APPENDIX 3-V

NOISE MODELLING METHODS

TABLE OF CONTENTS

SECTION **PAGE**

LIST OF TABLES

LIST OF FIGURES

1 DEFINITIONS

1.1 INTRODUCTION TO NOISE TERMINOLOGY

Noise can be described as “unwanted” sound, and the terms noise and sound are often used interchangeably. However, for the assessment, sound will be used to describe emissions while noise will be used to describe the levels at a receptor.

The following lists some of the key terminology that is used in the noise assessment:

- “Sound” or “sound emissions” refer to the acoustic energy generated by natural or man-made sources.
- “Noise” or “noise levels” refer to the levels that can be heard or measured at a receptor.
- A noise “receptor” is a location where measurements or predictions of noise levels are made.
- The “volume” of a sound or noise is expressed on a logarithmic scale, in units called decibels (dB). Since the scale is logarithmic, a sound or noise that is twice as loud as another will only be 3 dB higher. A sound or noise with double the number of decibels is much more than twice as loud.
- Sound emissions and noise levels also have a “frequency”. The human ear does not respond to all frequencies in the same way. Mid-range frequencies are most readily detected by the human ear, while low and high frequencies are harder to hear. Environmental noise levels are usually presented as dBA, which incorporates the frequency response of the human ear.
- While low frequency noise may not be “heard”, it can often be felt. A “C-weighted” decibel (or dBC) is a frequency-weighting in which the low frequencies are included more than with A weighting, making this unit useful in determining potential for low frequency noise impacts.
- Low Frequency Noise (LFN) is the portion of sound below a defined spectrum band. As per Energy Resources Conservation Board (ERCB) (formerly known as the Alberta Energy and Utilities Board (EUB)) Directive 038 (EUB 2007), LFN is defined as either a clear tone present below a frequency of 250 Hz or where the overall dBC minus dBA value exceeds 20 dB.
- Outdoor or environmental noise levels are typically not steady or continuous. To account for the time-varying nature of environmental noise, levels are usually expressed as energy equivalent sound levels, or

L_{eq}. The L_{eq} is defined as the continuous sound level that has the same acoustic energy as the varying sound for a given time period. This is expressed as a logarithmic average of the measured or predicted noise levels over a given period of time. For constant sources of noise, the sound level and L_{eq} are the same. The noise levels discussed in the assessment represent equivalent sound levels (L_{eq}).

- "Sound power level" or L_w is the level of sound power, expressed in decibels (dB) relative to a stated reference value of 1 x 10^{-12} Watt (dB re 10^{-12} Watts).
- "Sound Pressure Level" or L_p is the difference between the instantaneous pressure at a fixed point in a sound field, and the pressure at the same point with the sound absent. It is quantified by the following equation:

$$\mathbf{L_p} = 10 \log_{10}(p_{rms}/p_{ref})^2$$

Where p_{rms} is the root mean square sound pressure and p_{ref} is the reference root mean square sound pressure of 20×10^{-6} Pascal.

Noise levels from common sources are provided in Table 1 to give that will provide the reader a reference when comparing the noise levels predicted from the Project. The noise levels listed in the tables represent average values and could vary from one situation to the next.

Table 1 Summary of Noise Levels Associated With Common Activities

Activity	Noise Level [dBA]
lawnmower	95
loud shout	90
motorcycle passing 15 m away	85
car travelling 100 km/hr passing 15 m away	80
vacuum cleaner	75
faucet	62
normal conversation	60
moderate rainfall	50
bird singing	50
quiet living room	40
whispered speech	40
average rural sound level at night	35

1.2 NOISE PREDICTION METHODS

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

1.2.1 Addition of Noise Levels

Since noise levels are measured on a logarithmic scale, the combined effect of multiple sources is calculated accordingly.

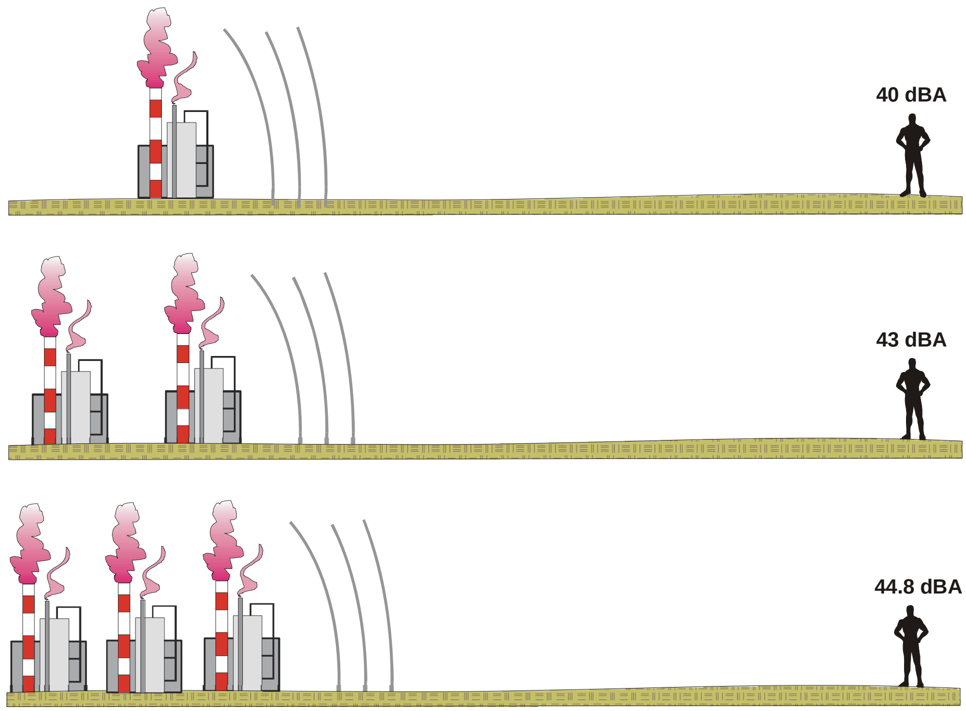
The following formula is used to combine multiple sources:

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

Where K is the total number of sound pressure levels.

The effects of additional noise sources on ambient noise levels are illustrated in Figure 1. If the sound emitted from a single facility results in noise levels of 40 dBA, then the emissions from two facilities would result in noise levels of 43 dBA. Therefore, a doubling of the sound emissions would result in a 3 dBA increase in the noise levels. When the emissions from a third facility are added, the noise level increases to 44.8 dBA.

Figure 1 Addition of Multiple Sources of Noise



1.2.2 Attenuation of Noise in the Environment

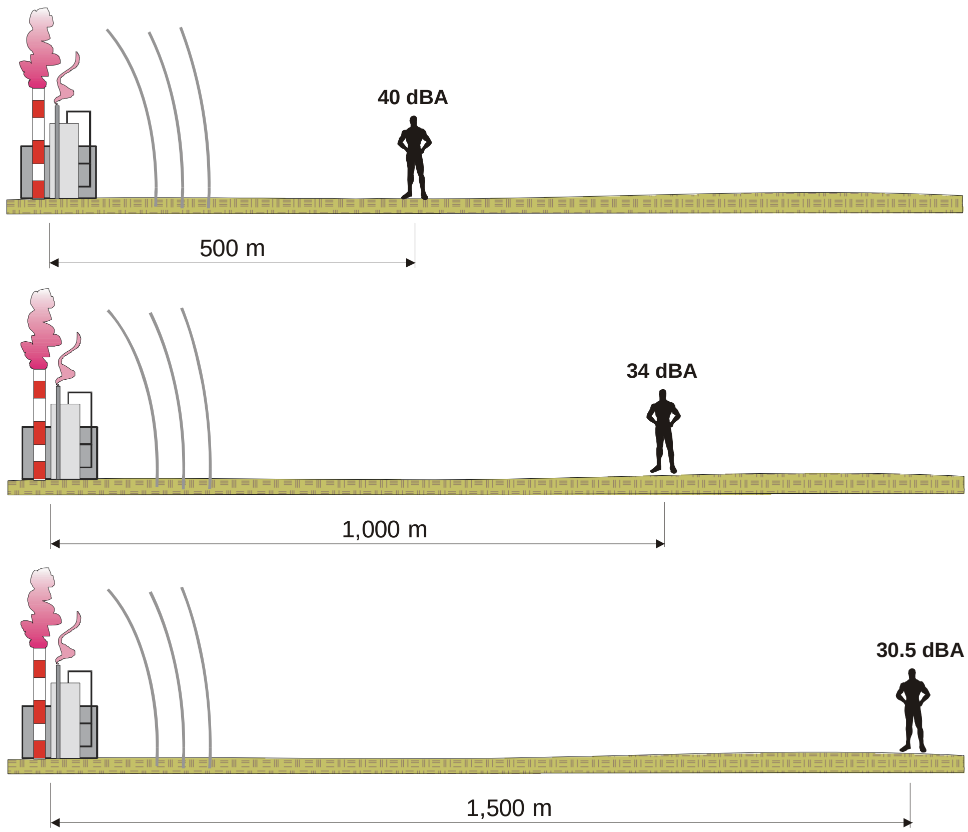
There are several factors that can mitigate noise emissions in the environment. These mitigating factors are referred to as noise attenuation. The most important factor for noise attenuation is the distance between the source and the receptor.

