5.4 Acoustic Environment

5.4.1 Introduction

The acoustic environment is a VC because activities during construction, operation, and decommissioning of the Project will generate noise. Noise is considered unwanted sound and has the potential to affect the health and well-being of humans. Noise levels are regulated by provincial guidelines. Federal guidance provides additional direction to manage the noise levels.

The quality of the acoustic environment is closely linked to other VCs: wildlife (Section 5.6), marine resources (Section 5.8), and human health (Section 9.2).

5.4.2 Scope of Assessment

5.4.2.1 Regulatory and Policy Setting

5.4.2.1.1 Municipal Codes

The only municipal noise code that is applicable within the study area is the town of Kitimat (under Part 9, Division 12, Subdivision 1). However, this code regulates noise generated by typical human activities (e.g., musical instruments, pets, power tools) and does not provide quantitative sound level limits for industrial activities. Thus, this assessment is based on provincial noise guidelines and federal guidance.

5.4.2.1.2 Provincial Guideline

Noise control guidelines for oil and gas activities in BC are specified in the OGC Noise Control Best Practices Guideline (BCOGC 2009). The OGC Noise Control Best Practices Guideline is a receptor-oriented regulation, which specifies allowable sound levels at designated receptor points (including residences). In the Guideline, a receptor is referred to as a dwelling unit, which can be any permanently or seasonally occupied residence with the exception of an employee residence or workforce accommodation centre located in an industrial facility boundary.

The OGC Noise Control Best Practices Guideline indicates that all new OGC regulated facilities, when operational, must meet a daytime (7 a.m. to 10 p.m.) and nighttime (10 p.m. to 7 a.m.) permissible sound level (PSL) at all receptors within 1.5 km of the Project fenceline. The determination of daytime and nighttime PSL at a receptor is a function of residential density and proximity to transportation. When there is no receptor within 1.5 km from the fence line, the daytime PSL is 50 dBA L_{eq} and nighttime PSL is 40 dBA L_{eq} at 1.5 km from the fence line. The Acoustic Environment TDR provides details on PSLs for noise receptors (Stantec Consulting Ltd. 2014). The Project's noise effect must be assessed cumulatively with approved operating OGC regulated facilities in the area of assessment.

The OGC Noise Control Guideline also addresses low frequency noise (LFN) concerns. There may be a LFN effect when the following two conditions are met:

- A clear tonal component exists at a frequency at or below 250 Hz, and
- The arithmetic difference between the overall C-weighted sound level and the overall A-weighted sound level exceeds 20 dB (i.e., dBC minus dBA is greater than 20 dB).

If either of these conditions is not met, the potential for a LFN effect is low.

The American National Standard ANSI 12.9 *Quantities and Procedures for Description and Measurement of Environmental Sound - Part 4: Noise Assessment and Prediction of Long-term Community Response* (ANSI 12.9 Part 4) place cautionary limits of 10 dB on the difference between the C-weighted and the A-weighted levels. In cases where the cautionary limits are not exceeded, potential adverse LFN effects are deemed as acceptable and no further assessment is required. When the cautionary limits are exceeded, the ANSI 12.9 Part 4 standard uses the threshold of 65 dB at 16 Hz, 31.5 Hz, and 63 Hz octave band centre frequencies. Generally, annoyance is minimal when the sound levels at the three midband frequencies are below the 65 dB.

The OGC Noise Control Guideline pertains only to operations and does not have defined noise level limits for construction and decommissioning activities. However, the Guideline requires that reasonable measures be implemented to limit noise from construction and decommissioning. The assessment uses the federal guidance (Section 5.4.2.1.3) to establish a noise level limit for construction and decommissioning activities.

5.4.2.1.3 Federal Guidance

The Project requires federal government review under the CEA Agency; therefore, noise guidance from Health Canada is applied.

Health Canada does not have a noise regulation and does not mandate specific noise limits. Instead, Health Canada's approach to noise assessment is based on a number of international standards and technical publications. Health Canada's *Useful Information for Environmental Assessments* document (Health Canada 2010) provides a brief summary of noise-induced health effects and recommendations for acceptable effects. This document and the technical standards and publications it references can be used as guidance for assessments.

The Health Canada guidance (Health Canada 2010) also has broader definitions of noise receptors than the OGC noise guideline. The following are considered as noise sensitive receptors in this assessment:

- First Nations communities
- workers' living quarters

- permanent and seasonal residences
- active and passive recreation areas
- commercial premises
- daycare centres
- places of worship and cemeteries
- senior residences
- schools, and
- hospitals.

The Health Canada guidance uses measureable parameters such as daytime or nighttime equivalent sound levels (L_d and L_n, respectively), adjusted day-night average sound levels (L_{dn}), and percent highly annoyed (%HA) to quantify noise effects.

The daytime sound level (L_d) is a 15-hour time average over the daytime period from 7 a.m. to 10 p.m. The nighttime sound level (L_n) is a 9-hour time average over the nighttime period from 10 p.m. to 7 a.m. The adjusted day-night average sound level (L_{dn}) is a 24-hour time-averaged L_{eq}, with a 10-dB penalty applied to nighttime hours and adjustments made for certain characteristics of sound such as tonality or impulsiveness.

Based on Health Canada guidance, the maximum allowable increase for change in %HA is 6.5%. Impulsive and tonal characteristics of source noise are accounted for with adjustments in the %HA calculations because their presence can increase the potential annoyance of sound.

If the change in %HA is exceeded, effects are considered to be of concern and may require mitigation. The Acoustic Environment TDR provides detailed descriptions of the Health Canada guidance (Stantec Consulting Ltd. 2014).

In BC, for provincially regulated workers, WorkSafeBC sets acceptable occupational exposure to noise. Health Canada does not provide advice on occupational exposure to noise. An indoor conservative sleep disturbance noise guidance of 30 dBA L_n from the World Health Organization (WHO) Night Noise Guidelines for Europe (2009) report can be used for construction workers.

The Health Canada guidance does not provide any method to assess potential adverse LFN effects.

5.4.2.2 Consultations' Influence on the Identification of Issues and the Assessment Process

Consultation with Aboriginal Groups and local community revealed concerns with Project-related noise. Key issues and concerns regarding the noise baseline studies were raised by Aboriginal Groups during stages 1 and 2 of the consultation activities. Feedback received from Aboriginal Groups, along with

learnings from other assessments in the area, resulted in changes to the noise baseline study program (Section 13.2.4, Table 13.2–14) and are also assessed in Section 14 as they relate to potential adverse effects on Aboriginal Interests.

Aboriginal Groups expressed interest in participating in baseline studies. As a result, the noise baseline studies included participation from Aboriginal Groups, including the Haisla Nation, Gitga'at First Nation, and Gitxaala Nation during the monitoring studies. Gitxaala Nation expressed concern that the LSA/RSA was inadequately scoped and requested that the boundaries be revised so that additional acoustic environment assessment sites may be included (Section 13.2.3, Table 13.2–16). In response to this feedback, additional assessment sites have been included.

Issues and concerns raised by the EAO Working Group members during the pre-application stage did not have any specific reference to noise.

5.4.2.3 Traditional Knowledge and Traditional Use Incorporation

TK and TU information was gathered from Project-specific studies submitted to LNG Canada and from publicly available sources. The available TK/TU information at the time of writing was used to inform the baseline conditions for this assessment. Haisla Nation, Gitxaala Nation, Gitga'at First Nation, Metlakatla First Nation, and Kitsumkalum First Nation provided Project-specific studies or reports from other projects to LNG Canada (Powell 2013; Calliou Group 2014; Crossroads Cultural Resource Management 2014; DM Cultural Services 2014; Satterfield et al. 2012).

In response to concerns raised during consultation with Gitxaala Nation (Section 13.2.3, Table 13.2–16), LNG Canada incorporated Gitxaala Nation's recommendations and included ten traditional use areas as noise sensitive receptors. Traditional use areas at locations such as Gil Island, Fin Island, Otter Channel, Anger Island, Banks Island (North), Banks Island (South), McCauley Island, Dolphin Island, Porcher Island, and Stephen Island were included as noise sensitive receptors in the assessment.

5.4.2.4 Selection of Effects

Most Project activities have the potential to emit noise. Two potential effects capture this issue: change (increase) in overall noise levels and increase in LFN during facility construction and operation.

5.4.2.5 Selection of Measurable Parameters

Table 5.4-1 lists the measurable parameters associated with change in the existing acoustic environment used to quantify the Project noise and LFN contribution. These parameters are compared with OGC and Health Canada noise guidance.

Table 5.4-1: Potential Effects on Acoustic Environment and Measurable Parameters

Potential Adverse Project Effects	Measurable Parameters
Change (increase) in overall noise levels	▪ Overall equivalent continuous A-weighted (dBA) daytime and nighttime sound level (L_d and L_n) ▪ A-weighted (dBA) daytime and nighttime equivalent sound level (L_{dn}) ▪ Percent highly annoyed (%HA)
Increase in LFN during facility construction and operation	▪ The difference between A-weighted and C-weighted (dBA and dBC) daytime sound level (L_d) ▪ The difference between A-weighted and C-weighted (dBA and dBC) nighttime sound level (L_n) ▪ Linear (dB) daytime and nighttime sound level (L_d and L_n)

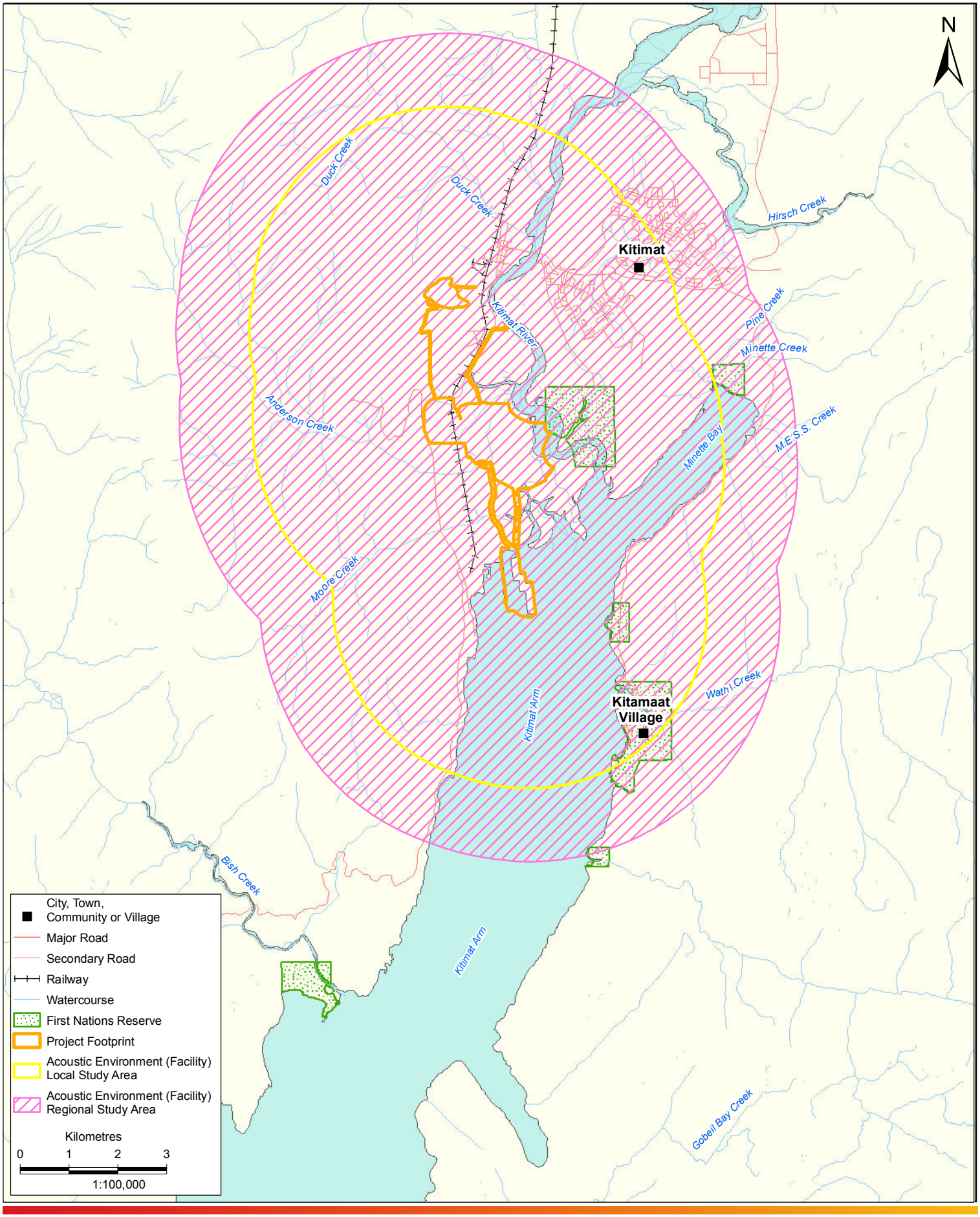
5.4.2.6 Boundaries

5.4.2.6.1 Spatial Boundaries

LSA—The OGC Noise Control Best Practices Guideline recommends that nighttime sound levels from industrial facilities not exceed 40 dBA at a distance of 1.5 km from the facility or at the nearest receptor, whichever is closer. To ensure acoustic emissions are fully characterized at various points of reception, the LSA for the facility is the area within 3.5 km of the LNG facility and for marine shipping, is within 2 km of the marine access route. The LNG facility includes the Project footprint and safety zones.

RSA—To encompass acoustic emissions that may emanate from surrounding facilities and interact with those from the Project, the RSA for the assessment of the acoustic environment extends 5 km from the LNG facility. Because of the noise limits established by the OGC Noise Control Guideline, acoustic emissions beyond this distance are not expected to result in cumulative effects. For marine shipping activities, the RSA will extend 5 km from the ship to either side of the marine access route. Some communities or receptors identified by First Nations near the marine access route are outside the RSA (e.g., Kitkatla, Metlakatla, Lax Kw'alaams) but will still be assessed.

Figure 5.4-1 and Figure 5.4-2 illustrates the spatial boundaries for this VC. Table 5.4-2 lists noise sensitive receptors and Figure 5.4-3 shows the receptor locations. Note that the noise sensitive receptors listed in Table 5.4-2 may differ from receptors identified for other VCs.



