Appendix I

Noise Impact Assessment

Genesee Generating Station Units 4 & 5 Project Noise Impact Assessment

Project #: 123510975

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Executive Summary

This assessment has been conducted to predict the noise effects associated with the construction and operation of a proposed expansion of Capital Power's existing Genesee Generating Station (GGS), which has a gross 1376 MW capacity. The proposed expansion consists of two identical natural gas-fired combined cycle gas turbines that are referred to as the Genesee Generating Station Units 4 & 5 Project, together "the Project". The Project will add a combined gross output of up to 1050 MW for a total gross output of up to 2426 MW for the Genesee site.The Project is located in Leduc County, north of Warburg, Alberta (Sec 25 of 50-3 W5M), approximately 17 km north of the Town of Warburg in Leduc County.

The closest dwelling is situated northeast of the Project boundary at a distance of 1.9 km. This is the closest and most affected dwelling. Other dwellings within the study area are located at greater distances from the Project boundary. The Project noise effects and the cumulative noise effects have been predicted at these dwellings.

The Permissible Sound Level (PSL) of 50 dBA daytime and 40 dBA nighttime applies to the closest dwelling. The noise impacts resulting from the Project at dwellings within 3 km from the Project were predicted. These predictions are based on information provided by Capital Power, and using internationally accepted sound propagation algorithms (ISO 9613).

The key findings of the study are:

- Predicted sound level contributions from the Project are below the existing noise levels at all dwellings, and are also below the mandated ASL at all dwellings.
- The predicted cumulative sound level (i.e., Project, existing facility, and mandated ASL) for the most impacted dwelling is below the PSL for both the nighttime period and the daytime periods.
- The potential for Low Frequency Noise (LFN) was considered in this assessment. The results indicate a slight potential for LFN at the closest dwelling.

Abbreviations

AADT	Average Annual Daily Traffic volume
AER	Alberta Energy Regulator
ASL	Ambient Sound Level
AUC	Alberta Utilities Commission
BSL	Basic Sound Level
CPC	Capital Power Corporation
CPEC	Capital Power Energy Center
dBA	A-Weighted Decibel
dBC	C-Weighted Decibel
DIL	Dynamic Insertion Loss. The applied attenuation with the noise mitigation in place under the specified operating conditions
ERCB	Energy Resources Conservation Board
GT	Gas Turbine
hp or HP	horsepower
HRSG	Heat Recovery Steam Generator
IL	Insertion Loss (dB), the net noise reduction achieved
ISO	International Organization for Standardization
Leq	Energy Equivalent Sound Level
km	kilometre
kW	kilowatt
m	metre
MW	Megawatt (1 million Watt)
NIA	Noise Impact Assessment
PCB	Permissible Sound Level Criterion Boundary
PSL	Permissible Sound Level
PWL	Sound Power Level re 10^{-12} Watt
rpm	Revolutions per minute—a measure of rotational frequency
Rule 012	AUC Rule 012, *Noise Control*
SPL	Sound Pressure Level

1.0 Introduction

Stantec Consulting Ltd. (Stantec) was contracted by Capital Power Corporation (Capital Power) to complete a Noise Impact Assessment (NIA) to support a regulatory application submitted to the Alberta Utilities Commission (AUC) for an expansion of Capital Power's existing Genesee Generating Station (GGS), which has a gross capacity of 1376 MW. The proposed expansion consists of two identical natural gas-fired combined cycle turbines that are referred to as the Genesee Generating Station Units 4 & 5 Project, together "the Project".

This report describes the methodologies and technical details used in the NIA for the Project. Information has been generated from existing literature, technical data sources, engineering predictions, vendor's and manufacturer's information, and computer noise propagation modeling.

The following key information is presented in this report:

- Project setting and expected noise baseline conditions;
- Applicable assessment criteria;
- Acoustic modeling approach;
- Project noise emission sources;
- Baseline acoustic environment conditions;
- Predicted Project and cumulative noise effects; and
- Conclusion of whether the Project is in compliance with AUC Rule 012, *Noise Control.*

2.0 Project Setting

2.1 PROJECT LOCATION

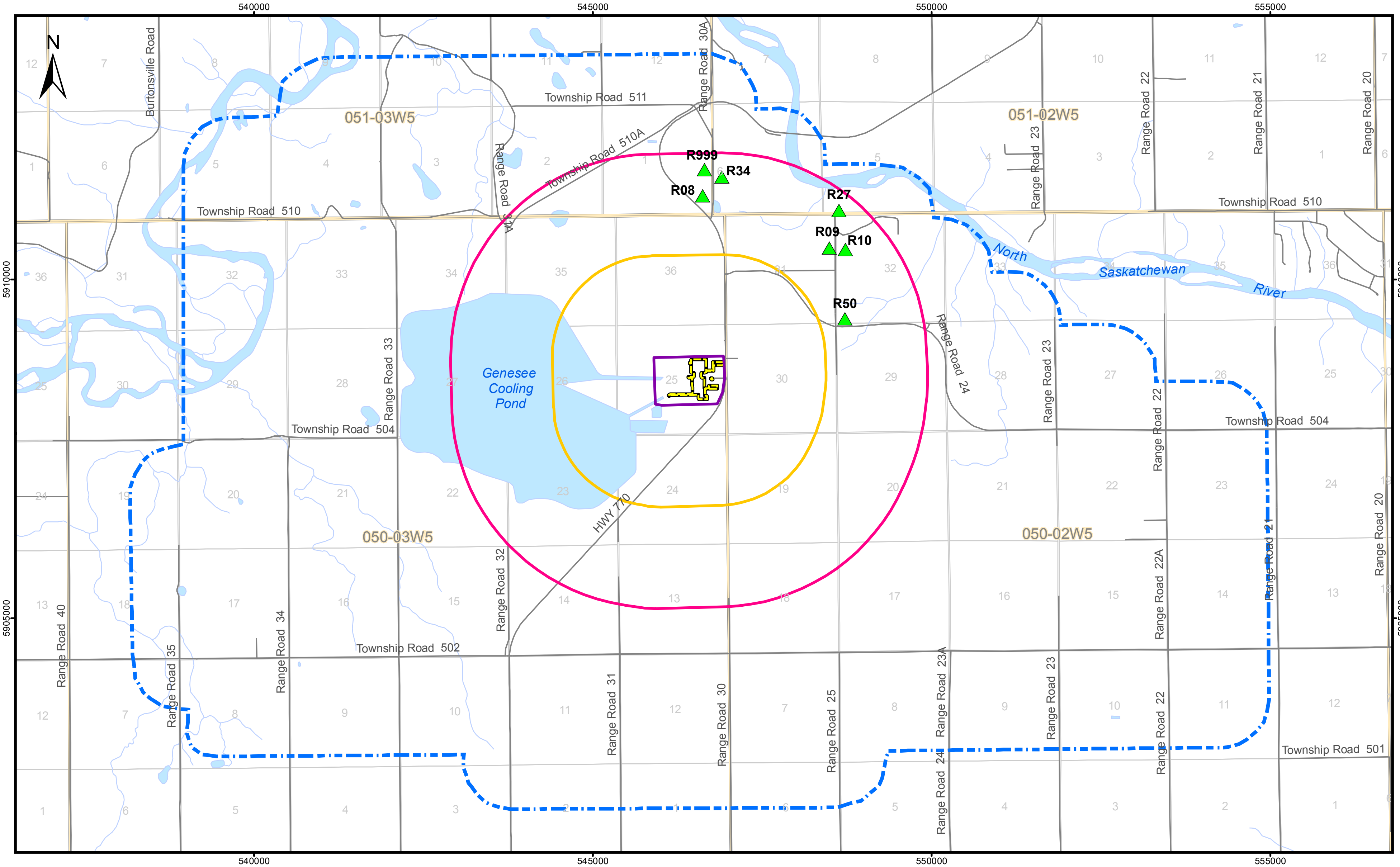
The Project is located in Leduc County, north of Warburg, Alberta (Sec 25 of 50-3 W5M), approximately 80 km southwest of Edmonton. The Project is situated within the boundaries of the existing Genesee Generating Station. The existing Station consists of three coal-fired generating facilities (G1, G2, and G3), and the Project is situated immediately east of G3 on what is now a laydown area. To the northwest of the Project is a newly constructed AltaLink substation situated (AltaLink Sunnybrook 510S). The Genesee coal mine operated by Sherritt International (Sherritt) provides the fuel for units G1 to G3. The Genesee Coal Mine project area surrounds the Genesee site.

2.2 NOISE STUDY AREA AND NOISE SENSITIVE RECEPTORS

The local study area includes an area within 3 km of the facility boundary. This distance was considered to be sufficient to capture potential noise effects associated with the Project. The closest dwelling is situated approximately 1.9 km northeast of the facility. Other dwellings are located north and northeast of the Project at greater distances. The dwellings are considered as potential noise sensitive receptors. Receptor locations identified in the vicinity of the Project are presented in Table 2-1. The receptor locations and Project boundary are shown in Figure 2-1.

