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Environmental Noise Impact Assessment
For

Great Divide Expansion Project

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Connacher Oil and Gas Limited

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Executive Summary

aci Acoustical Consultants Inc., of Edmonton AB, was retained by Connacher Oil and Gas Limited (Connacher) to conduct an environmental noise impact assessment (NIA) for the proposed Great Divide Expansion Project (the Project) in northeast Alberta. The purpose of the work was (i) to generate an updated computer model of the existing and pending Connacher facilities in the area to determine updated baseline noise levels, (ii) to augment the baseline noise model with additional noise sources associated with the Project, (iii) to compare the projected noise level results to the Alberta Energy Resources Conservation Board (ERCB) permissible sound level guidelines (ERCB Directive 038 on Noise Control, 2007), and (iv) to provide noise mitigation recommendations.

The results of the noise modeling indicated Baseline Case night-time noise levels (with noise from the Great Divide 10,000 bpd CPF, the 2 Great Divide wellpads, the Algar 10,000 bpd CPF, and the 3 Algar wellpads all combined with the 35 dBA ASL) below the ERCB Directive 038 permissible sound levels of 45 dBA L_{eq}Night[1]at the nearby Trapper's Cabin and 40 dBA L_{eq}Night for all surrounding 1,500 m receptors. Further, the dBC – dBA sound levels indicated minimal likelihood of low frequency tonal components.

The Application Case Construction Scenario noise levels (with typical construction activity for the Algar 24,000 bpd expansion) were only marginally higher than the Baseline Case and still below 40 dBA L_{eq} during the night-time and below 50 dBA L_{eq} during the day-time. General construction noise mitigation recommendations have been provided.

The Application Case Operational Scenario night-time noise levels (with noise from the Great Divide 10,000 bpd CPF, the Algar 10,000 bpd CPF, the expanded 24,000 Algar CPF, all 45 wellpads all combined with the 35 dBA ASL) below the ERCB Directive 038 permissible sound levels of 45 dBA at the nearby Trapper's Cabin and 40 dBA for all surrounding 1,500 m receptors. Further, the dBC – dBA sound levels indicated minimal likelihood of low frequency tonal components. As such, no additional noise mitigation is required for the normal operation of the Project.

[1] The term L_{eq} represents the energy equivalent sound level. This is a measure of the equivalent sound level for a specified period of time accounting for fluctuations. Night-time is defined from 22:00 – 07:00

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1.0 Introduction

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2.0 Project Location and Description

Since 2004, Connacher has been actively conducting exploration programs to delineate bitumen resources on its oil sands leases. As a result of this activity, Connacher had previously identified two discreet areas, or "Pods" that were suitable for economic development using the SAGD process. The first area, known as the Great Divide SAGD Project (ie. Pod 1), received development approval from the EUB (Approval No. 10587) on June 28, 2006. The second development area (i.e Pod 2) is called the Algar SAGD Project and received approval from ERCB (Approval No. 11253) on November 13, 2008.

Although Pod 1 and Pod 2 have common ownership and operatorship, each is a completely separate development from the other. Each project is similar in size and scope (approximately 10,000 bpd) having its own operating facilities to extract bitumen from geologically isolated pools in the McMurray formation of the Athabasca oil sands deposit.

The purpose for the Project is to expand the production the entire area by adding another 24,000 bpd production capacity to Pod 2 (Algar) and constructing additional wellpads. Thus, the total capacity will be approximately 44,000 bpd, split between the two central processing facility (CPF) sites of Great Divide and Algar. The design calls for 45 wellpads to be used, spaced out over 3 phases and approximately 25 years. There will only be a few wellpads operational at any one time with new ones being constructed and existing ones being decommissioned throughout the life of the Project.

The Project, as shown in Figure 1, will span Townships 81 – 82, and Ranges 11 – 12, West of the 4th Meridian. The 10,000 bpd Great Divide CPF is located at 12-16-82-12-W4M. There are also two existing wellpads in the south ½ of 21-82-12-W4M. The 10,000 bpd Algar CPF, which is currently under construction, is located in the north ½ of 18-82-11-W4M and the south ½ of 19-82-11-W4M. In addition, three wellpads are being constructed at:

- 16-18-82-11-W4M
- 05-19-82-11-W4M
- 02-24-82-11-W4M

The ERCB Directive 038 specifies that noise impact assessments are to be carried out to evaluate project impacts on the nearest dwelling. The nearest known dwelling is a Trapper's Cabin, which is located in between Pod 1 and Pod 2, as shown in Figure 1. The Directive further specifies that, in the event the nearest dwelling is greater than a 1.5 km distance from the Project, new facilities must meet a permissible sound night time level of 40 dBA 1.5 km from the facility fence-line. Consequently, the study area for the noise impact assessment for the Project is identified as being an area that encompasses a 1.5 km radius from all Project noise sources. Noise levels have also been calculated at the Trapper's Cabin. As a result, the local study area (LSA) will be taken as a radius of 1.5 km from the Project noise sources and the regional study area (RSA) will be taken as a radius of 5 km from the Project noise sources since anything further away will be insignificant.

The only major roadway in the area is Highway 63 which runs in a northeast-southwest direction. It is located approximately 350 m from the Pod 1 CPF. There are no other facilities within a 5 km radius of the Project. As such, noise from other industrial facilities has not been included in this impact assessment.

Topographically, the land in the study area to the east of Highway 63 is relatively flat with small fluctuations in elevation throughout and some small lakes. To the west of Highway 63, the elevation drops sharply towards the northwest (the furthest receptors are approximately 80 m below the elevation of the Highway). The area is covered with trees, bushes, and field grasses. As such, vegetative sound absorption is considered significant.

3.0 Measurement & Modeling Methods

3.1. Environmental Noise Monitoring

Since noise level information was already available for Pod 1, a baseline noise monitoring program was not conducted. This conforms with the requirements of the ERCB Directive 038 on Noise Control.

3.2. Computer Noise Modeling (General)

The computer noise modeling was conducted using the CADNA/A (version 3.72.131) software package. CADNA/A allows for the modeling of various noise sources such as road, rail, and stationary sources. Topographical features such as land contours, vegetation, and bodies of water and meteorological conditions such as temperature, relative humidity, wind-speed and wind-direction are considered in the assessment. The modeling methods used met or exceeded the requirements of the ERCB Directive 038 on Noise Control.

The calculation method used for noise propagation follows the International Standards Organization (ISO) 9613-2. All receiver locations were assumed as being downwind from the source(s). In particular, as stated in Section 5 of the ISO 9613-2 document:

> "*Downwind propagation conditions for the method specified in this part of IS0 9613 are as specified in 5.4.3.3 of IS0 1996-2:1987, namely*
>
> - *wind direction within an angle of ± 45^0 of the direction connecting the centre of the dominant sound source and the centre of the specified receiver region, with the wind blowing from source to receiver, and*
> - *wind speed between approximately 1 m/s and 5 m/s, measured at a height of 3 m to 11 m above the ground.*
>
> *The equations for calculating the average downwind sound pressure level LAT(DW) in this part of IS0 9613, including the equations for attenuation given in clause 7, are the average for meteorological conditions within these limits. The term average here means the average over a short time interval, as defined in 3.1.*
>
> *These equations also hold, equivalently, for average propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs on clear, calm nights*".

Due to the large size of the study area and the density of vegetation within the study area, vegetative sound absorption was included in the model. An absorption coefficient of 0.5 was used along with a temperature of 10^0C and a relative humidity of 70%. Note that trees were not specifically modeled. Over the large distance from the sources to the receivers, trees will add sound absorption. As a result, all sound level propagation calculations are considered conservatively representative of summertime conditions (as specified in Directive 038).

As part of the study, three specific noise modeling scenarios were conducted. These include:

- Baseline Case. This includes all noise sources associated with:
  - The existing Pod 1 CPF (10,000 bpd)
  - The existing Pod 1 wellpads (x2)
  - The Pod 2 CPF (10,000 bpd, currently under construction)
  - The Pod 2 wellpads (x3, currently under construction)
- Application Case Construction Scenario. This includes all equipment and noise sources associate with the Baseline Case as well as those associated with typical industrial construction equipment for the proposed Algar Expansion (24,000 bpd).
- Application Case Operational Scenario. This includes all equipment and noise sources associate with the Baseline Case as well as those associated with the operation of the proposed Algar Expansion (24,000 bpd) and all 40 future wellpads.

Note that a Planned Development Case (PDC) was not conducted since there are no known proposed facilities within at least 5 km of the Project.

The computer noise modeling results were calculated in two ways. First, sound levels were calculated at the Trapper's Cabin and the various 1,500 m receiver locations. Second, sound levels were calculated using a 20 m x 20 m receptor grid pattern within the entire study area. This provided color noise contours for easier visualization and evaluation of the results.

3.3. Noise Sources

The noise sources for the equipment associated with the Project are provided in Appendix I. The data were obtained either from (i) noise measurement assessments carried out for other projects using similar operating equipment or, (ii) aci in-house information and calculations using methods presented in various texts or, (iii) sound level information provided by equipment vendors. All sound power levels (SWLs) used in the modeling are considered conservative.

All noise sources have been modeled as point sources at their appropriate heights[1]. Sound power levels for all noise sources were modeled using octave-band information. Buildings and storage tanks were included in the modeling calculations because of their ability to provide shielding as well as reflection for noise[2]. Equipment proposed to be located within buildings was modeled using the octave band sound power levels and a generic octave band building attenuation. This attenuation is based on a typical construction of a metal clad, insulated building with minimal windows and some man-doors and overhead doors. This also assumes that the doors and windows remain closed at all times. At the time of report generation, specific information about the buildings (other than dimensions) is unknown. Refer to Appendix I for building and tank dimensions as well as building octave band noise attenuation values.

Noise sources associated with the individual SAGD well-pads were included in the model. Noise levels were obtained from sound level measurements of the well-pads at Pod 1. Note that the design calls for electric down-hole pumps for each of the well-pairs. These emit no noise at the surface. There is some minor noise-producing equipment at the surface (very small pumps and small instrument air compressors), however, all of the equipment is to be located within buildings. As such, given the typical noise levels associated with the equipment and the reduction from the buildings, the noise levels will be in-audible within approximately 100 m from the well-pads.

Finally, Directive 038 requires the assessment to include background ambient noise levels in the model. As specified in Directive 038, in most rural areas of Alberta where there is an absence of industrial noise sources the average night-time ambient noise level is approximately 35 dBA. This is known as the

[1] The heights for many of the sources are generally slightly higher than actual. This makes the model more conservative
[2] Exterior building and tank walls were modeled with an absorption coefficient of 0.21 which is generally highly reflective.

average ambient sound level (ASL). This value was used as the ambient condition in the modeling with the various Project related noise sources added.

3.4. Modeling Confidence

As mentioned previously, the algorithms used for the noise modeling follow the ISO 9613 standard. The published accuracy for this standard is ±3 dBA between 100 m – 1,000 m. Accuracy levels beyond 1,000 m are not published. Experience based on similar noise models conducted over large distances shows that, as expected, as the distance increases, the associated accuracy in prediction decreases. Experience has shown that environmental factors such as wind, temperature inversions, topography and ground cover all have increasing effects over distances larger than approximately 1,500 m. As such, for all receptors within approximately 1,500 m of the various noise sources, the prediction confidence is considered high, while for all receptors beyond 1,500 m, the prediction confidence is considered moderate.

4.0 Permissible Sound Levels

Environmental noise levels from industrial noise sources are commonly described in terms of equivalent sound levels or L_{eq}. This is the level of a steady sound having the same acoustic energy, over a given time period, as the fluctuating sound. In addition, this energy averaged level is A–weighted to account for the reduced sensitivity of average human hearing to low frequency sounds. These L_{eq} in dBA, which are the most common environmental noise measure, are often given for day-time (07:00 to 22:00) L_{eq}Day and night-time (22:00 to 07:00) L_{eq}Night while other criteria use the entire 24-hour period as L_{eq}24. Refer to Appendix II for a detailed description of the acoustical terms used and Appendix III for a list of common noise sources.

The document which most directly relates to the Permissible Sound Levels (PSL's) for this NIA is the ERCB Directive 038 on Noise Control (2007). Directive 038 sets the PSL at the receiver location based on population density and relative distances to heavily traveled road and rail as shown in Table 1. At the Trapper's Cabin, there is a Basic Sound Level (BSL) of 40 dBA for the night-time (night-time hours are 22:00 – 07:00) and 50 dBA for the day-time (day-time hours are 07:00 – 22:00) due to the proximity to Highway 63 (350 m) which is considered heavily traveled[1] during the night-time. Note that for this location, none of the other adjustments to the BSL, discussed in Directive 038, apply. In addition, Directive 038 specifies that new facilities must meet a PSL-Night of 40 dBA at 1,500 m from the facility fence-line if there are no closer dwellings. As such, the PSLs at a distance of 1,500 m are an **L_{eq}Night of 40 dBA and an L_{eq}Day of 50 dBA while the PSL at the Trapper's Cabin is 45 dBA L_{eq}Night and 55 dBA L_{eq}Day.** Refer to Appendix IV for a permissible sound level determination calculation.

The PSLs provided are related to noise associated with activities and processes at the Project and are not related to vehicle traffic on nearby highways (or access roads). This includes all traffic related to the construction and operation of the Facility. Noises from traffic sources are not covered by any regulations or guidelines at the municipal, provincial, or federal levels. As such, an assessment of the noises related to vehicle traffic was not conducted. However, recommendations for mitigation of vehicle traffic noise are provided in Section 5.4.2. In addition, construction noise is not specifically regulated by Directive 038. Construction noise mitigation recommendations are provided in Section 5.4.1.

