduce the overall noise generation.
- Schedule take-off and landing for aircraft to certain times of the day, and optimise flight paths to avoid adversely affected human and wildlife receptors.

With the successful implementation of these recommended mitigation and management measures a noise level reduction (including low frequency noise emissions) of 10 dBA may be achieved. This reduction applies to general operational and quarry noise assessed via the L_d, L_n, and L_{dn}

thresholds; however, a similar reduction may also be achieved for maximum (L_{max}) operational noise events. With the successful management of potential impulsive noise events, emissions that generate maximum noise levels can be avoided completely such that no adverse effects occur.

The effect of the noise and vibration mitigation measures defined above will be verified during a detailed design noise and blast assessment. The assessment will incorporate the features of the detailed mine design and will verify potential predicted noise, overpressure and vibration effects associated with Doris and Phase 2 mine operation. During this stage it may become necessary to prepare detailed noise contour mapping for the scenarios assessed to fully evaluate the extent of negative effects (if any) and define further remedial measures. This noise contour mapping will be documented in the detailed design noise and blast assessment if required.

3.5.4.2 Best Management Practices

The recommendations for construction noise, operational noise, blasting (overpressure and vibration) and aircraft noise mitigation and management measures described above should be implemented into the best mining practices established for Phase 2. These best mining practices can be incorporated into Phase 2 during the detailed design to eliminate, minimize, control, or reduce adverse effects on VECs. This is of particular relevance to the avoidance and optimisation recommendations provided for operational noise, blasting and aircraft noise, each of which is afforded the opportunity to eliminate emissions during the detailed design phase such that no adverse effects occur.

3.5.4.3 Noise Abatement Plan

In accordance with Section 9.4.15 of the EIS Guidelines (NIRB) a Noise Abatement Plan will be developed. It will provide information on monitoring and mitigating noise, overpressure and vibration levels and minimising potential impacts. It will be based the findings of this chapter and the Environmental Noise and Vibration Study Report (Appendix V4-3A). As a minimum the plan will discuss:

- applicable standards, guidelines and regulations that will be incorporated to minimize and mitigate noise effects from the Project;
- an environmental noise follow-up monitoring program indicating location, duration, timing and type of noise monitoring to be conducted;
- description of noise control methods based on the climatic conditions and available technologies to be employed should mitigation be required;
- measures and technologies to be adopted in the design and manufacturing of Project infrastructure and facilities to reduce noise;
- description of noise attenuation and minimization measures to be employed through choosing appropriate equipment, installation of noise silencing devices, scheduling of take-off and landing aircrafts, and blasting timing; and
- occupational related noise management programs.

The Noise Abatement Plan will be a living document that outlines the requirements for monitoring and mitigating noise, overpressure and vibration levels and minimising potential impacts. It will be developed in the early stages of the approvals process and will be updated as the Project design develops. The Noise Abatement Plan will be finalised prior to the final EIS being submitted.

3.5.4.4 Proposed Monitoring Plans and Adaptive Management

Checking and corrective action evaluates the predicted effects of the Phase 2 Project on receptors, and evaluates compliance. Evaluation of predicted effects should be conducted through facility-specific monitoring, quality control, and reporting procedures to assess the effectiveness of mitigation and management measures; identify Phase 2 Project effects requiring further mitigation efforts; comply with requests from regulators and stakeholders; and adapt to changes in the regulations or the Phase 2 Project.

The need for any corrective actions to on-site noise and vibration management or additional control measures should be determined on a case-by-case basis. Indications of the need for corrective actions or additional control measures may include monitoring data that shows an adverse effect on human or wildlife receptors and issues raised by on-site staff, regulators or local communities.

Following the detailed design of the Phase 2 Project a noise and blast monitoring program may be required to assess the magnitude of noise and vibration levels from Phase 2 activities. Noise and blast monitoring should be carried out (if required) by a qualified professional using a suitable measurement device/s e.g., sound level metre, noise logger or blast monitor. Noise and vibration levels should be monitored at representative locations were impacts are anticipated, post detailed design. The monitoring should capture suitable data to assess the effect of noise and vibration based on the thresholds identified here, including low frequency noise.