As distance increases, noise levels decrease. For facilities, the noise levels at increased distances can be calculated using the following formula (ERCB Directive 038 – Appendix 03):

$$\mathbf{L(R_2)} = L(R_1) - 20\ Log_{10}(R_2/R_1)$$

The effect of distance on noise levels is illustrated in Figure 2. The figure illustrates that a doubling of the distance from a facility results in a 6 dBA reduction in the noise levels. Therefore, increasing the distance from 500 to 1,000 m will drop the noise level from 40 to 34 dBA. Increasing the distance another 500 m from 1,000 to 1,500 m would decrease the noise level from 34 to 30.5 dBA.

Figure 2 Effect of Distance in Attenuating Noise Levels



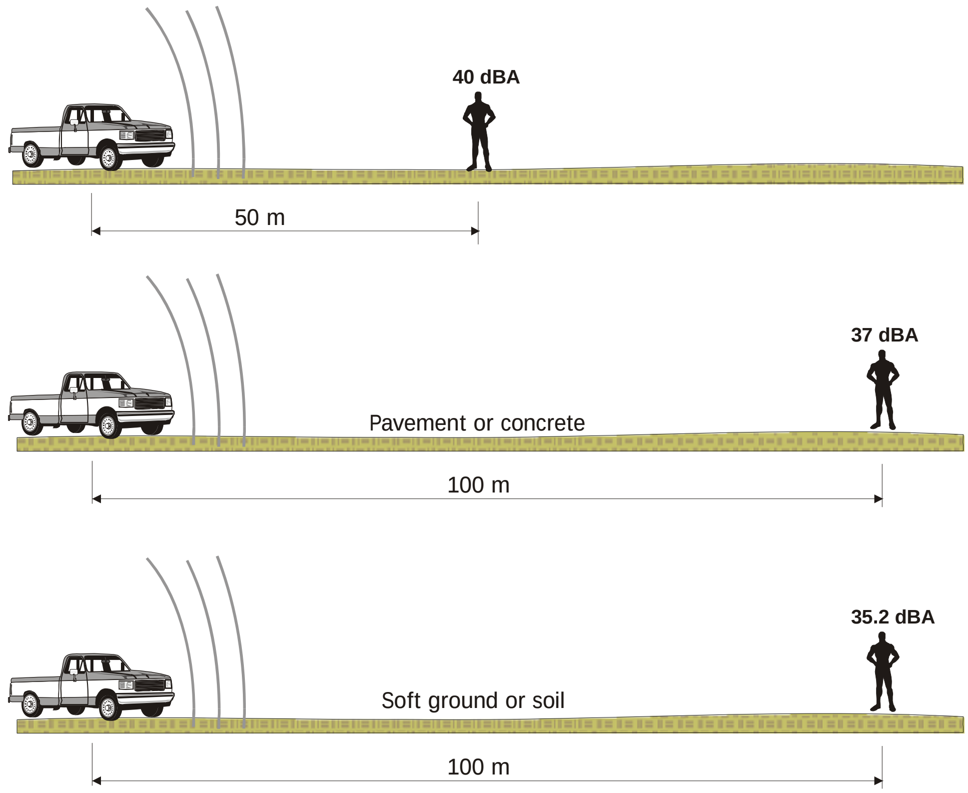
Noise from a roadway acts in a slightly different manner. The noise from a roadway is emitted along the entire length. As distance increases, the noise levels decrease at a slower rate than from a facility.

The amount that the noise decreases can be calculated using the following formula (OMOE 1989, 1999):

$$dBAL_{P(R2)} = dBAL_{P(R1)} - 10 \times (1+\alpha) \times \log\left(\frac{R_1}{R_2}\right)$$

In the above formula, the alpha term (α) is added to account for the nature of the ground surface between the road and the receptor. For paved or concrete surfaces, α is equal to zero. Therefore, a doubling of the distance from a paved or concrete roadway would result in a 3 dBA reduction in the noise levels (Figure 3). In most rural situations, the ground between the road and the receptor is soft, and covered with vegetation. In these situations, α would be larger than zero (typically in the range of 0.6). With the same doubling of distance, the noise level drops from 40 to 35.2 dBA when the ground between the roadway and receptor is soft.

Figure 3 Effect of Distance in Attenuating Roadway Noise Levels

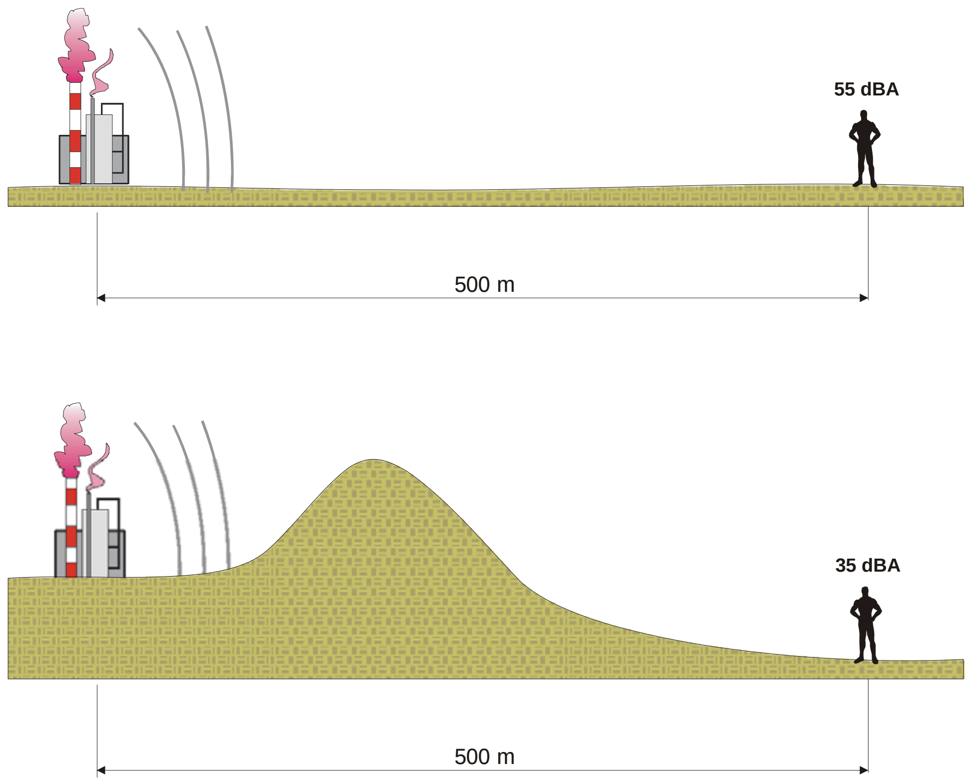


Several other environmental factors will result in attenuation of emitted sounds. These include the absorption of sound by air, the effect of barriers or hills on noise levels and the effect of trees and ground on the emitted noise.

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

Barriers and hills can also attenuate sound in the environment. As the sound waves “bend” around obstructions, they lose a great deal of energy. This phenomenon explains the use of barriers along major highways in urban areas. This also explains why people do not usually hear sounds from sources that are behind hills. The amount of attenuation afforded by an obstruction is a function of the amount the sound waves bend. Therefore, the attenuation is greatest close to the source, and is less effective at greater distances. Figure 4 illustrates how hills can attenuate industrial sounds.

Figure 4 Effect of Obstacles on the Attenuation of Sound



Another type of attenuation is the effect of trees on noise levels. Since trees are not solid they do not act the same as a barrier. However, a stand of trees can afford a good deal of attenuation if they are sufficiently deep and tall. The degree of attenuation is a function of the frequency of the noise, the trees species, the extent of trees and whether there are any edge effects. In evaluating noise for the Project, trees were not considered due to the complexity of such modelling. This will result in a conservative assessment since there are substantial stands of trees between the site and some receptors.