[1] ERCB Directive 038 defines "heavily traveled" as having 10 or more vehicles per hour.

Table 1. Basic Night-Time Sound Levels (as per ERCB Directive 038)

Proximity to Transportation	Dwelling Density per Quarter Section of Land		
	1-8 Dwellings	9-160 Dwellings	>160 Dwellings
Category 1	40	43	46
Category 2	45	48	51
Category 3	50	53	56

Category 1 Dwelling units more than 500m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers

Category 2 Dwelling units more than 30m but less than 500m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers

Category 3 Dwelling units less than 30m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers

5.0 Results and Discussion

5.1. Baseline Case

The results of the Baseline Case noise modeling are presented in Table 2 and illustrated in Fig. 2. The modeled noise levels will be under the PSL-Night of 45 dBA at the Trapper's Cabin and under the PSL-Night of 40 dBA at all of the 1,500 m receptor locations with noise from the Great Divide 10,000 bpd CPF, the 2 Great Divide wellpads, the Algar 10,000 bpd CPF, and the 3 Algar wellpads all combined with the 35 dBA ASL.

In addition to the broadband A-weighted sound levels, the modeling results at the various receptor locations indicated C-weighted sound levels have been calculated, as shown in Table 3. For most of the receptors, the dBC sound levels will be less than 20 dB above the dBA sound levels. As specified in Directive 038, if the dBC – dBA sound levels are less than 20 dB, the noise is not considered to have a low frequency tonal component. At some of the receptors, however, the dBC – dBA sound levels are greater than 20 dB. These receptors, however, are very far from the CPFs and have very low dBA sound levels. The reason for the larger difference between the dBC and dBA sound levels is because the higher frequency sounds from the CPF will be absorbed by the atmosphere and vegetation more than the low frequency sounds. This is not necessarily an indication of a strong low frequency noise source. In addition, even with a low frequency tonal penalty of 5 dBA (detailed in Directive 038) added to the modeled sound levels at these receptors, the overall noise levels would still be well below their respective PSLs. As such, there is no additional low frequency noise mitigation required as per ERCB Directive 038.

Table 2. Baseline Case Sound Levels

Receptor	ASL-Night (dBA)	Baseline Case L_{eq}Night (dBA)	ASL + Baseline Case L_{eq}Night (dBA)	PSL-Night (dBA)	Compliant
Cabin	40.0	34.0	41.0	45.0	YES
R1	35.0	18.2	35.1	40.0	YES
R2	35.0	19.5	35.1	40.0	YES
R3	35.0	23.9	35.3	40.0	YES
R4	35.0	24.0	35.3	40.0	YES
R5	35.0	27.6	35.7	40.0	YES
R6	35.0	22.9	35.3	40.0	YES
R7	35.0	21.2	35.2	40.0	YES
R8	35.0	22.0	35.2	40.0	YES
R9	35.0	23.9	35.3	40.0	YES
R10	35.0	28.2	35.8	40.0	YES
R11	35.0	27.0	35.6	40.0	YES
R12	35.0	29.1	36.0	40.0	YES
R13	35.0	31.0	36.5	40.0	YES
R14	35.0	33.5	37.3	40.0	YES
R15	35.0	34.3	37.7	40.0	YES
R16	35.0	33.3	37.2	40.0	YES
R17	35.0	32.9	37.1	40.0	YES
R18	35.0	30.6	36.3	40.0	YES
R19	35.0	27.9	35.8	40.0	YES
R20	35.0	24.2	35.3	40.0	YES
R21	35.0	22.1	35.2	40.0	YES
R22	35.0	23.0	35.3	40.0	YES
R23	35.0	25.5	35.5	40.0	YES
R24	35.0	26.4	35.6	40.0	YES
R25	35.0	24.3	35.4	40.0	YES
R26	35.0	23.2	35.3	40.0	YES
R27	35.0	25.4	35.5	40.0	YES
R28	35.0	30.8	36.4	40.0	YES
R29	35.0	29.9	36.2	40.0	YES
R30	35.0	29.4	36.1	40.0	YES
R31	35.0	30.6	36.3	40.0	YES
R32	35.0	31.3	36.5	40.0	YES
R33	35.0	31.4	36.6	40.0	YES
R34	35.0	25.6	35.5	40.0	YES
R35	35.0	21.9	35.2	40.0	YES
R36	35.0	24.2	35.3	40.0	YES
R37	35.0	18.3	35.1	40.0	YES
R38	35.0	27.3	35.7	40.0	YES
R39	35.0	23.9	35.3	40.0	YES
R40	35.0	22.2	35.2	40.0	YES
R41	35.0	19.4	35.1	40.0	YES
R42	35.0	16.6	35.1	40.0	YES
R43	35.0	15.2	35.0	40.0	YES
R44	35.0	14.5	35.0	40.0	YES
R45	35.0	12.8	35.0	40.0	YES
R46	35.0	6.3	35.0	40.0	YES
R47	35.0	12.0	35.0	40.0	YES
R48	35.0	13.6	35.0	40.0	YES
R49	35.0	15.9	35.1	40.0	YES
R50	35.0	17.2	35.1	40.0	YES
R51	35.0	20.6	35.2	40.0	YES
R52	35.0	23.4	35.3	40.0	YES
R53	35.0	28.5	35.9	40.0	YES

Table 3. Baseline Case dBA and dBC Sound Levels

Receptor	Baseline Case L_{eq}Night (dBA)	Baseline Case L_{eq}Night (dBC)	dBC - dBA	LFN Tonal
Cabin	34.0	48.1	14.1	NO
R1	18.2	38.1	19.9	NO
R2	19.5	39.3	19.8	NO
R3	23.9	44.0	20.1	POSSIBLE
R4	24.0	42.5	18.5	NO
R5	27.6	46.8	19.2	NO
R6	22.9	41.9	19.0	NO
R7	21.2	40.5	19.3	NO
R8	22.0	41.1	19.1	NO
R9	23.9	42.5	18.6	NO
R10	28.2	46.9	18.7	NO
R11	27.0	45.1	18.1	NO
R12	29.1	45.8	16.7	NO
R13	31.0	47.2	16.2	NO
R14	33.5	49.2	15.7	NO
R15	34.3	50.0	15.7	NO
R16	33.3	49.2	15.9	NO
R17	32.9	48.9	16.0	NO
R18	30.6	47.0	16.4	NO
R19	27.9	45.1	17.2	NO
R20	24.2	42.5	18.3	NO
R21	22.1	40.8	18.7	NO
R22	23.0	40.9	17.9	NO
R23	25.5	42.3	16.8	NO
R24	26.4	42.3	15.9	NO
R25	24.3	40.3	16.0	NO
R26	23.2	39.2	16.0	NO
R27	25.4	40.4	15.0	NO
R28	30.8	44.7	13.9	NO
R29	29.9	42.9	13.0	NO
R30	29.4	44.2	14.8	NO
R31	30.6	45.1	14.5	NO
R32	31.3	45.5	14.2	NO
R33	31.4	45.9	14.5	NO
R34	25.6	41.5	15.9	NO
R35	21.9	39.5	17.6	NO
R36	24.2	41.8	17.6	NO
R37	18.3	37.7	19.4	NO
R38	27.3	44.6	17.3	NO
R39	23.9	41.9	18.0	NO
R40	22.2	40.7	18.5	NO
R41	19.4	38.7	19.3	NO
R42	16.6	36.8	20.2	POSSIBLE
R43	15.2	35.8	20.6	POSSIBLE
R44	14.5	35.3	20.8	POSSIBLE
R45	12.8	34.2	21.4	POSSIBLE
R46	6.3	26.9	20.6	POSSIBLE
R47	12.0	33.7	21.7	POSSIBLE
R48	13.6	34.9	21.3	POSSIBLE
R49	15.9	36.4	20.5	POSSIBLE
R50	17.2	37.5	20.3	POSSIBLE
R51	20.6	40.1	19.5	NO
R52	23.4	42.1	18.7	NO
R53	28.5	47.1	18.6	NO

5.2. Application Case Construction Scenario

The results of the Application Case Construction Scenario noise modeling are presented in Table 4 and illustrated in Fig. 3. The modeled noise levels at all receptor locations will be under 40 dBA L_{eq} during the night-time and under 50 dBA L_{eq} during the day-time. Although there is no specific criteria for construction noise within ERCB Directive 038, the results indicate minimal impact relative to the Baseline Case.

Table 4. Application Case Sound Levels (Construction Scenario)

Receptor	Construction Case L_{eq}Night (dBA)	Construction Case L_{eq}Day (dBA)
Cabin	34.1	34.2
R1	18.9	20.8
R2	20.5	22.9
R3	24.9	27.2
R4	25.6	28.8
R5	28.9	31.6
R6	24.5	27.7
R7	22.7	25.8
R8	23.7	26.8
R9	25.8	29.1
R10	31.5	36.1
R11	29.4	33.3
R12	30.8	34.1
R13	32.8	36.3
R14	35.7	39.4
R15	37.0	41.2
R16	35.5	39.4
R17	35.9	40.3
R18	33.1	37.1
R19	29.8	33.2
R20	25.7	28.8
R21	23.3	25.8
R22	23.7	25.5
R23	26.0	27.3
R24	26.6	27.4
R25	24.5	25.1
R26	23.3	23.7
R27	25.5	25.5
R28	30.8	30.8
R29	29.9	29.9
R30	29.4	29.3
R31	30.6	30.5
R32	31.3	31.2
R33	31.4	31.3
R34	25.6	25.7
R35	22.0	22.4
R36	24.3	24.8
R37	18.8	20.2
R38	29.2	32.7
R39	25.4	28.5
R40	23.5	26.3
R41	20.5	23.0
R42	17.5	19.8
R43	17.7	21.7
R44	15.4	17.5
R45	14.4	17.6
R46	6.3	6.3
R47	12.8	14.9
R48	14.5	16.7
R49	16.9	19.2
R50	18.4	21.1
R51	22.0	24.8
R52	25.1	28.3
R53	32.2	37.0

5.3. Application Case Operational Scenario

The results of the Application Case Operational Scenario noise modeling are presented in Table 5 and illustrated in Fig. 4. The modeled noise levels will be under the PSL-Night of 45 dBA at the Trapper's Cabin and under the PSL-Night of 40 dBA at all of the 1,500 m receptor locations with noise from the Great Divide 10,000 bpd CPF, the Algar 10,000 bpd CPF, the expanded Algar 24,000 bpd CPF, and all 40 wellpads all combined with the 35 dBA ASL.

In addition to the broadband A-weighted sound levels, the modeling results at the various receptor locations indicated C-weighted sound levels have been calculated, as shown in Table 6. Similar to the Baseline Case, the dBC sound levels will be less than 20 dB above the dBA sound levels for most of the receptors while greater than 20 dB above the dBA sound levels at some of the receptors. As stated with the Baseline Case, the noise levels are very low and no low frequency noise mitigation is required as per ERCB Directive 038.

Finally, R15 resulted in the highest modeled sound level with 37.9 dBA without the ASL. Appendix V contains a table of the ranked noise sources from highest to lowest, indicating which sources contributed the most to the resultant noise levels.

Table 5. Application Case Sound Levels (Operational Scenario)

Receptor	ASL-Night (dBA)	Application Case L_{eq}Night (dBA)	ASL + Application Case L_{eq}Night (dBA)	PSL-Night (dBA)	Compliant
Cabin	40.0	34.2	41.0	45.0	YES
R1	35.0	21.0	35.2	40.0	YES
R2	35.0	22.6	35.2	40.0	YES
R3	35.0	27.2	35.7	40.0	YES
R4	35.0	27.4	35.7	40.0	YES
R5	35.0	31.0	36.5	40.0	YES
R6	35.0	26.8	35.6	40.0	YES
R7	35.0	25.1	35.4	40.0	YES
R8	35.0	25.9	35.5	40.0	YES
R9	35.0	27.9	35.8	40.0	YES
R10	35.0	31.7	36.7	40.0	YES
R11	35.0	30.6	36.3	40.0	YES
R12	35.0	32.9	37.1	40.0	YES
R13	35.0	34.6	37.8	40.0	YES
R14	35.0	37.4	39.4	40.0	YES
R15	35.0	37.9	39.7	40.0	YES
R16	35.0	37.2	39.2	40.0	YES
R17	35.0	37.1	39.2	40.0	YES
R18	35.0	34.4	37.7	40.0	YES
R19	35.0	31.7	36.7	40.0	YES
R20	35.0	28.0	35.8	40.0	YES
R21	35.0	25.1	35.4	40.0	YES
R22	35.0	25.1	35.4	40.0	YES
R23	35.0	27.0	35.6	40.0	YES
R24	35.0	27.3	35.7	40.0	YES
R25	35.0	25.2	35.4	40.0	YES
R26	35.0	23.8	35.3	40.0	YES
R27	35.0	25.7	35.5	40.0	YES
R28	35.0	30.9	36.4	40.0	YES
R29	35.0	30.0	36.2	40.0	YES
R30	35.0	29.5	36.1	40.0	YES
R31	35.0	30.7	36.4	40.0	YES
R32	35.0	31.4	36.6	40.0	YES
R33	35.0	31.5	36.6	40.0	YES
R34	35.0	25.9	35.5	40.0	YES
R35	35.0	22.6	35.2	40.0	YES
R36	35.0	25.0	35.4	40.0	YES
R37	35.0	20.3	35.1	40.0	YES
R38	35.0	30.8	36.4	40.0	YES
R39	35.0	27.6	35.7	40.0	YES
R40	35.0	26.0	35.5	40.0	YES
R41	35.0	23.2	35.3	40.0	YES
R42	35.0	20.4	35.1	40.0	YES
R43	35.0	19.1	35.1	40.0	YES
R44	35.0	18.5	35.1	40.0	YES
R45	35.0	16.6	35.1	40.0	YES
R46	35.0	11.1	35.0	40.0	YES
R47	35.0	15.4	35.0	40.0	YES
R48	35.0	17.0	35.1	40.0	YES
R49	35.0	19.8	35.1	40.0	YES
R50	35.0	20.7	35.2	40.0	YES
R51	35.0	23.5	35.3	40.0	YES
R52	35.0	26.6	35.6	40.0	YES
R53	35.0	31.2	36.5	40.0	YES