Monitoring may be required when equipment is first commissioned or perhaps on an annual basis but may not be required permanently. Overall the extent and schedule for monitoring (if required at all) should be confirmed following the detailed design of Phase 2.

3.5.5 Project-related Residual Effects

In summary the potential noise reduction anticipated for general construction noise, general operational noise and quarry noise will reduce noise effects to a moderate, low or negligible rating at most human and wildlife receptors. However, the closest and/or potentially most affected human and wildlife receptors are still likely to experience noise effects rated as moderate or high. Therefore, a residual effect is identified here and carried forward for additional characterization and a significance determination.

Those which are predicted to have high impacts are listed below:

- R_W081 and R_W322 from Table 3.5-6 as applicable to general Phase 2 construction noise.
- R_W049, R_W305, R_W144, R_W175, R_W354, R_W181, R_W216, R_W050, R_W282, R_W190 and R_H-W1 from Table 3.5-7 as applicable to general Doris operational noise.
- R_W081 and R_H-W3 from Table 3.5-8 as applicable to general Phase 2 operational noise (Years 6 to 10) and from Table 3.5-9 as applicable to general Phase 2 operational noise (Years 11 to 14).
- R_W081, R_H-W3, R_W049, R_W305, R_W144, R_W175, R_W354, R_W181, R_W216, R_W050, R_W282, R_W190 and R_H-W1 from Table 3.5-10 as applicable to general overall (Doris + Phase 2) operational noise (Years 6 to 10) and from Table 3.5-11 as applicable to general overall (Doris + Phase 2) operational noise (Years 11 to 14).
- R_W081 and R_W198 from Table 3.5-12 as applicable to general Phase 2 operational noise (Quarries).

The residual effects associated with construction and operational maximum noise (Table 3.5-13), aircraft noise (Tables 3.5-14 and 3.5-15) and blasting overpressure/vibration (Tables 3.5-16 and Table 3.5-17) are not easily estimated. However, all effects can be eliminated in full via management practices, rather than mitigation. As it is not possible to quantify the potential reduction associated with best management practices for blasting and aircraft emissions a residual effect is identified here and carried forward for additional characterization and a significance determination.

3.5.6 Characterization of Project-related Residual Effects

3.5.6.1 Definitions for Characterization of Residual Effects

The above mitigation and management measures incorporated into the Phase 2 Project design will reduce the potential for noise and vibration effects to occur. However, the potential for residual effects on local noise and vibration (as summarised above) still exists. A residual effect occurs where the proposed mitigation measures are not sufficient to eliminate the potential effect. Hence, after the application of mitigation measures, the following residual effects are predicted to occur for noise and vibration:

- Sleep disturbance (and annoyance, humans) — construction and operational noise levels (including aircraft) that exceed the night-time thresholds at the closest and most affected Project and non-Project receptor locations;
- Disturbance (wildlife) — construction and operational noise levels (including blasting and aircraft) that exceed the daytime and night-time thresholds at the closest and most affected receptor locations; and
- Habitat loss (wildlife) — construction and operational noise levels (including blasting and aircraft) that exceed the daytime and night-time thresholds at the closest and most affected receptor locations.

A **significant** residual effect is defined here to have high or moderate magnitude and occur outside the PDA. Effects may be sporadic or continuous and occur at all frequencies. Probability of the effect occurring is medium or high. A **not significant** residual effect is defined here to have a moderate or low magnitude, occur within the PDA and may occur at all frequencies and durations. Probability of the effect occurring may be low, medium or high.

3.5.6.2 Characterization of Residual Effect for Noise and Vibration

The characterization of these residual effects for noise and vibration are summarised in Tables 3.5-18 and 3.5-19.