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ACOUSTIC ENVIRONMENTAL EFFECTS ASSESSMENT

ACOUSTIC ENVIRONMENT (FACILITY)
LOCAL AND REGIONAL STUDY AREAS

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
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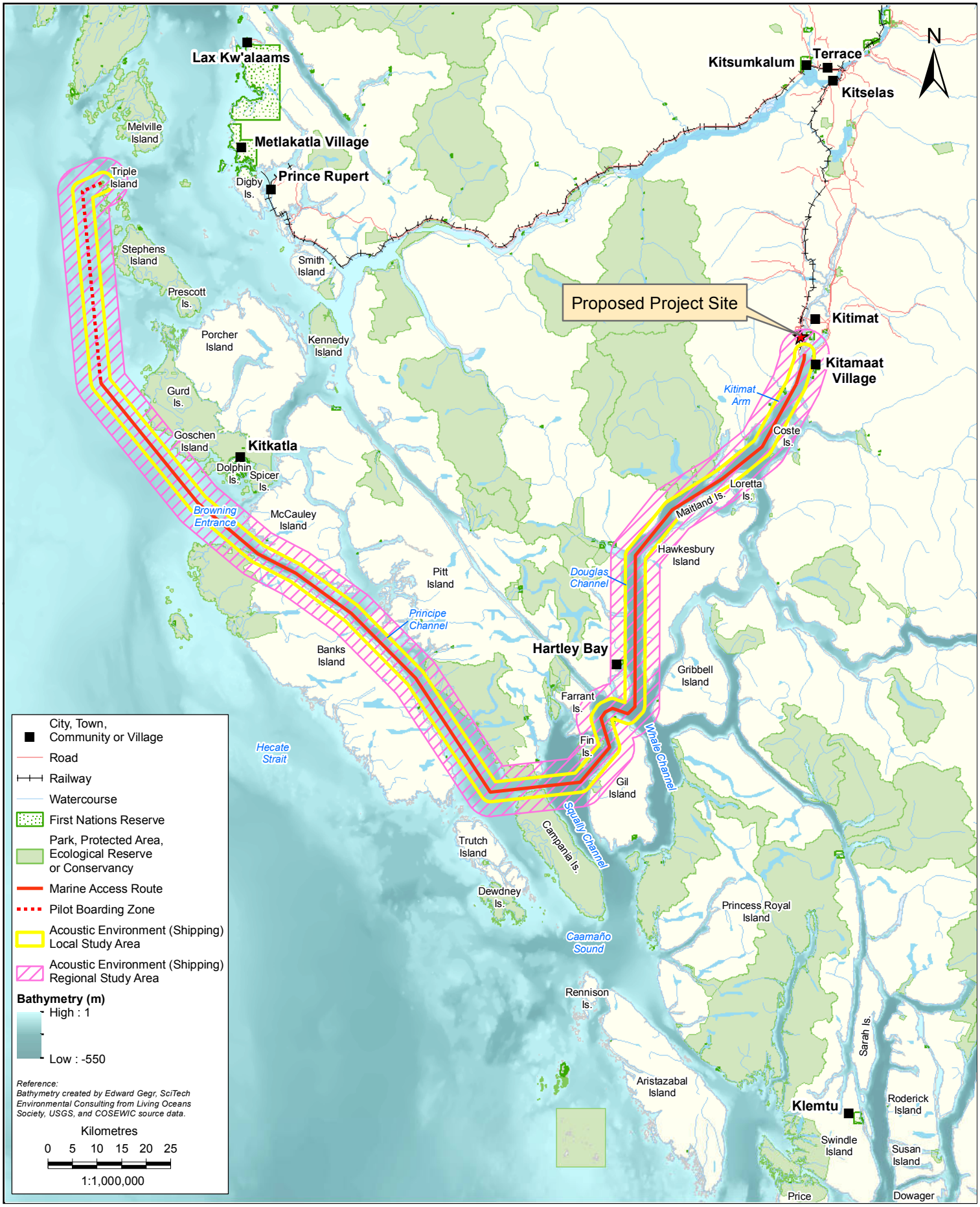

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ACOUSTIC ENVIRONMENTAL EFFECTS ASSESSMENT

ACOUSTIC ENVIRONMENT (SHIPPING) LOCAL AND REGIONAL STUDY AREAS

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
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Table 5.4-2: Noise Sensitive Receptors

Receptor ID	Description	Universal Transverse Mercator (UTM) Coordinates [a] (m)		In LSA, RSA, or Project Footprint	Approximate Distance from the Project Footprint or Marine Access Route (km)
		Easting	Northing		
R01	Kitimat rural residence	522873	5986436	LSA	1.6
R02	Kitimat residence	522055	5988455	LSA	2.0
R03	Kitimat cemetery	525535	5990120	RSA	5.6
R04	Kitimat City High School	521487	5989382	LSA	2.5
R05	Kitimat General Hospital	523026	5989089	LSA	3.1
R06	Kitimat Church of Latter Day Saints	521951	5988789	LSA	2.2
R07	Kitimat recreation area soccer field	522244	5988289	LSA	2.0
R08	Kitimat child care centre	523235	5989824	RSA	3.8
R09	Kitimat commercial premises	520340	5989694	LSA	2.6
R10	Project workforce accommodation centre	519328	5986729	LSA	0.1
R11	Kitamaat Village residence	523077	5981326	LSA	1.9
R12	Kitamaat Village childcare centre	523066	5980755	LSA	2.0
R13	Kitamaat Village school	523151	5980707	LSA	2.1
R14	Kitamaat Village church	522957	5980687	LSA	1.9
R15	Kitamaat Village health centre	523179	5980675	LSA	2.1
R16	Hartley Bay	483667	5919585	RSA	2.9
R17	Gil Island	481423	5908389	RSA	2.0
R18	Fin Island	478990	5902839	LSA	1.8
R19	Otter Channel	460900	5896173	RSA	3.2
R20	Anger Island	432995	5928312	LSA	1.9
R21	Banks Island (North)	404163	5943106	LSA	1.4
R22	McCauley Island	408572	5946470	RSA	3.0
R23	Kitkatla	405615	5961592	Outside RSA	12.1
R24	Metlakatla Village	406084	6021877	Outside RSA	33.2
R25	Lax Kw'alaams	407049	6045264	Outside RSA	46.5
R26	Banks Island (South)	440131	5914969	LSA	2.0
R27	Dolphin Island	404105	5957725	Outside RSA	8.6
R28	Porcher Island	391168	5966717	RSA	4.5
R29	Stephen Island	383278	6008718	Outside RSA	9.0

NOTES:
[a] UTM Zone 9 NAD 83

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ACOUSTIC ENVIRONMENTAL EFFECTS ASSESSMENT

NOISE RECEPTOR AND MONITORING STATION

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
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5.4.2.6.2 Temporal Boundaries

Based on the current Project schedule, the temporal boundaries are:

- construction, Phase 1 (trains 1 and 2) to be completed approximately five to six years following issuance of permits, the subsequent phase(s) (trains 3, 4) to be determined based on market demand
- operation, minimum of 25 years after commissioning, and
- decommissioning, approximately two years at the end of the Project life.

5.4.2.6.3 Administrative and Technical Boundaries

There are no administrative boundaries for noise and no applicable municipal requirements. There are no technical boundaries that are universally accepted. Technical boundaries associated with this assessment are primarily related to inherent uncertainties and assumptions associated with acoustic modelling.

5.4.2.7 Residual Effects Description Criteria

Table 5.4-3 lists residual effects description criteria used in the acoustic environment assessment.

Table 5.4-3: Characterization of Residual Effects for Acoustic Environment

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Characterization of Residual Effects		
Magnitude	The expected size or severity of effect. Low magnitude effects may have negligible to little effect, while high magnitude effects may have a substantial effect.	**Low** ▪ Operation and Construction: the noise effect is barely perceptible where the combined sound level will not exceed the baseline sound level by more than 3 dB. **Moderate** ▪ Operation and Construction: measurable change is perceptible, when the combined noise level exceeds the baseline sound level by more than 3 dB. **High** ▪ Operation: noise effect is perceptible and exceeds the OGC applicable criteria. ▪ Construction: noise effect is perceptible and exceeds the Health Canada applicable criteria.
Geographic Extent	The spatial scale over which the residual effects of the Project are expected to occur. The geographic extent of effects can be local or regional. Local effects may have a lower effect than regional effects.	**Project footprint**—effects are restricted to the Project footprint **LSA**—effects extend into the LSA **RSA**—effects extend into the RSA

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The length of time the residual effect persists. The duration of an effect can be short term or longer term.	**Short-term**—effect restricted to construction phase **Medium-term**—effect extends through operation phase **Long-term**—effect extends beyond closure **Permanent**—measurable parameter unlikely to recover to baseline
Frequency	How often the effect occurs. The frequency of an effect can be frequent or infrequent. Short-term and/or infrequent effects may have a lower effect than long-term and/or infrequent effects.	**Single event** — occurs once **Multiple irregular event (no set schedule)**— occurs sporadically at irregular intervals throughout construction, operation or decommissioning phases **Multiple regular event** —occurs on a regular basis and at regular intervals throughout construction, operation, or decommissioning phases **Continuous**—occurs continuously throughout the life of the Project
Reversibility	Whether or not the residual effect on the VC can be reversed once the physical work or activity causing the disturbance ceases. Effects can be reversible or permanent. Reversible effects may have lower effect than irreversible or permanent effects.	**Reversible**—will recover after Project closure and reclamation **Irreversible**—permanent
Context	Refers primarily to the sensitivity and resilience of the VC. Consideration of context draws heavily on the description of existing conditions of the VC, which reflect cumulative effects of other projects and activities that have been carried out, and information about the impact of natural and human-caused trends on the condition of the VC. Project effects may have a higher effect if they occur in areas or regions that have already been adversely affected by human activities (i.e., disturbed or undisturbed) or are ecologically fragile and have little resilience to imposed stresses (i.e., fragile)	**Low resilience—**low capacity for the VC to recover from a perturbation, with consideration of the baseline level of disturbance **Moderate resilience**—moderate capacity for the VC to recover from a perturbation, with consideration of the baseline level of disturbance **High resilience**—high capacity for the VC to recover from a perturbation, with consideration of the baseline level of disturbance.
Likelihood of Residual Effects		
Likelihood	Whether or not a residual effect is likely to occur	**Low—**low likelihood that there will be a residual effect. **Medium—**moderate likelihood that there will be a residual effect. **High—**high likelihood that there will be a residual effect.

5.4.2.8 Significance Thresholds for Residual Effects

An adverse residual effect on the acoustic environment is considered significant if there is an increase in overall noise levels or an increase in LFN during facility construction and operation such that the levels exceed the limits prescribed by OGC and the ANSI 12.9 Part 4 standard. The exceedance is quantified by measurable parameters described in Section 5.4.2.5.

5.4.3 Baseline Conditions

The existing ambient acoustic environment can be characterized as a combination of natural sounds and those generated by human activities in the area (anthropogenic noise). Human activities include rail traffic, aircraft flyovers, local business and industrial activities, and vehicular traffic on local roads. At the traditional use areas along the islands (i.e., Hartley Bay, Gil Island, Fin Island, Otter Channel, Anger Island, Banks Island, McCauley Island, Dolphin Island, Porcher Island, Stephen Island) with no industrial development, the acoustic environment is characterized primarily by sounds from nature, such as those originating from birds, insects, wind-generated noise from vegetation, rain, and waves, along with limited transient noises such as distant passing boats. In Aboriginal Group communities such as Hartley Bay, Kitamaat Village, Kitkatla, Metlakatla Village, and Lax Kw'alaams, the acoustic environment is influenced by local activities, marine traffic, aircraft flyovers, and natural sounds.

5.4.3.1 Baseline Data Sources

The OGC Noise Control Guideline advises that the average rural ambient sound level (ASL) is approximately 35 dBA L_{eq} during the nighttime periods. This value is based on research conducted in Alberta and set out in the AER Directive 038. The ASL at a given location is defined on the basis of population density (dwelling density) and proximity to transportation; it is set at 5 dB below the basic sound level (BSL) defined in the Table 1 of the OGC Guideline. For daytime periods, the ambient sound levels are set at 10 dB above those for nighttime periods.

In addition to the ASL, noise contribution from existing and approved facilities regulated by OGC is included in the determination of baseline sound level. The only other OGC regulated project in the RSA that has potential cumulative noise effect (see Section 5.4.8) is the Douglas Channel LNG (BC LNG) project. The BC LNG project is anticipated to be in operation during the construction phase of LNG Canada. To account for this, baseline sound levels include expected noise levels from the BC LNG project. These sound levels were developed based on assumptions made given Stantec experience with noise emission equipment associated with LNG projects.

In assessing the Project noise effects with respect to the Health Canada noise criteria, the baseline L_{dn} at each receptor or groups of receptors has to be established. Three baseline noise monitoring programs were conducted between June 2013 and February 2014 at six locations within the Project LSA: the town

of Kitimat (three locations), Kitamaat Village, Promise Island, and McCauley Island. Monitoring methods were consistent with the OGC Noise Control Guideline. The Kitamaat Village, Promise Island, and McCauley Island sites were selected in conjunction with Aboriginal Groups input. In addition, a First Nation technician was present at these three sites to assist with monitoring equipment setup. The selection of these sites was also constrained by factors such as security, access, and topography. For additional information regarding baseline data collection methods, refer to the Acoustic Environment TDR (Stantec Consulting Ltd. 2014).

5.4.3.2 Baseline Overview

The ASLs are determined for the residential noise sensitive receptors based on the OGC Noise Control Guideline and are summarized in Table 5.4-4. Some receptors in Table 5.4-2 are excluded from Table 5.4-4 because of their non-residential status (e.g., cemetery, recreation area). Details on how BSL is determined are presented in the Acoustic Environment TDR (Stantec Consulting Ltd. 2014). ASL and noise contribution from the approved BC LNG project at the residential receptors are required to determine the combined noise effect, which is compared to the OGC PSL for compliance.

Table 5.4-4: Ambient Sound Levels Based on OGC Basic Sound Level for Residential Receptors

Receptor ID	Description	BSL		ASL		BC LNG Noise Contribution	OGC Baseline Sound Level		
		L_d (dBA)	L_n (dBA)	L_d [3] (dBA)	L_d [3] (dBA)		L_d (dBA)	L_n (dBA)	L_{dn} (dB)
R01	Kitimat rural residence[1]	50	40	45	35	15	45.0	35.0	45.0
R02	Kitimat residence[2]	53	43	48	38	10	48.0	38.0	48.0
R05	Kitimat General Hospital[2]	53	43	48	38	10	48.0	38.0	48.0
R11	Kitamaat Village[2]	53	43	48	38	30	48.1	38.6	48.3
R16	Hartley Bay[2]	53	43	48	38	–	48.0	38.0	48.0
R17	Gil Island[1]	50	40	45	35	–	45.0	35.0	45.0
R18	Fin Island[1]	50	40	45	35	–	45.0	35.0	45.0
R19	Otter Channel[1]	50	40	45	35	–	45.0	35.0	45.0
R20	Anger Island[1]	50	40	45	35	–	45.0	35.0	45.0
R21	Banks Island (North)[1]	50	40	45	35	–	45.0	35.0	45.0
R22	McCauley Island[1]	50	40	45	35	–	45.0	35.0	45.0
R23	Kitkatla[2]	53	43	48	38	–	48.0	38.0	48.0
R24	Metlakatla Village[2]	53	43	48	38	–	48.0	38.0	48.0

Receptor ID	Description	BSL		ASL		BC LNG Noise Contribution	OGC Baseline Sound Level		
		L_d (dBA)	L_n (dBA)	L_d [3] (dBA)	L_d [3] (dBA)		L_d (dBA)	L_n (dBA)	L_{dn} (dB)
R25	Lax Kw'alaams[2]	53	43	48	38	–	48.0	38.0	48.0
R26	Banks Island (South)	50	40	45	35	–	45.0	35.0	45.0
R27	Dolphin Island	50	40	45	35	–	45.0	35.0	45.0
R28	Porcher Island	50	40	45	35	–	45.0	35.0	45.0
R29	Stephen Island	50	40	45	35	–	45.0	35.0	45.0

NOTE:
[1] OGC prescribed BSL for rural environment
[2] OGC prescribed BSL for area with population density between 9 to 160 dwelling per quarter section
[3] ASL is 5 dB below PSL as prescribed in the OGC noise guideline
– predicted level well below 0 dBA due the large distance between the receptor and the Project noise source

Results from baseline monitoring at the noise sensitive receptors are summarized in Table 5.4-5. The baseline L_{dn} levels for selected receptors are used as input in the Health Canada %HA calculations.