Table 6. Application Case dBA and dBC Sound Levels (Operational Scenario)

Receptor	Application Case L_{eq}Night (dBA)	Application Case L_{eq}Night (dBC)	dBC - dBA	LFN Tonal
Cabin	34.2	48.6	14.4	NO
R1	21.0	40.9	19.9	NO
R2	22.6	42.3	19.7	NO
R3	27.2	46.1	18.9	NO
R4	27.4	45.6	18.2	NO
R5	31.0	49.0	18.0	NO
R6	26.8	45.2	18.4	NO
R7	25.1	43.9	18.8	NO
R8	25.9	44.5	18.6	NO
R9	27.9	45.9	18.0	NO
R10	31.7	50.0	18.3	NO
R11	30.6	48.2	17.6	NO
R12	32.9	49.0	16.1	NO
R13	34.6	50.3	15.7	NO
R14	37.4	52.4	15.0	NO
R15	37.9	52.9	15.0	NO
R16	37.2	52.3	15.1	NO
R17	37.1	52.3	15.2	NO
R18	34.4	50.2	15.8	NO
R19	31.7	48.3	16.6	NO
R20	28.0	45.6	17.6	NO
R21	25.1	43.6	18.5	NO
R22	25.1	43.3	18.2	NO
R23	27.0	44.4	17.4	NO
R24	27.3	44.0	16.7	NO
R25	25.2	42.2	17.0	NO
R26	23.8	40.7	16.9	NO
R27	25.7	41.5	15.8	NO
R28	30.9	45.1	14.2	NO
R29	30.0	43.5	13.5	NO
R30	29.5	44.7	15.2	NO
R31	30.7	45.5	14.8	NO
R32	31.4	45.9	14.5	NO
R33	31.5	46.3	14.8	NO
R34	25.9	42.4	16.5	NO
R35	22.6	40.9	18.3	NO
R36	25.0	43.1	18.1	NO
R37	20.3	40.1	19.8	NO
R38	30.8	47.6	16.8	NO
R39	27.6	45.1	17.5	NO
R40	26.0	44.1	18.1	NO
R41	23.2	42.0	18.8	NO
R42	20.4	40.3	19.9	NO
R43	19.1	39.4	20.3	POSSIBLE
R44	18.5	38.9	20.4	POSSIBLE
R45	16.6	37.7	21.1	POSSIBLE
R46	11.1	32.0	20.9	POSSIBLE
R47	15.4	36.9	21.5	POSSIBLE
R48	17.0	38.0	21.0	POSSIBLE
R49	19.8	39.7	19.9	NO
R50	20.7	40.6	19.9	NO
R51	23.5	42.7	19.2	NO
R52	26.6	44.9	18.3	NO
R53	31.2	47.8	16.6	NO

5.4. Noise Mitigation Measures

The results of the noise modeling indicated that no specific additional noise mitigation measures are required for project equipment.

5.4.1. Construction Noise

Although there are no specific construction noise level limits detailed by Directive 038, there are general recommendations for construction noise mitigation. This includes all activities associated with construction of the facility, well-pads (including drilling), borrow-pits, etc. The document states:

> "*While Directive 038 is not applicable to construction noise, licensees should attempt to take the following reasonable mitigating measures to reduce the impact on nearby dwellings of construction noise from new facilities or modifications to existing facilities. Licensees should:*
>
> - *Conduct construction activity between the hours of 07:00 and 22:00 to reduce the potential impact of construction noise;*
> - *Advise nearby residents of significant noise-causing activities and schedule these events to reduce disruption to them;*
> - *Ensure all internal combustion engines are fitted with appropriate muffler systems; and*
> - *Take advantage of acoustical screening from existing on-site buildings to shield dwellings from construction equipment noise.*
>
> *Should a valid complaint be made during construction, the licensee is expected to respond expeditiously and take appropriate action to ensure that the issue has been managed responsibly.*"

5.4.2. Transportation Noise

During construction and regular operation activities at the Project, most material deliveries should be made during the hours of 07:00 – 20:00. While the movement of heavy loads at night-time will increase the night-time sound levels the duration will be short and frequency relatively low. During construction, large dimensional heavy loads requiring specific traffic control measures will likely be limited to night-time (01:00 – 5:00) and will be announced to those communities that are located en route. The noise associated with this activity is typically not a source for complaints.

5.4.3. Upset Operations Potential Noise Sources

Upset operational noise could occur during operational upset/emergency conditions. The following upset conditions with the potential to create noise have been identified:

- Conditions that require vent blow downs
- Conditions that require flaring at the CPFs and/or production wellpad sites.

During an emergency situation, the first priorities will always be to safeguard life and property. In the event that an emergency situation also results in excessive short term noise levels, it is recommended that the licensee will consult with any affected parties, on a case by case basis.

5.4.4. Residual Noise

Given the nature of noise producing equipment, once it is no longer in operation, there is no longer noise being produced. As such, there is no residual noise mitigation required once the individual wellpads or the CPFs once they are decommissioned.

5.5. Noise Monitoring

As per ERCB Directive 038, post-commissioning noise monitoring is not required. The results of the noise modeling indicated that the noise levels would be below the permissible sound levels without additional noise mitigation. If, however, a noise complaint is filed with the ERCB or Connacher, it is the responsibility of Connacher to conduct a comprehensive sound level survey in accordance with the requirements of ERCB Directive 038.

6.0 Conclusion

The results of the noise modeling indicated Baseline Case night-time noise levels (with noise from the Great Divide 10,000 bpd CPF, the 2 Great Divide wellpads, the Algar 10,000 bpd CPF, and the 3 Algar wellpads all combined with the 35 dBA ASL) below the ERCB Directive 038 permissible sound levels of 45 dBA at the nearby Trapper's Cabin and 40 dBA for all surrounding 1,500 m receptors. Further, the dBC – dBA sound levels indicated minimal likelihood of low frequency tonal components.

The Application Case Construction Scenario noise levels (with typical construction activity for the Algar 24,000 bpd expansion) were only marginally higher than the Baseline Case and still below 40 dBA L_{eq} during the night-time and below 50 dBA L_{eq} during the day-time. General construction noise mitigation recommendations have been provided.

The Application Case Operational Scenario night-time noise levels (with noise from the Great Divide 10,000 bpd CPF, the Algar 10,000 bpd CPF, the expanded 24,000 Algar CPF, all 40 wellpads all combined with the 35 dBA ASL) below the ERCB Directive 038 permissible sound levels of 45 dBA at the nearby Trapper's Cabin and 40 dBA for all surrounding 1,500 m receptors. Further, the dBC – dBA sound levels indicated minimal likelihood of low frequency tonal components. As such, no additional noise mitigation is required for the normal operation of the Project.

A short form (ERCB form) noise impact assessment is presented in Appendix VI.

7.0 References

- Alberta Energy Resources Conservation Board (ERCB), *Directive 038 on Noise Control, 2007*, Calgary, Alberta
- International Organization for Standardization (ISO), *Standard 1996-1, Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures, 2003*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-1, Acoustics – Attenuation of sound during propagation outdoors – Part 1: Calculation of absorption of sound by the atmosphere, 1993*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-2, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, 1996*, Geneva Switzerland.
- *Power Plant Construction Noise Emissions*. Allan M. Teplitzky & Eric W. Wood, Internoise '78 Conference Proceedings, pp 279 – 284.
- *Environmental Codes of Practice for Steam Electric Power Generation – Construction Phase*. Report EPS 1/PG/3, Environment Canada, 1989.