Table 2-1 Receptor Locations

Receptor ID	UTM coordinates		Height Above Grade (m)	Direction from Project	Approximate Distance to Project Boundary (km)
	Easting (m)	Northing (m)			
R10	681,820	5,916,046	1.5	Northeast	2.4
R09	681,581	5,916,057	1.5	Northeast	2.2
R50	681,838	5,915,020	1.5	East-northeast	1.9
R27	681,708	5,916,620	1.5	Northeast	2.7
R34	679,967	5,917,066	1.5	North	2.7
R08	679,690	5,916,775	1.5	North	2.4
R999	679,706	5,917,167	1.5	North	2.7



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December 2013
1102-19025

Stantec

Projection: 10TM AEP Forest Datum: NAD 83
Base data obtained from GeoBase®

- 1.5 km AUC Criteria Boundary - Project Only
- 3 km Boundary from Project Fenceline
- Power Plant Boundary
- 1.5 km AUC Cumulative Criteria Boundary
- Receptor
- Limit of Construction
- ATS Township Grid
- ATS Section Grid
- Waterbody
- Watercourse
- Road

0 1,000 2,000 3,000 4,000 5,000
1:80,000 Meters
This map is for reference purposes only

Client/Project
CAPITAL POWER CORPORATION
GENESEE GENERATING
STATION EXPANSION

Figure No.
2-1

Title
PROJECT STUDY AREA AND RECEPTORS

3.0 Regulatory Requirements

AUC Rule 012 Noise Control (AUC 2013) provides regulatory limits for the noise effects associated with power generation facilities. The intent of Rule 012 is to balance the interests of both public and the licensee. The regulation limits project noise effects to reasonable and acceptable levels; however, Rule 012 does not guarantee the inaudibility of a facility. In this application, noise criteria are applied in accordance with Rule 012.

3.1 PERMISSIBLE SOUND LEVEL

Rule 012 is a receptor-oriented regulation, which specifies allowable sound levels at designated receptor points (including residences). In accordance with Rule 012, all facilities 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 a project fence line. Only dwelling units are considered as receptors. A dwelling unit is defined as any permanently or seasonally occupied residence.

In cases where there is no receptor within 1.5 km from a project boundary, the daytime and nighttime PSL along the 1.5 km from the facility boundary (1.5 km criteria boundary) should be at 40 dBA and 50 dBA L_{eq}, respectively. The AUC 1.5 km criteria boundary for the Project is shown in Figure 2-1.

The Project is located within the proposed mine permit boundary of the Genesee coal mine project, which is also a regulated energy-related facility. The Genesee coal mine project boundary and the 1.5 km criteria boundary for the coal mine are shown in Figure 2-1. In cases where one project is located within another larger project boundary, the outer 1.5 km criteria boundary and all receptors within this boundary should be considered. No receptor is located within the Project 1.5 criteria boundary; however, there are receptors between the Project and the Genesee coal mine 1.5 km criteria boundary. Receptors that are less than 3 km from the Project boundary were evaluated in this NIA. Project noise effects for receptors beyond the 3 km distance are not expected to be measureable.

The determination of daytime and nighttime PSL at a receptor is a function of the time of day, duration of noise (e.g., continuous or temporary), residential density, and proximity to other noise sources (e.g., highways). Daytime PSL is 10 dBA L_{eq} above the nighttime value. The nearest dwelling from the Project, receptor R50, is located 1.9 km from the Project boundary and within the Genesee coal mine 1.5 km criteria boundary. The PSL at receptor R50 is determined to be 40 dBA and 50 dBA during daytime and nighttime period, respectively.

If a receptor is situated near a heavily travelled road or rail line or is subject to frequent aircraft flyovers, a higher PSL may apply. Within the Project study area, there is no frequent flyover or heavily travelled rail line. Highway 770 had an Average Annual Daily Traffic (AADT) volume in 2012 of 940 vehicles (north Highway 622 of St. Francis) and 1550 vehicles (south of Highway 627, Carvel). According to Rule 012, 10% of the AADT can be assumed to be nighttime traffic. If a Highway has a nighttime traffic volume of 90 vehicles or more, it can be classified as a heavy travelled highway. Thus, Highway 770 can be classified as a heavy travelled Highway. This results in an upward adjustment to the PSL of 5 dB for dwellings that are less than 500 m and more than 30 m from Highway 770. Receptors R08, R034 and R999 are within 500 m from Highway 770. Other receptors are more than 500 m from Highway 770.

The criteria discussed in this section are summarized in Table 3-1. Details on PSL determination for all other receptors are presented in Appendix B.

Table 3-1 Permissible Sound Level at Receptors

Receptor	PSL daytime (dBA)	PSL nighttime (dBA)
R10	50	40
R09	50	40
R50 *	50	40
R27	50	40
R34	55	45
R08	55	45
R999	55	45

NOTE:
"*" Closest receptor to the Project

3.2 CUMULATIVE NOISE LEVEL

In the assessment of noise levels, the cumulative noise level at a receptor is compared to the PSL. The cumulative noise level includes the noise contribution from the following:

- Project;
- Ambient Sound Level (ASL); and
- Existing and approved energy-related facilities.

The (mandated) ambient sound level is deemed to be 35 dBA during nighttime hours in rural Alberta, without the contribution of energy related industry. The daytime mandated ambient sound level can be expected to be 10 dB higher according to Rule 012 due to human activity and therefore is set at 45 dBA. If the soundscape is expected to differ significantly from the mandated value for the ASL, an ambient sound survey may be considered to assess the actual location-specific ambient sound level. The only areas mentioned in Rule 012 where such a survey may be necessary are areas considered to be pristine or areas with non-energy related industry that would affect ambient sound levels. No ASL adjustment is considered in this NIA.

The noise impact from other energy related facilities, both existing and approved. Other energy related facilities that may affect noise levels near the identified dwellings are:

- The Genesee coal mine;
- The existing Genesee Generating Station (G1–G3);
- The AltaLink Sunnybrook Substation 510S.

3.3 CONSTRUCTION NOISE AND EMERGENCY SITUATIONS

Rule 012 does not have quantitative noise limit on construction noise. This assessment does not include a quantitative assessment of construction noise.

The PSL does not apply to noise emission during emergency situation. An emergency is an unplanned event requiring immediate action to prevent loss of life or property. If an event occurs more than four times a year at a facility, it is not considered an unplanned event. This NIA does not include an assessment of unplanned events.

3.4 LOW FREQUENCY NOISE

According to Rule 012, the two following conditions determine the presence of Low Frequency Noise (LFN) near a dwelling:

1. The difference between the Project noise impact L_{eq} for the daytime or the nighttime period expressed in dBC and the same impact, expressed in dBA is 20 dB or more, **and** (emphasis added)
2. A tonal component is present in the spectrum (Hz). A tonal component is defined as follows:
   - The linear sound level of one band must be at least 10 dB or more above one of the adjacent bands within two one-third octave bandwidths.
   - There must be at least a five dB drop in level within two bandwidths on the opposite side of the frequency band exhibiting the high sound level.

Rule 012 contains a provision that addresses the potential presence of LFN. The LNF analysis should be considered in the NIA, if sufficient detailed data is available to do so. Detailed information required to assess the presence of a tonal component is typically not available in the NIA phase and can only be assessed via detailed measurements during operation. Therefore, only the first condition (dBC minus dBA) is assessed in this NIA. In the case of an exceedance, the result can only serve as an indication of potential LFN.

4.0 Methodology

4.1 ENVIRONMENTAL NOISE DESCRIPTORS

Noise is generally defined as unwanted sound. Environmental noise is typically not steady and continuous, but varies over time. To account for the time-varying nature of environmental noise, a single number descriptor known as the energy equivalent sound level (L_{eq}) is typically used. L_{eq} is defined as the steady, continuous sound level over a specified time that has the same acoustic energy as the actual varying sound levels over the same time. The unit for L_{eq} is dBA (A-weighted decibels), which reflects the response of the human ear to different sound frequencies. For additional details on environmental noise descriptors, refer to Appendix A.

Periods commonly used for L_{eq} measurements and regulatory criteria are daytime (07:00 AM to 10:00 PM) and nighttime (10:00 PM to 07:00 AM). The daytime L_{eq} is the 15-hour A-weighted energy equivalent sound level. Similarly, the nighttime L_{eq} is a 9-hour A-weighted energy equivalent sound level.

For reference purposes, examples of familiar sound levels are included in Table 4-1[1].