Table 5.4-5 Baseline Monitoring Results

ID	Monitoring Location Description	Monitoring Period	Daytime L_d (dBA)	Nighttime L_n (dBA)	Day-Night L_{dn} (dBA)
M1	Kitamaat Village residence	June 13–17, 2013	43.2	39.4	46.6
M2	Kitimat residence	June 13–16, 2013	46.9	41.3	49.1
M3	Kitimat residence	June 13–14, 2013	48.3	40.6	49.3
M4	Rural residence near Kitimat	June 15–17, 2013	39.9	40.2	46.6
M5	Promise Island, near Hartley Bay	October 3–10, 2013	47.7	39.0	48.3
M6	McCauley Island	February 4–8, 2014	44.9	43.9	50.4

NOTE:
Measurement results represent data that have been filtered from extraneous or non-representative events (i.e., field crew activities, rain, and high wind)

The L_{dn} at selected monitoring locations is used to approximate the baseline level at the noise sensitive receptors in the %HA determination. In addition to the measured baseline level, the noise contribution from the BC LNG project is included in the calculation of the combined baseline sound level. The baseline sound level used for %HA determination at each noise sensitive receptor is provided in Table 5.4-6.

Table 5.4-6: Baseline Sound Level Used in Determination of %HA

Receptor ID	Description	ASL		BC LNG	Combined Baseline Sound Levels		Baseline L_{dn} (dBA)	Reference
		L_d (dBA)	L_n (dBA)		L_d (dBA)	L_n (dBA)		
R01	Kitimat rural residence	39.9	40.2	15	39.9	40.3	46.6	M4[1]
R02	Kitimat residence	48.3	40.6	10	48.3	40.6	49.3	M4[2]
R03	Kitimat cemetery	48.0	38.0	–	48.0	38.0	48.0	OGC ASL[3]
R04	Kitimat City High School	48.0	38.0	10	48.0	38.0	48.0	OGC ASL[3]
R05	Kitimat General Hospital	48.0	38.0	10	48.0	38.0	48.0	OGC ASL[3]
R06	Kitimat Church of Latter Day Saints	48.0	38.0	10	48.0	38.0	48.0	OGC ASL[3]
R07	Kitimat recreation area soccer field	45.0	35.0	10	45.0	35.0	45.0	OGC ASL[3]
R08	Kitimat child care centre	48.0	38.0	5	48.0	38.0	48.0	OGC ASL[3]
R09	Kitimat commercial premises	48.0	38.0	10	48.0	38.0	48.0	OGC ASL[3]
R11	Kitamaat Village residence	43.2	39.4	30	43.4	39.9	47.0	M1[2]
R12	Kitamaat Village childcare centre	43.2	39.4	30	43.4	39.9	47.0	M1[2]
R13	Kitamaat Village school	43.2	39.4	30	43.4	39.9	47.0	M1[2]
R14	Kitamaat Village church	43.2	39.4	30	43.4	39.9	47.0	M1[2]
R15	Kitamaat Village health centre	43.2	39.4	30	43.4	39.9	47.0	M1[2]
R16	Hartley Bay	39.9	40.2	–	43.2	39.4	46.6	M1[2]
R17	Gil Island	48.3	40.6	–	45.0	35.0	45.0	OGC ASL[3]
R18	Fin Island	48.0	38.0	–	45.0	35.0	45.0	OGC ASL[3]
R19	Otter Channel	48.0	38.0	–	45.0	35.0	45.0	OGC ASL[3]
R20	Anger Island	48.0	38.0	–	45.0	35.0	45.0	OGC ASL[3]
R21	Banks Island (North)	48.0	38.0	–	45.0	35.0	45.0	OGC ASL[3]
R22	McCauley Island	45.0	35.0	–	44.9	43.9	50.4	M6[1]
R23	Kitkatla	48.0	38.0	–	43.2	39.4	46.6	M1[2]
R24	Metlakatla Village	48.0	38.0	–	43.2	39.4	46.6	M1[2]
R25	Lax Kw'alaams	45.0	35.0	–	43.2	39.4	46.6	M1[2]
R26	Banks Island (South)	48.0	38.0	–	45.0	35.0	45.0	OGC ASL [3]
R27	Dolphin Island	48.0	38.0	–	45.0	35.0	45.0	OGC ASL [3]
R28	Porcher Island	48.0	38.0	–	45.0	35.0	45.0	OGC ASL [3]
R29	Stephen Island	48.0	38.0	–	45.0	35.0	45.0	OGC ASL [3]

NOTES:

[1] Based on baseline measurement at the same location (see Table 5.4-5)

[2] Based on baseline measurement at a location with similar acoustic environment (see Table 5.4-5)

[3] Based on OGC prescribed ASL (see Table 5.4-4)

– predicted level well below 0 dBA because of the large distance between the receptor and the Project noise source

5.4.4 Project Interactions

Section 4, Table 4.4–1, identifies potential interactions of concern between Project activities and each of the selected VCs that are assessed. The potential effects identified in Section 5.4.2.4 that may result in an adverse effect as a result of interactions between Project activities and the acoustic environment are assessed. The extent to which the interactions will be considered is ranked in Table 5.4-7. The ranking categories (i.e., 0, 1, or 2) in Table 5.4-7 are defined in the footnote to the table.

Interactions with a meaningful degree of uncertainty are assigned Rank 2 so that a detailed effects assessment is conducted. Interactions with Rank 1 assignment will not be assessed.

Table 5.4-7: Potential Effects on Acoustic Environment

Project Activities and Physical Works	Potential Effects	
	Change in Overall Noise Level	Increase in LFN during Facility Construction and Operation
Facility Activities and Works		
Construction		
Site preparation (clearing, grubbing, grading, levelling, and set-up of temporary facilities)	2	2
Onshore construction (installation of LNG facility, utilities, ancillary support facilities, access roads, and includes hydrotesting)	2	2
Dredging (includes disposal)	2	2
Marine terminal construction (Modifications to existing wharf, installation of sheet piling, material offloading and laydown areas, transfer piping and electrical infrastructure)	2	2
Vehicle and rail traffic (haul road upgrades, road use, vehicle traffic)	1	1
Commissioning and start-up	1	1
Operation		
LNG production (including natural gas treatment, condensate extraction, storage, and transfer), storage, and loading	2	2
Vehicle and rail traffic (haul road upgrades, road use, vehicle traffic)	1	1
Decommissioning		
Dismantling of land-based and marine infrastructure	1	1
Remediation and reclamation of the site	1	1
Shipping		
Construction		
Shipping equipment and materials	1	1

Project Activities and Physical Works	Potential Effects	
	Change in Overall Noise Level	Increase in LFN during Facility Construction and Operation
Operation		
LNG shipping	2	2
Decommissioning		
Shipping equipment and materials	1	1

KEY:

0 = No interaction.

1 = Potential adverse effect requiring mitigation, but further consideration determines that any residual adverse effects will be eliminated or managed to negligible levels by existing codified practices, proven effective mitigation measures, or BMPs.

2 = Interaction may occur and the resulting effect may exceed acceptable levels without implementation of Project-specific mitigation. Further assessment is warranted.

NOTE: Only activities with an interaction of 1 or 2 for at least one effect are shown.

5.4.4.1 Justification of Interaction Rankings

Activities associated with waste management and decommissioning monitoring and follow-up are not expected to generate noise emissions that will affect the existing acoustic environment. These activities have been ranked as 0 (see Table 4.4-1 and Table 5.4-7) and are not carried forward in the assessment.

The noise effects from operation and construction activities ranked as 1 can be managed to acceptable levels using BMPs.

Interactions ranked as 1 include movement of construction-related vehicle and rail traffic. A Traffic Management Plan will be used to manage speed limits, shift changes and coordinated transport (i.e., bus), which will mitigate noise effects from construction-related vehicle traffic.

Shipping (transport of structures to and from the marine terminal) during the construction phase is ranked as 1. Construction-related marine shipping traffic will be scheduled to the daytime period, whenever possible, which should limit noise effects. For commissioning during the construction phase, the activities will be conducted during the daytime period, whenever possible, to limit noise effects.

Similarly to the construction phase, the noise effect from vehicle and rail traffic during operation phase can be managed to OGC and Health Canada threshold levels using BMPs.

Activities associated with decommissioning of marine and land-based structures are ranked 1. The quantity of equipment required for the decommissioning is expected to be well below the requirement for the construction phase, thus noise effects exceeding acceptable levels are not expected. Noise effects

during dismantling, site cleanup and reclamation activities can be managed to acceptable levels using BMPs and, as a result, no further assessment is warranted for interactions ranked as 1.

Activities ranked as 2 may result in noise effects that exceed acceptable levels without implementation of specified mitigation. Further assessment is warranted.

5.4.5 Assessment of Residual Effects from the Facility

5.4.5.1 Analytical Methods (Facility)

5.4.5.1.1 Analytical Assessment Techniques

The LNG facility includes the LNG processing facility and the marine terminal. During the operation phase, the LNG carrier approaches into the port of Kitimat are included in the assessment. Noise effects associated with the marine access route between Kitimat and Triple Island are considered in Section 5.4.6.

Potential noise effects during construction and normal operation of the facility are assessed based on the requirements of the OGC and Health Canada noise guidance as follows:

- define the LSA, RSA, and receptors
- establish the OGC ASL at residential receptors
- establish the baseline sound level at all noise sensitive receptors, based on the ambient noise monitoring results
- calculate the noise limits according to the OGC Noise Control Guideline and Health Canada guidance
- establish the sound level in the LSA, RSA, and at receptors from construction activities and normal operation activities by:
    - identifying noise emission sources from Project activities, and
    - characterizing these sources by their sound power levels using manufacturer's data, acceptable theoretical calculation methods, or similar equipment noise data from an archived database of measurements.
- assess compliance of the Project by comparing the modelled results to the applicable criteria.

If the modelled combined sound level is in compliance with applicable criteria, the noise effect is considered to be acceptable. Otherwise, mitigation measures are identified to manage the sound level so the noise effect complies with the established limits. Combined sound levels which include the ASL, existing regulated energy-related facilities, and the Project, are used in the assessment of compliance.

Methods for modelling sound propagation used in this assessment are prescribed by the International Organization for Standardization (ISO) Standard 9613 (ISO 1993, 1996), which are commonly applied and are accepted by OGC and Health Canada. The noise modelling used the latest version (4.3.143) of the Cadna/A software (DataKustik 2013), which incorporates ISO 9613 algorithms. Details on acoustic modelling are provided in the Acoustic Environment TDR (Stantec Consulting Ltd. 2014).

5.4.5.1.2 Assumptions and the Conservative Approach

Key Assumptions

The following assumptions are used in modelling sound level during construction activities:

- Pile installation activities will be planned to occur between the hours of 7 a.m. and 10 p.m. whenever possible (daytime period). If required, pile installation activities could occur outside of this time period; however, efforts will be made to limit piling activities outside of this period.

The following assumptions are considered conservative and used in modelling sound level during marine terminal operation:

- LNG carriers
  - LNG carrier capacity specification of 266,000 m^3, rated power of 20 MW to 46 MW, service speeds 18.5 knots to 20.5 knots (open water), and manoeuvering speed is 10 knots to 12 knots
  - two LNG carriers and two escort tugs at the same time (one in, one out)
  - LNG carrier berthing and deberthing time range from 1 to 2 hours, hotelling time 16 to 24 hours (worst case)
  - marine terminal will receive up to 350 LNG carriers per year, and
  - only one activity at the marine terminal at any given time (berthing or deberthing).
- Tug boats
  - diesel-powered tug boats and shore power for standby tugs
  - one tug will escort each LNG carrier to terminal
  - four tugs running during berthing and deberthing, and
  - manoeuvering speed of tug boats is 10 km/h.

Key Conservative Assumptions

The following assumptions are considered conservative approaches used in the noise assessment modelling:

- Tonality occurs in the noise emissions of most land-based mobile equipment during the construction phase (e.g., back-up alarm).

- In the predicted sound level for the daytime period during the construction phase, land-based and marine-based construction (including piling) and dredging occurs concurrently.
- Facility operates continuously during a 24-hour period at 100% throughput.

In addition to the assumptions stated above, the ISO 9613 model used for the noise assessment produces conservative results representative of worst case meteorological conditions that enhance sound propagation (e.g., downwind and temperature inversion conditions). These conditions do not occur all the time; thus, the modelling results are expected to be conservative. Detailed modelling assumptions are provided in the Acoustic Environment TDR (Stantec Consulting Ltd. 2014).

5.4.5.2 Assessment of Change in Overall Noise Levels and Low Frequency Noise

5.4.5.2.1 Description of Project Effect Mechanisms for Change in Overall Noise Levels and Low Frequency Noise

In the construction phase, noise emission from activities such as site preparation, onshore construction, dredging, and marine construction will result in a change in overall noise levels. The duration of the construction phase is expected to be approximately five to six years for Phase 1.

In the operation phase, noise emitted from the LNG processing facility, marine terminal, marine shipping, docking, and hotelling of LNG carriers might result in a change in overall noise levels. The operation phase is expected to last for a minimum duration of 25 years.

In the decommissioning phase, noise effects during dismantling of the LNG facility are expected to be lower than during the construction phase. Given the uncertainty around activities during decommissioning, the potential effects are assessed qualitatively.

5.4.5.2.2 Mitigation for Change in Overall Noise Levels and Low Frequency Noise

Construction

The following mitigation measures will be implemented to address noise effects during construction and decommissioning activities:

- Most construction activities, including pile installation, will be planned to occur between the daytime hours of 7 a.m. and 10 p.m. Night shifts will be required to complete specific activities or meet schedules (Mitigation 5.4-1).
- Vibro-hammer piling equipment will be considered for use where conditions permit for land-based piling operations (Mitigation 5.4-2).
- Fit gas or diesel engine exhausts with noise mufflers, where available (Mitigation 5.4-3).
- Rubber-wheeled equipment will be used instead of steel-tracked equipment, where practical (Mitigation 5.4-4).

- Construction equipment will be turned off when not in use, where practical, to minimize idling (Mitigation 5.4-5).
- Develop and implement a Traffic Management Plan (Mitigation 5.4-6).
- Equipment enclosure doors will be kept closed unless safe operations require otherwise (Mitigation 5.4-7).
- LNG Canada will develop a notification protocol with input from the local community and other stakeholders for advance notification of planned substantial noise-causing activities at the LNG facility (Mitigation 5.4-8).
- A process will be implemented to address all noise complaints in a timely manner (Mitigation 5.4-9).
- A Noise Management Plan will be developed and implemented (Mitigation 5.4-10).