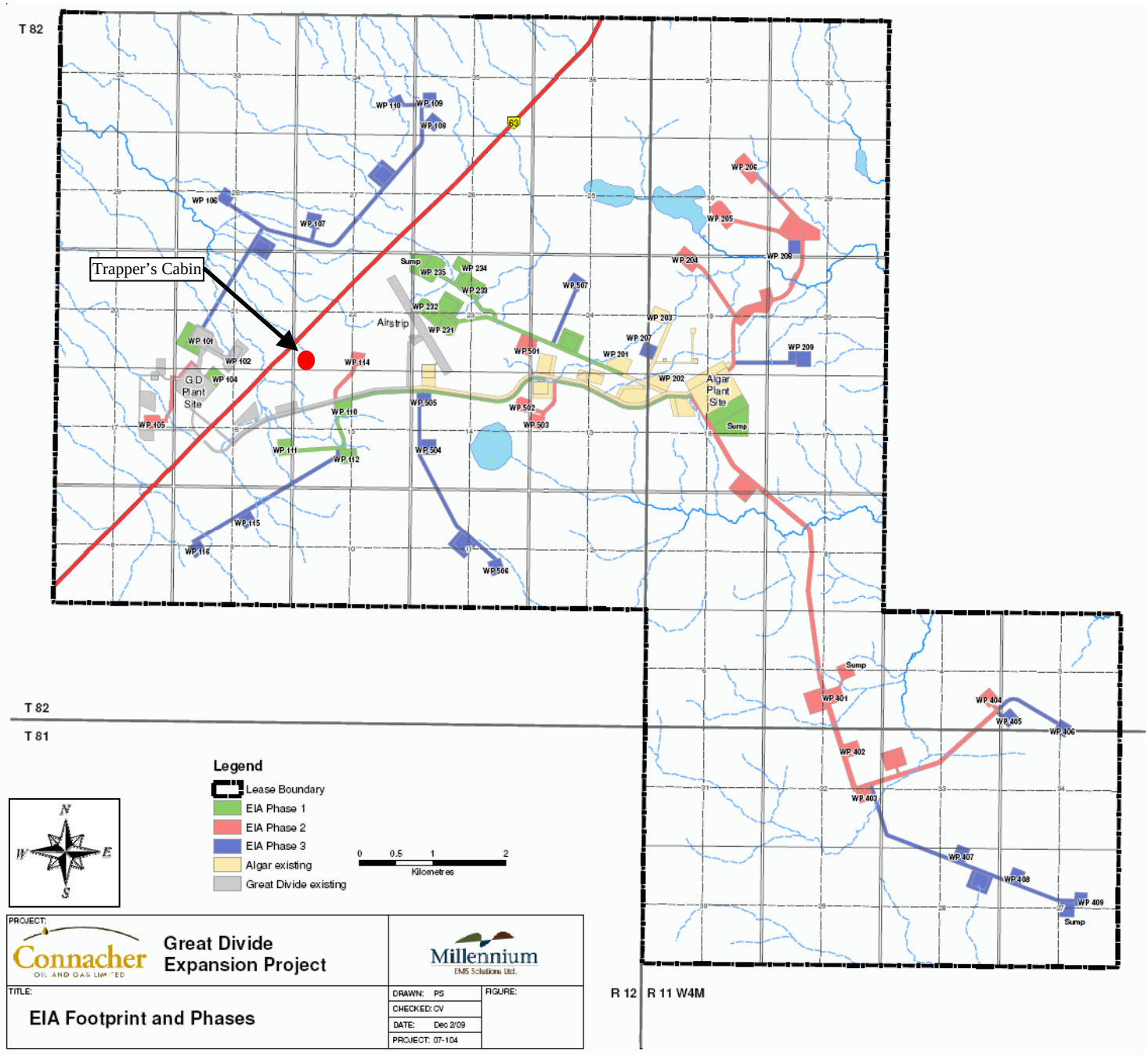


Figure 1. Project Study Area

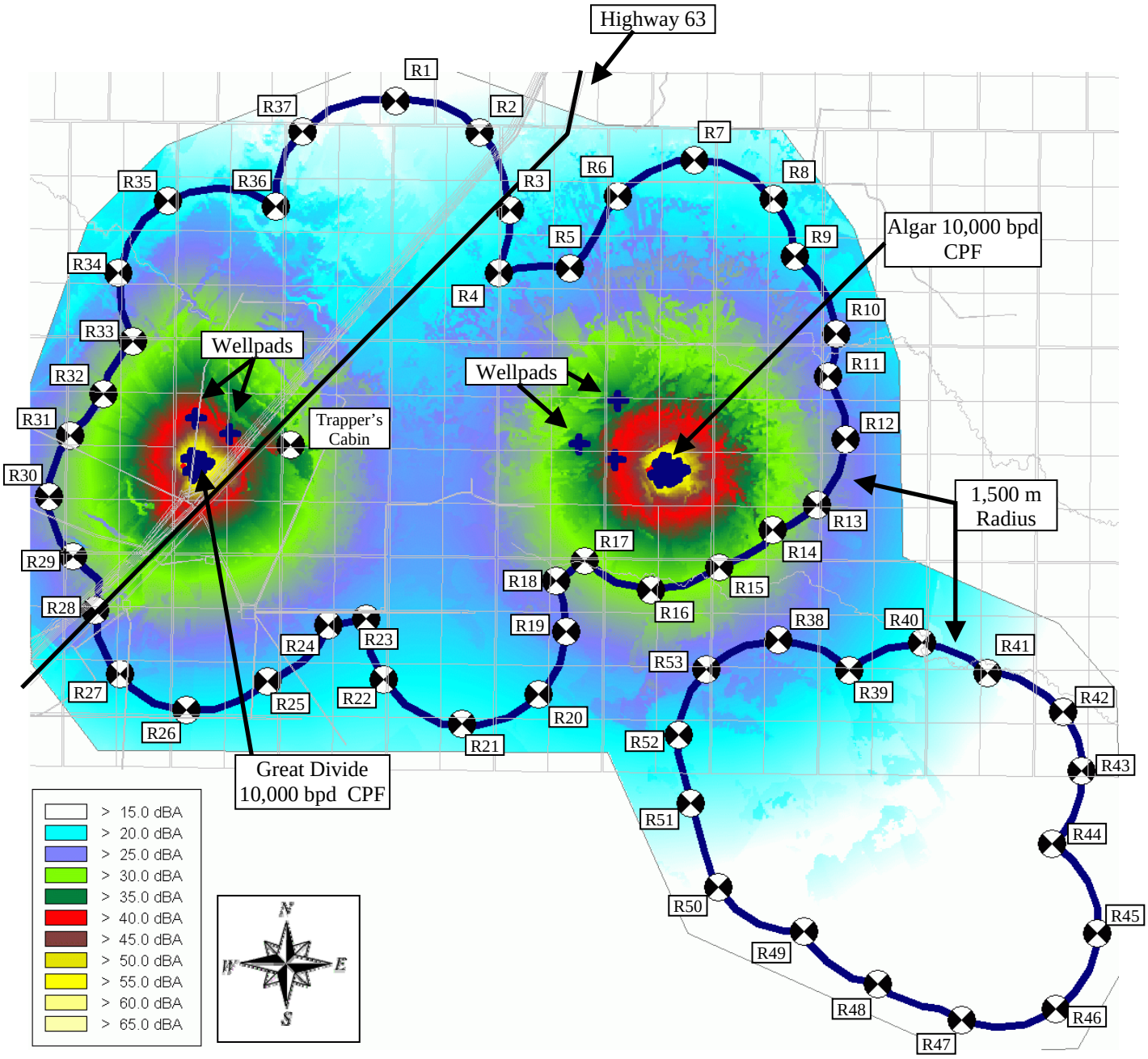


Figure 2. Baseline Case Noise Modeling Results (Without ASL)

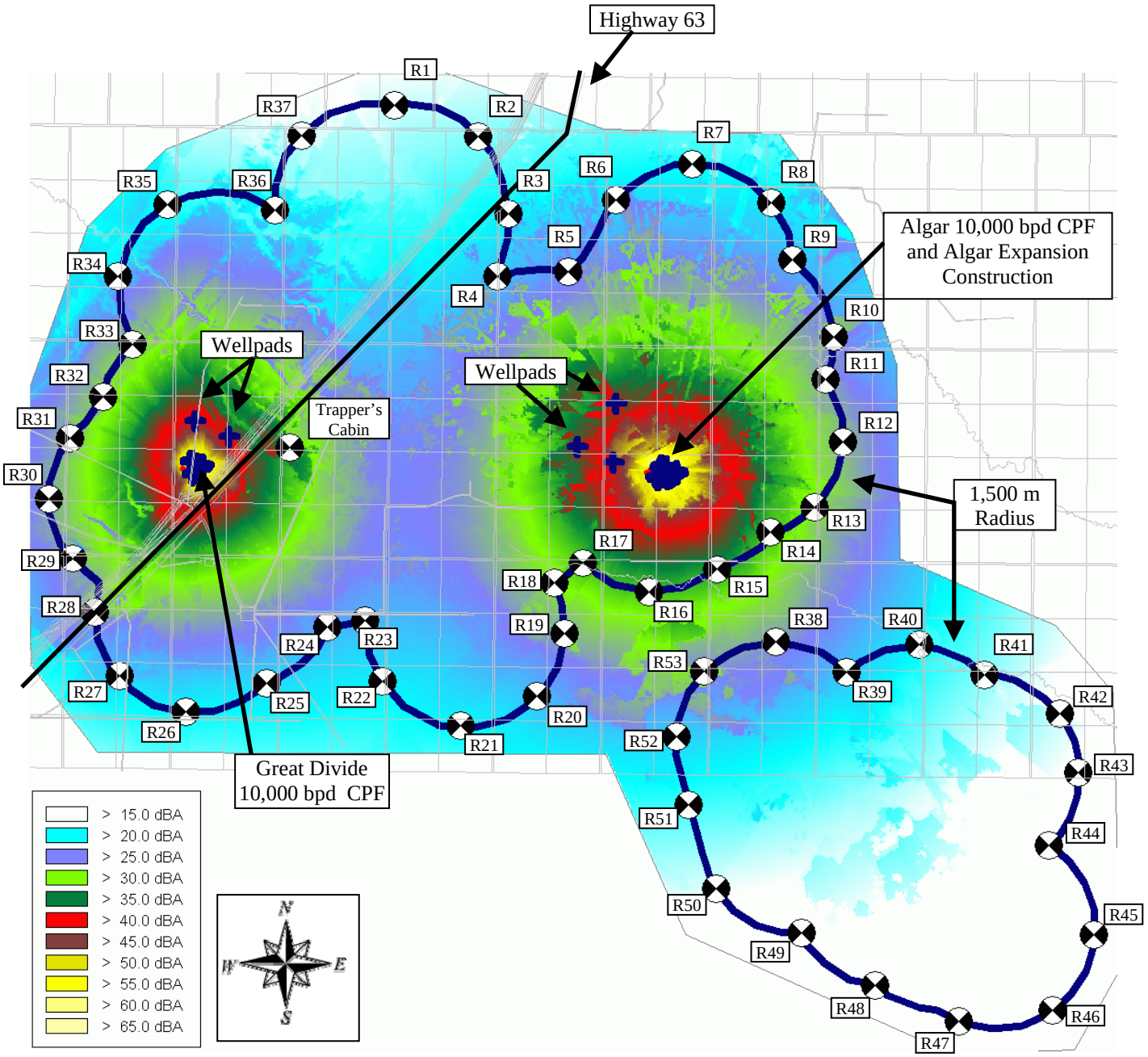


Figure 3. Application Case Noise Modeling Results (Construction Scenario, Without ASL)

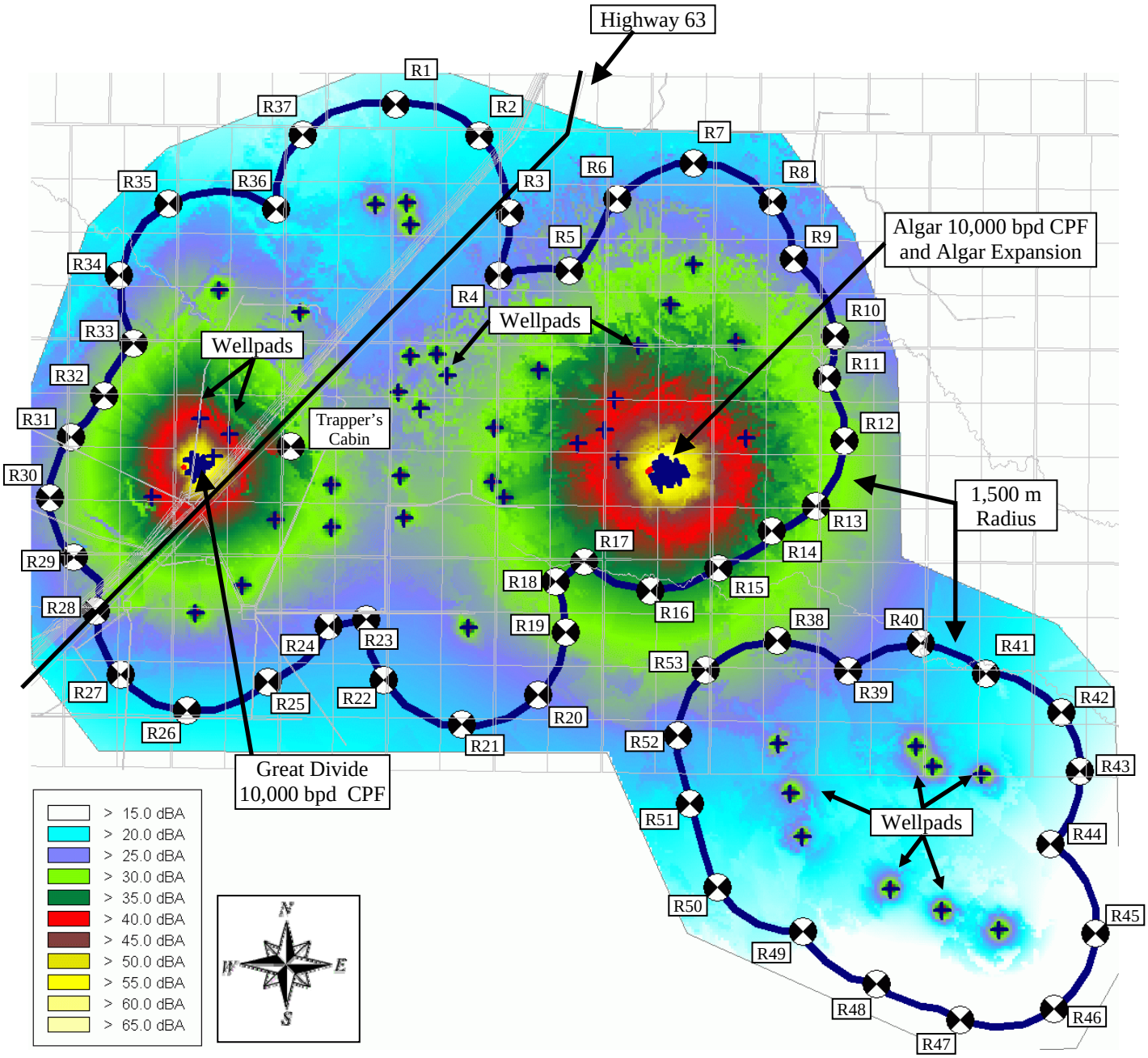


Figure 4. Application Case Noise Modeling Results (Operational Scenario, Without ASL)

Appendix I

NOISE MODELING PARAMETERS

Noise Sources for Pod 1 (Great Divide)

Tag	Description	Location	Height (mm)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
P-513	BLOWDOWN RECYCLE PUMP	BFW PUMP BLDG	2000	CENTRIFUGAL	11	1	101.1	24	**77.1**
P-541 A/B/C	H.P. BOILER FEEDWATER PUMPS	BFW PUMP BLDG	2000	CENTRIFUGAL	261	2	108.3	24	**84.3**
E-411	SEAL WATER COOLER	EVAPORATOR BLDG	6000	F760	50	1	104.6	0	**104.6**
K-606	VAPOR COMPRESSOR	EVAPORATOR BLDG	2000	VAPOR COMPRESSOR	1679	1	121.2	25	**96.2**
K-616	VAPOR COMPRESSOR	EVAPORATOR BLDG	2000	VAPOR COMPRESSOR	1679	1	121.2	25	**96.2**
P-580	SECONDARY FEED PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	11	1	101.1	24	**77.1**
P-590	SECONDARY FEED PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	11	1	101.1	24	**77.1**
P-520	FEED PUMP (EVAPORATOR #1)	EVAPORATOR BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-530	PRIMARY FEED PUMP (EVAPORATOR #2)	EVAPORATOR BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-581	DISTILLATE PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-591	DISTILLATE PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-582	EVAPORATOR RECIRCULATION PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	373	1	105.7	24	**81.7**
P-592	EVAPORATOR RECIRCULATION PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	373	1	105.7	24	**81.7**
E-421 A/B/C/D	GLYCOL COOLER	GLYCOL AREA	6000	ARIEL COOLER	360	1	106.5	0	**106.5**
K-610	GLYCOL HEATER BLOWER	GLYCOL BLDG	6000	FORCED DRAFT FAN	7	1	95.7	0	**95.7**
H-808	GLYCOL HEATER	GLYCOL BLDG	2000	WATER TUBE	2,678m 3/d	1	110.0	20	**90.0**
H-808	Glycol Heater Stack	Glycol BLDG Stack	5000	Stack	N/A	1	110.0	0	**110.0**
P-554 A/B	HEATING GLYCOL CIRCULATION PUMPS	GLYCOL BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-553 A/B/C	COOLING GLYCOL CIRCULATION PUMPS	GLYCOL BLDG	2000	CENTRIFUGAL	56	2	106.3	24	**82.3**
P-523 A/B	IGF RECYCLE PUMPS	IGF BLDG	2000	DGF CENTRIF.	22	2	105.1	24	**81.1**

Noise Sources for Pod 1 (Great Divide)