Table 4-1 Familiar Sound Levels

Sound Description	L_{eq} (dBA)
Soft whisper at 1.5 m	30
Nighttime sound level in rural setting	35
Quiet office or living room	40
Moderate rainfall	50
Inside average urban home	50
Quiet street	50
Normal conversation at 1 m	60
Noisy restaurant	70
Highway traffic at 15 m	75
Bus or heavy truck at 15 m	88-94
Freight train at 15 m	95
Modified motorcycle	95
Jet taking off at 600 m	100
Amplified rock music	110
Jet taking off at 60 m	120

[1] SOURCE: AER Directive 038, Noise Control, Appendix 2

4.2 ASSESSMENT APPROACH

This noise assessment used methodology consistent with the requirements of Rule 012. The assessment approach can be detailed as follows:

1. Define the receptors and the study area for the Project.
2. Determine the PSL at the receptors according to Rule 012.
3. Determine the baseline condition by considering the ASL and noise effects from other energy related facilities, both existing and approved. Information is based on the NIA conducted for the 2011 Genesee coal mine extension application (ACI 2011).
4. Predict noise levels from the Project operations by:
   a. Identifying contributing noise sources from the Project;
   b. Characterizing these sources in terms of acoustical power;
   c. Modeling the propagation of sound from these sound sources to the receptors of concern;
   d. Calculating the expected noise levels at the selected receptors, following internationally accepted standards.
5. If the predicted cumulative sound level is less than or equal to the PSL, the effect is acceptable. If the PSL is exceeded due to the Project, mitigation measures are identified, where feasible, to reduce the predicted sound level so it is less than or equal to the PSL.
6. Low frequency noise analysis will be conducted to indicate if there are any indications of potential LFN.

4.3 COMPUTER MODELING

Sound propagation methods used in this assessment are those prescribed by the International Organization for Standardization (ISO) Standard 9613. The ISO 9613 Standard was developed to predict the long-term average sound level L_{eq} for receptors around a facility. This standard was selected as appropriate for this assessment.

Sound propagation from the Project was calculated using "CadnaA" (DataKustik 2009), a state of the art noise modeling software package incorporating ISO 9613 algorithms.

The modeling approach accounts for factors included in ISO 9613, such as:

- Distance attenuation (geometrical dissipation of sound with respect to distance)
- Atmospheric attenuation (effect of sound absorption by the mass of air between sound sources and receptors)
- Directivity of the sound sources
- Reflection of the sound waves during propagation (first-order reflection)
- Mitigation measures incorporated in the equipment and facility design (e.g., silencers, buildings, barrier effects)
- Ground attenuation (effect of sound absorption by the ground as sound passes over various terrain types between the source and receptor)
- Meteorological conditions and effects on sound propagation

4.4 MODEL CONFIGURATION

The following subsections describe specific settings of the computer noise model.

4.4.1 Meteorology

Meteorological factors, such as temperature, humidity, wind speed, and direction affect sound propagation. Effects of wind on outdoor sound propagation during various weather conditions can cause large variations in project-related sound levels measured at a dwelling. If the dwelling is upwind of the facility, the wind could cause greater than normal outdoor sound attenuation and lower sound levels at the dwelling than would occur with no wind. However, if the dwelling is downwind of the facility, the opposite effect could occur, resulting in higher sound levels than normal at the dwelling. Crosswinds do not affect outdoor sound propagation and would result in sound levels at the dwelling that are essentially the same as those during calm conditions. The ISO 9613 algorithms used in this assessment simulate downwind propagation or propagation under a mildly developed temperature inversion (both of which enhance sound propagation) and provide a reasonable conservative assessment of potential effects from wind. Also, sound is absorbed in that atmosphere. The absorption varies with temperature and humidity. Lower frequencies are not as well absorbed as higher frequencies; the relative low-frequency content of a noise signal will increase with distance, but the absolute sound level will drop in every frequency band. Atmospheric absorption in this assessment is based on standard ISO 9613-1 (ISO 1993).

The following meteorological parameters consistent with requirements in Rule 012 were applied in the noise model:

- Temperature = 10°C
- Relative humidity = 70%
- Wind direction = downwind (i.e., wind blowing from the Project to the receptor)

The ISO methods are valid for wind speeds between 1 m/s and 5 m/s, measured at a height between 3 and 11 metres above ground. These meteorological parameters and modeling approach are considered typical of nighttime conditions in the spring and summer.

4.4.2 Terrain and Ground Cover Condition

Ground terrain information in the form of height points consistent with site conditions was used in the noise model. The terrain information is based on Canadian Digital Elevation Data (Geobase 2013)

As the Project will be operating year-round, a variety of ground conditions could occur, ranging from soft, porous ground in spring, summer, and fall (i.e., high ground attenuation values) to hard, frozen ground in winter (i.e., low ground attenuation values). Winter ground conditions might also range from soft, fresh snow with high ground-attenuation values to hard, crusty snow with low ground-attenuation values.

To provide a representative assessment of the noise impacts during summer conditions, the ground condition was modeled as 50% absorptive) outside the Project areas, and partly hard ground (20% absorptive) in the Project areas. Large water bodies (e.g. lakes) were modeled as fully reflective (0% absorptive), as were ground areas under buildings.

4.5 PREDICTION CONFIDENCE

According to ISO 9613-2 (ISO 1996), the overall accuracy of the standard is ± 3 dB for distances between source and receiver of up to 1 km. The accuracy for distances longer than 1 km is not stated. The accuracy is expected to decrease with increasing distance.

The ISO 9613 model produces results representative of meteorological conditions enhancing sound propagation (downwind and moderate temperature inversion conditions). These conditions do not occur all the time. Another conservative assumption is that all operated equipment operates at 100% capacity, both during daytime and nighttime hours. Therefore the model predictions are expected to be conservative and actual sound levels at the receptor locations are expected to be less than indicated for much of the time. Based on these factors, confidence is high that the model has not under-predicted the noise effects from the Project.

5.0 Project Noise Sources

5.1 CONSTRUCTION

Project construction noise will occur during typical construction activities, such as leveling and grading, excavation, and component erection. Rule 012 does not set specific noise limits for construction activities; however, these activities must be conducted with some consideration for noise. Rule 012 requires that reasonable measures be implemented to minimize noise effects from construction activities. As most construction activities will occur during the daytime, construction activity will have little effect on nighttime sound levels.

The following mitigation and noise management measures will be implemented to limit noise disturbance during construction of the Project:

- Where practical, noisy construction activities will be scheduled during daytime hours of 07:00 to 22:00 and/or in conjunction with any municipal ordnance requirements.
- Nearby residents will be notified in advance of substantial noise-causing activities, where possible.
- Noise mitigation measures installed on construction equipment (e.g., mufflers) will be kept in good working condition.
- Screening effects of barriers around construction equipment will be used where practical.
- Construction vehicles will follow posted speed limits.
- Construction equipment not in use will be turned off, where practical.

Capital Power is committed to managing noise issues and to promptly responding to any noise complaints during construction.

Noise generating activities associated with the decommissioning of the Project are also expected to be of limited duration and ending as the Project site, ancillary facilities and infrastructures are reclaimed. After decommissioning of the Project, the sound environment is expected to revert to the original ambient conditions.

5.2 PROJECT OPERATING SCENARIO

The Project will be operating as primarily a base load power facility, indicating that the facility is intended to run at (close to) maximum generating capacity continuously. In accordance to Rule 012, this NIA considers the Project as if it will operate continuously at 100%.

5.3 PROJECT NOISE SOURCES

The Project will use natural gas combined-cycle (NGCC) technology. Specifically, the Project consists of two "1-on-1" units, each consisting of a single natural gas turbine paired with a heat recovery steam generator (HRSG), and a single steam turbine with a combined gross output of up to 1050 MW. The Project will be water-cooled by the existing Genesee cooling pond for G1, G2, and G3. Major Project components that are noise emissions sources for each unit include the following:

- Heat Recovery Steam Generator (HRSG) Stack;
- HRSG enclosure;
- Gas Turbine (GT) Combustion Air Inlet ;
- GT building;
- Pump house;
- Water treatment (WT) building;
- Boiler Feed Water Pump (BFWP) enclosure;
- Transformer; and
- Fuel Gas Compressor (FGC) enclosure.

The location of the individual pieces of equipment was determined from the plot plan, included as Figure 5-1. The plot plan is based on CPC/Black and Veatch Corporation drawing 180144-CGAU-GGS 1000 (Rev 0, September 12, 2013). The equipment description, location, power rating, capacity, and quantity are listed in Table 5-1.