Operation

A combination of the following mitigation measures will be implemented as needed to meet regulatory limits and to address potential noise effects during the operation phase:

- Regularly maintain all machinery and equipment to ensure that air and noise emissions are within range set by manufacturer when available (Mitigation 5.4-11).
- Ensure that project related noise generated during operation complies with the OGC Noise Control Best Practices Guidelines at sensitive receptor locations (Mitigation 5.4-12).
- Develop and implement a Traffic Management Plan (Mitigation 5.4-6).
- LNG Canada will develop a notification protocol with input from the local community and other stakeholders for advance notification of planned substantial noise-causing activities at the LNG facility (Mitigation 5.4-8).
- A Noise Management Plan will be developed and implemented (Mitigation 5.4-10).
- A process will be implemented to address noise complaints in a timely manner (Mitigation 5.4-9).

The operational sound levels listed in the Acoustic Environment TDR are the target overall facility sound power or acoustical specification used in the acoustic modelling, and it is assumed that these acoustical specifications can be achieved by the suppliers (Stantec Consulting Ltd. 2014). The goal is to achieve the required noise limits and that equipment will be acoustically treated if required.

A process will be implemented to address noise complaints in a timely manner (Mitigation 5.4-9). The OGC Noise Control Guideline provides a Noise Complaint Investigation Form (Appendix 2 of the guideline). For further reference, the Alberta provincial noise guideline (Alberta Utilities Commission Rule 012: Noise Control) provides a sample framework to handle noise complaints. The framework includes a general investigation procedure and sample investigation form.

5.4.5.2.3 Characterization of Change in Overall Noise Levels and Low Frequency Noise

5.4.5.2.3.1 Assessment Scenario

One construction phase scenario is assessed for the LNG facility, and one operation phase scenario is assessed for the LNG facility (Table 5.4-8). Details on noise sources used as inputs in the acoustic modelling are presented in the Acoustic Environment TDR (Stantec Consulting Ltd. 2014).

The noise assessment for construction considered land-based mobile equipment for the LNG facility. Construction activities are summarized in Table 5.4-8. The sound power level of a backup alarm (115 dB at 1,000 Hz) including the prominent Tone sound adjustment of 5 dB is added to the noise emission of selected land-based mobile equipment. In addition, the highly impulsive adjustment of 12 dBA is added to the piling equipment noise source.

There will be flaring noise emission during the startup phase; however, the event is expected to be temporary, short term, and intermittent. Flaring events during normal operation are not expected. The potential noise effects of temporary, short term, intermittent flaring events are assessed qualitatively.

Table 5.4-8: Noise Assessment Model Scenarios

Scenario	Timeline	Activity Description
Construction of trains 1 and 2 [a]	Approximately 6 years	▪ LNG facility area – site preparation ▪ Marine terminal – piling, dredging, and site preparation
Operation	Minimum of 25 years	▪ LNG processing facility ▪ Marine terminal ▪ LNG carrier approach between Kitamaat and the marine terminal. The approach between Kitamaat and Triple Island, through the Principe Channel, is considered in the assessment for shipping (Section 5.4.6)

NOTE:
[a] Construction of trains 3 and 4 will have similar noise emissions as trains 1 and 2 but not during the same time period.

Model Results

Table 5.4-9 and Table 5.4-10 summarize the predicted sound levels for construction and operation of the LNG processing facility and marine terminal. Receptors outside the Facility RSA (Figure 5.4-1) are not included in the assessment of the LNG processing facility. At distances greater than 5 km from the LNG processing facility and the marine terminal, noise from construction and operation activities will attenuate to a level that is well below the ambient sound level. These receptors (R16 to R25) will not be considered in the subsequent sections associated with the noise effects of the LNG facilities. Figure 5.4-4 and Figure 5.4-5 show daytime and nighttime predicted sound levels for construction. Figure 5.4-6 and Figure 5.4-7 show the daytime and nighttime predicted sound levels for operation. Detailed results are presented in the Acoustic Environment TDR (Stantec Consulting Ltd. 2014).

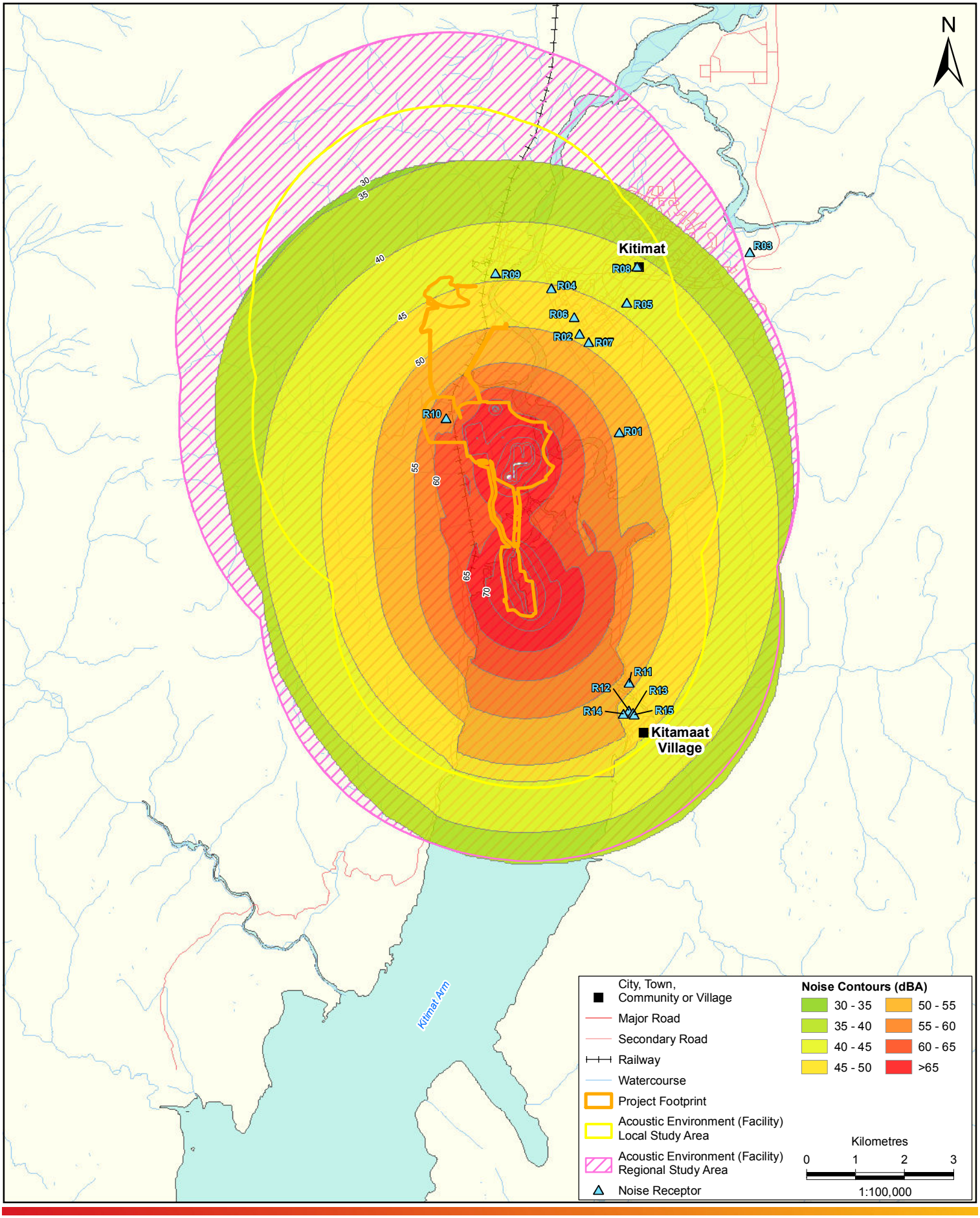
Table 5.4-9: Noise Modelling Results – Construction

ID	Receptor Description	Day L_d (dBA)[1]	Day L_d (dBC)[1]	Night L_n (dBA)	Night L_n (dBC)
R01	Kitimat rural residence	53.6	62.0	35.9	54.0
R02	Kitimat residence	49.0	59.7	36.1	54.0
R03	Kitimat cemetery	34.9	51.6	22.7	45.6
R04	Kitimat City High School	45.5	57.7	33.8	52.6
R05	Kitimat General Hospital	43.9	56.6	30.6	50.7
R06	Kitimat Church of Latter Day Saints	47.6	58.9	35.2	53.4
R07	Kitimat recreation area soccer field	49.4	59.8	36.0	53.9
R08	Kitimat child care centre	40.8	55.1	28.2	49.3
R09	Kitimat commercial premises	44.3	57.2	33.6	52.4
R10	Workforce accommodation centre	58.1	66.4	50.6	63.1
R11	Kitamaat Village residence	50.7	58.7	33.8	50.6
R12	Kitamaat Village childcare center	48.3	57.4	32.1	49.5
R13	Kitamaat Village school	47.7	57.1	31.7	49.3
R14	Kitamaat Village church	48.5	57.4	32.3	49.6
R15	Kitamaat Village health centre	47.5	57.0	31.5	49.2

NOTE:
[1] Construction phase activities such as piling will be conducted during daytime period only, whenever possible

Table 5.4-10: Noise Modelling Results – Operation

ID	Receptor Description	Day L_d (dBA)	Day L_d (dBC)	Night L_n (dBA)	Night L_n (dBC)
R01	Kitimat rural residence	36.6	56.3	36.5	56.0
R02	Kitimat residence	33.6	54.1	33.6	53.9
R03	Kitimat cemetery	20.6	44.5	20.6	44.5
R04	Kitimat City High School	30.3	50.5	30.3	50.5
R05	Kitimat General Hospital	28.4	49.4	28.4	49.4
R06	Kitimat Church of Latter Day Saints	32.2	51.7	32.2	51.7
R07	Kitimat recreation area soccer field	33.8	54.2	33.8	54.0
R08	Kitimat child care centre	25.8	47.9	25.8	47.9
R09	Kitimat commercial premises	29.4	50.0	29.4	50.0
R11	Kitamaat Village residence	28.5	56.9	27.9	56.3
R12	Kitamaat Village childcare centre	29.2	57.3	28.6	56.7
R13	Kitamaat Village school	28.8	57.1	28.3	56.5
R14	Kitamaat Village church	29.3	57.4	28.8	56.8
R15	Kitamaat Village health centre	28.7	57.0	28.2	56.4



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ACOUSTIC ENVIRONMENTAL EFFECTS ASSESSMENT

CONSTRUCTION PHASE (FACILITY)
DAYTIME NOISE LEVEL MODELLING RESULTS

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

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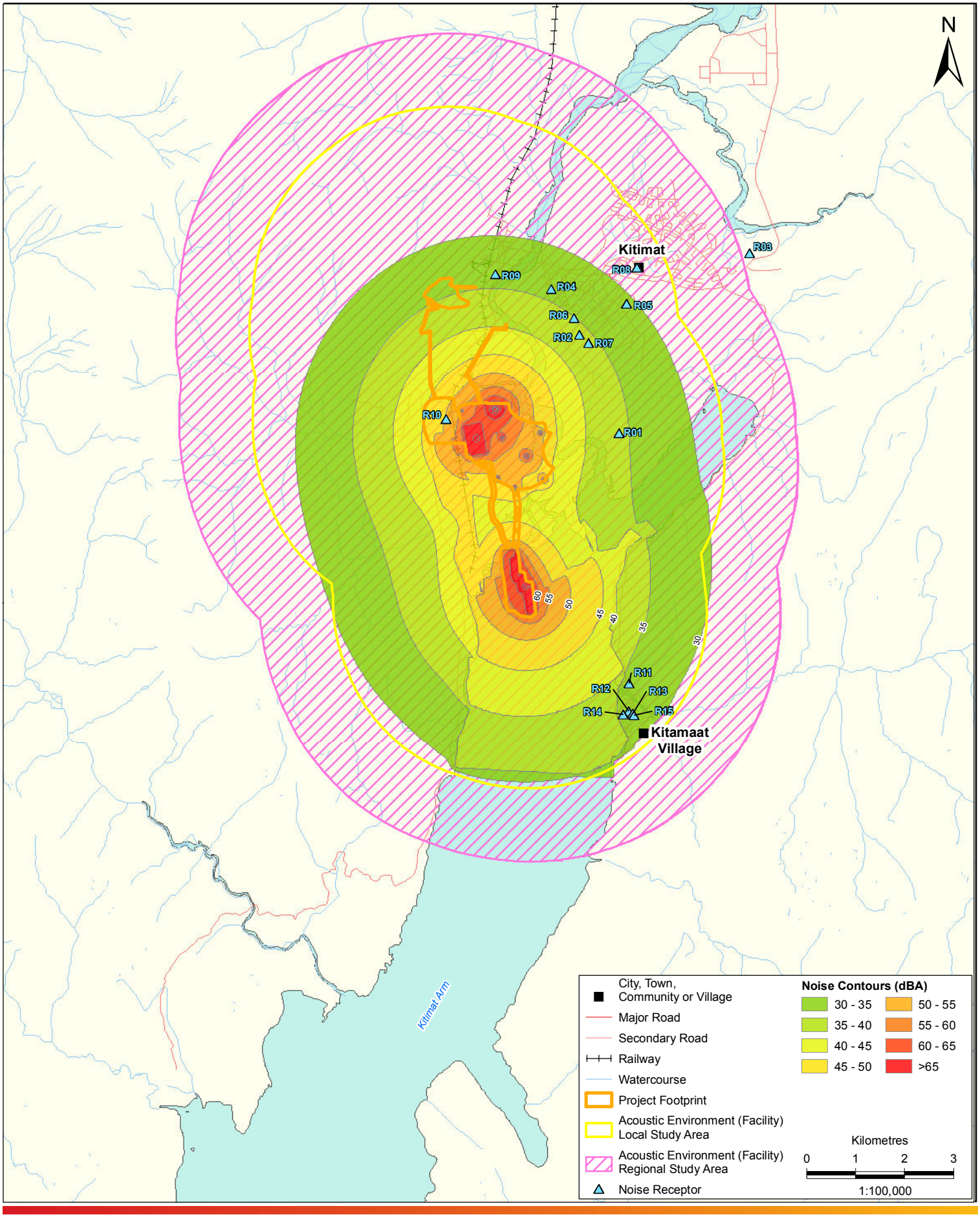