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

In addition to environmental attenuation from distance, ground obstructions, trees and other natural features, man-made features can also reduce sound levels.

Project buildings, weather enclosures, exhaust mufflers and other similar components reduce the amount of noise effects from facilities. Noise-reducing components can be designed to increase reductions in noise emissions beyond what would otherwise result (e.g., addition of extra insulation to structures).

2 NOISE MODELLING

2.1 MODEL SELECTION

In selecting a prediction model to evaluate noise levels due to sound emitted from the Project, the following key conditions were considered:

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

The Computer Aided Noise Attenuation (CadnaA) prediction model (developed by DataKustik GmbH 2007) was identified as appropriate for assessing the noise impacts associated with the Project. The algorithms used by the model are consistent with ERCB directives and guidelines. The model was used to determine the hourly L_{eq} generated by the Project Case activities at the selected sensitive receptors. It was also used to indicate where noise from the operations may occur in the areas surrounding the site, for each key operating scenario.

The model has the capability to simulate emission sources such as roads, railways, airports and industrial facilities, which are represented as a series of point, line and area sources. Each source type can be characterized by entering noise emissions in terms of total noise or as the frequency components of the emission. Other parameters such as building dimensions, frequency of use, hours of operation, equipment enclosure noise attenuation ratings, traffic (ground or air) composition and traffic volumes also define the nature of noise emissions. The CadnaA model also accounts for noise attenuation related to meteorological (prevailing wind) conditions, ground cover and physical barriers, either natural (terrain based) or man-made.

2.2 NOISE MODELLING LIMITATIONS

The modelling of outdoor noise attenuation is conducted using standard algorithms and assumptions that tend to simplify the acoustic environment. Noise, whether natural or man-made, is normally variable over time. The algorithms and the L_{eq} indicator account for that variability, but do not predict it. The variation of noise sources over time can be addressed in the CadnaA model in many ways, depending on the noise source being assessed and the level of detail required.

The quality and relevance of predictions from the noise model is dependant on the data inputs. For the assessment, noise sources were established with actual field measurements of similar equipment or vendor sound emission data where available to ensure the accuracy of sources. Where spectral data was not available, typical spectrum data from acoustical literature was referenced to provide representative data.

The CadnaA model was designed to predict outdoor noise in accordance with *International Organization for Standardization (ISO) 9613 (1&2)*: *Attenuation of Sound During Propagation Outdoors* (ISO 9613) as well as several international and European acoustic standards. The ISO 9613 method predicts noise attenuation to within ±3 dBA. Supplier literature and third-party publications do not verify this level of accuracy for the CadnaA model. To validate that the CadnaA model meets the ISO standard, an independent study was completed that verified the model calculates the ISO method correctly and that simulations of outdoor noise levels match field measurements of a known source to within ±3 dBA (Drew et al. 2005).

2.3 SCIENTIFIC UNCERTAINTY

As indicated in Section 2.2, the modelling of outdoor noise attenuation is conducted using standard algorithms and assumptions that tend to simplify the acoustic environment. Normal variation of noise sources is addressed in the modelling depending on the noise source being assessed and the level of detail required.

The quality and relevance of predictions from the noise model is dependant on the data inputs. Sound emissions and site data used for the assessment were established with a high level of professional care to ensure the simulations were representative of the site.

The CadnaA model used for the assessment predicted noise levels in accordance with *International Organization for Standardization 9613 (1&2): Attenuation of Sound During Propagation Outdoors (ISO 9613)*. The ISO 9613 method predicts noise attenuation to within ±3 dBA.

2.4 MODEL CONFIGURATION

Table 2 lists the configuration of the calculation parameters used to complete noise modelling for the Project.

Table 2 Noise Model Configuration Parameters

Parameter	Model Setting	Description/Notes
standards	ISO 9613 only	all sources and attenuators are treated as required by the cited standard
source directivity	steam generator stack (90° directivity included) vertical/building sources applied to larger structures	building enclosures with indoor noise sources were modelled as structures with one horizontal area source (roof) and four vertical area sources along the sides; hence, directivity of the source emission and the barrier effect of the unit itself were included note the design process is not sufficiently advanced to warrant application of directionality to smaller sources such as air inlets
ground absorption	0.4	area is comprised of muskeg and boreal forest
temperature/humidity	10°C/ 70% Relative Humidity	average summer conditions for area
wind conditions	default ISO 9613 – moderate inversion condition	the propagation conditions in the ISO standard are valid for wind speeds between 4 and 18 km/hr; all points are considered downwind
terrain	no terrain considered (conservative scenario)	terrain in the area is relatively flat as no obvious ridges or natural barriers were identified in the field study
reflections	1	one reflection is taken into account as mirror image sources from reflecting structures (e.g., pre-engineered metal building).

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

3 SOURCE-SPECIFIC MODEL DATA

Tables 3 through 43 list the sound emission spectra for the various sources enclosed within each building associated with the Project. The sound pressure (Lp) or sound power (Lw) levels were used to calculate the noise emissions from each building in the modelling of the two following cases:

- Existing and Approved Case: Phases 1, 2 and 2B; and
- Project Case: Phases 1, 2, 2B and 3 (including Plant Facilities 3A and 3B).

Table 3 Emission Spectra Used for Modelling Project Case – 1-BU-191 Process Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
1P403A/B	Diluent Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
1PM403A/B	Diluent Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
1P415	Slop Oil Demulsifier Injection Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
1P501A/B	Reverse Demulsifier Injection Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
Total Inside Building		Lw	**104**	**105**	**106**	**108**	**109**	**111**	**109**	**104**	**98**	**115**	**117**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 4 Emission Spectra Used for Modelling Project Case – 1-BU-192 De-Oiling Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
1P120	Disposal Water Tank Feed Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
1PM120	Disposal Water Tank Feed Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		Lw	**98**	**99**	**101**	**103**	**104**	**106**	**104**	**99**	**92**	**110**	**112**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 5 Emission Spectra Used for Modelling Project Case – 1-BU-291 Water Treatment Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
1P202A/B	Raw Water Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
1PM202A/B	Raw Water Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
1P205A/B	Backwash Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
1PM205A/B	Backwash Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
1P263A/B	Regen Dilution Water Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
1PM263A/B	Regen Dilution Water Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
1P301A/B	Low Pressure Boiler Feed Water Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
1PM301A/B	Low Pressure Boiler Feed Water Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		Lw	**107**	**108**	**110**	**112**	**113**	**115**	**113**	**108**	**101**	**119**	**121**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 6 Emission Spectra Used for Modelling Project Case – 1-BU-391 Steam Generation Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
1P304A/B	High Pressure Boiler Feed Water Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
1PM304A/B	High Pressure Boiler Feed Water Pump Motor	Lp	69	69	72	74	77	77	76	71	63	82	83
1K310	Combustion Air Blower	Lp	88	88	82	85	82	80	75	73	72	85	93
1KM310	Combustion Air Blower Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
1K571A/B	Plant Instrument Air Compressor	Lp	77	77	76	74	74	76	80	79	75	85	86
1KM571A/B	Plant Instrument Air Compressor Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
1B305	Steam Generator	Lp	93	88	90	91	93	90	85	84	86	95	99.5
Total Inside Building		Lw	**117**	**114**	**114**	**115**	**116**	**115**	**112**	**110**	**109**	**120**	**124**

(a) Golder Acoustic Database – Steam generator exhaust stack measurement at similar Steam Assisted Gravity Drainage (SAGD) facility.

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 7 Emission Spectra Used for Modelling Project Case – 1-BU-491 Disposal Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
1P123A/B	Produced Water Booster Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
1PM123A/B	Produced Water Booster Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
1P125A/B/C	Produced Water Disposal Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
1PM125A/B/C	Produced Water Disposal Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
1P403A/B	Diluent Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
1PM403A/M	Diluent Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		Lw	**106**	**107**	**109**	**111**	**112**	**114**	**112**	**107**	**100**	**118**	**120**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 8 Emission Spectra Used for Modelling Project Case – 1-BU-551 Glycol Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
1P513A/B	Glycol Circulation Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
1PM513A/B	Glycol Circulation Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
1P516	Glycol Make-up Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
1PM516	Glycol Make-up Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		Lw	**98**	**99**	**101**	**103**	**104**	**106**	**104**	**99**	**92**	**110**	**112**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 9 Emission Spectra Used for Modelling Project Case – Phase 1 Outdoor Noise Emission Source

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power /Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
1B305	Steam Generator Stack	Lw	114	104	91	93	85	81	80	76	61	89	114
1EA510	Glycol Cooler	Lp	95	92	91	84	82	80	76	73	61	85	98
1H511	Glycol Heater	Lp	94	90	91	88	81	76	75	71	60	85	98
K041 and KM041	Wellpad ‘A’ Instrument Air Compressor Building	Lw	91	88	84	81	76	75	72	62	58	80	94
1AHU2910	Building 1-BU-291 Air Handling Unit and Motor	Lw	100	100	94	97	94	92	87	85	84	97	105
1P116A/B 1PM116	Induced Gas Flotation Eductor Pump and Motor	Lw	86	87	89	91	92	94	92	87	80	98	100

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003; Assumed sound pressure level of 85 dBA at 1m; Golder Acoustic Database – Steam generator exhaust stack measurement at similar SAGD facility; Golder Acoustic Database – Glycol Cooler measurement at similar SAGD facility.