Table 3.5-18. Summary of Residual Effects and Overall Significance Rating for Phase 2

Residual Effect	Attribute Characteristic						Overall Significance Rating		
	Direction *(positive, variable, negative)*	**Magnitude** *(negligible, low, moderate, high)*	**Duration** *(short, medium, long)*	**Frequency** *(infrequent, intermittent, continuous)*	**Geographic Extent** *(PDA, LSA, RSA, beyond regional)*	**Reversibility** *(reversible, reversible with effort, irreversible)*	**Probability** *(unlikely, moderate, likely)*	**Significance** *(not significant, significant)*	**Confidence** *(low, medium, high)*
Noise and Vibration (Human Receptors)									
Sleep disturbance	Negative	Low	Medium	Intermittent	LSA	Reversible	Moderate	Not Significant	Medium
Interference with speech communication	Negative	Low	Medium	Intermittent	LSA	Reversible	Moderate	Not Significant	Medium
Complaints	Negative	Negligible	Medium	Intermittent	PDA	Reversible	Moderate	Not Significant	Medium
High annoyance	Negative	Negligible	Medium	Intermittent	PDA	Reversible	Moderate	Not Significant	Medium

[1] *Discussion of the potential residual effects of noise and vibration on wildlife (disturbance and habitat loss) is given in the Terrestrial Wildlife and Wildlife Habitat chapter (Volume 4, Section 9).*

Table 3.5-19. Summary of Residual Effects and Overall Significance Rating for Hope Bay Project

Residual Effect	Attribute Characteristic						Overall Significance Rating		
	Direction *(positive, variable, negative)*	**Magnitude** *(negligible, low, moderate, high)*	**Duration** *(short, medium, long)*	**Frequency** *(infrequent, intermittent, continuous)*	**Geographic Extent** *(PDA, LSA, RSA, beyond regional)*	**Reversibility** *(reversible, reversible with effort, irreversible)*	**Probability** *(unlikely, moderate, likely)*	**Significance** *(not significant, significant)*	**Confidence** *(low, medium, high)*
Noise and Vibration (Human Receptors)									
Sleep disturbance	Negative	Low	Medium	Intermittent	LSA	Reversible	Moderate	Not Significant	Medium
Interference with speech communication	Negative	Low	Medium	Intermittent	LSA	Reversible	Moderate	Not Significant	Medium
Complaints	Negative	Negligible	Medium	Intermittent	PDA	Reversible	Moderate	Not Significant	Medium
High annoyance	Negative	Negligible	Medium	Intermittent	PDA	Reversible	Moderate	Not Significant	Medium

[1] *Discussion of the potential residual effects of noise and vibration on wildlife (disturbance and habitat loss) is given in the Terrestrial Wildlife and Wildlife Habitat chapter (Volume 4, Section 9).*

Characterization of Residual Effect for Sources

Further discussion regarding the characterization of residual effect for each source assessed is provided below.

- **General construction noise:** the residual effect of construction noise is deemed **not significant** as the successful implementation of the mitigation described here (or others that achieve similar noise level reductions) will reduce the probability of the effect occurring to low. The same status is deemed for construction maximum noise. The same status is deemed for Reclamation and Closure works.
- **General operational noise:** the residual effect of general operational noise is deemed **not significant** as the successful implementation of the mitigation described here (or others that achieve similar noise level reductions) will reduce the probability of the effect occurring to low. The same status is deemed for Years 6 to 10 and Years 11 to 14. The same status is deemed for operational maximum noise.
- **Aircraft Noise (Doris and Boston Airstrip):** the residual effect of aircraft noise is deemed **not significant** as the successful implementation of the recommendations described here (or others that achieve similar noise level reductions) will reduce the probability of the effect occurring to low.
- **General operational (Quarry) noise and blasting:** the residual effect of quarry noise and blasting overpressure and vibration is deemed **significant**. The successful implementation of the recommendations described here (or others that achieve similar noise level reductions) will reduce the magnitude and probability of the effect occurring but the probability of the effect occurring is medium or high.