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ACOUSTIC ENVIRONMENTAL EFFECTS ASSESSMENT

CONSTRUCTION PHASE (FACILITY)
NIGHT TIME NOISE LEVEL MODELLING RESULTS

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

PROJECTION	DRAWN BY
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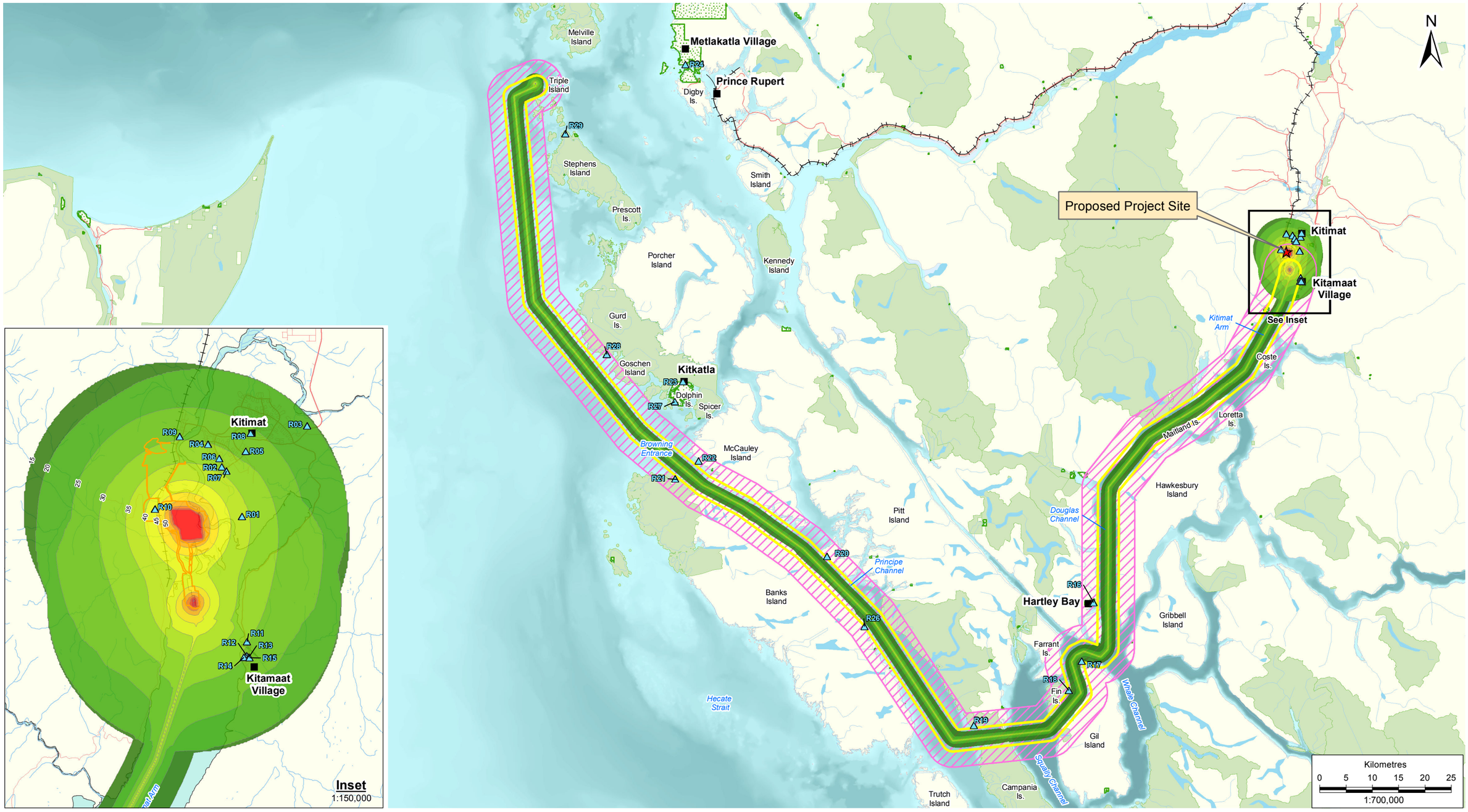

City, Town, Community or Village
Road
Railway
Watercourse
First Nations Reserve
Park, Protected Area, Ecological Reserve or Conservancy

Project Footprint
Acoustic Environment (Shipping) Local Study Area
Acoustic Environment (Shipping) Regional Study Area
Noise Receptor

Bathymetry (m)
High : 1
Low : -550

Reference:
Bathymetry created by Edward Gegr, SciTech Environmental Consulting from Living Oceans Society, USGS, and COSEWIC source data.

Noise Contours (dBA)

15 - 20	45 - 50
20 - 25	50 - 55
25 - 30	55 - 60
30 - 35	60 - 65
35 - 40	>65
40 - 45	

ACOUSTIC ENVIRONMENTAL EFFECTS ASSESSMENT

OPERATION PHASE DAYTIME NOISE LEVEL MODELLING RESULTS

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

Sources:

Stantec

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City, Town, Community or Village
Road
Railway
Watercourse
First Nations Reserve
Park, Protected Area, Ecological Reserve or Conservancy

Project Footprint
Acoustic Environment (Shipping) Local Study Area
Acoustic Environment (Shipping) Regional Study Area
Noise Receptor

Bathymetry (m)
High : 1
Low : -550

Reference:
Bathymetry created by Edward Gegr, SciTech Environmental Consulting from Living Oceans Society, USGS, and COSEWIC source data.

Noise Contours (dBA)

15 - 20	45 - 50
20 - 25	50 - 55
25 - 30	55 - 60
30 - 35	60 - 65
35 - 40	>65
40 - 45	

ACOUSTIC ENVIRONMENTAL EFFECTS ASSESSMENT

OPERATION PHASE NIGHT TIME NOISE LEVEL MODELLING RESULTS

LNG CANADA EXPORT TERMINAL
KITIMAT, BRITISH COLUMBIA

Sources:

Stantec

LNG CANADA
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5.4.5.2.3.2 Assessment of Compliance with OGC Noise Control Guideline

The assessment of compliance with the OGC Noise Control Guideline is performed for the operation phase only. OGC does not provide methodology or compliance criteria for construction noise assessment.

Table 5.4-11 lists modelling results for the operation phase and the ASL used in the combined sound level (noise effect) at the noise sensitive receptors.

The OGC recommends that the ASL of 35 dBA be used for receptors in rural areas to assess compliance with the Guideline. The Guideline recognizes that daytime ambient conditions are commonly 10 dB higher than nighttime levels. Therefore, the daytime ASL is set to 45 dBA. In cases where a receptor is located in higher population density or near transportation routes, the ASL is adjusted higher.

Receptors R02 and R05 are classified as Category 1 proximity to transportation with a population density of 9 to 160 dwellings per quarter section. Based on Table 1 in the Guideline, the daytime and nighttime ASLs are set at 48 dBA and 38 dBA for the two receptors. Similarly to the ASL, the PSLs at a receptor depend on residential density and proximity to transportation. Additionally, the daytime PSLs are set at 10 dB above the nighttime values. Based on Section 2 in the Guideline, daytime and nighttime PSLs are 53 dBA L_{eq} and 43 dBA L_{eq} for R02 and R05.

Conservatively, all other residential receptors are classified as Category 1 proximity to transportation with a population density of 0 to 8 dwellings per quarter section. The daytime and nighttime ASLs are 45 dBA L_{eq} and 35 dBA L_{eq} for these receptors. The daytime and nighttime PSLs are 50 dBA L_{eq} and 40 dBA L_{eq} for these receptors.

The combined sound levels are determined by logarithmically adding the predicted sound level to the ASL for the daytime and nighttime periods. The highest combined sound level is 48.2 dBA at receptor R02, which complies with the OGC nighttime PSLs.

Table 5.4-11: Operation Phase Modelled Combined Sound Levels (Ambient plus Project) at Residential Receptors

ID	Modelled Sound Level from Operation Phase (dBA)		OGC Baseline Sound Level[1] (dBA)		Combined Sound Level (dBA)		OGC Permissible Sound Level (PSL) (dBA)		Meets OGC Noise Control Guideline Limit?
	Day Ld (dBA)	Night Ln (dBA)	Day Ld (dBA)	Night Ln (dBA)	Day Ld (dBA)	Night Ln (dBA)	Day Ld (dBA)	Night Ln (dBA)	
R01	36.6	36.5	45.0	35.0	45.6	38.8	50	40	Yes
R02	33.6	33.6	48.0	38.0	48.2	39.4	53	43	Yes
R05	28.4	28.4	48.0	38.0	48.0	38.5	53	43	Yes
R11	28.5	27.9	48.1	38.6	48.1	39.0	53	43	Yes

NOTE:
[1] Results from Table 5.4-4

5.4.5.2.3.3 Assessment of Compliance with Health Canada Noise Guidance

Table 5.4-12 summarizes modelling results and the calculated change in %HA at each receptor for the construction phase.

Table 5.4-12: Construction Phase Compliance with Health Canada Noise Limits

ID	Receptor Description	Day L_d (dBA)	Night L_n (dBA)	Day-Night L_{dn} (dBA)	Change in %HA	Change in %HA Exceeds Limit of 6.5%
R01	Kitimat rural residence	53.6	35.9	52.0	6.1	No
R02	Kitimat residence	49.0	36.1	48.1	0.7	No
R03	Kitimat cemetery	34.9	22.7	34.2	0.1	No
R04	Kitimat City High School	45.5	33.8	44.9	0.4	No
R05	Kitimat General Hospital	43.9	30.6	42.9	0.3	No
R06	Kitimat Church of Latter Day Saints	47.6	35.2	46.8	0.6	No
R07	Kitimat recreation area soccer field	49.4	36.0	48.4	1.1	No
R08	Kitimat child care centre	40.8	28.2	40.0	0.1	No
R09	Kitimat commercial premises	44.3	33.6	44.1	0.4	No
R10	Workforce accommodation centre	58.1	50.6	59.2	6.0	No
R11	Kitamaat Village residence	50.7	33.8	49.2	3.7	No
R12	Kitamaat Village childcare centre	48.3	32.1	46.8	0.7	No
R13	Kitamaat Village school	47.7	31.7	46.3	0.6	No
R14	Kitamaat Village church	48.5	32.3	47.0	0.7	No
R15	Kitamaat Village health centre	47.5	31.5	46.1	0.6	No

The change in %HA at all receptors is below the limit of 6.5%. Tonality and impulsiveness adjustment have been incorporated in the %HA analysis. A tonality adjustment of 5 dB (i.e., back-up alarm) is included in the noise emission of land-based mobile construction equipment with back-up alarm in the construction model. Piling installation is expected during the construction phase. The noise emission associated with the typical piling operation is considered highly impulsive. The impulsive sound adjustment of 12 dB is applied to the piling equipment noise sources in all construction models. An option to utilize a vibro-hammer will be considered for the land-based piling operation where geotechnical conditions permit. The noise emission characteristic from the vibro-hammer operation is not considered impulsive.

The change in %HA limit does not apply to the workforce accommodation centre(s). A sleep disturbance conservative guidance of 30 dBA indoor nighttime L_{eq} can be used for the workforce accommodation centre(s). Considering the outdoor predicted nighttime sound level of 50 dBA (see Table 5.4-9), the

workforce accommodation centre(s) sleeping quarter structure will be designed to meet the indoor noise limit of 30 dBA during nighttime period. This can be achieved with a combination of standard wall construction, forced ventilation system (i.e., avoid the need to open windows) and strategic positioning of sleeping quarters (i.e., located further from construction noise sources). .

Table 5.4-13 presents a summary of modelling results for the operation phase. The change in %HA at all receptors is below the limit of 6.5%.

Table 5.4-13: Operation Phase Compliance with Health Canada Noise Limits

ID	Receptor Description	Day L_d (dBA)	Night L_n (dBA)	Day-Night L_{dn} (dBA)	Change in %HA	Change in %HA Exceeds Limit of 6.5
R01	Kitimat rural residence	36.6	36.5	42.9	1.1	No
R02	Kitimat residence	33.6	33.6	40.0	0.1	No
R03	Kitimat cemetery	20.6	20.6	27.0	0.0	No
R04	Kitimat City High School	30.3	30.3	36.7	0.1	No
R05	Kitimat General Hospital	28.4	28.4	34.8	0.0	No
R06	Kitimat Church of Latter Day Saints	32.2	32.2	38.6	0.1	No
R07	Kitimat recreation area soccer field	33.8	33.8	40.2	0.2	No
R08	Kitimat child care centre	25.8	25.8	32.2	0.0	No
R09	Kitimat commercial premises	29.4	29.4	35.8	0.1	No
R11	Kitamaat Village residence	28.5	27.9	34.4	0.2	No
R12	Kitamaat Village childcare centre	29.2	28.6	35.1	0.1	No
R13	Kitamaat Village school	28.8	28.3	34.8	0.0	No
R14	Kitamaat Village Church	29.3	28.8	35.3	0.1	No
R15	Kitamaat Village health centre	28.7	28.2	34.7	0.0	No

5.4.5.2.3.4 Low Frequency Noise

Table 5.4-14 and Table 5.4-15 summarize the LFN assessment results for the construction and operation phases.

OGC and Health Canada both advise that potential adverse LFN effects should be assessed. The assessment is based on an evaluation of the difference between the C-weighted and A-weighted sound levels, the overall C-weighted sound levels, and presence of low frequency tones at the residential receptors. OGC place cautionary limits (e.g., OGC = 20 dB) on the difference between the C-weighted and the A-weighted levels. When the actual difference exceeds the cautionary limit, further evaluation is recommended. Under the OGC noise guideline, the evaluation considers low frequency tones. If no low

frequency tonality is present or expected, potential adverse LFN effects are deemed as acceptable even if the cautionary limit is exceeded.

The ANSI 12.9 standard is used to assess potential LFN effects once the difference between the C-weighted and A-weighted Project noise levels exceeds the 20 dB cautionary limit. The ANSI 12.9 standard assigns acceptable limits on noise (65 dB) in 16 Hz, 31.5 Hz and 63 Hz octave bands. When the cautionary limits are not exceeded, potential adverse LFN effects are deemed as acceptable and no further assessment is required. Generally, annoyance is minimal when octave-band sound pressure levels are less than 65 dB at 16 Hz, 31.5 Hz, and 63 Hz mid-band frequencies. If the predicted sound level exceeds 65 dB at any one of the 16Hz, 31.5Hz and 63 Hz band, the resulting overall dBC level will exceed 65 dBC. A conservative equivalent single number threshold to the aforementioned limits at 16 Hz, 31.5 Hz, and 63 Hz is provided by the 65 dBC level.

During the construction phase, 3 out of 15 receptors exceed the OGC cautionary limits of a 20 dB difference between the C-weighted and A-weighted sound levels (Table 5.4-14). However, no low-frequency tonality is expected to be associated with the construction activities, and the overall C-weighed levels are below the 65 dBC level for all receptors with the exception of receptor R10. The predicted daytime level at the nearest proposed Project workforce accommodation centre location (R10) is 66.4 dBC, exceeding the 65 dBC level. However, the predicted linear sound levels at R10 are 61.5 dB and 63.1 dB at the octave band frequencies of 31.5 Hz and 63 Hz, respectively, which are below the threshold of 65 dB as recommended by the ANSI 12.9 standard.

During the operation phase, 12 out of 15 receptors exceed the OGC cautionary limit of a 20 dB difference between the C-weighted and A-weighted sound levels (Table 5.4-15). However, no low-frequency tonality is expected to be associated with the operation activities, and the overall C-weighed levels are below the 65 dBC level all receptors.