Table 5-1 Project Noise Source Summary

Description	GGS Unit	Location	Power rating (HP)	% of capacity	# of units
GT Combustion Air Inlet	4	Outdoors	n/a	100%	1
GT and Generator	4	GT Enclosure	450 MW	100%	1
HRSG	4	HRSG Enclosure	n/a	100%	1
Steam turbine	4	GT Enclosure	n/a	100%	1
Stack	4	Outdoors	n/a	100%	1
4S Cooler	4	Outdoors	n/a	100%	1
Vent Fan A/B	4	Outdoors	n/a	100%	1
GT Combustion Air Inlet	5	Outdoors	n/a	100%	1
GT and Generator	5	GT Enclosure	450 MW	100%	1
HRSG	5	HRSG Enclosure	n/a	100%	1
Steam turbine	5	GT Enclosure	n/a	100%	1
Stack	5	Outdoors	n/a	100%	1
4S Cooler	5	Outdoors	n/a	100%	1
Vent Fan A/B	5	Outdoors	n/a	100%	1

Table 5-1 Project Noise Source Summary

Description	GGS Unit	Location	Power rating (HP)	% of capacity	# of units
Circulating Water Pumps	4&5	Pump House	1,250	25%	4
Boiler Feed Water Pumps	4	BFW Enclosure	4,000	100%	2
Boiler Feed Water Pumps	5	BFW Enclosure	4,000	100%	2
Condensate Pumps	4	BFW Enclosure	500	100%	2
Condensate Pumps	5	BFW Enclosure	500	50%	2
Demi Water Transfer Pumps	4&5	Water Treatment Building	400	50%	4
Fuel Gas Compressors	4&5	FG Enclosure	1,500	50%	2
Air Extraction Fan	4&5	Building Roofs	n/a	100%	30
NOTE: "n/a" not applicable					

It was assumed that all equipment building windows and doors are closed during operation. Ventilation, including mechanical ventilation was included in the assessment according to Table 5-2 to Table 5-7.

Table 5-2 Gas Turbine Enclosure

GT Enclosure	Type	Quantity
Roof	Fan	5
East Façade	Louver (2.6 x 2 m)	4
West Façade		4
South Façade		1
North Façade		2

Table 5-3 Heat Recovery Steam Generator Enclosure

HRSG Enclosure	Type	Quantity
Roof	Fan	4
East Façade	Louver (2.6 x 2 m)	4
West Façade		4
South Façade		2
North Façade		1

Table 5-4 Boiler Feed Water Enclosure

BFW Enclosure	Type	Quantity
Roof	Fan	1
East Façade	Louver (2.6 x 2 m)	1
North Façade		1

Table 5-5 Pump House

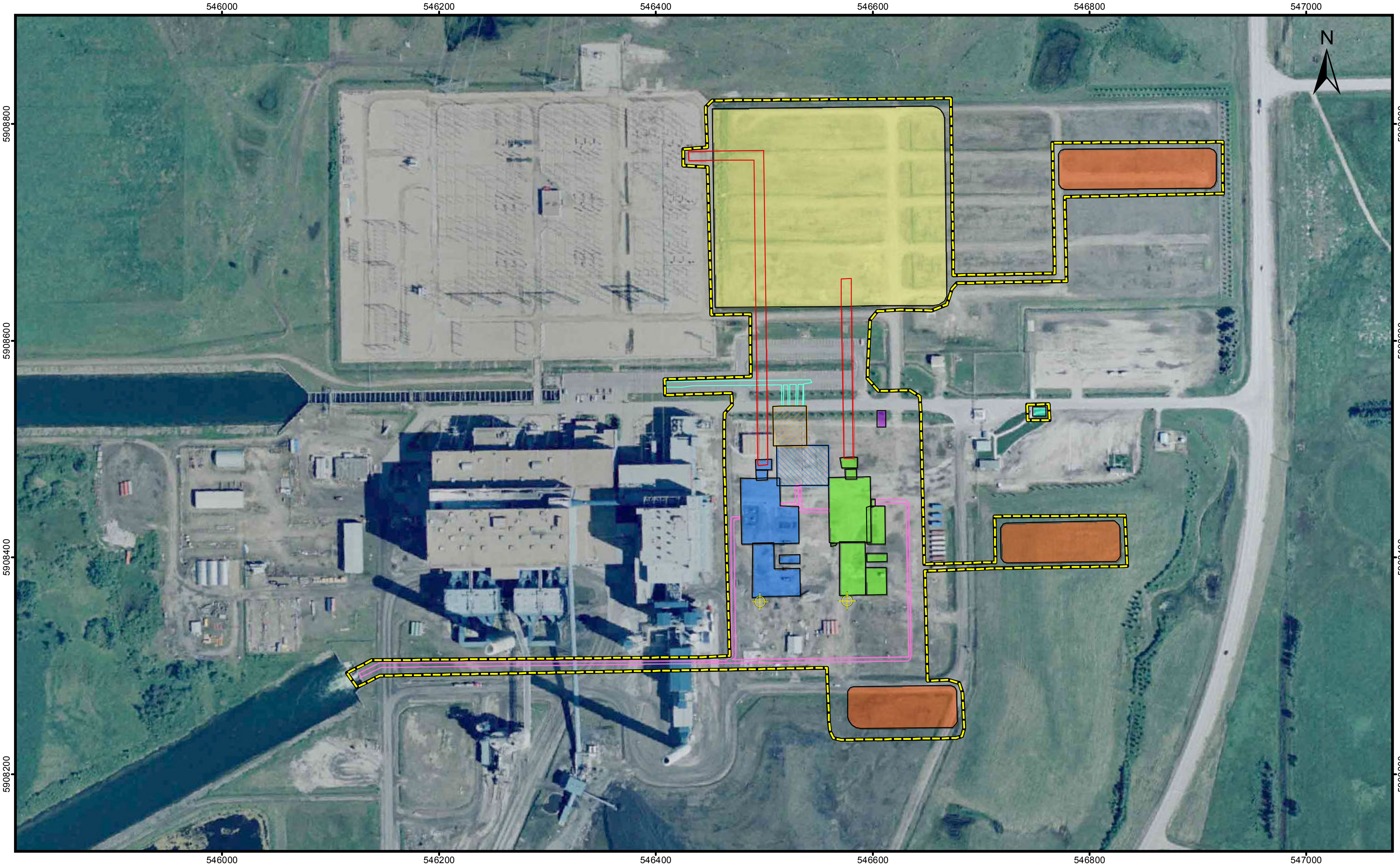
Pump House	Type	Quantity
Roof	Fan	1
East façade	Louver (3.6 x 1 m)	1
West façade		1

Table 5-6 Fuel Gas Compressor Enclosure

Fuel Gas Compressor Enclosure	Type	Quantity
Roof	Fan	1
East façade	Louver (1.2 x 1 m)	1
West façade		1

Table 5-7 Water Treatment Building

Water Treatment Facility	Type	Quantity
North Wall	Fan	1
East façade	Louver (3.6 x 2 m)	1
West façade		1
North façade	Louver (2.6 x 1 m)	1



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November 2013
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Projection: 10TM AEP Forest Datum: NAD 83
Imagery obtained from CPC, 2011.

- Proposed Stack
- Limit of Construction
- GGS4
- GGS5
- GGS 4&5 Pump House
- GGS 4&5 Guard House
- GGS 4&5 Admin Control and Water Treatment
- GGS5 Switchyard
- GGS 4&5 Fuel Gas Compressor
- Construction Laydown
- Inlet
- Outlet
- Overhead Powerline

0 50 100 150 200 250
1:5,000 Metres
This map is for reference purposes only

Client/Project
CAPITAL POWER CORPORATION
GENESEE GENERATING
STATION EXPANSION

Figure No.
5-1

Title
SITE PLAN OF GENESEE GENERATING STATION UNIT 4 & 5

5.4 SOUND POWER LEVEL AND SOUND PRESSURE LEVEL

The parameter to characterize a noise source is the sound power level (PWL).

The actual sound pressure level (SPL) at a specific location depends on many factors, such as the acoustic power of the sound source (sound power level or PWL), whether or not the source is located indoors, the distance to the sound source, reflections and shielding, and absorption in the atmosphere. A useful comparison between PWL and SPL is the amount of watts of a light bulb, and the actual amount of light on the pages of a book that we're reading. The amount of light on the pages of our book depends not only on the wattage of the light bulb, but also depends on the distance to it, the distance to walls and ceiling, and the reflectiveness of wall and ceiling. Using the PWL in a noise model allows the calculation of the sound level at multiple locations at different distances from the noise source, taking propagation in effect.

The most accurate source of noise emission information is operating equipment noise measurements. Such measurements are not always available, specifically, when a project has not been constructed and operated. Some manufacturers provide equipment noise information measured under standardized conditions. This is a close second in accuracy of information compared to measurements on installed equipment. If noise data is not available from measurement or manufacturer, estimates can be made using engineering formulae. Such methods tend to be conservative and do not distinguish between make and model of equipment.