Table 10 Emission Spectra Used for Modelling Project Case – 2-BU-190 Process Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2P110A/B/C	Sales Oil Transfer Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM110A/B/C	Sales Oil Transfer Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2P525	Recovered Diluent Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM525	Recovered Diluent Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**100**	**101**	**103**	**105**	**106**	**108**	**106**	**101**	**94**	**112**	**114**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 11 Emission Spectra Used for Modelling Project Case – 2-BU-192 De-Oiling Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2P117A/B	Induced Gas Flotation Froth Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM117A/B	Induced Gas Flotation Froth Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2P119	Skim Oil Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM119	Skim Oil Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2P120A/B	Produced Water Transfer Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM120A/B	Produced Water Transfer Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2P135A/B	Hot Line Softening Feed Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2P135A/B	Hot Line Softening Feed Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2P406A/B	Off-Spec Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2P406A/B	Off-Spec Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**104**	**105**	**107**	**109**	**110**	**112**	**110**	**105**	**98**	**116**	**117**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 12 Emission Spectra Used for Modelling Project Case – 2-BU-194 Oil Removal Facility Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2MXM136A/B	ORF Vessel Agitator Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**97**	**97**	**100**	**102**	**105**	**105**	**104**	**99**	**91**	**110**	**111**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 13 Emission Spectra Used for Modelling Project Case – 2-BU-290 Water Treatment Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2P205A/B	Hot Lime Softening Recirculation Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM205A/B	Hot Lime Softening Recirculation Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2P206A/B	After Filter Backwash Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM206A/B	After Filter Backwash Pump Motor	Lp	63	63	66	68	71	71	70	65	57	76	77
2P209A/B	Soft Acid Caption/Weak Acid Caption Feed Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM209A/B	Soft Acid Caption/Weak Acid Caption Feed Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2P218A/B	Dilution/Service Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM218A/B	Dilution/Service Pump Motor	Lp	74	75	76	78	78	81	78	74	68	85	86
2P301A/B/C	Low Pressure Boiler Feed Water Pump	Lp	72	72	75	77	80	80	79	74	66	85	86
2PM301A/B/C	Low Pressure Boiler Feed Water Pump Motor	Lp	74	75	76	78	78	81	78	74	68	85	86
2P551A/B	Utility Water Pump	Lp	61	62	63	65	65	68	65	61	55	72	73
2PM551A/B	Utility Water Pump Motor	Lp	74	75	76	78	78	81	78	74	68	85	86
2AHM2901	Water Treatment Building Air Handling Unit Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**105**	**106**	**108**	**110**	**111**	**113**	**111**	**106**	**99**	**117**	**118**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 14 Emission Spectra Used for Modelling Project Case – 2-BU-390 Steam Generation Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2PK330	Steam Generator Package	Lp	90	85	87	88	90	87	82	81	83	92	97
2K309	Air Make-Up Unit Blower, Steam Generator Building	Lp	88	88	82	85	82	80	75	73	72	85	93
2KM309	Air Make-Up Unit Blower Motor, Steam Generator Building	Lp	72	72	75	77	80	80	79	74	66	85	86
2K310	Combustion Air Blower	Lp	88	88	82	85	82	80	75	73	72	85	93
2K310	Combustion Air Blower Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	117	115	113	115	116	113	108	106	107	118	123

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003; Golder Acoustic Database – Steam generator exhaust stack measurement at similar SAGD facility.

Table 15 Emission Spectra Used for Modelling Project Case – 2-BU-393 Co-Generation Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2P304A/B/C	High Pressure Boiler Feed Water Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM304A/B/C	High Pressure Boiler Feed Water Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2K353A/B	Scanner Cooling Air Blower	Lp	88	88	82	85	82	80	75	73	72	85	93
2KM353A/B	Scanner Cooling Air Blower Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2P3172A/B	Gas Turbine/Generator Lube Oil Aerial Circulation Package Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM3172A/B	Gas Turbine/Generator Lube Oil Aerial Circulation Package Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2EAM3174A/B	Gas Turbine/Generator Lube Oil Aerial Cooler Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2EAM3175A/B	Gas Turbine/Generator Lube Oil Aerial Cooler Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2P3205	Gas Turbine Wash Water RO Feed Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
PK314	Gas Turbine/Generator Package	Lp	100	104	92	87	83	79	80	85	73	90	106
Total Inside Building		**Lw**	**126**	**130**	**120**	**117**	**116**	**116**	**114**	**113**	**104**	**121**	**133**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003; Golder Acoustic Database – manufacturer's published noise data of GE 7FA – pro-rated to represent Generator Turbine set in this assessment.

Table 16 Emission Spectra Used for Modelling Project Case – 2-BU-490 Diluent Pump Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2P403A/B	Diluent Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM403A/B	Diluent Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**97**	**98**	**100**	**102**	**103**	**105**	**103**	**98**	**91**	**109**	**111**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 17 Emission Spectra Used for Modelling Project Case – 2-BU-493 Slop Treater Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2P411	Slop Treater Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM411	Slop Treater Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**94**	**95**	**97**	**99**	**100**	**102**	**100**	**95**	**88**	**106**	**108**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 18 Emission Spectra Used for Modelling Project Case – 2-BU-553 Glycol Utility Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2K571A/B	Plant Instrument Air Compressor	Lp	67	67	66	64	64	66	70	69	65	75	76
2KM571A/B	Plant Instrument Air Compressor Motor	Lp	62	62	65	67	70	70	69	64	56	75	76
Total Inside Building		**Lw**	**93**	**93**	**94**	**94**	**96**	**96**	**98**	**95**	**91**	**103**	**104**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 19 Emission Spectra Used for Modelling Project Case – 2-BU-555 Vapour Recovery Unit Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2K593	Vapour Recovery Unit 1st Stage Compressor	Lp	76	76	75	73	73	75	79	78	74	84	85
2KM593	Vapour Recovery Unit Compressor Motor	Lp	69	69	72	74	77	77	76	71	63	82	83
2K593	Vapour Recovery Unit 2nd Stage Compressor	Lp	76	76	75	73	73	75	79	78	74	84	85
2KM593	Vapour Recovery Unit 2nd Stage Compressor Motor	Lp	69	69	72	74	77	77	76	71	63	82	83
Total Inside Building		**Lw**	**102**	**102**	**102**	**102**	**103**	**104**	**106**	**104**	**99**	**111**	**113**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 20 Emission Spectra Used for Modelling Project Case – 2-BU-557 Lift Gas Compressor Building

Tab #	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2K582A/B	Lift Gas Compressor	Lp	77	77	76	74	74	76	80	79	75	85	**86**
2KM582A/B	Lift Gas Compressor Motor	Lp	72	72	75	77	80	80	79	74	66	85	**86**
Total Inside Building		**Lw**	**103**	**103**	**104**	**104**	**106**	**106**	**108**	**105**	**101**	**113**	**114**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 21 Emission Spectra Used for Modelling Project Case – 2-BU-567 Potable Water Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2P569	Nanofilter Feed Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM569	Nanofilter Feed Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2P5693	Nanofiltration system Booster Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM5693	Nanofiltration System Booster Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2P5694	Clean In Place (CIP) Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2PM5694	Clean In Place (CIP) Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**103**	**104**	**106**	**108**	**109**	**111**	**109**	**104**	**97**	**115**	**116**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 22 Emission Spectra Used for Modelling Project Case – Phase 2 Outdoor Noise Emission Source

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2B305	Steam Generator Stack	Lw	114	105	92	94	85	82	81	77	62	90	115
2PK310	Gas Turbine Exhaust Stack	Lw	107	101	102	99	92	82	71	55	46	94	109
2PK350	Heat Recovery Steam Generator	Lw	112	114	108	100	93	84	83	81	71	97	117
2PK310	Gas Turbine Air Inlet	Lw	100.8	108.6	97.5	90	91.6	85.4	92.2	90.4	78.5	97	110
2P116A/B 2PM116	Induced Gas Floatation Eductor Pump and Motor	Lw	86	87	89	91	92	94	92	87	80	98	100
2EA510	Glycol Cooler	Lp	95	92	91	84	82	80	76	73	61	85	98
2PK518	Glycol Heater	Lp	94	90	91	88	81	76	75	71	60	85	98
2K041 & 2KM041	Wellpad 'B-E' Instrument Air Compressor Building	Lw	74	71	67	65	60	60	55	45	39	64	76
2AHU2001	Air Handling Unit and Motor for 2-BU-290	Lw	100	100	94	97	94	92	87	85	84	97	105
2PK360	Air Make-up unit for 2-BU-390	Lw	100	100	94	97	94	92	87	85	84	97	105
2PK590	Vapour Recovery Unit package	Lw	84	85	87	89	90	92	90	85	78	96	98

Source: MEG 2007 Pers. Comm.; Bies and Hansen 2003; Golder Acoustic Database – Steam generator exhaust stack measurement at similar SAGD facility; Golder Acoustic Database – Glycol Cooler measurement at similar SAGD facility; Golder Acoustic Database – manufacturer's published noise data of GE 7FA – pro-rated to represent Generator Turbine Set in this assessment. Golder Acoustic Database – HRSG manufacturer noise data from similar facility; Assume Lp of 85 dBA at 1m.