3.6 CUMULATIVE EFFECTS ASSESSMENT

3.6.1 Methodology Overview

The assessment of cumulative effects followed the methodology outlined in the General Methodology Section (Volume 2, Section 4). The assessment consisted of the following steps:

- identification of the potential for Doris and Phase 2 Project residual effects to interact with the residual effects from other past, existing, or reasonably foreseeable future human activities and projects within the specified spatial and temporal boundaries;
- characterization of potential cumulative effects and the identification and description of additional mitigation measures for those potential effects;
- identifying the cumulative residual effects after the implementation of mitigation and management measures; and
- determining the significance of any cumulative residual effects, which will explicitly consider the portion of the residual effect from the Project contributing to the cumulative effect relative to other projects and activities.

The cumulative residual effects from interacting projects and activities may be created by additive or synergistic processes. An additive effect increases the effect in a linear fashion, whereas a synergistic effect may be greater than the sum of the contributing effects.

3.6.2 Potential Interactions of Residual Effects with Other Projects

Potential noise, overpressure or vibration effects are typically restricted to within 10 km of a source (i.e., construction or operational activities with the potential to generate nose, overpressure of vibration emissions).

As there are no present and future projects within 10 km of the Doris and Phase 2 PDA there is limited or no potential interaction of residual effects with other projects such that cumulative effects are unlikely to occur.

The only project within this 10 km geographic overlap is the existing Doris project which is located within the PDA and was considered in the previous assessment (Section 3.5).

Hence, there is no potential for a cumulative effect from noise and vibration on human and wildlife receptors. Potential cumulative effects are not assessed further.

3.7 TRANSBOUNDARY EFFECTS

The residual effect identified for noise and vibration from Doris and Phase 2 is expected to remain within the LSA, which is located within Nunavut. As such, no transboundary effects on noise are predicted.

3.8 IMPACT STATEMENT

Noise and vibration was included as a VEC for the EIS. A review of the potential Phase 2 Project interactions with noise and vibration identified six potential effects that may occur; four potential effects on humans and two potential effects on wildlife. These six potential effects are: sleep disturbance (humans), interference with speech communications (humans), complaints (humans), high annoyance (humans), loss of habitat (wildlife) and disturbance (wildlife). Three other potential effects on humans were considered but no potential Phase 2 Project interactions were identified; these were noise induced rattling (humans), noise induced hearing loss (humans), cosmetic and structural damage of buildings (humans).

The effects assessment included the identification of key indicators and thresholds for the evaluation of potential effects. The assessment described the mitigation and management activities planned to reduce or eliminate potential effects on noise and vibration and concluded that the potential effects could remain as residual effects after mitigation but would be unlikely with the successful implementation of mitigation and detailed design.

The residual effect of sleep disturbance, interference with speech communication, complaints and high annoyance on humans is predicted to be reduced to a low or negligible rating for the majority of the human receptors assessed. Only a very small number of receptors have the potential to experience moderate or high residual effects, and in most cases the probability of the effect occurring will be moderate but unlikely with the successful implementation of mitigation and detailed design.

Furthermore, noise and vibration levels may actually be lower than those predicted here for much of the time and, therefore, the potential negative effects are not expected to occur continuously. The effect is fully reversible as the noise levels will return to baseline levels as soon as the noise and vibration sources are removed. The effect is considered to be moderate (likelihood) and is expected to occur if the Phase 2 Project is developed in addition the existing Doris operation. The confidence in the effects occurring is medium as it is based on measured and modelled data but contingent on the successful implementation of the measures defined here. The overall significance of the residual effect

of sleep disturbance, interference with speech communication, complaints and high annoyance on humans is **not significant**.

Further discussion of the residual effects of noise and vibration on humans is provided in the Human Health and Environmental Risk Assessment (Volume 6, Section 5). Discussion of the potential residual effects of noise and vibration on wildlife (disturbance and habitat loss) is given in the Terrestrial Wildlife and Wildlife Habitat chapter (Volume 4, Section 9).

A cumulative effects assessment was conducted because a residual Project effect was predicted. The closest past, present and future project that could potentially interact with the Hope Bar Project is located outside the spatial boundary of the cumulative effects assessment and, hence, there are no potential cumulative effects on noise and vibration.

3.9 REFERENCES

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