Tag	Description	Location	Height (mm)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
K-604	STEAM GENERATOR COMBUSTION AIR FAN	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	448	1	103.5	0	**103.5**
K-605	STEAM GENERATOR COMBUSTION AIR FAN	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	448	1	103.5	0	**103.5**
K-607	SEAL AIR FAN BLOWER	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	2	1	90.5	0	**90.5**
K-617	SEAL AIR FAN BLOWER	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	2	1	90.5	0	**90.5**
H-801	H.P. STEAM BOILER	STEAM GENERATOR BLDG	2000	A-STYLE WATER TUBE	90000 kg/hr	1	105.8	20	**85.8**
H-801	H.P Steam Boiler Stack	STEAM GENERATOR BLDG Stack	30500	Stack	N/A	1	105.8	0	**105.8**
H-802	H.P. STEAM BOILER	STEAM GENERATOR BLDG	2000	A-STYLE WATER TUBE	90000 kg/hr	1	105.8	20	**85.8**
H-802	H.P Steam Boiler Stack	STEAM GENERATOR BLDG Stack	30500	Stack	N/A	1	105.8	0	**105.8**
H-807	Utility Steam Boiler	STEAM GENERATOR BLDG	2000	A-STYLE WATER TUBE	4,700kg/hr	1	101.5	20	**81.5**
H-807	Utility Steam Boiler Stack	STEAM GENERATOR BLDG Stack	13000	Stack	N/A	1	101.5	0	**101.5**
K-600	VRU COMPRESSOR	TANK BLDG	2000	LIQUID RING	93	1	108.7	25	**83.7**
K-601	VRU COMPRESSOR	TANK BLDG	2000	LIQUID RING	19	1	101.7	25	**76.7**
P-560	FLOOR DRAIN TANK PUMP	TANK BLDG	2000	CENTRIFUGAL	11	1	101.1	24	**77.1**
P-503	OFF SPEC. OIL RECYCLE PUMP	TANK BLDG	2000	PROGRESSIVE CAVITY	22	1	102.0	24	**78.0**
P-505	SLOP OIL TRANSFER PUMP	TANK BLDG	2000	PROGRESSIVE CAVITY	22	1	102.0	24	**78.0**
P-507	SLOP WATER PUMP	TANK BLDG	2000	PROGRESSIVE CAVITY	22	1	102.0	24	**78.0**
P-557	RECYCLE PUMP	TANK BLDG	2000	PROGRESSIVE CAVITY	22	1	102.0	24	**78.0**
P-559 A/B	SKIM TANK FEED PUMPS	TANK BLDG	2000	CENTRIFUGAL	22	1	102.0	24	**78.0**
P-509 A/B	DILUENT PUMPS	TANK BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-521	WASH WATER PUMP	TANK BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-525 A/B	DE-OILED WATER PUMPS	TANK BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-524 A/B	OIL REMOVAL FILTER FEED PUMPS	TANK BLDG	2000	CENTRIFUGAL	45	1	103.0	24	**79.0**
K-603	RECYCLE TREATER BLOWER	TREATER/FWKO BLDG	7000	FORCED DRAFT FAN	11	1	97.5	0	**97.5**
K-608	AIR COMPRESSOR	WATER PUMP BLDG	2000	ROTARY SCREW	37	1	104.7	25	**79.7**
K-609	AIR COMPRESSOR	WATER PUMP BLDG	2000	ROTARY SCREW	37	1	104.7	25	**79.7**
P-543 A/B	UTILITY WATER PUMPS	WATER PUMP BLDG	2000	CENTRIFUGAL	11	1	101.1	24	**77.1**
P-537 A/B/C	L.P. BOILER FEEDWATER PUMPS	WATER PUMP BLDG	2000	CENTRIFUGAL	93	2	106.9	24	**82.9**

Noise Sources for Pod 2 (Algar)

Tag	Description	Location	Height (mm)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
P-513	BLOWDOWN RECYCLE PUMP	BFW PUMP BLDG	2000	CENTRIFUGAL	11	1	101.1	24	**77.1**
P-541 A/B/C	H.P. BOILER FEEDWATER PUMPS	BFW PUMP BLDG	2000	CENTRIFUGAL	261	2	108.3	24	**84.3**
E-411	SEAL WATER COOLER	EVAPORATOR BLDG	6000	F760	50	1	104.6	0	**104.6**
K-606	VAPOR COMPRESSOR	EVAPORATOR BLDG	2000	VAPOR COMPRESSOR	1679	1	121.2	25	**96.2**
K-616	VAPOR COMPRESSOR	EVAPORATOR BLDG	2000	VAPOR COMPRESSOR	1679	1	121.2	25	**96.2**
P-580	SECONDARY FEED PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	11	1	101.1	24	**77.1**
P-590	SECONDARY FEED PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	11	1	101.1	24	**77.1**
P-520	FEED PUMP (EVAPORATOR #1)	EVAPORATOR BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-530	PRIMARY FEED PUMP (EVAPORATOR #2)	EVAPORATOR BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-581	DISTILLATE PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-591	DISTILLATE PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-582	EVAPORATOR RECIRCULATION PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	373	1	105.7	24	**81.7**
P-592	EVAPORATOR RECIRCULATION PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	373	1	105.7	24	**81.7**
E-421 A/B/C/D	GLYCOL COOLER	GLYCOL AREA	6000	ARIEL COOLER	360	1	106.5	0	**106.5**
K-610	GLYCOL HEATER BLOWER	GLYCOL BLDG	6000	FORCED DRAFT FAN	7	1	95.7	0	**95.7**
H-808	GLYCOL HEATER	GLYCOL BLDG	2000	WATER TUBE	2,678m3/d	1	110.0	20	**90.0**
H-808	Glycol Heater Stack	Glycol BLDG Stack	5000	Stack	N/A	1	110.0	0	**110.0**
P-554 A/B	HEATING GLYCOL CIRCULATION PUMPS	GLYCOL BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-553 A/B/C	COOLING GLYCOL CIRCULATION PUMPS	GLYCOL BLDG	2000	CENTRIFUGAL	56	2	106.3	24	**82.3**
P-523 A/B	IGF RECYCLE PUMPS	IGF BLDG	2000	DGF CENTRIF.	22	2	105.1	24	**81.1**

Noise Sources for Pod 2 (Algar)

Tag	Description	Location	Height (mm)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
K-604	STEAM GENERATOR COMBUSTION AIR FAN	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	448	1	103.5	0	**103.5**
K-605	STEAM GENERATOR COMBUSTION AIR FAN	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	448	1	103.5	0	**103.5**
K-607	SEAL AIR FAN BLOWER	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	2	1	90.5	0	**90.5**
K-617	SEAL AIR FAN BLOWER	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	2	1	90.5	0	**90.5**
H-801	H.P. STEAM BOILER	STEAM GENERATOR BLDG	2000	A-STYLE WATER TUBE	90000 kg/hr	1	105.8	20	**85.8**
H-801	H.P Steam Boiler Stack	STEAM GENERATOR BLDG Stack	30500	Stack	N/A	1	105.8	0	**105.8**
H-802	H.P. STEAM BOILER	STEAM GENERATOR BLDG	2000	A-STYLE WATER TUBE	90000 kg/hr	1	105.8	20	**85.8**
H-802	H.P Steam Boiler Stack	STEAM GENERATOR BLDG Stack	30500	Stack	N/A	1	105.8	0	**105.8**
H-807	Utility Steam Boiler	STEAM GENERATOR BLDG	2000	A-STYLE WATER TUBE	4,700kg/hr	1	101.5	20	**81.5**
H-807	Utility Steam Boiler Stack	STEAM GENERATOR BLDG Stack	13000	Stack	N/A	1	101.5	0	**101.5**
K-600	VRU COMPRESSOR	TANK BLDG	2000	LIQUID RING	93	1	108.7	25	**83.7**
K-601	VRU COMPRESSOR	TANK BLDG	2000	LIQUID RING	19	1	101.7	25	**76.7**
P-560	FLOOR DRAIN TANK PUMP	TANK BLDG	2000	CENTRIFUGAL	11	1	101.1	24	**77.1**
P-503	OFF SPEC. OIL RECYCLE PUMP	TANK BLDG	2000	PROGRESSIVE CAVITY	22	1	102.0	24	**78.0**
P-505	SLOP OIL TRANSFER PUMP	TANK BLDG	2000	PROGRESSIVE CAVITY	22	1	102.0	24	**78.0**
P-507	SLOP WATER PUMP	TANK BLDG	2000	PROGRESSIVE CAVITY	22	1	102.0	24	**78.0**
P-557	RECYCLE PUMP	TANK BLDG	2000	PROGRESSIVE CAVITY	22	1	102.0	24	**78.0**
P-559 A/B	SKIM TANK FEED PUMPS	TANK BLDG	2000	CENTRIFUGAL	22	1	102.0	24	**78.0**
P-509 A/B	DILUENT PUMPS	TANK BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-521	WASH WATER PUMP	TANK BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-525 A/B	DE-OILED WATER PUMPS	TANK BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-524 A/B	OIL REMOVAL FILTER FEED PUMPS	TANK BLDG	2000	CENTRIFUGAL	45	1	103.0	24	**79.0**
K-603	RECYCLE TREATER BLOWER	TREATER/FWKO BLDG	7000	FORCED DRAFT FAN	11	1	97.5	0	**97.5**
K-608	AIR COMPRESSOR	WATER PUMP BLDG	2000	ROTARY SCREW	37	1	104.7	25	**79.7**
K-609	AIR COMPRESSOR	WATER PUMP BLDG	2000	ROTARY SCREW	37	1	104.7	25	**79.7**
P-543 A/B	UTILITY WATER PUMPS	WATER PUMP BLDG	2000	CENTRIFUGAL	11	1	101.1	24	**77.1**
P-537 A/B/C	L.P. BOILER FEEDWATER PUMPS	WATER PUMP BLDG	2000	CENTRIFUGAL	93	2	106.9	24	**82.9**
N/A	Crystallizer	Crystallizer	12000	Crystallizer	2.81 MMBtu/hr	1	75.0	0	**75.0**
N/A	CoGen Transformer	CoGen	4000	Tansformer	144-13.8 kV, 85/113 MVA	1	106.0	0	**106.0**

Noise Sources for Algar Expansion

Tag	Description	Location	Height (mm)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
P-513	BLOWDOWN RECYCLE PUMP	BFW PUMP BLDG	2000	CENTRIFUGAL	11	1	101.1	24	**77.1**
P-541 A/B/C	H.P. BOILER FEEDWATER PUMPS	BFW PUMP BLDG	2000	CENTRIFUGAL	261	2	108.3	24	**84.3**
E-411	SEAL WATER COOLER	EVAPORATOR BLDG	6000	F760	50	1	104.6	0	**104.6**
K-656A	VAPOR COMPRESSOR	EVAPORATOR BLDG	2000	VAPOR COMPRESSOR	3400	1	124.3	25	**99.3**
K-656B	VAPOR COMPRESSOR	EVAPORATOR BLDG	2000	VAPOR COMPRESSOR	3400	1	124.3	25	**99.3**
K-666	2nd Stage Vapour Compressor	EVAPORATOR BLDG	2000	VAPOR COMPRESSOR	750	1	117.8	25	**92.8**
K-667	Vent Condenser Compressor	EVAPORATOR BLDG	2000	VAPOR COMPRESSOR	100	1	109.0	25	**84.0**
P-580	SECONDARY FEED PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	11	1	101.1	24	**77.1**
P-520	FEED PUMP (EVAPORATOR #1)	EVAPORATOR BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-535	Cleaning Pump	EVAPORATOR BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-581	DISTILLATE PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	60	1	103.3	24	**79.3**
P-590	2nd Stage Recirc Pump	EVAPORATOR BLDG	2000	CENTRIFUGAL	150	1	104.5	24	**80.5**
P-591	2nd Stage Evap. Recirc Pump	EVAPORATOR BLDG	2000	CENTRIFUGAL	150	1	104.5	24	**80.5**
P-582	EVAPORATOR RECIRCULATION PUMP	EVAPORATOR BLDG	2000	CENTRIFUGAL	600	1	106.3	24	**82.3**
P-592	2nd Stage Distillate Pump	EVAPORATOR BLDG	2000	CENTRIFUGAL	15	1	101.5	24	**77.5**
E-421 A/B/C/D	GLYCOL COOLER	GLYCOL AREA	6000	ARIEL COOLER	360	1	106.5	0	**106.5**
K-610	GLYCOL HEATER BLOWER	GLYCOL BLDG	6000	FORCED DRAFT FAN	15	1	98.8	0	**98.8**
H-808	GLYCOL HEATER	GLYCOL BLDG	2000	WATER TUBE	2,678m3/d	1	110.0	20	**90.0**
H-808	Glycol Heater Stack	Glycol BLDG Stack	5000	Stack	N/A	1	110.0	0	**110.0**
P-554 A/B	HEATING GLYCOL CIRCULATION PUMPS	GLYCOL BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-553 A/B/C	COOLING GLYCOL CIRCULATION PUMPS	GLYCOL BLDG	2000	CENTRIFUGAL	110	2	107.1	24	**83.1**