There is no information available for the LFN effect from the BC LNG project. Using a conservative approach, the 20 dB C-weighted and A-weighted difference is added to the A-weighted results presented in Table 5.4-6. Using this approach, the highest C-weighted level noise contribution is 50 dBC (i.e., 30 dBA + 20) at the receptor Kitamaat Village residence (R11). This estimated level is well below the threshold of 65 dBC. Cumulatively, the combined C-weighted difference from the BC LNG project and the Project at R11 is 60.1 dBC, which is below the threshold of 65 dBC. Therefore, LFN noise effects from the approved BC LNG project alone or acting cumulatively with those of the Project are not expected at any of the receptor locations.

Table 5.4-14: Construction Phase Low Frequency Noise Analysis

ID	Receptor Description	Daytime		Nighttime		Exceed OGC Limit of 20 dB	LFN Tonality	Exceed Equivalent Threshold of 65 dBC	LFN Issue?
		dBC	dBC-dBA[1]	dBC	dBC-dBA[1]				
R01	Kitimat rural residence	62.0	8.4	54.0	18.1	No	No	No	No
R02	Kitimat residence	59.7	10.7	54.0	17.9	No	No	No	No
R03	Kitimat cemetery	51.6	16.7	45.6	22.9	Yes	No	No	No
R04	Kitimat City High School	57.7	12.2	52.6	18.8	No	No	No	No
R05	Kitimat General Hospital	56.6	12.7	50.7	20.1	Yes	No	No	No
R06	Kitimat Church of Latter Day Saints	58.9	11.3	53.4	18.2	No	No	No	No
R07	Kitimat recreation area soccer field	59.8	10.4	53.9	17.9	No	No	No	No
R08	Kitimat child care centre	55.1	14.3	49.3	21.1	Yes	No	No	No
R09	Kitimat commercial premises	57.2	12.9	52.4	18.8	No	No	No	No
R10	Nearest proposed workforce accommodation centre location	66.4	8.3	63.1	12.5	No	No	No	No
R11	Kitamaat Village residence	58.7	8	50.6	16.8	No	No	No	No
R12	Kitamaat Village childcare centre	57.4	9.1	49.5	17.4	No	No	No	No
R13	Kitamaat Village school	57.1	9.4	49.3	17.6	No	No	No	No
R14	Kitamaat Village church	57.4	8.9	49.6	17.3	No	No	No	No
R15	Kitamaat Village health centre	57.0	9.5	49.2	17.7	No	No	No	No

NOTE:
[1] A-weighted results from Table 5.4-9.

Table 5.4-15: Operation Phase Low Frequency Noise Analysis

ID	Receptor Description	Daytime		Nighttime		Exceed OGC limit of 20 dB	LFN Tonality	Exceed Health Canada Derived Threshold of 65 dBC	LFN Issue?
		dBC	dBC-dBA	dBC	dBC-dBA				
R01	Kitimat rural residence	56.3	19.7	56.0	19.5	No	No	No	No
R02	Kitimat residence	54.1	20.5	53.9	20.3	Yes	No	No	No
R03	Kitimat cemetery	44.5	23.9	44.5	23.9	Yes	No	No	No
R04	Kitimat City High School	50.5	20.2	50.5	20.2	Yes	No	No	No
R05	Kitimat General Hospital	49.4	21	49.4	21	Yes	No	No	No
R06	Kitimat Church of Latter Day Saints	51.7	19.5	51.7	19.5	No	No	No	No
R07	Kitimat recreation area soccer field	54.2	20.4	54.0	20.2	Yes	No	No	No
R08	Kitimat child care centre	47.9	22.1	47.9	22.1	Yes	No	No	No
R09	Kitimat commercial premises	50.0	20.6	50.0	20.6	Yes	No	No	No
R10	Workforce accommodation centre	58.6	15	58.6	15	No	No	No	No
R11	Kitamaat Village residence	56.9	28.4	56.3	28.4	Yes	No	No	No
R12	Kitamaat Village childcare centre	57.3	28.1	56.7	28.1	Yes	No	No	No
R13	Kitamaat Village school	57.1	28.3	56.5	28.2	Yes	No	No	No
R14	Kitamaat Village church	57.4	28.1	56.8	28	Yes	No	No	No
R15	Kitamaat Village health centre	57.0	28.3	56.4	28.2	Yes	No	No	No

NOTE:
[1]. A-weighted results from Table 5.4-9.

5.4.5.2.3.5 Measurable Change from Baseline Level

Daytime and nighttime sound levels are compared with the baseline sound levels in Table 5.4-16 and Table 5.4-17. The results indicate that the Project construction noise levels are above the baseline sound level at most receptor during the daytime and below the baseline noise level at all receptors during the nighttime. The operation noise level is below (i.e., negative value) the baseline sound level at all receptor locations.

Table 5.4-16: Comparison to Baseline Level – Construction Noise Effect

ID	Receptor Description	Baseline [1] L_d (dBA)	Baseline [1] L_n (dBA)	Construction [2] L_d (dBA)	Construction [2] L_n (dBA)	Difference between Construction Noise Effect and Baseline Level [3] (dB)
R01	Kitimat rural residence	39.9	40.2	53.6	35.9	13.7
R02	Kitimat residence	48.3	40.6	49.0	36.1	0.7
R03	Kitimat cemetery	48.0	38.0	34.9	22.7	-13.1
R04	Kitimat City High School	48.0	38.0	45.5	33.8	-2.5
R05	Kitimat General Hospital	48.0	38.0	43.9	30.6	-4.1
R06	Kitimat Church of Latter Day Saints	48.0	38.0	47.6	35.2	-0.4
R07	Kitimat recreation area soccer field	45.0	35.0	49.4	36.0	4.4
R08	Kitimat child care centre	48.0	38.0	40.8	28.2	-7.2
R09	Kitimat commercial premises	48.0	38.0	44.3	33.6	-3.7
R11	Kitamaat Village residence	43.2	39.4	50.7	33.8	7.5
R12	Kitamaat Village childcare centre	43.2	39.4	48.3	32.1	5.1
R13	Kitamaat Village school	43.2	39.4	47.7	31.7	4.5
R14	Kitamaat Village church	43.2	39.4	48.5	32.3	5.3
R15	Kitamaat Village health centre	43.2	39.4	47.5	31.5	4.3

NOTES:

1. Based on the results presented in Table 5.4-6
2. Based on the results presented in Table 5.4-9
3. Maximum difference between the Project operation noise effect and baseline sound level. As an example, the baseline and operation noise effect at receptor R1 is 13.7 and -4.3 dB for daytime and nighttime, respectively. The maximum value of 13.7 is presented.

Table 5.4-17: Comparison to Baseline Level – Operation Noise Effect

ID	Receptor Description	Baseline [1] L_d (dBA)	Baseline [1] L_n (dBA)	Operation [2] L_d (dBA)	Operation [2] L_n (dBA)	Difference between Operation Noise Effect and Baseline Level [3] (dB)
R01	Kitimat rural residence	39.9	40.2	36.6	36.5	-3.3
R02	Kitimat residence	48.3	40.6	33.6	33.6	-7.0
R03	Kitimat cemetery	48.0	38.0	20.6	20.6	-17.4
R04	Kitimat City High School	48.0	38.0	30.3	30.3	-7.7
R05	Kitimat General Hospital	48.0	38.0	28.4	28.4	-9.6
R06	Kitimat Church of Latter Day Saints	48.0	38.0	32.2	32.2	-5.8
R07	Kitimat recreation area soccer field	45.0	35.0	33.8	33.8	-1.2
R08	Kitimat child care centre	48.0	38.0	25.8	25.8	-12.2
R09	Kitimat commercial premises	48.0	38.0	29.4	29.4	-8.6
R11	Kitamaat Village residence	43.2	39.4	28.5	27.9	-11.5
R12	Kitamaat Village childcare centre	43.2	39.4	29.2	28.6	-10.8
R13	Kitamaat Village school	43.2	39.4	28.8	28.3	-11.1
R14	Kitamaat Village church	43.2	39.4	29.3	28.8	-10.6
R15	Kitamaat Village health centre	43.2	39.4	28.7	28.2	-11.2

NOTES:

1. Based on the results presented in Table 5.4-6
2. Based on the results presented in Table 5.4-10
3. Maximum difference between the Project operation noise effect and baseline sound level. As an example, the baseline and operation noise effect at receptor R1 is -3.7 and -3.3 dB for daytime and nighttime, respectively. The maximum value of -3.3 is presented.

5.4.5.2.4 Determination of Significance for Change in Overall Noise Level and LFN

During the construction and operation phases of the LNG facility, residual effects are adverse because the sound level in the LSA is expected to increase compared with the existing acoustic environment.

The magnitude of residual effects is based on criteria in Table 5.4-3. The predicted sound levels at a receptor are compared with the OGC regulatory limits and Health Canada guidance as follows:

- during construction, compared with Health Canada noise guidance for %HA and LFN (Table 5.4-12 and Table 5.4-14); during operation, compliance with the OGC noise guideline for PSL and LFN criteria (Table 5.4-11 and Table 5.4-15), and
- during operation, compliance with the Health Canada noise guidance for %HA (Table 5.4-13).

The magnitude of residual effects during construction and operation for each receptor are summarized in Table 5.4-18 and Table 5.4-19. All effects are low in magnitude.

Table 5.4-18: Construction Phase Magnitude Classification

ID	Description	Meets Health Canada Change in %HA Limit	Measureable Change Perceptible	Meets LFN Guidance	Magnitude
R01	Kitimat rural residence	Yes	Yes	Yes	Moderate
R02	Kitimat residence	Yes	No	Yes	Low
R03	Kitimat cemetery	Yes	No	Yes	Low
R04	Kitimat City High School	Yes	No	Yes	Low
R05	Kitimat General Hospital	Yes	No	Yes	Low
R06	Kitimat Church of Latter Day Saints	Yes	No	Yes	Low
R07	Kitimat recreation area soccer field	Yes	Yes	Yes	Moderate
R08	Kitimat child care centre	Yes	No	Yes	Low
R09	Kitimat commercial premises	Yes	No	Yes	Low
R10	Workforce accommodation centre	n/a	No	Yes	Low
R11	Kitamaat Village residence	Yes	Yes	Yes	Moderate
R12	Kitamaat Village childcare centre	Yes	Yes	Yes	Moderate
R13	Kitamaat Village school	Yes	Yes	Yes	Moderate
R14	Kitamaat Village church	Yes	Yes	Yes	Moderate
R15	Kitamaat Village health centre	Yes	Yes	Yes	Moderate

Table 5.4-19: Operation Phase Magnitude Classification

ID	Description	Meets OGC PSL	Meets Health Canada Change in %HA Limit	Measureable Change Perceptible	Meets LFN Guidance	Magnitude
R01	Kitimat rural residence	Yes	Yes	No	Yes	Low
R02	Kitimat residence	Yes	Yes	No	Yes	Low
R03	Kitimat cemetery	N/A	Yes	No	Yes	Low
R04	Kitimat City High School	N/A	Yes	No	Yes	Low
R05	Kitimat General Hospital	N/A	Yes	No	Yes	Low
R06	Kitimat Church of Latter Day Saints	N/A	Yes	No	Yes	Low
R07	Kitimat recreation area soccer field	N/A	Yes	No	Yes	Low
R08	Kitimat child care centre	N/A	Yes	No	Yes	Low
R09	Kitimat commercial premises	N/A	Yes	No	Yes	Low
R11	Kitamaat Village residence	Yes	Yes	No	Yes	Low
R12	Kitamaat Village childcare centre	N/A	Yes	No	Yes	Low
R13	Kitamaat Village school	N/A	Yes	No	Yes	Low
R14	Kitamaat Village church	N/A	Yes	No	Yes	Low
R15	Kitamaat Village health centre	N/A	Yes	No	Yes	Low

NOTE:
N/A Not applicable

The geographic extent of residual effects is local for all receptors, except the effects at four receptors (R08, R12, R13, and R15) that are considered regional because the noise effect extends beyond the LSA into the RSA. The timing and frequency of exposure is continuous during the construction and operation phases. Duration of Project residual effects during construction and operation is considered medium term. The residual effect from the noise emitting activities is reversible and will cease once the activities have been completed or after the decommissioning phase.

Significance thresholds for residual effects on the acoustic environment are summarized in Section 5.4.2.8. These thresholds rely on compliance with regulatory limits and noise guidance. With mitigation, noise effects from construction and operation of the LNG facility will comply with provincial noise guidelines and federal guidance. Therefore, residual effects, and an increase in LFN during all phases of the Project, are not significant.

5.4.5.3 Summary of Project Residual Effects from the LNG Facility

With mitigation, noise effects from construction and operation of the LNG processing facility and marine terminal will comply with the provincial noise guideline and federal noise guidance. Therefore, residual effects are assessed as not significant.

5.4.6 Assessment of Residual Effects from Shipping

5.4.6.1 Analytical Methods (Shipping)

5.4.6.1.1 Analytical Assessment Techniques

The analytical methods for the assessment of the marine access route are similar to the methods presented in Section 5.4.5.1. The assessment considers noise effects along the marine access route between Kitimat and Triple Island. Details on acoustic modelling are provided in the Acoustic Environment TDR (Stantec Consulting Ltd. 2014). The assessment of underwater acoustic effects from shipping is addressed in Section 5.8.

5.4.6.1.2 Assumptions and the Conservative Approach

Key Assumptions

Assumptions for the marine shipping operation are presented in Section 5.4.5.1 because the LNG carrier and tug boat operation near the marine terminal are considered in the LNG facility assessment. The following additional assumptions are considered conservative and were used in modelling noise effects resulting from marine shipping activities:

- LNG carriers may move simultaneously in the channel (one in, one out).
- LNG carriers will always travel between Triple Island and Kitimat with an escort tug.
- LNG carrier movement along the channel takes approximately 13 hours, assumes 4 hours during daytime period and 9 hours during nighttime period.
- Three tug boats will be at the marine terminal to berth the LNG carrier.

Additionally, the ISO 9613 model used for the assessment produces conservative results representative of worst case meteorological conditions that enhance the sound propagation (e.g., downwind and temperature inversion conditions). These conditions do not occur all the time; thus, modelling results are expected to be conservative.

Detailed modelling assumptions are provided in the Acoustic Environment TDR (Stantec Consulting Ltd. 2014).

5.4.6.2 Assessment of Change in Overall Noise Levels

5.4.6.2.1 Description of Project Effect Mechanisms for Change in Overall Noise Levels

During operation, noise emitted from the LNG carriers between Kitimat and Triple Island might result in a change in overall noise levels.

5.4.6.2.2 Mitigation for Change in Overall Noise Levels

Marine vessels are assumed to be equipped with standard exhaust stacks which include standard silencers in acoustic modelling. No Project specific mitigation measures are required to meet regulatory limits during the operation phase.

5.4.6.2.3 Characterization of Change in Overall Noise Levels

5.4.6.2.3.1 Assessment Scenario

One operation phase scenario is assessed for marine shipping (Table 5.4-20) along the marine access route between Triple Island and Kitimat. Noise effects from the LNG carrier and tug boat operation within the facility RSA are included in the LNG facility noise assessment (Section 5.4.5) because of the cumulative nature of noise effects in the facility RSA.

Details on noise sources used as inputs in the acoustic modelling are provided in the Acoustic Environment TDR (Stantec Consulting Ltd. 2014).