5.5 NOISE EMISSIONS FROM PROJECT NOISE SOURCES

Mechanical equipment generates noise as an unwanted sound (e.g., gas turbine exhaust and combustion air intake). Associated equipment such as vents and fans will also generate noise. The amount of noise generated can vary with manufacturer, model, and operating conditions (e.g., rpm). If a noise source is enclosed, the walls and roof of the enclosure will contain a portion of the acoustic energy and restrict the amount of noise emitted to distant receptors.

The GT and HRSG manufacturer (Mitsubishi) provided information for the GT, HRSG, Steam turbine and generator noise sources. Other noise sources were based on calculations, using engineering formulae and measurements on similar equipment in comparable operating conditions. The GT stack exhaust PWL was adjusted for directivity.

Most major noise sources are located inside an enclosure that provides additional attenuation:

- HRSGs (i.e. HRSG enclosure);
- GTs, generators, and associated equipment;
- Processing pumps (i.e. Boiler Feed Water Enclosure, Pump House, Water Treatment Facility);
- Fuel Gas compressors.

A building attenuates the interior noise sources from indoor to outdoor. Based on the noise emission source sound power level, building dimensions and the amount of sound absorption inside a building, the indoor sound level was predicted for each enclosure. Both the direct sound field and the indirect sound field were considered. The building walls and roofs interior were assumed to be reflective (i.e. sheet metal cladding). This conservative assumption results in higher indoor sound levels, compared to perforated wall panels. The indoor sound levels were used to predict the outdoor sound power level of walls, roofing, and louvers

The PWL per equipment item in full octave band frequency are presented in Table 5-8. The PWL listed includes the application of mitigation measures (i.e. silencer, enclosure). The acoustic performance specification associated with a building is listed in Table 5-9. The transmission loss values used for wall and roof panels are typical for pre-engineered industrial buildings sandwich panel walls and roof.

Table 5-8 Indoor Noise Emission Source Sound Power Levels Summary

Equipment	Location	PWL (dBA)	Octave Band Center Frequency (Hz), Sound Power Level in dBA									Reference
			31.5	63	125	250	500	1000	2000	4000	8000	
GT, generator, and associated equipment	G4 GT enclosure G5 GT enclosure	111	--	97	90	90	97	105	107	102	94	4
HRSG	G4 HRSG Enclosure G5 HRSG Enclosure	110	--	96	102	104	101	99	105	95	80	4
Circulating Water Pump	Pump House	103	56	64	81	89	96	99	98	93	83	1,2
Circulating Water Pump Motor		101	52	67	79	86	92	95	96	93	84	3
Boiler Feed Water Pump	G4 BFW Enclosure G5 BFW Enclosure	113	66	74	91	99	106	109	108	103	93	1,2
Boiler Feed Water Pump Motor		104	55	70	82	89	95	98	99	96	87	3
Condensate Pump	G4 BFW Enclosure G5 BFW Enclosure	106	59	67	84	92	99	102	101	96	86	1,2
Condensate Pump Motor		104	52	67	79	86	92	95	96	93	84	3
Demi Water Transfer Pump	Water Treatment Building	103	56	64	81	89	96	99	98	93	83	1,2
Demi Water Transfer Pump Motor		101	52	67	79	86	92	95	96	93	84	3
Fuel Gas Compressor	FG Enclosure	116	67	76	91	98	101	107	114	110	101	1
Fuel Gas Compressor Motor		101	52	67	79	86	92	95	96	93	84	3

NOTES:
[a] PWL represent per equipment unit
1 Handbook of Noise And Vibration Control, Malcolm J. Crocker, John Wiley & Sons, New York, 2007 - Chapter 73 (Overall PWL)
2 Taschenbuch der Technischen Akustik, 2. Auflage (spectrum corrections)
3 Engineering Noise Control, 4nd edition (David A. van Bies, Colin H. Hansen), Spon Press, London, 2009
4 Mitsubishi

Table 5-9 Outdoor Noise Emission Sound Power Level Summary

Equipment	# of units	PWL [a] (dBA)	Octave Band Center Frequency (Hz), Sound Power Level in dBA									Reference
			31.5	63	125	250	500	1000	2000	4000	8000	
GT Stack Mouth - Directivity included	2	96	78	90	93	86	80	69	71	60	54	2
Main Step up Transformer	2	105	61	76	85	100	103	94	89	83	77	1
GT Combustion Air Inlet Filter Complete	2	92	89	86	84	81	67	65	55	56	52	2
4S Cooler	2	98	72	77	86	88	91	91	84	95	74	2
Vent fan A/B Cooler	2	96	85	73	83	86	89	91	89	83	73	2
G4 & G5 GT Building walls	2	95	--	94	85	83	57	58	76	65	58	2, 3
G4 & G5 GT Building roof	2	91	--	90	81	79	53	54	72	61	54	2, 3
G4 & G5 GT Building louvers	22	68	--	65	58	64	51	42	41	44	38	2, 3
G4 & G5 HRSG Building walls	2	93	--	87	92	81	55	50	72	56	40	2, 3
G4 & G5 HRSG Building roof	2	87	--	80	85	75	48	43	65	50	34	2, 3
G4 & G5 HRSG Building louvers	22	68	--	58	66	62	50	35	37	35	21	2, 3
G4 & G5 BFW Enclosure walls	2	88	--	77	87	80	63	63	79	67	57	3
G4 & G5 BFW Enclosure roof	2	90	--	79	88	81	65	65	80	69	59	3
G4 & G5 BFW Enclosure louvers	4	73	--	56	68	68	65	56	51	54	46	3
Pump Building walls	1	94	--	84	92	85	68	68	85	74	64	3
Pump Building roof	1	92	--	81	90	82	65	66	82	72	62	3
Pump Building louvers	2	75	--	60	70	70	67	58	54	57	49	3
Water Treatment Building walls	1	89	--	81	90	80	63	63	79	69	59	3
Water Treatment Building louvers	3	74	--	59	70	70	67	57	53	57	49	3
Fuel Gas Compressors Enclosure walls	1	86	--	76	85	76	61	58	79	69	59	3
Fuel Gas Compressors Enclosure roof	1	86	--	75	84	76	55	58	79	69	59	3
Fuel Gas Compressors Enclosure louvers	2	90	--	57	68	81	64	64	80	70	60	3
Air Extraction Fan	25	94	73	82	87	87	84	85	87	85	78	1

NOTES:

[a] PWL representative per equipment unit

1 Measurements Golder 2009 (mine application 2011), -10 dB adjusted (Golder recommended mitigation included)

2 Mitsubishi

3 Engineering Formulae

Table 5-10 Building Acoustic Performance information

Building Element	Parameter	Unit	63	125	250	500	1000	2000	4000	8000
Wall and roof panel	Absorption coefficient Panel (inside)	n/a	0.05	0.05	0.05	0.1	0.3	0.4	0.5	0.6
Wall and roof panel	Transmission Loss	dB	12	18	33	54	53	36	42	42
Louver	Insertion Loss	dB	11	15	23	30	39	42	34	32

6.0 Results

6.1 BASELINE CASE

As indicated in section 4, the baseline acoustical environment is considered to be the reported noise impact according to the Genesee coal mine extension application (ACI 2011). The cumulative noise levels reported in the application include the noise effects of the following:

- mandated ASL;
- existing Genesee Generating Station (G1–G3);
- AltaLink substation 510S (Sunnybrook), and
- Genesee coal existing and expanded mine operation.