Noise Sources for Algar Expansion

Tag	Description	Location	Height (mm)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
K-654	STEAM GENERATOR COMBUSTION AIR FAN	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	600	1	104.8	0	**104.8**
K-655	STEAM GENERATOR COMBUSTION AIR FAN	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	600	1	104.8	0	**104.8**
K-656	STEAM GENERATOR COMBUSTION AIR FAN	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	600	1	104.8	0	**104.8**
K-657	STEAM GENERATOR COMBUSTION AIR FAN	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	600	1	104.8	0	**104.8**
K-658	STEAM GENERATOR COMBUSTION AIR FAN	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	600	1	104.8	0	**104.8**
K-607	SEAL AIR FAN BLOWER	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	2	1	90.5	0	**90.5**
K-617	SEAL AIR FAN BLOWER	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	2	1	90.5	0	**90.5**
K-627	SEAL AIR FAN BLOWER	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	2	1	90.5	0	**90.5**
K-637	SEAL AIR FAN BLOWER	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	2	1	90.5	0	**90.5**
K-647	SEAL AIR FAN BLOWER	STEAM GENERATOR BLDG	7000	FORCED DRAFT FAN	2	1	90.5	0	**90.5**
H-821	H.P. STEAM BOILER	STEAM GENERATOR BLDG	2000	A-STYLE WATER TUBE	90000 kg/hr	1	105.8	20	**85.8**
H-821	H.P Steam Boiler Stack	STEAM GENERATOR BLDG Stack	30500	Stack	N/A	1	105.8	0	**105.8**
H-822	H.P. STEAM BOILER	STEAM GENERATOR BLDG	2000	A-STYLE WATER TUBE	90000 kg/hr	1	105.8	20	**85.8**
H-822	H.P Steam Boiler Stack	STEAM GENERATOR BLDG Stack	30500	Stack	N/A	1	105.8	0	**105.8**
H-823	H.P. STEAM BOILER	STEAM GENERATOR BLDG	2000	A-STYLE WATER TUBE	90000 kg/hr	1	105.8	20	**85.8**
H-823	H.P Steam Boiler Stack	STEAM GENERATOR BLDG Stack	30500	Stack	N/A	1	105.8	0	**105.8**
H-824	H.P. STEAM BOILER	STEAM GENERATOR BLDG	2000	A-STYLE WATER TUBE	90000 kg/hr	1	105.8	20	**85.8**
H-824	H.P Steam Boiler Stack	STEAM GENERATOR BLDG Stack	30500	Stack	N/A	1	105.8	0	**105.8**
H-825	H.P. STEAM BOILER	STEAM GENERATOR BLDG	2000	A-STYLE WATER TUBE	90000 kg/hr	1	105.8	20	**85.8**
H-825	H.P Steam Boiler Stack	STEAM GENERATOR BLDG Stack	30500	Stack	N/A	1	105.8	0	**105.8**
H-807	Utility Steam Boiler	STEAM GENERATOR BLDG	2000	A-STYLE WATER TUBE	4,700kg/hr	1	101.5	20	**81.5**
H-807	Utility Steam Boiler Stack	STEAM GENERATOR BLDG Stack	13000	Stack	N/A	1	101.5	0	**101.5**
K-650	VRU COMPRESSOR	TANK BLDG	2000	LIQUID RING	150	1	110.8	25	**85.8**
K-651	VRU COMPRESSOR	TANK BLDG	2000	LIQUID RING	150	1	110.8	25	**85.8**
P-560	FLOOR DRAIN TANK PUMP	TANK BLDG	2000	CENTRIFUGAL	11	1	101.1	24	**77.1**
P-503	OFF SPEC. OIL RECYCLE PUMP	TANK BLDG	2000	PROGRESSIVE CAVITY	22	1	102.0	24	**78.0**
P-505	SLOP OIL TRANSFER PUMP	TANK BLDG	2000	PROGRESSIVE CAVITY	22	1	102.0	24	**78.0**
P-507	SLOP WATER PUMP	TANK BLDG	2000	PROGRESSIVE CAVITY	22	1	102.0	24	**78.0**
P-557	RECYCLE PUMP	TANK BLDG	2000	PROGRESSIVE CAVITY	22	1	102.0	24	**78.0**
P-559 A/B	SKIM TANK FEED PUMPS	TANK BLDG	2000	CENTRIFUGAL	22	1	102.0	24	**78.0**
P-509 A/B	DILUENT PUMPS	TANK BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-521	WASH WATER PUMP	TANK BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-525 A/B	DE-OILED WATER PUMPS	TANK BLDG	2000	CENTRIFUGAL	30	1	102.4	24	**78.4**
P-524 A/B	OIL REMOVAL FILTER FEED PUMPS	TANK BLDG	2000	CENTRIFUGAL	45	1	103.0	24	**79.0**

Noise Sources for Algar Expansion

Tag	Description	Location	Height (mm)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
K-603	RECYCLE TREATER BLOWER	TREATER/FWKO BLDG	7000	FORCED DRAFT FAN	11	1	97.5	0	**97.5**
K-608	AIR COMPRESSOR	WATER PUMP BLDG	2000	ROTARY SCREW	150	1	110.8	25	**85.8**
K-609	AIR COMPRESSOR	WATER PUMP BLDG	2000	ROTARY SCREW	150	1	110.8	25	**85.8**
P-500A/B	Source Water Pump	Source Water Bldg	2000	CENTRIFUGAL	20	1	101.9	24	**77.9**
P-543 A/B	UTILITY WATER PUMPS	WATER PUMP BLDG	2000	CENTRIFUGAL	11	1	101.1	24	**77.1**
P-537 A/B/C	L.P. BOILER FEEDWATER PUMPS	WATER PUMP BLDG	2000	CENTRIFUGAL	93	2	106.9	24	**82.9**
N/A	Crystallizer	Crystallizer	12000	Crystallizer	2.81 MMBtu/hr	1	75.0	0	**75.0**
P-526	Crystallizer Recirculation Pump	Crystallizer	2000	CENTRIFUGAL	100	1	104.0	24	**80.0**
k-663	Crystallizer Vapour Compressor	Crystallizer	2000	ROTARY SCREW	450	1	115.5	25	**90.5**
N/A	CoGen Transformer	CoGen	4000	Tansformer	144-13.8 kV, 85/113 MVA	1	106.0	0	**106.0**

Octave Band Sound Power Levels for Great Divide (Re 10^{-12} Watts, un-mitigated)

Tag	Description	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
P-513	BLOWDOWN RECYCLE PUMP	90.1	91.1	92.1	94.1	94.1	97.1	94.1	90.1	84.1
P-541 A/B/C	H.P. BOILER FEEDWATER PUMPS	97.3	98.3	99.3	101.3	101.3	104.3	101.3	97.3	91.3
E-411	SEAL WATER COOLER	105.6	108.6	108.6	105.6	102.6	98.6	95.6	92.6	84.6
K-606	VAPOR COMPRESSOR	111.2	107.2	112.2	111.2	109.2	112.2	117.2	114.2	107.2
K-616	VAPOR COMPRESSOR	111.2	107.2	112.2	111.2	109.2	112.2	117.2	114.2	107.2
P-580	SECONDARY FEED PUMP	90.1	91.1	92.1	94.1	94.1	97.1	94.1	90.1	84.1
P-590	SECONDARY FEED PUMP	90.1	91.1	92.1	94.1	94.1	97.1	94.1	90.1	84.1
P-520	FEED PUMP (EVAPORATOR #1)	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-530	PRIMARY FEED PUMP (EVAPORATOR #2)	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-581	DISTILLATE PUMP	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-591	DISTILLATE PUMP	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-582	EVAPORATOR RECIRCULATION PUMP	94.7	95.7	96.7	98.7	98.7	101.7	98.7	94.7	88.7
P-592	EVAPORATOR RECIRCULATION PUMP	94.7	95.7	96.7	98.7	98.7	101.7	98.7	94.7	88.7
E-421 A/B/C/D	GLYCOL COOLER	107.5	110.5	110.5	107.5	104.5	100.5	97.5	94.5	86.5
K-610	GLYCOL HEATER BLOWER	96.7	99.7	99.7	96.7	93.7	89.7	86.7	83.7	75.7
H-808	GLYCOL HEATER	119.0	118.0	113.0	107.0	106.0	104.0	102.0	102.0	102.0
H-808	Glycol Heater Stack	119.0	118.0	113.0	107.0	106.0	104.0	102.0	102.0	102.0
P-554 A/B	HEATING GLYCOL CIRCULATION PUMPS	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-553 A/B/C	COOLING GLYCOL CIRCULATION PUMPS	95.3	96.3	97.3	99.3	99.3	102.3	99.3	95.3	89.3
P-523 A/B	IGF RECYCLE PUMPS	94.1	95.1	96.1	98.1	98.1	101.1	98.1	94.1	88.1

Octave Band Sound Power Levels for Great Divide (Re 10^{-12} Watts, un-mitigated)

Tag	Description	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
K-604	STEAM GENERATOR COMBUSTION AIR FAN	104.5	107.5	107.5	104.5	101.5	97.5	94.5	91.5	83.5
K-605	STEAM GENERATOR COMBUSTION AIR FAN	104.5	107.5	107.5	104.5	101.5	97.5	94.5	91.5	83.5
K-607	SEAL AIR FAN BLOWER	91.5	94.5	94.5	91.5	88.5	84.5	81.5	78.5	70.5
K-617	SEAL AIR FAN BLOWER	91.5	94.5	94.5	91.5	88.5	84.5	81.5	78.5	70.5
H-801	H.P. STEAM BOILER	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-801	H.P Steam Boiler Stack	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-802	H.P. STEAM BOILER	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-802	H.P Steam Boiler Stack	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-807	Utility Steam Boiler	104.5	104.5	103.5	101.5	98.5	95.5	92.5	89.5	86.5
H-807	Utility Steam Boiler Stack	104.5	104.5	103.5	101.5	98.5	95.5	92.5	89.5	86.5
K-600	VRU COMPRESSOR	98.7	94.7	99.7	98.7	96.7	99.7	104.7	101.7	94.7
K-601	VRU COMPRESSOR	91.7	87.7	92.7	91.7	89.7	92.7	97.7	94.7	87.7
P-560	FLOOR DRAIN TANK PUMP	90.1	91.1	92.1	94.1	94.1	97.1	94.1	90.1	84.1
P-503	OFF SPEC. OIL RECYCLE PUMP	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-505	SLOP OIL TRANSFER PUMP	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-507	SLOP WATER PUMP	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-557	RECYCLE PUMP	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-559 A/B	SKIM TANK FEED PUMPS	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-509 A/B	DILUENT PUMPS	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-521	WASH WATER PUMP	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-525 A/B	DE-OILED WATER PUMPS	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-524 A/B	OIL REMOVAL FILTER FEED PUMPS	92.0	93.0	94.0	96.0	96.0	99.0	96.0	92.0	86.0
K-603	RECYCLE TREATER BLOWER	98.5	101.5	101.5	98.5	95.5	91.5	88.5	85.5	77.5
K-608	AIR COMPRESSOR	94.7	90.7	95.7	94.7	92.7	95.7	100.7	97.7	90.7
K-609	AIR COMPRESSOR	94.7	90.7	95.7	94.7	92.7	95.7	100.7	97.7	90.7
P-543 A/B	UTILITY WATER PUMPS	90.1	91.1	92.1	94.1	94.1	97.1	94.1	90.1	84.1
P-537 A/B/C	L.P. BOILER FEEDWATER PUMPS	95.9	96.9	97.9	99.9	99.9	102.9	99.9	95.9	89.9

Octave Band Sound Power Levels for Algar (Re 10^{-12} Watts, un-mitigated)

Tag	Description	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
P-513	BLOWDOWN RECYCLE PUMP	90.1	91.1	92.1	94.1	94.1	97.1	94.1	90.1	84.1
P-541 A/B/C	H.P. BOILER FEEDWATER PUMPS	97.3	98.3	99.3	101.3	101.3	104.3	101.3	97.3	91.3
E-411	SEAL WATER COOLER	105.6	108.6	108.6	105.6	102.6	98.6	95.6	92.6	84.6
K-606	VAPOR COMPRESSOR	111.2	107.2	112.2	111.2	109.2	112.2	117.2	114.2	107.2
K-616	VAPOR COMPRESSOR	111.2	107.2	112.2	111.2	109.2	112.2	117.2	114.2	107.2
P-580	SECONDARY FEED PUMP	90.1	91.1	92.1	94.1	94.1	97.1	94.1	90.1	84.1
P-590	SECONDARY FEED PUMP	90.1	91.1	92.1	94.1	94.1	97.1	94.1	90.1	84.1
P-520	FEED PUMP (EVAPORATOR #1)	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-530	PRIMARY FEED PUMP (EVAPORATOR #2)	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-581	DISTILLATE PUMP	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-591	DISTILLATE PUMP	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-582	EVAPORATOR RECIRCULATION PUMP	94.7	95.7	96.7	98.7	98.7	101.7	98.7	94.7	88.7
P-592	EVAPORATOR RECIRCULATION PUMP	94.7	95.7	96.7	98.7	98.7	101.7	98.7	94.7	88.7
E-421 A/B/C/D	GLYCOL COOLER	107.5	110.5	110.5	107.5	104.5	100.5	97.5	94.5	86.5
K-610	GLYCOL HEATER BLOWER	96.7	99.7	99.7	96.7	93.7	89.7	86.7	83.7	75.7
H-808	GLYCOL HEATER	119.0	118.0	113.0	107.0	106.0	104.0	102.0	102.0	102.0
H-808	Glycol Heater Stack	119.0	118.0	113.0	107.0	106.0	104.0	102.0	102.0	102.0
P-554 A/B	HEATING GLYCOL CIRCULATION PUMPS	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-553 A/B/C	COOLING GLYCOL CIRCULATION PUMPS	95.3	96.3	97.3	99.3	99.3	102.3	99.3	95.3	89.3
P-523 A/B	IGF RECYCLE PUMPS	94.1	95.1	96.1	98.1	98.1	101.1	98.1	94.1	88.1

Octave Band Sound Power Levels for Algar (Re 10^{-12} Watts, un-mitigated)