Table 23 Emission Spectra Used for Modelling Project Case – 2B-BU-190 Process Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2B-P202A/B	Raw Water Pump/Motor	Lp	75	76	78	80	81	83	81	76	69	86	88
2B-P116	Induce Gas Flotation Eductor Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P117A/B	Induce Gas Flotation Froth Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P119	Skim Oil Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P120	Produced Water Transfer Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P121	De-Sand Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P135A/B	Hot Line Softening Feed Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P250	Deoiling Polymer Injection Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P406A/B	Off-Spec Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90

Table 23 Emission Spectra Used for Modelling Project Case – 2B-BU-190 Process Building (continued)

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2B-P501	Reverse Demulsifier Injection Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P503	Demulsifier Injection Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P525	Recovered Diluent Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P532A/B	HP Flare Knock Out Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-202A/B	Raw Water Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
Total Inside Building		**Lw**	**106**	**107**	**109**	**111**	**112**	**114**	**112**	**107**	**100**	**118**	**120**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 24 Emission Spectra Used for Modelling Project Case – 2B-BU-290 Water Treatment Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2B-P204	Dirty Backwash Transfer Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P205	Hot Line Softening Recirculation Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P206A/B	After Filter Backwash Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P209	After Filter Feed Pumps/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P217A/B	Neutralization Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P218A/B	Dilution/Service Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P227	Magox Slurry Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P228	Lime Slurry Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P244	Flocculent Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P261	Caustic Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P263	Acid Dosing Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P267	Hot Line Softening Sludge Sampling Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P301A/B	Low Pressure Boiler Feed Water Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P507	Oxygen (O_2) Scavenger Injection Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P551A/B	Utility Water Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
Total Inside Building		**Lw**	**107**	**108**	**110**	**112**	**113**	**115**	**113**	**108**	**101**	**119**	**121**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 25 Emission Spectra Used for Modelling Project Case – 2B-BU-390 Steam Generation Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2B-PK330	Steam Generator Package	Lp	90	85	87	88	90	87	82	81	83	92	97
2B-P330A/B	High Pressure Boiler Feed Water Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2B-PM304A/B	High Pressure Boiler Feed Water Pump/Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2B-K310	Combustion Air Blower	Lp	91	91	85	88	85	83	78	76	75	88	96
2B-KM310	Combustion Air Blower / Motor	Lp	75	75	78	80	83	83	82	77	69	88	89
2B-K571	Plant Instrument Air Compressor	Lp	68	68	67	65	65	67	71	70	66	76	77
2B-KM571	Plant Instrument Air Compressor	Lp	63	63	66	68	71	71	70	65	57	76	77
Total Inside Building		**Lw**	**125**	**120**	**122**	**123**	**125**	**121**	**116**	**115**	**117**	**126**	**131**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003; Golder Acoustic Database – Steam generator exhaust stack measurement at similar SAGD facility.

Table 26 Emission Spectra Used for Modelling Project Case – 2B-BU-393 Co-Generation Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2B-K353A/B	Scanner Cooling Air Blower	Lp	91	91	85	88	85	83	78	76	75	88	96
2B-KM353A/B	Scanner Cooling Air Blower/Motor	Lp	75	75	78	80	83	83	82	77	69	88	89
2B-P3172A/B	Gas Turbine/Generator Lube Oil Aerial Circulation Package Pump	Lp	77	78	79	81	81	84	81	77	71	88	89
2B-PM3172A/B	Gas Turbine/Generator Lube Oil Aerial Circulation Package Pump/Motor	Lp	75	75	78	80	83	83	82	77	69	88	89
2B-PK314	Gas Turbine/Generator Package	Lp	100	104	92	87	83	79	80	85	73	90	106
Total Inside Building		**Lw**	**127**	**130**	**119**	**116**	**113**	**112**	**111**	**112**	**102**	**119**	**132**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003; Golder Acoustic Database – manufacturer's published noise data of GE 7FA – pro-rated to represent Generator Turbine Set in this assessment.

Table 27 Emission Spectra Used for Modelling Project Case – 2B-BU-490 Diluent Pump Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2B-K593	Vapour Recovery Unit 1st Stage Compressor/Motor	Lp	74	74	73	71	71	73	77	76	72	82	83
2B-KM593	Vapour Recovery Unit 1st Stage Compressor/Motor	Lp	69	69	72	74	77	77	76	71	63	82	83
2B-K597	Vapour Recovery Unit 2nd Stage Compressor/Motor	Lp	74	74	73	71	71	73	77	76	72	82	83
2B-KM597	Vapour Recovery Unit 2nd Stage Compressor/Motor	Lp	69	69	72	74	77	77	76	71	63	82	83
2B-P595	Vapour Recovery Unit Liquid Recycle Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2B-P403A/B/C	Diluent Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2B-PM403A/B/C	Diluent Pump/Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
2B-P110A/B	Sales Oil Transfer Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2B-PM110A/B	Sales Oil Transfer Pump/Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**107**	**107**	**109**	**111**	**112**	**114**	**112**	**108**	**102**	**118**	**120**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 28 Emission Spectra Used for Modelling Project Case – 2B-BU-567 Potable Water Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2B-P569	Nanofilter Feed Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P5661	Treated Water Distribution Pump/Motor (Jockey)	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P5662A/B	Treated Water Distribution Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P5663	Treated Water Sodium Hypochlorite Injection Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P5681	Greensand Filter Feed Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P5682	Greensand Filter Backwash Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P5684	Hypochlorite Injection Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P5685	Potassium Permanganate Injection Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90

Table 28 Emission Spectra Used for Modelling Project Case – 2B-BU-567 Potable Water Building (continued)

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2B-P5687	Greensand Filter Feed Tank Blower	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P5693	Nanofiltration system Booster Pump / Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P5694	Clean In Place (CIP) Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P5695	Hydrochloric Acid Injection Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P5696	Antiscalent Injection Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P5697	Sodium Metabisulphate Injection Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
Total Inside Building		**Lw**	**106**	**107**	**109**	**111**	**112**	**114**	**112**	**107**	**100**	**118**	**119**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 29 Emission Spectra Used for Modelling Project Case – 2B-BU-580 Lift Gas Compressor Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power /Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2B-P5824	Lift Gas Compressor Pre-lube Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
2B-K582A/B	Lift Gas Compressor	Lp	77	77	76	74	74	76	80	79	75	85	86
2B-KM582A/B	Lift Gas Compressor Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**104**	**104**	**105**	**105**	**107**	**108**	**108**	**106**	**101**	**114**	**115**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 30 Emission Spectra Used for Modelling Project Case – 2B-BU-690 Amine Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power /Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2B-P505	Filming Amine Pump (High Pressure)/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P515	Filming Amine Pump (Low Pressure)/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-K600	Sour Gas Compressor	Lp	77	77	76	74	74	76	80	79	75	85	86
2B-P600	Amine Recirculation Pumps	Lp	74	75	76	78	78	81	78	74	68	85	86
2B-P601	Amine Storage Pumps	Lp	74	75	76	78	78	81	78	74	68	85	86
2B-P602	Amine Condenser Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
Total Inside Building		**Lw**	**106**	**107**	**108**	**110**	**110**	**113**	**111**	**107**	**101**	**117**	**119**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 31 Emission Spectra Used for Modelling Project Case – Phase 2B Outdoor Noise Emission Source