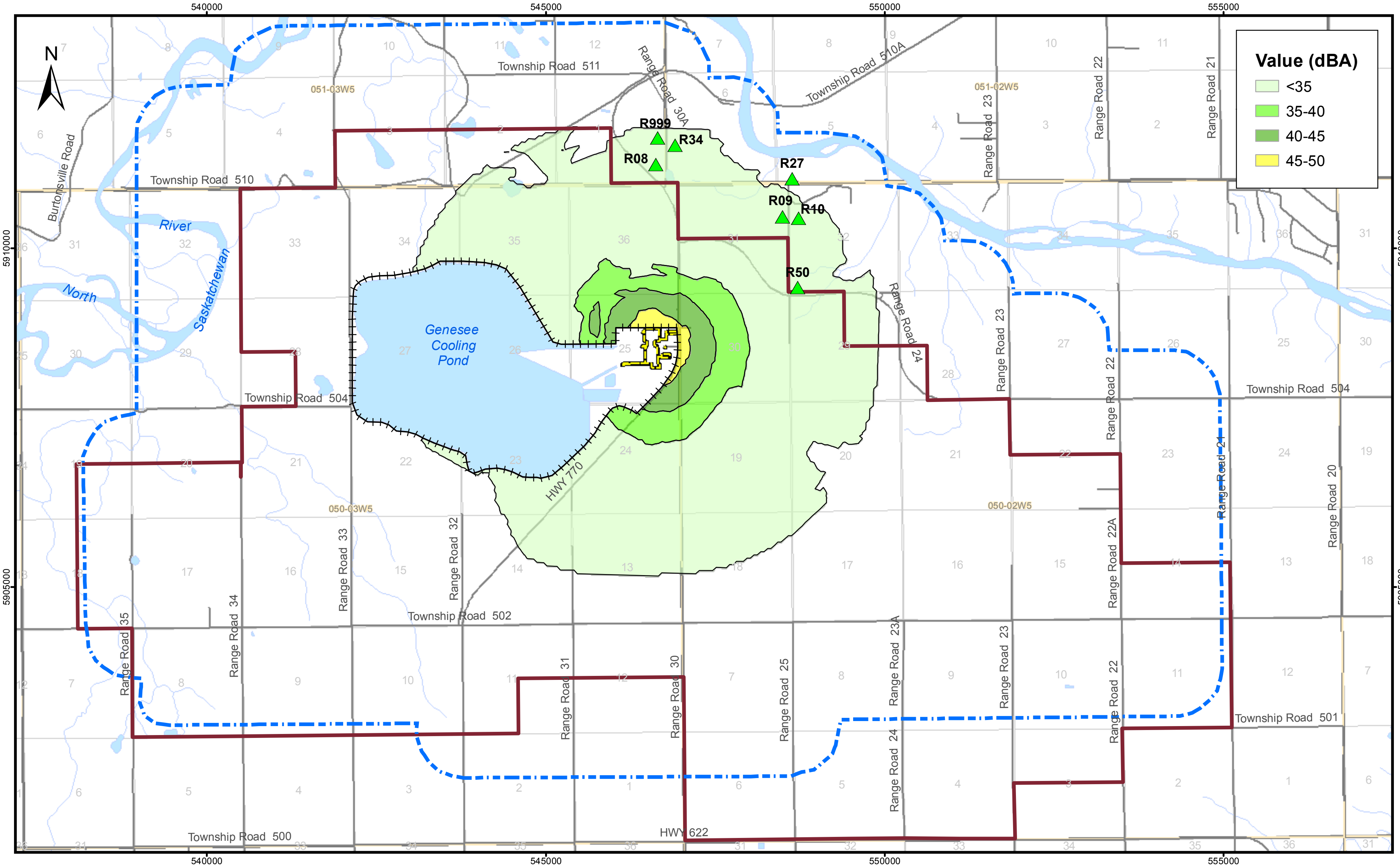
The baseline sound level is summarized in Table 6-1.

Table 6-1 Baseline Nighttime Noise Impact

Name	Nighttime ASL	AltaLink 510S Substation	Mine Application 2011 GGS and Sherritt Facilities Only	Baseline Sound Level
R_010	35	16.3	32.9	37.1
R_009	35	20.6	34.2	37.7
R_050	35	20.1	36.4	38.8
R_027	35	14.2	29.8	36.2
R_034	40	21.3	33.0	37.2
R_008	40	23.0	34.2	41.1
R_999	40	19.5	30.5	40.5

6.2 PREDICTED PROJECT NOISE EFFECT

This section discusses the potential noise effects of the Project on the surrounding areas. The noise effects from the Project is expected to be identical during daytime and nighttime hours Table 6-2 summarizes the model results for the Project only noise effects near the dwellings. Figure 6-1 presents the predicted noise contour map showing the noise contribution from the Project to the surrounding area.



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12/9/2013 By: alundell

December 2013
1102-19025

Stantec

Projection: 10TM AEP Forest Datum: NAD 83
Base data obtained from GeoBase®

Receptor
Project Boundary
Limit of Construction
ATS Township Grid
1.5 km AUC Cumulative Criteria Boundary
ATS Section Grid
Waterbody
Watercourse
Road
Mine Permit Boundary

0 1,000 2,000 3,000 4,000 5,000
1:80,000 Meters
This map is for reference purposes only

Client/Project
CAPITAL POWER CORPORATION
GENESEE GENERATING
STATION EXPANSION

Figure No.
6-1

Title
PROJECT ONLY DAYTIME AND NIGHTTIME NOISE CONTOURS

Table 6-2 Project Only Daytime or Nighttime Equivalent Sound Level

Receptor ID	Project Only Daytime or Nighttime L_{eq} (dBA)
R_010	27.4
R_009	27.7
R_050	29.3
R_027	23.4
R_034	27.5
R_008	28.6
R_999	27.3

The highest predicted sound level of 29.3 dBA is at the closest (receptor R50 northeast of the Project. The predicted sound level at the closest dwelling is 5.7 dB lower than the mandated ambient sound level of 35 dBA during nighttime hours, and 9.5 dB below the baseline noise impact. The Project noise effect will result in an increase of less than 3 dB from the ASL, without the consideration of other existing energy-related facilities. A sound level increase of 3 dB or less is considered to be just perceptible (Bies and Hansen 2009). A 5 dB sound level increase is considered to be clearly noticeable, and a difference of 10 dB indicates that humans experience the sound level as half as loud. This indicates that the predicted noise impact from the Project can be classified as just perceptible.

6.3 POTENTIAL NOISE MITIGATION

Additional noise mitigation for the Project was provided to achieve compliance with the PSL. Only noise mitigation for G4 and G5 was considered in this assessment. The additional noise mitigation included:

- adding more silencers for the combustion air intakes for both G4 and G5;
- adding stack silencers for both G4 and G5;
- limiting the PWL for both step-up transformers to 105 dBA under full load, as included in Table 5-9.

Table 6-3 includes the acoustic performance of silencers recommended for the GT air combustion inlet (additional silencer) and the exhaust stack as potential noise mitigation for G4 and G5.

Table 6-3 Silencer Dynamic Insertion Loss

Description	31.5	63	125	250	500	1000	2000	4000	8000
G4, G5 stack silencer	3	7	11	15	19	23	14	14	14
GT Combustion Air intake additional GT Combustion air inlet silencer	5	11	15	23	30	39	42	34	32

Besides implementing the noise mitigation measures described in Table 6-3, which involve reducing noise levels from the Project (G4 & G5), another possibility to reducing noise levels from the GGS site collectively to achieve post-construction compliance with AUC Rule 012 is to reduce the noise levels from the existing GGS (G1 to G3). Reductions in noise levels from the existing GGS may partly or entirely offset the requirements for the noise mitigation measures outlined above solely for the Project.

The baseline noise impact resulting from the existing GGS is predicted to be 36.4 dBA at the closest and most affected receptor R50, whereas the Project only noise impact is predicted to be 29.3 dBA. These noise levels suggest that reducing the noise impact from the existing GGS may be a more effective approach to mitigating the noise impact from the Project. To optimize its noise mitigation efforts, Capital Power will assess the effects of potential noise mitigation for Units G1-G3 to achieve compliance with the PSL, taking the Project noise contribution into account.

6.4 CUMULATIVE EFFECT ASSESSMENT AND COMPLIANCE

6.4.1 Broadband Noise Assessment

The predicted cumulative sound level (Baseline case and Project Only Sound levels) is summarized and assessed against the PSL in Table 6-4.

Table 6-4 Assessment of Noise Impact

Receptor ID	Mine Application 2011 Facilities Only	2011 mine appl. Total Noise Impact	Project Only Noise Impact	Cumulative Noise Impact	Nighttime PSL	Compliant?
R_010	33.0	37.1	27.4	37.6	40	yes
R_009	34.4	37.7	27.7	38.1	40	yes
R_050	36.5	38.8	29.3	39.3	40	yes
R_027	29.9	36.2	23.4	36.4	40	yes
R_034	33.3	37.2	27.5	37.7	45	yes
R_008	34.5	41.1	28.6	41.3	45	yes
R_999	30.5	36.3	27.3	36.8	40	yes

The cumulative noise impact is approximately 10 dB or more higher than the Project only noise impact, indicating that the increase in noise levels is expected to be negligible (less than 1 dB). Thus, the noise impact from the Project is expected to also be negligible. The predicted cumulative sound level meets the PSL at all dwellings. Therefore, the cumulative effects of the Project are predicted to be in compliance with Rule 012.

6.4.2 Predicted Low Frequency Noise Assessment

The Project Only results in Table 6-4 indicate that the difference between the C-weighted (dBC) and A-weighted (dBA) sound levels are higher than 20 dBA.

The predicted difference between dBA and dBC values is more than 20 dB; this seems to indicate there is some potential for low frequency noise (LFN) effects from the Project. The LFN analysis is often conducted for Project Only noise contribution, as is included in Table 6-5. However, the cumulative noise effects from the combined facilities may affect the soundscape near the selected dwellings. Stantec therefore believes that is more representative to assess the difference between the cumulative facilities only noise effects, expressed in dBC and in dBA. If the A and C-weighted results from the Genesee coal mine extension application (Sherritt 2011) are applied in a cumulative LFN analysis, the dBC minus dBA results are less than 20 dB at all receptors, as shown in Table 6-6. This indicates that there is low potential for LFN concerns near dwellings.