Table 5.4-20: Noise Assessment Model Scenarios

Scenario	Timeline	Activity Description
Operation	Minimum of 25 years	The approach between Triple Island and Kitimat through Principe Channel

5.4.6.2.3.2 Model Results

Table 5.4-21 summarizes the predicted sound levels for marine shipping activities at selected receptors from Table 5.4-2 . Receptors within the RSA of the Project facility (i.e., R01 to R15) are not presented here because the noise effects from shipping at these receptors are considered in Section 5.4.5. Figure 5.4-6 and Figure 5.4-7 present the operation phase results for daytime and nighttime predicted sound levels. Detailed results are presented in the Acoustic Environment TDR (Stantec Consulting Ltd. 2014).

Table 5.4-21: Shipping Noise Modelling Results

ID	Receptor Description	Day L_d (dBA)	Night L_n (dBA)
R16	Hartley Bay	9.7	14.7
R17	Gil Island	17.2	22.2
R18	Fin Island	14.8	19.7
R19	Otter Channel	11.0	16.0
R20	Anger Island	11.4	16.4
R21	Banks Island (North)	10.7	15.7
R22	McCauley Island	9.3	14.3
R23	Kitkatla	–	–
R24	Metlakatla Village	–	–
R25	Lax Kw'alaams	–	–
R26	Banks Island (South)	12.3	17.3
R27	Dolphin Island	-	-
R28	Porcher Island	6.9	11.9
R29	Stephen Island	-	-

NOTE:
– predicted project effects noise level well below 0 dBA because of the large distance between the receptor and the Project noise source

5.4.6.2.3.3 Comparison to OGC Noise Control Guideline

Table 5.4-22 lists modelling results for the operation phase and the ASL used in the combined sound level (noise effect) at the noise sensitive receptors. Conservatively, all First Nations traditional land use areas (i.e., R17, R18, R19, R20, R21, R22, R26, R27, R28, and R29) are considered as residential receptors. All receptors comply with the OGC daytime and nighttime PSLs.

Table 5.4-22: Modelled Combined Sound Levels (Ambient plus Project) at Residential Receptors

ID	Modelled Sound Level from Operation Phase (dBA)		Ambient Sound Level (dBA)		Combined Sound Level (dBA)		OGC Permissible Sound Level (PSL) (dBA)		Meets OGC Noise Control Guideline Limit?
	Day L_d (dBA)	Night L_n (dBA)	Day L_d (dBA)	Night L_n (dBA)	Day L_d (dBA)	Night L_n (dBA)	Day L_d (dBA)	Night L_n (dBA)	
R16	9.7	14.7	48	38	48.0	38.0	53	43	Yes
R17	17.2	22.2	45	35	45.0	35.2	50	40	Yes
R18	14.8	19.7	45	35	45.0	35.1	50	40	Yes
R19	11.0	16.0	45	35	45.0	35.1	50	40	Yes
R20	11.4	16.4	45	35	45.0	35.1	50	40	Yes
R21	10.7	15.7	45	35	45.0	35.1	50	40	Yes
R22	9.3	14.3	45	35	45.0	35.0	50	40	Yes
R23	–	–	48	38	48.0	38.0	53	43	Yes
R24	–	–	48	38	48.0	38.0	53	43	Yes
R25	–	–	48	38	48.0	38.0	53	43	Yes
R26	12.3	17.3	45.0	35.0	45.0	35.1	50	40	Yes
R27	-	-	45.0	35.0	45.0	35.0	50	40	Yes
R28	6.9	11.9	45.0	35.0	45.0	35.0	50	40	Yes
R29	-	-	45.0	35.0	45.0	35.0	50	40	Yes

NOTE:
– predicted project effects noise level well below 0 dBA due the large distance between the receptor and the Project noise source

Comparison to Health Canada Noise Guidance

Table 5.4-23 lists modelling results and calculated change in %HA at each receptor for marine shipping activities. The change in %HA at all receptors is below the limit of 6.5%.

Table 5.4-23: Operation Phase Shipping Activities Compliance with Health Canada Noise Limits

ID	Receptor Description	Day L_d (dBA)	Night L_n (dBA)	Day-Night L_{dn} (dBA)	Change in %HA	Change in %HA Exceeds Limit of 6.5%
R16	Hartley Bay	9.7	14.7	20.7	0	No
R17	Gil Island	17.2	22.2	28.2	0	No
R18	Fin Island	14.8	19.7	25.7	0	No
R19	Otter Channel	11.0	16.0	22.0	0	No
R20	Anger Island	11.4	16.4	22.4	0	No
R21	Banks Island (North)	10.7	15.7	21.7	0	No
R22	McCauley Island	9.3	14.3	20.3	0	No
R23	Kitkatla	–	–	–	0	No
R24	Metlakatla Village	–	–	–	0	No
R25	Lax Kw'alaams	–	–	–	0	No
R26	Banks Island (South)	12.3	17.3	23.3	0	No
R27	Dolphin Island	–	–	–	0	No
R28	Porcher Island	6.9	11.9	17.9	0	No
R29	Stephen Island	-	-	-	0	No

NOTE:
– predicted project effects noise level well below 0 dBA because of the large distance between the receptor and the Project noise source

5.4.6.2.3.4 Measurable Change from Baseline Level

Daytime and nighttime sound levels are compared with the baseline sound level in Table 5.4-6. The results in Table 5.4-24 indicate that the Project operation noise level is well below (i.e., negative value) the baseline sound level at all receptor locations. Therefore, the measurable change from baseline level is not expected to be perceptible.

Table 5.4-24: Comparison to Baseline Level - Operation Noise Effect Perceptibility

ID	Receptor Description	Baseline L_d (dBA)[1]	Baseline L_n (dBA)[1]	Operation L_d (dBA)[2]	Operation L_n (dBA)[2]	Difference between Operation and Baseline Level[3] (dB)
R16	Hartley Bay	43.2	39.4	9.7	14.7	-24.7
R17	Gil Island	45.0	35.0	17.2	22.2	-12.8
R18	Fin Island	45.0	35.0	14.8	19.7	-15.3
R19	Otter Channel	45.0	35.0	11.0	16.0	-19.0
R20	Anger Island	45.0	35.0	11.4	16.4	-18.6
R21	Banks Island (North)	45.0	35.0	10.7	15.7	-19.3
R22	McCauley Island	44.9	43.9	9.3	14.3	-29.6
R26	Banks Island (South)	45.0	35.0	12.3	17.3	-17.7
R28	Porcher Island	45.0	35.0	6.9	11.9	-23.1

NOTES:

1. Based on the results presented in Table 5.4-6
2. Based on the results presented in Table 5.4-21
3. Maximum difference between the Project operation noise effect and baseline sound level. As an example, the baseline and operation noise effect at receptor R16 is -34.3 and -25.5 dB for daytime and nighttime, respectively. The maximum value of -25.5 is presented.

5.4.6.2.4 Determination of Significance for Change in Overall Noise Level

During marine shipping, residual effects are adverse because the sound level in the shipping LSA is expected to increase compared with the existing acoustic environment.

The magnitude of residual effects is based on criteria described in Table 5.4-3. The predicted sound levels at a receptor are compared with the OGC PSL (Table 5.4-22), Health Canada change in %HA (Table 5.4-23), and baseline sound level (Table 5.4-24). The magnitude of residual effects at each receptor is summarized in Table 5.4-25. All residual effects are low in magnitude.

Table 5.4-25: Operation Phase Magnitude Classification

ID	Description	Meets OGC PSL?	Meets Health Canada Change in %HA?	Measureable Change Perceptible?	Magnitude
R16	Hartley Bay	Yes	Yes	No	Low
R17	Gil Island	Yes	Yes	No	Low
R18	Fin Island	Yes	Yes	No	Low
R19	Otter Channel	Yes	Yes	No	Low
R20	Anger Island	Yes	Yes	No	Low
R21	Banks Island (North)	Yes	Yes	No	Low
R22	McCauley Island	Yes	Yes	No	Low
R23	Kitkatla	Yes	Yes	No	Low
R24	Metlakatla Village	Yes	Yes	No	Low
R26	Banks Island (South)	Yes	Yes	No	Low
R27	Dolphin Island	Yes	Yes	No	Low
R28	Porcher Island	Yes	Yes	No	Low
R29	Stephen Island	Yes	Yes	No	Low

The geographic extent of residual effects is regional as the noise effect extends beyond the shipping LSA into the shipping RSA. The frequency of residual effects is a multiple regular event during marine shipping activities. Duration of effects is medium term. The residual effect from the noise emitting activities is reversible and will cease once the activities have been completed.

Residual effects from Project activities will be adverse for the existing acoustic environment within the shipping RSA and LSA. Marine shipping activities will result in low magnitude. This residual effect will occur at multiple regular frequencies during the operation phase. Based on past evidence, this residual effect will be reversible after the operation phase.

Significance thresholds used to assess residual effects on the acoustic environment are summarized in Section 5.4.2.8. The significance thresholds rely on compliance with the regulatory limits and noise guidance. With mitigation, noise effects from marine shipping activities comply with provincial noise guideline and federal noise guidance. Therefore, change in overall sound levels during marine shipping activities is not significant.

5.4.6.3 Summary of Project Residual Effects from Shipping

Noise effects from marine shipping activities are expected to comply with provincial noise guidelines and federal noise guidance. Therefore, residual effects on the acoustic environment during marine shipping are not significant.

5.4.7 Summary of Project Residual Effects

With mitigation, noise effects from construction and operation of the LNG processing facility and marine terminal and from marine shipping activities will comply with provincial noise guideline and federal noise guidance. Therefore, the residual effects of the Project in the facility LSA and shipping LSA are assessed as not significant. Table 5.4-26 summarizes the residual effects on the acoustic environment.

Table 5.4-26: Summary of Project Residual Effects: Acoustic Environment

Project Phase	Mitigation Measures	Residual Effects Rating Criteria						Likelihood of Residual Effects	Significance	Prediction Confidence	Follow-up and Monitoring
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context				
Facility Works and Activities											
Change (increase) in overall noise levels											
Construction	Mitigation 5.4-1 Mitigation 5.4-2 Mitigation 5.4-3 Mitigation 5.4-4 Mitigation 5.4-5 Mitigation 5.4-6 Mitigation 5.4-7 Mitigation 5.4-8 Mitigation 5.4-9 Mitigation 5.4-10 Mitigation 5.4-11 Mitigation 5.4-12	L to M	RSA	MT	MI	R	M	H	N	M	No follow-up programs are proposed for acoustic environment.
Operation		L	RSA	MT	C	R	M	H	N	M	
Decommissioning		L to M	RSA	MT	MI	R	M	H	N	M	
Residual effects for all phases		L	RSA	MT	MI/C	R	M	H	N	M	
Increase in low frequency noise during facility construction and operation											
Construction	Mitigation 5.4-1 Mitigation 5.4-2 Mitigation 5.4-3 Mitigation 5.4-4 Mitigation 5.4-5 Mitigation 5.4-6 Mitigation 5.4-7 Mitigation 5.4-8 Mitigation 5.4-9 Mitigation 5.4-10 Mitigation 5.4-11 Mitigation 5.4-12	L	RSA	MT	MI	R	M	H	N	M	No follow-up programs are proposed for acoustic environment.
Operation		L	RSA	MT	C	R	M	H	N	M	
Residual effects for all phases		L	RSA	MT	MI/C	R	M	H	N	M	

Project Phase	Mitigation Measures	Residual Effects Rating Criteria						Likelihood of Residual Effects	Significance	Prediction Confidence	Follow-up and Monitoring
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context				
Shipping Activities											
Change (increase) in overall noise levels and increase in low frequency noise during facility construction and operation											
Operation		L	RSA	MT	MR	R	M	H	N	M	No follow-up programs are proposed for acoustic environment.

KEY

MAGNITUDE:

L = Low

Operation and Construction: the noise effect is barely perceptible where the combined sound level will not exceed the baseline sound level by more than 3 dB

M = Moderate

Operation and Construction: measurable change is perceptible, when the combined noise level exceeds the baseline sound level by more than 3 dB

H = High

Operation: noise effect is perceptible and exceeds the OGC applicable criteria

Construction: noise effect is perceptible and exceeds the Health Canada applicable criteria

GEOGRAPHIC EXTENT:

Project footprint—effects are restricted to the Project footprint

LSA—effects extend into the LSA

RSA—effects extend into the RSA

DURATION:

ST = Short term—Effect restricted to construction phase

MT = Medium term—Effect extends through operation phase

LT = Long-term—Effect extends beyond closure

P = Permanent—measurable parameter unlikely to recover to baseline

FREQUENCY:

S = Single event—occurs once

MI = Multiple irregular event—no set schedule, occurs sporadically at irregular intervals throughout construction, operation or decommissioning phases

MR = Multiple regular event—occurs on a regular basis and at regular intervals throughout construction, operation, or decommissioning phases

C = Continuous—occurs continuously throughout the life of the Project

REVERSIBILITY:

R = Reversible—will recover after Project closure and reclamation

I = Irreversible—permanent

CONTEXT:

L = Low resilience—low capacity for the VC to recover from a perturbation, with consideration of the baseline level of disturbance

M = Moderate resilience—moderate capacity for the VC to recover from a perturbation, with consideration of the baseline level of disturbance

H = High resilience—high capacity for the VC to recover from a perturbation, with consideration of the baseline level of disturbance

SIGNIFICANCE:

S = Significant

N = Not Significant

PREDICTION CONFIDENCE:

Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation, and assumptions made.

L = Low level of confidence

M = Moderate level of confidence

H = High level of confidence

LIKELIHOOD OF RESIDUAL EFFECT OCCURRING:

Based on professional judgment

L = Low likelihood that there will be a residual effect

M = Moderate likelihood that there will be a residual effect

H = High likelihood that there will be a residual effect

5.4.8 Assessment of Cumulative Effects

Cumulative effects are considered for each Project residual effect. Three stages are involved: Stage 1 establishes context by providing an overview of the cumulative effects of other projects and activities on the acoustic environment; Stage 2 determines the potential for Project residual effects to interact with the effects of other projects and activities; and if the Project does interact cumulatively with other projects and activities, Stage 3 assesses the significance of the resulting overall cumulative effect and characterizes the Project's contribution to the change in cumulative effects.

5.4.8.1 Stage 1, Cumulative Effects Context

There are no cumulative noise effects from past physical works and activities because noise effects are reversible. The effects cease after the activities are completed.

The existing cumulative noise effects are characterized by a combination of residential, industrial, and commercial activities, and the natural environment. Section 5.4.3 provides information on the existing baseline acoustic environment in the facility RSA. The baseline noise level includes all the existing noise emission activities (i.e., residential, industrial, commercial, and natural environment) in the facility RSA. These existing noise emission activities included regulated or non-regulated projects.

An assessment of the potential cumulative effects was conducted for other regulated (i.e., OGC or NEB) projects and activities that have potential to interact with the Project. Approved projects from the OGC or NEB regulated facilities (i.e., BC LNG and Kitimat LNG projects) have been considered in the cumulative effects. Potential noise effects from some of the industrial and commercial activities that are not regulated by the OGC or the NEB are difficult to quantify due to a lack of public information. In addition, no quantitative noise limits are applicable to such activities. Therefore, these foreseeable non-regulated projects are not included in the cumulative assessment.