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2B-PK330	Steam Generator Stack[(a)]	Lw	116	106	93	95	87	83	83	78	64	92	116
2B-PK314	Gas Turbine Exhaust Stack[(c)]	Lw	107	101	102	99	92	82	71	55	46	94	109
2B-PK350	Heat Recovery Steam Generator[(d)]	Lw	112	114	108	100	93	84	83	81	71	97	117
2B-PK314	Gas Turbine Air Inlet[(c)]	Lw	100.8	108.6	97.5	90	91.6	85.4	92.2	90.4	78.5	97	110
2B-EA510	Glycol Cooler[(b)]	Lp	95	92	91	84	82	80	76	73	61	85	98
2B-PK518	Glycol Heater[(e)]	Lp	94	90	91	88	81	76	75	71	60	85	98
2B-PK040	Wellpad 'G-N' Instrument Air Compressor Building	Lw	79	76	72	69	64	63	60	50	46	68	82
n/a	Air Handling Unit and Motor for 2B-BU-290	Lw	100	100	94	97	94	92	87	85	84	97	105
n/a	Air Make-up unit for 2B-BU-390	Lw	101	109	98	90	92	85	92	90	79	97	110
2B-I611	Train 1 Incinerator	Lw	96	89	87	87	88	91	92	91	83	97	100
2B-K611	Train 1 Reaction Furnace Air Blower	Lw	91	91	85	88	85	83	78	76	75	88	96
2B-K612	Train 1 Incinerator Air Blower	Lw	91	91	85	88	85	83	78	76	75	88	96
3A-I611	Train 2 Waste Heat Boiler	Lw	96	89	87	87	88	91	92	91	83	97	100
3A-K611	Train 2 Reaction Furnace	Lw	96	89	87	87	88	91	92	91	83	97	100
3A-K612	Train 2 Reaction Furnace Air Blower	Lw	91	91	85	88	85	83	78	76	75	88	96
3A-K641	Train 2 Incinerator	Lw	96	89	87	87	88	91	92	91	83	97	100
3A-P516	Train 2 Incinerator Air Blower	Lw	91	91	85	88	85	83	78	76	75	88	96

Table 31 Emission Spectra Used for Modelling Project Case – Phase 2B Outdoor Noise Emission Source (continued)

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
2B-K641	Molten Sulphur Degassers Air Blowers	Lw	91	91	85	88	85	83	78	76	75	88	96
2B-P516	Glycol Make-up Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
2B-P549	Utility Well Water Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90

[a] Golder Acoustic Database – Steam generator exhaust stack measurement at similar SAGD facility.

[b] Golder Acoustic Database – Glycol Cooler measurement at similar SAGD facility.

[c] Golder Acoustic Database – manufacturer's published noise data of GE 7FA – pro-rated to represent GT in this assessment.

[d] Golder Acoustic Database – HRSG manufacturer noise data from similar facility.

[e] Assume Lp of 85 dBA at 1 m.

n/a = Not available.

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 32 Emission Spectra Used for Modelling Project Case – 3A-BU-190 Process Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
3A-P117A/B/C	Induced Fas Flotation Froth Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P116A/B/C	Induced Fas Flotation Eductor Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P119A/B	Skim Oil Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P120A/B	Produced Water Transfer Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P121A/B	Desand Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P135A/B/C	Hot Line Softening Feed Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P250A/B	Deoiling Polymer Injection Pump (PK250)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-P250A/B	Deoiling Polymer Injection Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P501	Reverse Demulsifier Injection Pump (PK579)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-P501	Reverse Demulsifier Injection Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P503	Demulsifier Injection Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P525A/B	Recovered Diluent Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P532A/B/C	High Pressure Flare Knock Out Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P541	Process Sump Pumps	Lp	74	75	76	78	78	81	78	74	68	85	86
Total Inside Building		**Lw**	**108**	**109**	**111**	**113**	**114**	**116**	**114**	**109**	**102**	**120**	**122**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 33 Emission Spectra Used for Modelling Project Case – 3A-BU-290 Water Treatment Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power/Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
3A-P202A/B/C	Raw Water Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P204A/B	Dirty Backwash Transfer Pump (PK237)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM204A/B	Dirty Backwash Transfer Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P205A/B	Hot Line Softening Recirculation Pump (PK237)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM205A/B	Hot Line Softening Recirculation Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P206A/B/C	After Filter Backwash Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P209A/B	After Filter Feed Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P217A/B/C	Neutralization Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P218A/B/C	Dilution/Service Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P227A/B	Magox Slurry Pump (PK235)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM227A/B	Magox Slurry Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P228A/B	Lime Slurry Pump (PK236)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM228A/B	Lime Slurry Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P244A/B	Flocculent Pump (PK242)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM244A/B	Flocculent Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P261A/B	Caustic Pump (PK260)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM261A/B	Caustic Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P263A/B	Acid Dosing Pump (PK262)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM263A/B	Acid Dosing Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P267	Hot Line Softening Sludge Sampling Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P301A/B/C	Low Pressure Boiler Feed Water Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P551A/B/C	Utility Water Pump/Motor	Lp	76	77	79	81	82	84	82	77	70	88	90
3A-P507A/B	O_2 Scavenger Injection Pump (PK585)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM507A/B	O_2 Scavenger Injection Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**108**	**109**	**111**	**113**	**114**	**116**	**114**	**109**	**102**	**120**	**122**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003; Beranek 1992; Golder Acoustic Database – Steam generator exhaust stack measurement at similar SAGD facility.

Table 34 Emission Spectra Used for Modelling Project Case – 3A-BU-390 Steam Generation Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power /Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
3A-PK330	Steam Generator Package	Lp	90	85	87	88	90	87	82	81	83	92	97
3A-P304A/B/C	High Pressure Boiler Feed Water Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM304A/B/C	High Pressure Boiler Feed Water Pump/Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-K310	Combustion Air Blower (PK330)	Lp	88	88	82	85	82	80	75	73	72	85	93
3A-KM310	Combustion Air Blower Motor (PK330)	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P311A/B/C	Boiler Feed Water Head Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM311A/B/C	Boiler Feed Water Head Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-K353A/B	Scanner Cooling Air Blower	Lp	88	88	82	85	82	80	75	73	72	85	93
3A-KM353A/B	Scanner Cooling Air Blower Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-K571	Plant Instrument Air Compressor (PK517)	Lp	68	68	67	65	65	67	71	70	66	76	77
3A-KM571	Plant Instrument Air Compressor Motor (PK517)	Lp	63	63	66	68	71	71	70	65	57	76	77
3A-P505A/B	Filming Amine Pump (High Pressure) (PK586)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM505A/B	Filming Amine Pump (High Pressure) Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P515A/B	Filming Amine Pump (Low Pressure) (PK586)	Lp	74	75	76	78	78	81	78	74	68	85	86
Total Inside Building		**Lw**	**127**	**122**	**124**	**125**	**127**	**124**	**119**	**117**	**119**	**129**	**133**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003; Golder Acoustic Database – Steam generator exhaust stack measurement at similar SAGD facility.

Table 35 Emission Spectra Used for Modelling Project Case – 3A-BU-490 Diluent Pump Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power /Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
3A-P110A/B/C	Sales Oil Transfer Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM110A/B/C	Sales Oil Transfer Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P403A/B/C	Off-Spec Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM403A/B/C	Off-Spec Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P406A/B/C	Diluent Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM406A/B/C	Diluent Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**104**	**105**	**107**	**109**	**110**	**112**	**110**	**105**	**98**	**116**	**117**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 36 Emission Spectra Used for Modelling Project Case – 3A-BU-493 Slop Treater Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power /Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
3A-P411	Slop Treater Pump (PK408)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM411	Slop Treater Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P413	Slop Treater Hydrocarbon Pump (PK408)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-P414	Slop Treater Water Pump	Lp	74	75	76	78	78	81	78	74	68	85	86
Total Inside Building		**Lw**	**97**	**98**	**100**	**102**	**103**	**105**	**103**	**98**	**91**	**109**	**111**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 37 Emission Spectra Used for Modelling Project Case – 3A-BU-555/155 Vapour Recovery Unit Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power /Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
3A-K593	Vapour Recovery Unit 1st Stage Compressor (PK590)	Lp	74	74	73	71	71	73	77	76	72	82	83
3A-KM593	Vapour Recovery Unit Compressor Motor (PK590)	Lp	69	69	72	74	77	77	76	71	63	82	83
3A-KM594	Vapour Recovery Unit 1st Stage Cooler Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-K595	Vapour Recovery Unit Eductor (PK590)	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-K597	Vapour Recovery Unit 2nd Stage Compressor (PK590)	Lp	74	74	73	71	71	73	77	76	72	82	83
3A-KM597	Vapour Recovery Unit 2nd Stage Compressor Motor (PK597)	Lp	69	69	72	74	77	77	76	71	63	82	83
3A-EAM598	Vapour Recovery Unit Discharge Cooler Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**103**	**103**	**104**	**106**	**108**	**108**	**108**	**105**	**99**	**114**	**115**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 38 Emission Spectra Used for Modelling Project Case – 3A-BU-567 Potable Water Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power /Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
3A-P569	Nanofilter Feed Pump (PK565)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM5661	Treated Water Distribution Pump Motor (Jockey) (PK565)	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P5661	Treated Water Distribution Pump (Jockey)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-P5662A/B	Treated Water Distribution Pump (PK565)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM5662A/B	Treated Water Distribution Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P5663	Treated Water Sodium Hypochlorite Injection Pump (PK565)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM5663	Treated Water Sodium Hypochlorite Injection Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P5681	Greensand Filter Feed Pump (PK565)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM5681	Greensand Filter Feed Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P5682	Greensand Filter Backwash Pump (PK565)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM5682	Greensand Filter Backwash Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P5684	Hypochlorite Injection Pump (PK565)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM5684	Hypochlorite Injection Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P5685	Potassium Permanganate Injection Pump (PK565)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM5685	Potassium Permanganate Injection Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P5687	Greensand Filter Feed Tank Blower	Lp	88	88	82	85	82	80	75	73	72	85	93
3A-P5691	Nanofilter Feed Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P5693	Nanofiltration System Booster Pump (PK565)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM5693	Clean In Place (CIP) Pump (PK565)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-P5693	Nanofiltration System Booster Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-PM5693	Clean In Place (CIP) Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P5694	Sodium Metabisulphate Injection Pump (PK565)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM5694	Sodium Metabisulphate Injection Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P5695	Hydrochloric Acid Injection Pump (PK565)	Lp	74	75	76	78	78	81	78	74	68	85	86