Table 6-5 Project Only Low Frequency Noise Analysis

Receptor ID	Project Only Daytime or Nighttime L_{eq}			dBC - dBA
	A-weighted dBA	C-weighted dBC	Linear dBZ	
R_010	27.4	49.8	50.6	22
R_009	27.7	50	50.7	22
R_050	29.3	51.8	52.6	23
R_027	23.4	45.9	46.7	23
R_034	27.5	50.1	50.9	23
R_008	28.6	51.1	51.9	23
R_999	27.3	50.1	50.8	23

Table 6-6 Cumulative Low Frequency Noise Analysis

Receptor ID	Cumulative Facilities Only Sound Level (dBA)	Project Only Daytime or Nighttime L_{eq}			dBC - dBA
		Project Only (dBC)	Sherritt NIA (dBC)	Cumulative results (dBC)	
R_010	34.1	49.8	48.8	52.3	18.3
R_009	35.2	50	50.2	53.1	17.9
R_050	37.3	51.8	52.4	55.1	17.9
R_027	30.8	45.9	46.7	49.3	18.5
R_034	34.3	50.1	49.3	52.7	18.4
R_008	35.5	51.1	50.0	53.6	18.1
R_999	30.5	50.1	46.9	51.8	19.4

7.0 Follow-Up and Noise Management

Capital Power is committed to managing noise issues and to promptly responding to any noise complaints. CPC has conducted regular noise monitoring around its facilities since 2006 at selected dwellings. Capital Power considers a "no net increase" noise effect from the Project; however, cumulative noise levels are expected to be close to the PSL near several dwellings included in this study. Therefore, Capital will consider the following noise follow-up and management plans:

- Request noise guarantees from its vendors for this Project;
- Verify the noise footprint of the Project by:
  - Verifying the PWL from major equipment by conducting post construction noise measurements near that equipment;
  - Using the verified PWL, together with as-built plot plans and cross sections to keep the computer noise model, used in this assessment, up to date;
  - Conducting post-construction noise measurements in the far field to verify the computer noise model, at receptor locations where this makes sense from an acoustical perspective;
- Verify the noise emissions from its current generating facilities;
- Verify the possible noise mitigation options for both the Project and the existing generating facilities G1, G2, and G3 to maintain compliance with the PSL;
- Assess mitigation measure options for the dominant noise emissions in the current generating facilities;
- Results from this program will be shared with the AUC.

8.0 Summary and Conclusions

This assessment has been conducted to predict the noise effects associated with the construction and operation of a proposed expansion of Capital Power's existing Genesee Generating Station (GGS), which has a gross capacity of 1376 MW. The proposed expansion consists of two identical natural gas-fired combined cycle turbines that are referred to as the Genesee Generating Station Units 4 & 5 Project, together "the Project". The Project is located in Leduc County, north of Warburg, Alberta (Sec 25 of 50-3 W5M), approximately 80 km southwest of Edmonton.

The closest dwelling is situated northeast of the Project Boundary at a distance of 1.9 km. This is the closest and most impacted dwelling. The Permissible Sound Level (PSL) of 50 dBA daytime and 40 dBA nighttime applies to the closest dwelling. Other dwellings within the study area are located at larger distances from the Project boundary. The noise impact resulting from the Project at dwellings within 3 km from the Project has been predicted. These predictions are based on information provided by Capital Power, and using internationally accepted sound propagation algorithms (ISO 9613).

The key findings of the study are:

- Predicted sound level contributions from the Project are below the existing noise levels at all dwellings, and are also below the mandated ASL at all dwellings.
- The predicted cumulative sound level (i.e., facility contribution plus mandated ASL) for the most impacted dwelling is below the PSL for both the nighttime period and the daytime period.
- The potential for Low Frequency Noise (LFN) was considered in this assessment. The results indicate no potential for LFN at the closest dwelling.

Respectfully submitted,

Stantec Consulting Ltd.

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Appendix A Commonly Used Noise Terminology

Airborne Sound—Sound that reaches the point of interest by propagation through air.

Ambient Noise—All noises that exist in an area and are not related to a facility. Ambient noise includes sound from other industrial noise not subject to this directive, transportation sources, animals, and nature. Ambient noise is the same as background sound level.

Ambient Sound Level (ASL)—The ASL consists of all noise in the area that is not related to regulated facilities. This noise includes sound from other non-regulated industrial facilities, transportation sources, animals and nature. The ASL does not include any energy-related industrial component and must be measured without it. The ASL can be measured when the sound level in an area is not felt to be represented by the BSLs. The ASL must be measured under representative conditions. As with comprehensive sound levels, representative conditions do not constitute absolute worst-case conditions (i.e., the quietest day in this case) but conditions that portray typical conditions for the area.

Attenuation—The reduction of sound intensity by various means (e.g., air, barrier, porous materials, silencers, enclosures, etc.).

Background Sound Level (i.e., Baseline)—It includes noise from all sources other than the sound of interest (i.e., sound other than that being measured, for example, sound from other industrial noise not being measured, transportation sources, animals, and natures sound).

Bands (octave, 1/3 octave)—A series of electronic filters separate sound into discrete frequency bands, making it possible to know how sound energy is distributed as a function of frequency. Each octave band has a centre frequency that is double the centre frequency of the octave band preceding it.

Basic Sound Level (BSL)—The A-weighted L_{eq} sound level commonly observed to occur in the designated land-use categories with industrial presence. The BSL is assumed to be 5 dBA above the ASL and is set out in Table 1 of *OGC 2009*.

Calibration—The procedure used for the adjustment of a sound level meter using a reference source of a known sound pressure level and frequency. Calibration must take place before and after the sound level measurements.

Calibrator (Acoustical)—A device which produces a known sound pressure on the microphone of a sound level measurement system, and is used to adjust the system to standard specifications.

Category—A classification of a dwelling unit in relation to transportation routes used to arrive at a BSL.

Class A Adjustment—Consists of the sum of adjustments that account for the adjustment seasonal nature of the noise source, absence of both tonal and impulse/impact components, and the actual ASL in an area. It cannot exceed +10 dBA. The Class A adjustment is added to the BSL, the daytime adjustment, and the Class B adjustment to arrive at a permissible sound level.

Class B Adjustment—An adjustment based on the duration of a noisy activity that recognizes that additional noise can be tolerated if it is known that the duration will be limited. An adjustment of B1, B2, B3, or B4 may be selected as applicable.

Comprehensive Sound Level (CSL)—The sound level that is a composite of different airborne sounds from many sources far away from and near the point of measurement. The CSL does include industrial components and must be measured with them, but it should exclude abnormal noise events.

Daytime—Defined as the hours from 07:00 to 22:00.

Daytime Adjustment—An adjustment that allows a 10 dBA increase because daytime sound levels are generally about 10 dBA higher than nighttime values.

dB - Decibel—The logarithmic units associated with sound pressure level, sound power level, or acceleration level. See sound pressure level, for example.

dBA - Decibel, A-Weighted—The logarithmic units associated with a sound pressure level, where the sound pressure signal has been filtered using a frequency weighting that mimics the response of the human ear to quiet sound levels. The resultant sound pressure level is therefore representative of the subjective response of the human ear. A-weighted sound pressure levels are denoted by the suffix 'A' (i.e., dBA), and the term pressure is normally omitted from the description (i.e., sound level or noise level).

dBC - Decibel, C-Weighted—The logarithmic units associated with a sound pressure level, where the sound pressure signal has been filtered using a frequency weighting that mimics the response of the human ear to loud sound levels. C-weighted sound pressure levels are denoted by the suffix 'C' (i.e., dBC). C-weighted levels are often used in low-frequency noise analysis, as the filtering effect is nearly flat at lower frequencies.

Decibel Addition:

In acoustics, due to the logarithmic nature of the decibel scale, the addition of two or more sound pressure levels (denoted as SPL1, SPL2 … SPLn) is done as follows:

$$SPL1 + SPL2 + \ldots SPLn = 10 \log \left(10^{(SPL1/10)} + 10^{(SPL2/10)} + \ldots + 10^{(SPLn/10)}\right)$$

As an example:

0 dB + 0 dB = 3 dB

50 dB + 50 dB = 53 dB

50 dB + 47 dB = 52 dB

50 dB + 40 dB = 50 dB

Directivity Factor (Q) (also, Directional or Directionality Factor)—A factor mathematically related to Directivity Index, used in calculating propagated sound levels to account for the effect of reflecting surfaces near to the source. For example, for a source in free space where the sound is radiating spherically, Q = 1. For a source located on or very near to a surface (such as the ground, a wall, rooftop, etc.), where the sound is radiating hemispherically, Q = 2. This accounts for the additional sound energy reflecting off the surface, and translates into a +3 dB addition.