5.4.8.2 Stage 2, Determination of Potential Cumulative Interactions

The second stage, determination of whether Project noise effects have the potential to interact with the noise effects of other projects and activities, proceeds with an analysis of whether the following two conditions are met:

- The Project results in a demonstrable or measurable residual noise effect.
- The Project's residual effect on the acoustic environment does, or is likely to, act in a cumulative fashion with the effects of other past, existing or future projects and activities in the area (i.e., there is an overlap of effects).

If either of these conditions is not met, further assessment is not warranted—the Project does not have the potential to contribute to the cumulative effect being considered.

Table 5.4-27 indicates for each potential effect whether there is potential for the Project to contribute to cumulative effects on the acoustic environment (i.e., whether both of the first two conditions are met).

Table 5.4-27: Potential for Cumulative Effects on Acoustic Environment

Other Projects and Activities with Potential for Cumulative Effects	Potential Cumulative Effects			
	Increase in overall noise levels from the facility	Increase in overall noise levels from shipping	LFN effect from the facility	LFN effect from shipping
Kitimat Area Project/Facility				
Coastal GasLink Pipeline Project	✓			
Douglas Channel LNG Project (also known as BC LNG)	✓	✓	✓	✓
Enbridge Northern Gateway Project	✓	✓	✓	✓
Kitimat LNG Terminal Project	✓	✓	✓	✓
MK Bay Marina	✓		✓	
Pacific Northern Gas Pipeline (includes proposed looping)	✓		✓	
Pacific Trail Pipelines Project	✓		✓	
Rio Tinto Alcan Facility and Modernization Project	✓		✓	
Activities				
BC Ferries		✓		✓
Cruise Ships		✓		✓
Forestry Activities	✓	✓	✓	✓
Fishing and Aquaculture Activities	✓	✓	✓	✓

NOTES:
✓ **=** those 'other projects and activities' whose effects have potential to interact cumulatively with the Project's residual effects.

Noise effects from projects located outside the facility RSA are not expected to add cumulatively to residual effects from the Project because the geographic extent for Project residual effects is mostly limited to the facility LSA; noise is expected to attenuate to levels well below the background level within 5 km of their source.

Some projects are located inside the facility RSA; however, some noise sources (e.g., Coastal GasLink Titanium Peak compressor station) are located more than 5 km from any of the noise sensitive receptors included in this assessment. Therefore, noise is expected to attenuate to levels well below the background level. These projects are summarized as follows:

- Coastal GasLink Pipeline Project

- Enbridge Northern Gateway Project
- Kitimat LNG Terminal Project
- Pacific Northern Gas Pipeline (includes proposed looping), and
- Pacific Trail Pipelines Project.

There is no quantitative noise limit for some projects because they are not regulated by the OGC and Health Canada. These projects include the following:

- MK Bay Marina
- Rio Tinto Alcan Facility and Modernization Project

Noise effects from the existing MK Bay Marina and Rio Tinto Alcan operation have been included as part of the measured baseline sound level at selected receptors. Noise effects from Rio Tinto Alcan modernization project are expected to interact with the Project noise effects.

Shipping activities associated with several projects (e.g., Kitimat LNG Terminal, Enbridge Northern Gateway Project) may increase marine traffic along the Project marine access route. There is no information available to quantify the noise effects along the marine access route attributable to marine activities of these proposed projects. The highest predicted sound level at receptors along the marine access route is 20 dBA (see Table 5.4-21) during the nighttime period, which is 12.8 dB below the OGC nighttime ASL of 35 dBA. The cumulative noise effect of adding 22 dBA Project shipping noise effect to the ASL of 35 dBA is an increase of less than 0.25 dBA. The Project's contribution to cumulative noise effects is not expected to be significant (equal to or less than 0.25 dBA increase). If the shipping noise effects from the other three projects (i.e. BC LNG, Gateway, and Kitimat LNG) are available and added to the ASL of 35 dBA, the baseline noise level would likely be equal to or higher than the current value of 35 dBA. A higher baseline sound level would result in a lower Project noise effect. As an example, the cumulative shipping noise effects from the other three projects may result in a baseline noise level equal to the OGC noise threshold (i.e. 40 dBA). The cumulative effect of adding the Project shipping noise effect of 22 dBA to a baseline noise level of 40 dBA is a net increase of 0.08 dB, which is considerably less than the 0.25 dB net increase.

Reasonably foreseeable future regulated projects that have not been approved are not expected to be included for comparison with the OGC PSL threshold or Health Canada guidance. Potential noise effects from foreseeable future industrial and commercial activities that are not regulated by the OGC or the NEB are difficult to quantify due to a lack of public information. In addition, no quantitative noise limits are applicable to such activities. Therefore, these foreseeable non-regulated projects are not included in the cumulative assessment.

Noise effects from existing BC Ferries, cruise ships, forestry, fishing, and aquaculture activities have been included as part of the measured baseline sound level for selected receptors. Potential future activities may interact with Project noise effects. However, there is no available information to quantify the potential effects. These activities could possibly overlap either spatially or temporally with the noise effects of the Project.

The following three former projects are not expected to have any noise effects that will interact cumulatively with the Project:

- Eurocan Pulp and Paper Co. Site
- Methanex/Cenovus Terminal, and
- Moon Bay Marina (footprint only).

5.4.8.3 Stage 3, Determining Significance of Cumulative Effects

The BC LNG project's residual effects interact cumulatively with the Project's residual effects (With mitigation, noise effects from construction and operation of the LNG processing facility and marine terminal and from marine shipping activities will comply with provincial noise guideline and federal noise guidance. Therefore, the residual effects of the Project in the facility LSA and shipping LSA are assessed as not significant. Table 5.4-28 summarizes the residual effects on the acoustic environment.

Noise contributions from the BC LNG project have been considered in the combined baseline sound level predicted for noise sensitive receptors (see Table 5.4-4 and Table 5.4-6). The LFN noise effect from the BC LNG project has been considered in Section 5.4.5.2. The determination of significance considers cumulative noise effects including the BC LNG project. Similar to the conclusion presented in Section 5.4.7, the cumulative noise effects from the operation and construction of the LNG processing facility and marine terminal comply with provincial noise guideline and federal noise guidance. Therefore, cumulative effects are not significant.

5.4.8.4 Summary of Cumulative Effects

Residual effects on the acoustic environment from past and present OGC–regulated projects and activities in the facility RSA, in combination with those of the Project, will not overlap in such a way as to exceed OGC regulatory thresholds on a persistent basis. In addition, residual effects of reasonably foreseeable OGC–regulated projects and activities in the facility RSA, in combination with those of the Project, are expected to comply with regulatory guidelines. Cumulative effects are therefore predicted to be not significant.

Table 5.4-28: Summary of Cumulative Effects on Acoustic Environment

Effect	Other Projects, Activities and Actions	Cumulative Effects Characterization					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context
Facility Works and Activities [a]							
Cumulative change (increase) in overall noise levels							
Cumulative effect with the Project and other projects, activities, and actions Expected to comply with regulatory guidelines	▪ Coastal GasLink Pipeline Project ▪ Douglas Channel LNG Project (also known as BC LNG) ▪ Enbridge Northern Gateway Project ▪ Kitimat LNG Terminal Project ▪ Pacific Northern Gas Pipeline (includes proposed looping) ▪ Pacific Trail Pipelines Project	L	RSA	MT	MI/C	R	M
Contribution from the Project to the overall cumulative effect Expected to comply with regulatory guidelines.		L	LSA	MT	MI/C	R	M
Cumulative increase in low frequency noise during facility construction and operation							
Cumulative effect with the Project and other projects, activities, and actions Expected to comply with regulatory guidelines	▪ Coastal GasLink Pipeline Project ▪ Douglas Channel LNG Project (also known as BC LNG) ▪ Enbridge Northern Gateway Project ▪ Kitimat LNG Terminal Project ▪ Pacific Northern Gas Pipeline (includes proposed looping) ▪ Pacific Trail Pipelines Project	L	RSA	MT	MI/C	R	M
Contribution from the Project to the cumulative effect Expected to comply with regulatory guidelines		L	LSA	MT	MI/C	R	M

Effect	Other Projects, Activities and Actions	Cumulative Effects Characterization					
		Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context
Shipping Activities							
Cumulative change (increase) in overall noise levels and increase in low frequency noise during facility construction and operation							
Cumulative effect with the Project and other projects, activities, and actions Expected to comply with regulatory guidelines	▪ Douglas Channel LNG Project (also known as BC LNG) ▪ Enbridge Northern Gateway Project ▪ Kitimat LNG Terminal Project ▪ BC Ferries ▪ Cruise Ships ▪ Forestry Activities ▪ Fishing and Aquaculture Activities	L	RSA	MT	MR	R	M
Contribution from the Project to the cumulative effect ▪ Expected to comply with regulatory guidelines		L	LSA	MT	MR	R	M

NOTE:

[a] There is no quantitative noise limit for some projects because they are not regulated by the OGC and Health Canada. These projects include the MK Bay Marina and the RTA facility and Kitimat Modernization Project

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GEOGRAPHIC EXTENT:

Project footprint—effects are restricted to the Project footprint

LSA—effects extend into the LSA

RSA—effects extend into the RSA

DURATION:

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MT = Medium term—Effect extends through operation phase

LT = Long-term—Effect extends beyond closure

P = Permanent—measurable parameter unlikely to recover to baseline

FREQUENCY:

S = Single event—occurs once

MI = Multiple irregular event—no set schedule, occurs sporadically at irregular intervals throughout construction, operation or decommissioning phases

MR = Multiple regular event—occurs on a regular basis and at regular intervals throughout construction, operation, or decommissioning phases

C = Continuous—occurs continuously throughout the life of the Project

REVERSIBILITY:

R = Reversible—will recover after Project closure and reclamation

I = Irreversible—permanent

CONTEXT:

L = Low resilience—low capacity for the VC to recover from a perturbation, with consideration of the baseline level of disturbance

M = Moderate resilience—moderate capacity for the VC to recover from a perturbation, with consideration of the baseline level of disturbance

H = High resilience—high capacity for the VC to recover from a perturbation, with consideration of the baseline level of disturbance

SIGNIFICANCE:

S = Significant

N = Not Significant

PREDICTION CONFIDENCE:

Based on scientific information and statistical analysis, professional judgment and effectiveness of mitigation, and assumptions made.

L = Low level of confidence

M = Moderate level of confidence

H = High level of confidence

LIKELIHOOD OF RESIDUAL EFFECT OCCURRING:

Based on professional judgment

L = Low likelihood that there will be a residual effect

M = Moderate likelihood that there will be a residual effect

H = High likelihood that there will be a residual effect

5.4.9 Prediction Confidence and Risk

Confidence in predictions for this assessment is moderate. Overall, accuracy of predictions depends on several factors, including the accuracy of the Project design information, noise source data, and the sound propagation algorithm. The latest Project design information available at the time of this assessment is used. The sound power levels of the noise sources were established with field measurements of similar equipment or vendor sound emission data, where available. Acoustic models can be revised (if necessary) when final design information is available.

The Cadna/A model predicts outdoor noise in accordance with ISO 9613. The ISO 9613 sound propagation algorithms have a published accuracy of ±3 dB over source receiver distances between 100 m and 1,000 m. The accuracy for distances up to or over 1.5 km is not stated. The ISO 9613 model also produces results representative of meteorological conditions enhancing sound propagation (e.g., downwind and temperature inversion conditions). These conditions do not occur all the time; therefore, model predictions are expected to be conservative.

To account for the level of uncertainty in the noise predictions, conservative assumptions regarding the Project have been made (see Sections 5.4.5.1 and 5.4.6.1). These include the assumptions that downwind conditions exist 100% of the time and that all equipment operates at rated capacity during the nighttime period.

Since the confidence in this prediction is not low, no additional risk analysis has been conducted.

5.4.10 Follow-up Program and Compliance Monitoring

No follow-up programs are proposed for acoustic environment. Compliance monitoring to be implemented through Environmental Management Plans is described in Section 12 and Section 21 (Table 21.3-1).

5.4.11 Summary of Mitigation Measures

LNG Canada commits to the following measures to avoid or manage potential effects on the acoustic environment. The mitigation measures that have been incorporated in the noise modelling assumptions will be implemented. If any of the listed acoustic specifications are not achievable because of limitations by the selected supplier, other mitigation measures or options will be considered.

Acoustic models can be revised (if necessary) when final design information is available.

The following mitigation measures will be implemented to address noise effects during construction and decommissioning activities:

- Most construction activities, including pile installation, will be planned to occur between the daytime hours of 7 a.m. and 10 p.m. Night shifts will be required to complete specific activities or meet schedules (Mitigation 5.4-1).
- Vibro-hammer piling equipment will be considered for use where conditions permit for land-based piling operations (Mitigation 5.4-2).
- Fit gas or diesel engine exhausts with noise mufflers, where available (Mitigation 5.4-3).
- Rubber-wheeled equipment will be used instead of steel-tracked equipment, where practical (Mitigation 5.4-4).
- Construction equipment will be turned off when not in use, where practical, to reduce idling (Mitigation 5.4-5).
- Develop and implement a Traffic Management Plan (Mitigation 5.4-6).
- Equipment enclosure doors will be kept closed unless safe operations require otherwise (Mitigation 5.4-7).
- Nearby residents will be notified in advance of planned substantial noise-causing activities at the LNG facility (Mitigation 5.4-8).
- A process will be implemented to address noise complaints in a timely manner (Mitigation 5.4-9).
- A Noise Management Plan will be developed and implemented (Mitigation 5.4-10).

A combination of the following mitigation measures will be implemented as needed to meet regulatory limits and to address noise effects during the operation phase:

- Regularly maintain all machinery and equipment to ensure that air and noise emissions are within range set by manufacturer when available (Mitigation 5.4-11).
- Ensure that project related noise generated during operation complies with the OGC Noise Control Best Practices Guidelines at sensitive receptor locations (Mitigation 5.4-12).
- Develop and implement a Traffic Management Plan (Mitigation 5.4-6).
- Nearby residents will be notified in advance of planned substantial noise-causing activities at the LNG facility (Mitigation 5.4-8).
- A Noise Management Plan will be developed and implemented (Mitigation 5.4-10).
- A process will be implemented to address noise complaints in a timely manner (Mitigation 5.4-9).

5.4.12 Conclusion

Noise effects from the construction and operation phases of the Project are predicted to comply with the OGC and Health Canada noise guidance. The noise effect during the decommissioning phase is expected to be lower than the construction phase. Construction and operation will result in low-magnitude residual effects. These residual effects will occur continuously during the facility operation phases, multiple regular intervals during the marine activities in the operation phases, and at multiple irregular intervals during construction and decommissioning of the Project. Residual effects will be reversible after the decommissioning phase. Change (increase) in overall noise levels and an increase in LFN, during all phases of the Project are rated as not significant. The reasonably foreseeable OGC regulated projects and activities in the facility RSA, in combination with the residual noise effects of the Project, are expected to comply with regulatory guideline. Cumulative effects are therefore not significant.

This conclusion has been determined with a moderate level of confidence based on conservative assumptions used in modelling and professional judgment.