Table 38 Emission Spectra Used for Modelling Project Case – 3A-BU-567 Potable Water Building (continued)

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power /Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
3A-PM5695	Hydrochloric Acid Injection Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-P5696	Antiscalent Injection Pump (PK565)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-PM5696	Antiscalent Injection Pump Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**106**	**107**	**109**	**111**	**112**	**114**	**112**	**107**	**100**	**118**	**119**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 39 Emission Spectra Used for Modelling Project Case – 3A-BU-580 Lift Gas Compressor Building

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power /Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
3A-K582A/B	Lift Gas Compressor	Lp	77	77	76	74	74	76	80	79	75	85	86
3A-KM582A/B	Lift Gas Compressor Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
3A-EAM583	Lift Gas Cooler Motor	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**104**	**104**	**104**	**105**	**107**	**108**	**108**	**106**	**101**	**114**	**115**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 40 Emission Spectra Used for Modelling Project Case – 3A-BU-690 Amine Dehydration/Compressor Building

Tab #	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power /Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
3A-K600	Sour Gas Compressor	Lp	77	77	76	74	74	76	80	79	75	85	86
3A-P600	Amine Recirculation Pumps	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-P601	Amine Storage Pumps (PK600)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-P602	Amine Condenser Pump (PK600)	Lp	74	75	76	78	78	81	78	74	68	85	86
3A-K610	Acid Gas Transfer Compressor Package	Lp	77	77	76	74	74	76	80	79	75	85	86
3A-PK620	Acid Gas Dehy Package	Lp	72	72	75	77	80	80	79	74	66	85	86
Total Inside Building		**Lw**	**106**	**106**	**107**	**108**	**109**	**111**	**110**	**107**	**102**	**116**	**117**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 41 Emission Spectra Used for Modelling Project Case – Phase 3A Outdoor Noise Emission Sources

Equipment ID	Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power /Pressure	
			31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
3A-PK330	Steam Generator Stack[(a)]	Lw	116	106	93	95	87	83	83	78	64	92	116
3A-EA510	Glycol Cooler[(b)]	Lp	95	92	91	84	82	80	76	73	61	85	98
3A-PK518	Glycol Heater[(c)]	Lp	106	102	103	100	93	88	87	83	72	97	110
3A-PK040	Wellpad Instrument Air Compressor Building	Lw	79	76	72	69	64	63	60	50	46	68	82
	Air Handling Unit and Motor for 2B-BU-290	Lw	100	100	94	97	94	92	87	85	84	97	105
	Air Make-up Unit for 2B-BU-390	Lw	100	100	94	97	94	92	87	85	84	97	105
	Wellpad pump station building (for all Phase 3A and 3B)	Lw	100	98	92	89	83	84	80	71	67	88	103
	Wellpad pump station cooler	Lw	95	95	98	100	103	103	102	97	89	108	109
3B-I611	Train 3 Waste Heat Boiler	Lw	96	89	87	87	88	91	92	91	83	97	100
3B-K611	Train 3 Reaction Furnace	Lw	96	89	87	87	88	91	92	91	83	97	100
3B-K612	Train 3 Reaction Furnace Air Blower	Lw	91	91	85	88	85	83	78	76	75	88	96
3B-K641	Train 3 Incinerator	Lw	96	89	87	87	88	91	92	91	83	97	100
3B-P516	Train 3 Incinerator Air Blower	Lw	91	91	85	88	85	83	78	76	75	88	96

(a) Golder Acoustic Database – Steam generator exhaust stack measurement at similar SAGD facility.

(b) Golder Acoustic Database – Glycol Cooler measurement at similar SAGD facility.

(c) Assume Lp of 85 dBA at 1 m.

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 42 Emission Spectra Used for Modelling Project Case – SAGD Reservoir Repressurization Compressor Buildings (Indoor)

Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power /Pressure	
		31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
Booster Gas Compressors	Lw	97	97	96	94	94	96	100	99	95	105	106
Booster Gas Compressor Motors	Lw	101	101	104	106	109	109	108	103	95	113	115
Multistage Reciprocal Gas Compressors	Lw	112	108	113	112	110	113	118	115	108	122	122
Multistage Reciprocal Gas Compressor Motors	Lw	106	106	109	111	114	114	113	108	100	118	120
Final Gas Compressors	Lw	107	103	108	107	105	108	113	110	103	117	118
Final Gas Compressor motors	Lw	101	101	104	106	109	109	108	103	95	113	115
Total Inside Building	**Lw**	**122**	**120**	**124**	**124**	**125**	**126**	**128**	**125**	**118**	**133**	**134**

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

Table 43 Emission Spectra Used for Modelling Project Case – SAGD Reservoir Repressurization Compressor Buildings (Outdoor)

Source Name	Lw or Lp	Octave Spectrum [dB]									Overall Sound Power /Pressure	
		31.5	63	125	250	500	1000	2000	4000	8000	dBA	dB
Booster Gas Cooler Fan[s]	Lw	98	101	101	98	95	91	88	85	77	98	107
Multistage Reciprocating Compressor Gas Cooler Fans	Lw	99	105	105	102	99	95	92	89	81	101	110
Final Gas Cooler Fans	Lw	95	101	101	98	95	91	88	85	77	98	106

Source: MEG 2007, Pers. Comm.; Bies and Hansen 2003.

4 SPECTRAL RECEPTOR RESULTS

Tables 44 through 48 list the spectral noise results at the identified receptors. The results are ranked in descending order from the source with the greatest contribution. Individual sources that contribute less than 10 dBA were not included as they are not considered to contribute to the overall noise prediction. Receptors with overall spectral noise results less than 10 dBA were not included because the individual sources contribution associated with the overall noise level were all below 10 dBA.