Tag	Description	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
K-604	STEAM GENERATOR COMBUSTION AIR FAN	104.5	107.5	107.5	104.5	101.5	97.5	94.5	91.5	83.5
K-605	STEAM GENERATOR COMBUSTION AIR FAN	104.5	107.5	107.5	104.5	101.5	97.5	94.5	91.5	83.5
K-607	SEAL AIR FAN BLOWER	91.5	94.5	94.5	91.5	88.5	84.5	81.5	78.5	70.5
K-617	SEAL AIR FAN BLOWER	91.5	94.5	94.5	91.5	88.5	84.5	81.5	78.5	70.5
H-801	H.P. STEAM BOILER	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-801	H.P Steam Boiler Stack	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-802	H.P. STEAM BOILER	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-802	H.P Steam Boiler Stack	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-807	Utility Steam Boiler	104.5	104.5	103.5	101.5	98.5	95.5	92.5	89.5	86.5
H-807	Utility Steam Boiler Stack	104.5	104.5	103.5	101.5	98.5	95.5	92.5	89.5	86.5
K-600	VRU COMPRESSOR	98.7	94.7	99.7	98.7	96.7	99.7	104.7	101.7	94.7
K-601	VRU COMPRESSOR	91.7	87.7	92.7	91.7	89.7	92.7	97.7	94.7	87.7
P-560	FLOOR DRAIN TANK PUMP	90.1	91.1	92.1	94.1	94.1	97.1	94.1	90.1	84.1
P-503	OFF SPEC. OIL RECYCLE PUMP	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-505	SLOP OIL TRANSFER PUMP	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-507	SLOP WATER PUMP	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-557	RECYCLE PUMP	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-559 A/B	SKIM TANK FEED PUMPS	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-509 A/B	DILUENT PUMPS	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-521	WASH WATER PUMP	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-525 A/B	DE-OILED WATER PUMPS	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-524 A/B	OIL REMOVAL FILTER FEED PUMPS	92.0	93.0	94.0	96.0	96.0	99.0	96.0	92.0	86.0
K-603	RECYCLE TREATER BLOWER	98.5	101.5	101.5	98.5	95.5	91.5	88.5	85.5	77.5
K-608	AIR COMPRESSOR	94.7	90.7	95.7	94.7	92.7	95.7	100.7	97.7	90.7
K-609	AIR COMPRESSOR	94.7	90.7	95.7	94.7	92.7	95.7	100.7	97.7	90.7
P-543 A/B	UTILITY WATER PUMPS	90.1	91.1	92.1	94.1	94.1	97.1	94.1	90.1	84.1
P-537 A/B/C	L.P. BOILER FEEDWATER PUMPS	95.9	96.9	97.9	99.9	99.9	102.9	99.9	95.9	89.9
N/A	Crystallizer	78.0	78.0	77.0	75.0	72.0	69.0	66.0	63.0	60.0
N/A	CoGen Transformer	103.0	109.0	111.0	106.0	106.0	100.0	95.0	90.0	83.0

Octave Band Sound Power Levels for Algar Expansion (Re 10^{-12} Watts, un-mitigated)

Tag	Description	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
P-513	BLOWDOWN RECYCLE PUMP	90.1	91.1	92.1	94.1	94.1	97.1	94.1	90.1	84.1
P-541 A/B/C	H.P. BOILER FEEDWATER PUMPS	97.3	98.3	99.3	101.3	101.3	104.3	101.3	97.3	91.3
E-411	SEAL WATER COOLER	105.6	108.6	108.6	105.6	102.6	98.6	95.6	92.6	84.6
K-606	VAPOR COMPRESSOR	114.3	110.3	115.3	114.3	112.3	115.3	120.3	117.3	110.3
K-616	VAPOR COMPRESSOR	114.3	110.3	115.3	114.3	112.3	115.3	120.3	117.3	110.3
K-666	2nd Stage Vapour Compressor	107.8	103.8	108.8	107.8	105.8	108.8	113.8	110.8	103.8
K-667	Vent Condenser Compressor	99.0	95.0	100.0	99.0	97.0	100.0	105.0	102.0	95.0
P-580	SECONDARY FEED PUMP	90.1	91.1	92.1	94.1	94.1	97.1	94.1	90.1	84.1
P-520	FEED PUMP (EVAPORATOR #1)	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-535	Cleaning Pump	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-581	DISTILLATE PUMP	92.3	93.3	94.3	96.3	96.3	99.3	96.3	92.3	86.3
P-590	2nd Stage Recirc Pump	93.5	94.5	95.5	97.5	97.5	100.5	97.5	93.5	87.5
P-591	2nd Stage Evap. Recirc Pump	93.5	94.5	95.5	97.5	97.5	100.5	97.5	93.5	87.5
P-582	EVAPORATOR RECIRCULATION PUMP	95.3	96.3	97.3	99.3	99.3	102.3	99.3	95.3	89.3
P-592	2nd Stage Distillate Pump	90.5	91.5	92.5	94.5	94.5	97.5	94.5	90.5	84.5
E-421 A/B/C/D	GLYCOL COOLER	107.5	110.5	110.5	107.5	104.5	100.5	97.5	94.5	86.5
K-610	GLYCOL HEATER BLOWER	99.8	102.8	102.8	99.8	96.8	92.8	89.8	86.8	78.8
H-808	GLYCOL HEATER	119.0	118.0	113.0	107.0	106.0	104.0	102.0	102.0	102.0
H-808	Glycol Heater Stack	119.0	118.0	113.0	107.0	106.0	104.0	102.0	102.0	102.0
P-554 A/B	HEATING GLYCOL CIRCULATION PUMPS	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-553 A/B/C	COOLING GLYCOL CIRCULATION PUMPS	96.1	97.1	98.1	100.1	100.1	103.1	100.1	96.1	90.1

Octave Band Sound Power Levels for Algar Expansion (Re 10^{-12} Watts, un-mitigated)

Tag	Description	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
K-654	STEAM GENERATOR COMBUSTION AIR FAN	105.8	108.8	108.8	105.8	102.8	98.8	95.8	92.8	84.8
K-655	STEAM GENERATOR COMBUSTION AIR FAN	105.8	108.8	108.8	105.8	102.8	98.8	95.8	92.8	84.8
K-656	STEAM GENERATOR COMBUSTION AIR FAN	105.8	108.8	108.8	105.8	102.8	98.8	95.8	92.8	84.8
K-657	STEAM GENERATOR COMBUSTION AIR FAN	105.8	108.8	108.8	105.8	102.8	98.8	95.8	92.8	84.8
K-658	STEAM GENERATOR COMBUSTION AIR FAN	105.8	108.8	108.8	105.8	102.8	98.8	95.8	92.8	84.8
K-607	SEAL AIR FAN BLOWER	91.5	94.5	94.5	91.5	88.5	84.5	81.5	78.5	70.5
K-617	SEAL AIR FAN BLOWER	91.5	94.5	94.5	91.5	88.5	84.5	81.5	78.5	70.5
K-627	SEAL AIR FAN BLOWER	91.5	94.5	94.5	91.5	88.5	84.5	81.5	78.5	70.5
K-637	SEAL AIR FAN BLOWER	91.5	94.5	94.5	91.5	88.5	84.5	81.5	78.5	70.5
K-647	SEAL AIR FAN BLOWER	91.5	94.5	94.5	91.5	88.5	84.5	81.5	78.5	70.5
H-821	H.P. STEAM BOILER	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-821	H.P Steam Boiler Stack	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-822	H.P. STEAM BOILER	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-822	H.P Steam Boiler Stack	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-823	H.P. STEAM BOILER	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-823	H.P Steam Boiler Stack	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-824	H.P. STEAM BOILER	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-824	H.P Steam Boiler Stack	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-825	H.P. STEAM BOILER	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-825	H.P Steam Boiler Stack	108.8	108.8	107.8	105.8	102.8	99.8	96.8	93.8	90.8
H-807	Utility Steam Boiler	104.5	104.5	103.5	101.5	98.5	95.5	92.5	89.5	86.5
H-807	Utility Steam Boiler Stack	104.5	104.5	103.5	101.5	98.5	95.5	92.5	89.5	86.5
K-600	VRU COMPRESSOR	100.8	96.8	101.8	100.8	98.8	101.8	106.8	103.8	96.8
K-601	VRU COMPRESSOR	100.8	96.8	101.8	100.8	98.8	101.8	106.8	103.8	96.8
P-560	FLOOR DRAIN TANK PUMP	90.1	91.1	92.1	94.1	94.1	97.1	94.1	90.1	84.1
P-503	OFF SPEC. OIL RECYCLE PUMP	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-505	SLOP OIL TRANSFER PUMP	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-507	SLOP WATER PUMP	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-557	RECYCLE PUMP	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-559 A/B	SKIM TANK FEED PUMPS	91.0	92.0	93.0	95.0	95.0	98.0	95.0	91.0	85.0
P-509 A/B	DILUENT PUMPS	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-521	WASH WATER PUMP	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-525 A/B	DE-OILED WATER PUMPS	91.4	92.4	93.4	95.4	95.4	98.4	95.4	91.4	85.4
P-524 A/B	OIL REMOVAL FILTER FEED PUMPS	92.0	93.0	94.0	96.0	96.0	99.0	96.0	92.0	86.0

Octave Band Sound Power Levels for Algar Expansion (Re 10^{-12} Watts, un-mitigated)

Tag	Description	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
K-603	RECYCLE TREATER BLOWER	98.5	101.5	101.5	98.5	95.5	91.5	88.5	85.5	77.5
K-608	AIR COMPRESSOR	100.8	96.8	101.8	100.8	98.8	101.8	106.8	103.8	96.8
K-609	AIR COMPRESSOR	100.8	96.8	101.8	100.8	98.8	101.8	106.8	103.8	96.8
P-500A/B	Source Water Pump	90.9	91.9	92.9	94.9	94.9	97.9	94.9	90.9	84.9
P-543 A/B	UTILITY WATER PUMPS	90.1	91.1	92.1	94.1	94.1	97.1	94.1	90.1	84.1
P-537 A/B/C	L.P. BOILER FEEDWATER PUMPS	95.9	96.9	97.9	99.9	99.9	102.9	99.9	95.9	89.9
N/A	Crystallizer	78.0	78.0	77.0	75.0	72.0	69.0	66.0	63.0	60.0
P-526	Crystallizer Recirculation Pump	93.0	94.0	95.0	97.0	97.0	100.0	97.0	93.0	87.0
k-663	Crystallizer Vapour Compressor	105.5	101.5	106.5	105.5	103.5	106.5	111.5	108.5	101.5
N/A	CoGen Transformer	103.0	109.0	111.0	106.0	106.0	100.0	95.0	90.0	83.0

In addition to the equipment lists above for each of the three CPF sections, there will be a gas turbine CoGeneration unit for each of the Algar 10,000 bpd and the Algar Expansion 24,000 bpd CPFs. The noise levels for the CoGen units are provided below.

Solar Turbines Titan 130 (Algar 10,000 bpd) Cogen Noise Source Octave Band Sound Power Levels

Gas Turbine Air Inlet (5 m elevation)	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBA
Unsilenced Combustion Air Inlet SPL @ 15 m	82	88	94	95	96	98	101	131	123	132
Inlet Pulse Cleaning Up-Draft Filter Insertion Loss	-2	-4	-8	-9	-13	-26	-27	-27	-33	
Subtotal	80	84	86	86	83	72	74	104	90	
Titan Inlet Silencer Insertion Loss	-3	-7	-13	-23	-40	-54	-57	-59	-48	
Subtotal	77	77	73	63	43	18	17	45	42	
Combustion Air Inlet SWL	**112**	**112**	**108**	**98**	**78**	**53**	**52**	**80**	**77**	**95**

Gas Turbine Exhaust (13 m elevation)	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBA
Unsilenced Combustion Exhaust SPL @ 15 m	92	96	94	97	101	96	88	78	68	101
Titan Exhaust Silencer Insertion Loss	-1	-6	-10	-20	-35	-38	-36	-24	-16	
Subtotal	91	90	84	77	66	58	52	54	52	
Combustion Air Inlet SWL	**126**	**125**	**119**	**112**	**101**	**93**	**87**	**89**	**87**	**108**

Gas Turbine Casing (3 m elevation)	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBA
Unenclosed Casing SPL @ 15 m	82	81	89	86	83	79	80	92	85	94
Building Attenuation	3	9	12	16	20	25	30	35	40	
Casing Noise SPL @ 15 m	79	72	77	70	63	54	50	57	45	
Casing Noise SWL	**114**	**107**	**112**	**105**	**98**	**89**	**85**	**92**	**80**	**102**

HRSG Casing (3 m elevation)	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBA
Unenclosed Casing SPL @ 15 m	82	81	89	86	83	79	80	92	85	94
Building Attenuation	3	9	12	16	20	25	30	35	40	
Casing Noise SPL @ 15 m	79	72	77	70	63	54	50	57	45	
Casing Noise SWL	**114**	**107**	**112**	**105**	**98**	**89**	**85**	**92**	**80**	**102**

Lube Oil Cooler (3 m elevation)	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBA
Lube Oil Cooler SPL @ 15 m	73	80	77	70	65	62	58	54	49	68
Lube Oil Cooler SWL	**108**	**115**	**112**	**105**	**100**	**97**	**93**	**89**	**84**	**104**

Solar Turbines Titan 250 (Algar Expansion) Cogen Noise Source Octave Band Sound Power Levels

Gas Turbine Air Inlet (5 m elevation)	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBA
Unsilenced Combustion Air Inlet SPL @ 15 m	82	88	94	95	96	98	101	140	132	141
Inlet Pulse Cleaning Up-Draft Filter Insertion Loss	-2	-4	-8	-9	-13	-26	-27	-27	-33	
Subtotal	80	84	86	86	83	72	74	113	99	
Titan Inlet Silencer Insertion Loss	-3	-7	-13	-23	-40	-54	-57	-59	-48	
Subtotal	77	77	73	63	43	18	17	54	51	
Combustion Air Inlet SWL	**112**	**112**	**108**	**98**	**78**	**53**	**52**	**89**	**86**	**96**

Gas Turbine Exhaust (13 m elevation)	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBA
Unsilenced Combustion Exhaust SPL @ 15 m	92	96	94	97	101	96	88	78	68	101
Titan Exhaust Silencer Insertion Loss	-1	-6	-10	-20	-35	-38	-36	-24	-16	
Subtotal	91	90	84	77	66	58	52	54	52	
Combustion Air Inlet SWL	**126**	**125**	**119**	**112**	**101**	**93**	**87**	**89**	**87**	**108**

Gas Turbine Casing (3 m elevation)	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBA
Unenclosed Casing SPL @ 15 m	82	81	89	86	83	79	80	92	85	94
Building Attenuation	3	9	12	16	20	25	30	35	40	
Casing Noise SPL @ 15 m	79	72	77	70	63	54	50	57	45	
Casing Noise SWL	**114**	**107**	**112**	**105**	**98**	**89**	**85**	**92**	**80**	**102**

HRSG Casing (3 m elevation)	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBA
Unenclosed Casing SPL @ 15 m	82	81	89	86	83	79	80	92	85	94
Building Attenuation	3	9	12	16	20	25	30	35	40	
Casing Noise SPL @ 15 m	79	72	77	70	63	54	50	57	45	
Casing Noise SWL	**114**	**107**	**112**	**105**	**98**	**89**	**85**	**92**	**80**	**102**

Lube Oil Cooler (3 m elevation)	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBA
Lube Oil Cooler SPL @ 15 m	73	80	77	70	65	62	58	54	49	68
Lube Oil Cooler SWL	**108**	**115**	**112**	**105**	**100**	**97**	**93**	**89**	**84**	**104**

As mentioned, there will be a total of 5 wellpads for the Baseline Case and 45 wellpads for the Application Case Operational Scenario. The noise levels for each of the wellpads are provided below.