Dwelling Unit—Any permanently or seasonally occupied dwelling with the exception of an employee or worker dwelling, dormitory, or construction camp located within an industrial plant boundary. Trailer parks and campgrounds may qualify as a dwelling unit if it can be demonstrated that they are in regular and consistent use during the applicable season.

Dwelling Unit (most impacted)—The nearest dwelling unit may not necessarily be the one most adversely affected because of factors such as topography or man-made features. For example, the nearest dwelling unit to a facility may be located behind an intervening ridge, while a more distant dwelling unit may be in direct line of sight with the facility. Care must be taken in determining the most impacted dwelling unit.

Emergency—An unplanned event requiring immediate action to prevent loss of life or property. Events occurring more than four times a year are not considered unplanned.

Energy Equivalent Sound Level (L_{eq})—An energy-average sound level taken over a specified period of time. It represents the average sound pressure encountered for the period. The time period is often added as a suffix to the label (e.g., L_{eq}(24) for the 24-hour equivalent sound level). L_{eq} is usually A-weighted. An L_{eq} value expressed in dBA is a good, single value descriptor of the annoyance of noise.

Far Field—Describes a region in free space where the sound pressure level from a source obeys the inverse-square law (the sound pressure level decreases 6 dB with each doubling of distance from the source). The far field is that area far enough away from the noise source that the noise emissions can be treated as if they come from a single point or line source and the individual components of the noise source are not apparent as separate sources. This is typically at a distance of at least three to five times the major dimensions of the noise sources.

Filter—A device separating the components of an incoming signal by its frequencies.

Free Sound Field (Free Field)—A sound field in which the effects of obstacles or boundaries on sound propagated in that field are negligible.

Frequency—The number of times per second that the sine wave of sound or of a vibrating object repeats itself. Now expressed in hertz (Hz), formerly in cycles per second (cps).

Frequent Aircraft Flyovers—Used in the assessment of categories as part of a site specific analysis for dwellings that lie within a contour area with a noise exposure forecast (NEF) 25 or greater, as designated by Transport Canada. In the absence of any NEF contours for local airport, Transport Canada is to be contacted for current air traffic statistics. In this case, to qualify for the BSL adjustment, a dwelling must be within 5 km of an airport that has a minimum of nine aircraft takeoffs or landings over the nighttime period.

Heavily Travelled Road—Generally includes highways and any other road where the average traffic count is at least 10 vehicles per hour over the nighttime period. It is acknowledged that highways are sometimes lightly travelled during the nighttime period, which is usually the period of greatest concern.

Heavy Truck—Any truck having a gross vehicle weight of 12,000 kg or more and having three or more axles.

Hertz (Hz)—Unit of measurement of frequency, numerically equal to cycles per second.

Human Perception of Sound—The human perception of noise impact is an important consideration in qualifying the noise effects caused by projects. Table C-1 presents a general guideline.

Insertion Loss (IL)—The arithmetic difference between the sound level from a source before and after the installation of a noise mitigation measure, at the same location. Insertion loss is typically presented as a positive number, i.e., the post-mitigation sound level is lower than the pre-mitigation level. Insertion loss is expressed in dB and is usually specified per 1/1 octave band, per 1/3 octave band, or overall.

Intensity—The sound energy flow through a unit area in a unit time.

Low Frequency Noise (LFN)—Noise in the low frequency range, 20 Hz up to 250 Hz, where a clear tone is present below and including 250 HZ and the difference between the overall C-weighted sound level and the overall A-weighted sound level exceeds 20 dB.

Masking—a) The process by which the threshold of audibility for a sound is raised by the presence of another (masking) sound.

Near Field—The region or sound field very near to a source, where sound pressure does not obey the inverse-square law (i.e., 6 dBA loss per doubling of distance for a point source does not apply). Usually this region is located within a few wavelength of the source and is also controlled by the dimension of the source.

Nighttime—Defined as the hours from 22:00 to 07:00.

Noise—Unwanted sound.

Noise Exposure Forecast (NEF)—The NEF contours are site specific to each airport and take into account such factors as traffic levels, proximity to runways, flight paths, and aircraft type and size.

Noise Impact Assessment (NIA)—An NIA identifies the expected sound level emanating from a facility as measured 15 m from the nearest or most impacted permanently or seasonally occupied dwelling. It also identifies what the permissible sound level is and how it was calculated.

Noise Level—Same as Sound Level, except applied to unwanted sounds.

Permanent Facility—Any existing or proposed facility that will be at a location longer than two months.

Permanently Occupied Dwelling—A fixed dwelling occupied on a full-time basis.

Permissible Sound Level (PSL)—The maximum sound level that a facility should not exceed at a point 15 m from the nearest or most impacted dwelling unit. The PSL is the sum of the BSL, daytime adjustment, Class A adjustment, and Class B adjustment.

Pristine Area—A pure, natural area that might have a dwelling but no industrial presence, including energy, agricultural, forestry, manufacturing, recreational, or other industries that could make noise generation a consideration.

Representative Conditions—Those conditions typical for an area and/or the nature of a complaint. For ASLs, these are conditions that portray the typical activities for the area, not the quietest time. For CSLs, these do not constitute absolute worst-case conditions or the exact conditions the complainant has highlighted if those conditions are not easily duplicated. Sound levels must be taken only when representative conditions exist; this may necessitate a survey of extensive duration (two or more consecutive nights).

Seasonally Occupied Dwelling—A fixed dwelling that, while not being occupied on a full-time basis, is occupied on a regular basis. A regular basis does not imply a scheduled occupancy but implies use of six weeks per year or more. The dwelling must not be mobile and should have some sort of foundation or features of permanence (e.g., electrical power, domestic water supply, septic system) associated with it. Summer cottages or mobile homes are examples of seasonally occupied dwellings, while a holiday trailer simply pulled onto a site is not.

Sound—A dynamic (fluctuating) pressure.

Sound Level (SL)—The A-weighted Sound Pressure Level expressed in dBA.

Sound Level Meter—An instrument comprised of a microphone, amplifier, output meter, and frequency-weighting networks which is used for the measurement of noise and sound levels.

Sound Pressure Level (SPL)—The logarithmic ratio of the RMS sound pressure to the sound pressure at the threshold of hearing. The sound pressure level is defined by equation (1) where P is the RMS pressure due to a sound and P_0 is the reference pressure. P_0 is usually taken as 2.0×10^{-5} Pascals.

$$SPL\ (dB) = 20 \log(P_{RMS}/P_0)$$

Sound Power Level (PWL)—The logarithmic ratio of the instantaneous sound power (energy) of a noise source to that of an international standard reference power. The sound power level is defined by equation (2) where W is the sound power of the source in watts, and W0 is the reference power of 10^{-12} watts.

$$PWL\ (dB) = 10 \log(W/W_0)$$

Inter-relationships between sound pressure level (SPL) and sound power level (PWL) depend on the location and type of source.

Spectrum—The description of a sound wave's resolution into its components of frequency and amplitude.

Tonal Components—Most energy industrial facilities typically exhibit a tonal component. Examples of tonal components are transformer hum, sirens, and piping noise. The test for the presence of tonal components consists of two parts.

The first part must demonstrate that the sound pressure level of any one of the slow-response, A-weighted, 1/3-octave bands between 20 and 16 kHz is 10 dBA or more than the sound pressure level of at least one of the adjacent bands within two 1/3-octave bandwidths. In addition, there must be a minimum of a 5 dBA drop from the band containing the tone within 2 bandwidths on the opposite side. The second part is that the tonal component must be a pronounced peak clearly obvious within the spectrum

Transmission Loss—A measure of the reduction in sound energy resulting from incident sound waves striking a wall, partition or enclosure, and radiating through to the other side. Mathematically, the transmission coefficient t is the ratio of transmitted acoustic power to the incident acoustic power, and in decibels, the Transmission Loss (TL) of the wall is:

$$TL = 10 \log (1 / t)$$

The TL of a wall varies by frequency. The associated noise reduction (NR) due to the TL of the wall is a function of the TL and the acoustical parameters of the receiving space. For noise radiating from an enclosure into the outdoors, NR $\approx \square(TL + 6)$.

Windscreen—A specialized piece of porous sponge that fits over the microphone in order to reduce the noise generated by the wind blowing around the microphone, that is useful in moderately low wind speeds. Generally, outdoor measurements are not recommended when wind speeds exceed 15 km/hour, as the wind-induced noise on the microphone becomes of the same magnitude as the levels being measured.

Appendix B PSL Determination