Table 44 Spectral Noise Results at Worst-Case Noise Level at 1.5 km From Project Boundary (Project Case Contribution Only, Ambient Noise Excluded)

Source Name	Octave Spectrum [dBA]									Overall Sound Pressure Level
	31.5	63	125	250	500	1000	2000	4000	8000	[dBA]
Phase 3b glycol cooler outlet	7	17	25	25	26	25	11	0	0	32
Phase 3b Life Gas Compressor	0	7	10	17	25	28	19	0	0	31
Phase 3b glycol cooler outlet	6	16	25	24	25	23	10	0	0	30
Phase 3a Glycol Cooler Inlet	9	18	22	20	22	23	11	0	0	29
Phase 3a Glycol Cooler Inlet	9	19	22	20	22	23	11	0	0	29
Phase 3b Life Gas Compressor	0	0	6	14	19	20	10	0	0	23
Phase 3a Steam Gen casing	5	10	11	15	15	14	0	0	0	21
Phase 3a Steam Gen casing	4	9	10	14	15	13	0	0	0	20
Phase 3b Steam Gen	1	11	7	14	13	15	0	0	0	20
Phase 3a Steam Gen casing	4	9	10	14	14	13	0	0	0	20
Phase 3a Steam Gen casing	4	9	9	14	14	13	0	0	0	19
Phase 3a Steam Gen casing	3	8	9	13	14	12	0	0	0	19
Phase 3b Water Treatment	0	5	6	12	11	14	0	0	0	18
Phase 3b Process	0	5	6	12	11	14	0	0	0	18
Phase 3b Steam Gen Stack	6	10	2	10	7	6	0	0	0	16
Phase 3b Steam Gen Stack	6	9	2	10	7	6	0	0	0	16
Phase 3b Steam Gen Stack	6	9	2	10	7	5	0	0	0	16
Phase 3b Steam Gen Stack	6	9	2	10	7	5	0	0	0	15
Phase 3b Steam Gen Stack	6	9	2	10	7	5	0	0	0	15
Phase 3b Steam Gen Stack	6	9	2	10	7	5	0	0	0	15
Phase 3b Steam Gen Stack	6	9	2	10	7	5	0	0	0	15
Phase 3b Steam Gen Stack	6	9	1	9	6	4	0	0	0	15
Phase 3b Portable Water	0	3	3	7	7	11	0	0	0	15
Phase 3b Steam Gen Stack	5	9	1	9	6	4	0	0	0	15
Phase 3b Steam Gen Stack	5	8	1	9	6	4	0	0	0	15
Phase 3b Steam Gen Stack	5	8	1	9	6	4	0	0	0	14
Phase 3b Steam Gen Stack	5	8	1	9	5	3	0	0	0	14
Phase 3b Portable Water	0	2	3	7	7	11	0	0	0	15
Phase 3b Steam Gen Stack	5	8	1	9	5	3	0	0	0	14
Phase 3b Steam Gen Stack	5	8	1	9	5	3	0	0	0	14
Phase 3b glycol heater	0	0	6	9	6	1	0	0	0	14
Phase 3b glycol heater	0	0	6	9	6	1	0	0	0	14

Table 44 Spectral Noise Results at Worst-Case Noise Level at 1.5 km From Project Boundary (Project Case Contribution Only, Ambient Noise Excluded) (continued)

Source Name	Octave Spectrum [dBA]									Overall Sound Pressure Level
	31.5	63	125	250	500	1000	2000	4000	8000	[dBA]
Phase 3a Steam Gen casing	0	0	4	7	4	0	0	0	0	12
Phase 3b Water Treatment	0	0	1	6	4	5	0	0	0	12
Phase 3b Process	0	0	0	6	4	5	0	0	0	11
Phase 3b Diluent Pump	0	0	0	4	3	6	0	0	0	11
Phase 3a Steam Gen casing	0	0	3	6	4	0	0	0	0	11
Total	**20**	**26**	**30**	**31**	**33**	**33**	**22**	**15**	**16**	**38**

Source: Bies and Hansen 2003; Beranek and Ver 1992.

Table 45 Spectral Noise Result at Cabin A (Project Case Contribution Only, Ambient Noise Excluded)

Source Name	Octave Spectrum [dBA]									Overall Sound Pressure Level
	31.5	63	125	250	500	1000	2000	4000	8000	[dBA]
Phase 2 CoGen Bldg Inside	6	20	7	2	0	0	0	0	0	20
Phase 2b Glycol Cooler Outlet	0	5	13	10	8	0	0	0	0	16
Phase 2b Turbine Generator Set	2	15	2	0	0	0	0	0	0	16
Phase 2 Turbine Generator Set	2	15	2	0	0	0	0	0	0	16
Phase 2b HRSG module casing	0	11	8	4	0	0	0	0	0	14
Phase 2 Glycol Cooler Outlet	0	3	10	7	5	0	0	0	0	14
Phase 2 RePressurization Compressor Coolers	0	1	9	9	5	0	0	0	0	14
Phase 2 Repressurization compressor	0	6	7	7	4	0	0	0	0	13
Phase 2b Glycol Cooler Inlet	0	2	9	5	3	0	0	0	0	13
Phase 2 Glycol Cooler inlet	0	0	7	4	2	0	0	0	0	12
Total	**11**	**23**	**18**	**16**	**14**	**10**	**10**	**10**	**10**	**26**

Source: Bies and Hansen 2003; Beranek and Ver 1992.

Table 46 Spectral Noise Result at Operator Residence (Project Case Contribution Only, Ambient Noise Excluded)

Source Name	Octave Spectrum [dBA]									Overall Sound Pressure Level
	31.5	63	125	250	500	1000	2000	4000	8000	[dBA]
Phase 2 CoGen Bldg Inside	5	19	5	0	0	0	0	0	0	19
Phase 2b Turbine Generator Set	1	14	1	0	0	0	0	0	0	15
Phase 2 Turbine Generator Set	1	14	1	0	0	0	0	0	0	15

Table 46 Spectral Noise Result at Operator Residence (Project Case Contribution Only, Ambient Noise Excluded) (continued)

Source Name	Octave Spectrum [dBA]									Overall Sound Pressure Level
	31.5	63	125	250	500	1000	2000	4000	8000	[dBA]
Phase 2b Glycol Cooler Outlet	0	5	12	8	6	0	0	0	0	15
Phase 2b HRSG module casing	0	10	7	2	0	0	0	0	0	13
Phase 2 RePressurization Compressor Coolers	0	0	8	8	4	0	0	0	0	13
Phase 2 Glycol Cooler Outlet	0	2	9	5	3	0	0	0	0	13
Phase 2 Repressurization compressor	0	5	5	5	2	0	0	0	0	12
Phase 2b Glycol Cooler Inlet	0	1	8	4	1	0	0	0	0	12
Phase 2 Glycol Cooler inlet	0	0	6	2	0	0	0	0	0	11
Phase 3 RePressurization Compressor Coolers	0	4	4	0	0	0	0	0	0	11
Total	**11**	**22**	**17**	**15**	**12**	**10**	**10**	**10**	**10**	**25**

HRSG = Heat Recovery Steam Generator.

Source: Bies and Hansen 2003; Beranek and Ver 1992.

Table 47 Spectral Noise Result at Winefred Lake (Project Case Contribution Only, Ambient Noise Excluded)

Source Name	Octave Spectrum [dB]									Overall Sound Pressure Level
	31.5	63	125	250	500	1000	2000	4000	8000	[dBA]
Phase 3a glycol cooler outlet	0	5	12	9	7	0	0	0	0	16
Phase 3a glycol cooler outlet	0	5	12	8	6	0	0	0	0	15
Phase 3a Glycol Cooler Inlet	0	3	9	5	3	0	0	0	0	13
Phase 3a Glycol Cooler Inlet	0	2	9	5	3	0	0	0	0	13
Phase 3a Life Gas Compressor	0	0	0	1	5	0	0	0	0	11
Phase 3 RePressurization Compressor Coolers	0	0	4	3	0	0	0	0	0	11
Total	**7**	**10**	**17**	**14**	**11**	**7**	**7**	**8**	**8**	**21**

Source: Bies and Hansen 2003; Beranek and Ver 1992.

Table 48 Spectral Noise Result at Cabin B (Project Case Contribution Only, Ambient Noise Excluded)

Source Name	Octave Spectrum [dBA]									Overall Sound Pressure Level
	31.5	63	125	250	500	1000	2000	4000	8000	[dBA]
Phase 2 CoGen Bldg Inside	0	12	0	0	0	0	0	0	0	14
Phase 3b Pump Station Cooler	0	0	0	1	7	6	0	0	0	12
Phase 3b glycol cooler outlet	0	1	8	2	0	0	0	0	0	12
Phase 3b glycol cooler outlet	0	1	7	2	0	0	0	0	0	12
Phase 2b Glycol Cooler Inlet	0	5	5	0	0	0	0	0	0	11
Phase 2 RePressurization Compressor Coolers	0	5	5	1	0	0	0	0	0	11
Total	**8**	**14**	**13**	**9**	**10**	**10**	**8**	**8**	**8**	**20**

5 PERMISSIBLE SOUND LEVEL CALCULATIONS

Permissible Sound Level (PSL) criteria for all receptors were calculated using the detailed methodology set out in Directive 038 (EUB 2007). Tables 49 and 50 detail the calculations for the Project.

Table 49 Permissible Sound Levels at All Receptors Except Conklin

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

Note: Shaded fields are selected values used in the PSL calculation.
n/a = Not applicable.

Table 50 Permissible Sound Levels at Conklin

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

Note: Shaded fields are selected values used in the calculation.

n/a = Not applicable.

6 REFERENCES

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6.1 PERSONAL COMMUNICATION

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