Project Wellpad Octave Band Sound Power Levels

	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	dBA
Well-Pad SWL	95.4	88.5	83.0	78.5	77.4	79.4	80.7	78.9	75.5	86.2

Building Octave Band Sound Attenuation Levels

Description	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Building Attenuation (dB)	3	9	12	16	20	25	30	35	40

Building Dimensions (Great Divide CPF)

Building	Length (m)	Width (m)	Height (m)
Tank Building	24.0	61.5	14.0
IGF Building	6.9	21.2	3.0
MCC-200	5.0	17.0	3.0
Exchanger Building	6.3	16.5	3.0
Treater Building	15.5	61.0	14.0
Fuel Gas Building	5.9	11.0	3.0
Glycol Building	18.4	14.4	10.0
Evaporator Building	26.9	33.2	14.4
MCC-100	7.0	23.0	3.0
Source Water Pump Building	19.2	22.3	7.0
Inlet Building	18.1	25.0	10.7
BFW Pump Building	7.7	15.5	7.0
Steam Generator Building	30.0	26.0	12.0
Flare Knockout Building	6.0	9.1	3.0
Office / Warehouse	30.5	27.4	6.0
Lab Building	3.6	12.2	3.0

Tank Dimensions (Great Divide CPF)

Tag	Description	Location	Dimensions
T-700	OIL PRODUCTION TANK	TANK FARM	14478ø x 9760 high
T-701	SALES OIL TANK	TANK FARM	14478ø x 9760 high
T-702	OFF SPEC. OIL TANK	TANK FARM	14478ø x 9760 high
T-703	SLOP TANK	TANK FARM	7163ø x 9760 high
T-706	DILUENT TANK	TANK FARM	14478ø x 9760 high
T-712	SKIM TANK	TANK FARM	12954ø x 9760 high
T-713	SURGE TANK	TANK FARM	14478ø x 9760 high
T-714	DESAND TANK	TANK FARM	7163ø x 9760 high
T-715	DE-OILED WATER TANK	TANK FARM	14478ø x 9760 high
T-732	FLOOR DRAIN TANK	TANK BUILDING	4724ø x 4877 high
T-740	SOURCE WATER TANK	WATER PUMP BLDG	12954ø x 9760 high

Building Dimensions (Algar 10,000 bpd CPF)

Building	Length (m)	Width (m)	Height (m)
Tank Building	83.0	26.0	8.9
IGF Building	6.9	21.2	3.0
MCC-210	7.0	30.0	4.2
Exchanger Building	6.3	16.5	3.0
Treater Building	47.0	18.5	6.5
Fuel Gas Building	5.9	12.0	4.5
Glycol Building	17.0	20.0	4.4
Evaporator Building	26.9	33.2	13.9
MCC-110	7.0	30.0	4.2
Source Water Pump Building	29.5	19.5	6.5
Inlet Building	31.0	19.0	6.8
BFW Pump Building	18.0	7.0	4.7
Steam Generator Building	32.0	31.0	11.2
Flare Knockout Building	6.0	9.1	5.0
Office / Warehouse	30.5	27.4	6.0
Electrical Building SWGR-100	15.0	7.0	4.2
Electrical Building SWGR-101	15.0	7.0	4.2
MCC-310	7.0	20.0	4.2
CoGen MCC	12.0	7.0	4.2
Chemical Building	26.0	7.0	5.2
Crystallizer Building	31.0	16.0	15.5
CoGen Building	35.5	15.0	11.4
Lab Building	3.6	12.2	3.0

Tank Dimensions (Algar 10,000 bpd CPF)

Tag	Description	Location	Dimensions
T-700	BLOWDOWN TANK	BFW PUMP BLDG	7163ø x 7925 high
T-701	BRINE DISSOLVING TANK	EVAPORATOR	2438ø x 4572 S/S
T-702	EVAPORATOR FEED TANK	EVAPORATOR	3200ø x 4343 high
T-704	CAUSTIC STORAGE TANK	EVAPORATOR	3048ø x 4420 high
T-707	WASTE WATER TANK	EVAPORATOR	6096ø x 8230 high
T-708	POP DRUM	FLARE KO SKID	3048ø x 9144 S/S
T-712	NITROGEN LIQUID TANK	NITROGEN PKG	2901ø x 11811 high
T-713	FLOOR DRAIN TANK	TANK BLDG	4724ø x 4877 high
T-714	OIIL PRODUCTION TANK	TANK FARM	14478ø x 9760 high
T-715	SALES OIL TANK	TANK FARM	14478ø x 9760 high
T-717	OFF SPEC. OIL TANK	TANK FARM	14478ø x 9760 high
T-718	SLOP TANK	TANK FARM	7163ø x 9760 high
T-719	DILUENT TANK	TANK FARM	14478ø x 9754 high
T-721	SKIM TANK	TANK FARM	12954ø x 9760 high
T-722	SURGE TANK	TANK FARM	14478ø x 9760 high
T-723	DESAND TANK	TANK FARM	7163ø x 9760 high
T-724	DE-OILED WATER TANK	TANK FARM	14478ø x 9760 high
T-732	BOILER FEEDWATER TANK	WATER PUMP BLDG	14478ø x 9754 high
T-740	SOURCE WATER TANK	WATER PUMP BLDG	12954ø x 9760 high

Building Dimensions (Algar Expansion CPF)

Building	Width (m)	Length (m)	Height (m)
Tank Building	24.0	66.5	8.8
MCC-220	30.0	7.0	4.2
Treater Building	17.0	49.0	6.5
Fuel Gas Building	6.0	13.0	4.5
Glycol Building	20.0	16.0	4.4
Evaporator Building	27.0	49.0	13.9
MCC-120	30.0	7.0	4.2
Inlet Building	21.0	33.0	6.8
BFW Pump Building	7.0	21.5	4.7
Steam Generator Building	45.0	32.6	11.2
Maintenance Shop	27.4	30.5	6.0
MCC-320	20.0	7.0	4.2
CoGen MCC	7.0	12.0	4.2
Chemical Building	7.0	14.0	5.2
Crystallizer Building	16.0	31.0	15.5
CoGen Building	15.0	35.5	11.4
Group Seperator Building	6.0	13.0	5.0
Lab Building	3.6	7.3	2.4

Tank Dimensions (Algar Expansion CPF)

Tag	Description	Location	Dimensions
T-770	SKIM TANK	TANK FARM	20438ø x 9760 high
T-771	IGF FEED TANK	TANK FARM	20438ø x 9760 high
T-772	DE-OILED WATER TANK	TANK FARM	20438ø x 9760 high
T-773	OIL PRODUCTION TANK	TANK FARM	20438ø x 9760 high
T-774	SALES OIL TANK	TANK FARM	20438ø x 9760 high
T-775	DESAND TANK	TANK BLDG	14478ø x 9760 high
T-776	DILUENT TANK	TANK BLDG	20438ø x 9760 high
T-782	CRYSTALLIZER FEED TANK	CRYSTALLIZER	7163ø x 7600 high
T-784	BOILER FEEDWATER TANK	SOURCE WATER	20438ø x 9760 high

Appendix II

THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

Sound Pressure Level

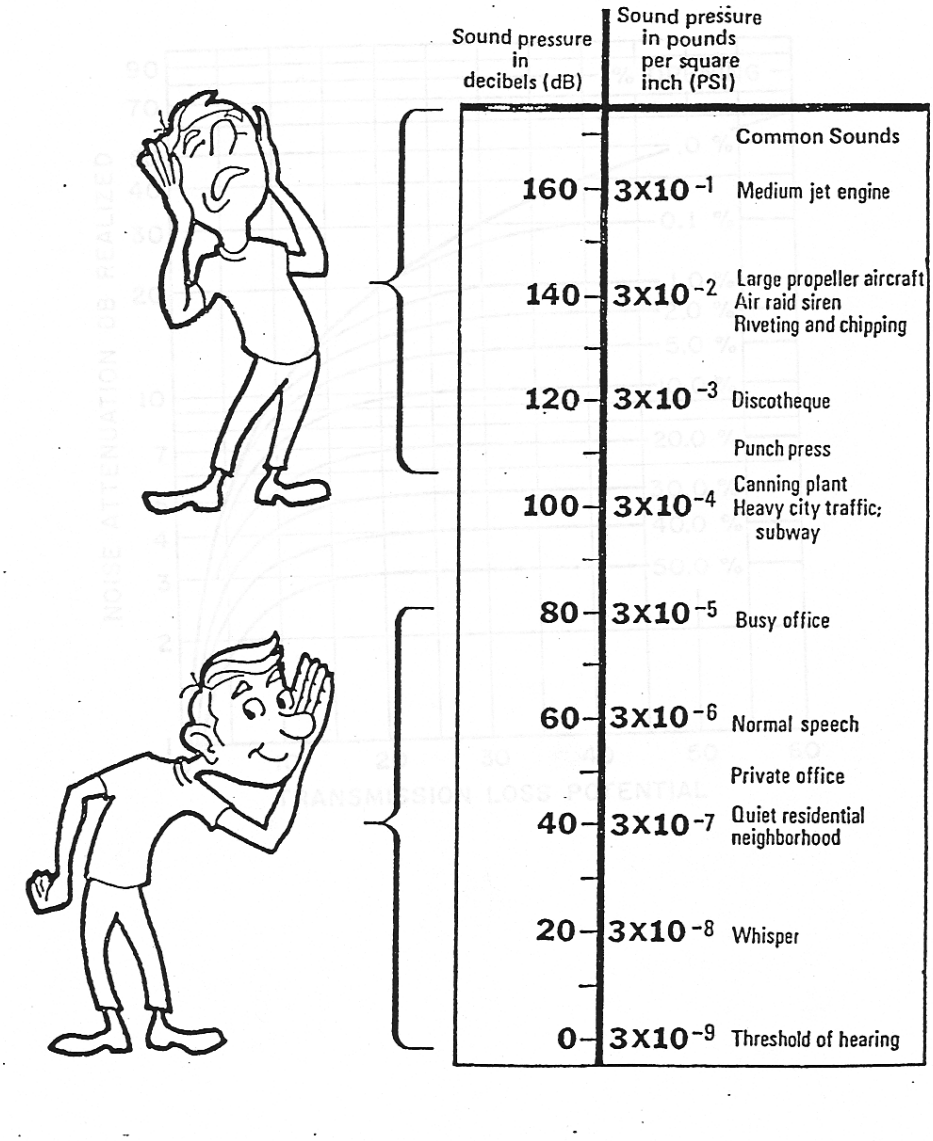
Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we measure pressure we typically measure the RMS sound pressure.

$$SPL = 10\log_{10}\left[\frac{P_{RMS}^{2}}{P_{ref}^{2}}\right] = 20\log_{10}\left[\frac{P_{RMS}}{P_{ref}}\right]$$

Where: SPL = Sound Pressure Level in dB
P_{RMS} = Root Mean Square measured pressure (Pa)
P_{ref} = Reference sound pressure level ($P_{ref} = 2\text{x}10^{-5}$ Pa = 20 μPa)

This reference sound pressure level is an internationally agreed upon value. It represents the threshold of human hearing for "typical" people based on numerous testing. It is possible to have a threshold which is lower than 20 μPa which will result in negative dB levels. As such, zero dB does not mean there is no sound!

In general, a difference of 1 – 2 dB is the threshold for humans to notice that there has been a change in sound level. A difference of 3 dB (factor of 2 in acoustical energy) is perceptible and a change of 5 dB is strongly perceptible. A change of 10 dB is typically considered a factor of 2. This is quite remarkable when considering that 10 dB is 10-times the acoustical energy!


Sound pressure in decibels (dB)
Sound pressure in pounds per square inch (PSI)
Common Sounds
160
3X10 -1
Medium jet engine
140
3X10 -2
Large propeller aircraft
Air raid siren
Riveting and chipping
120
3X10 -3
Discotheque
Punch press
100
3X10 -4
Canning plant
Heavy city traffic; subway
80
3X10 -5
Busy office
60
3X10 -6
Normal speech
Private office
40
3X10 -7
Quiet residential neighborhood
20
3X10 -8
Whisper
0
3X10 -9
Threshold of hearing

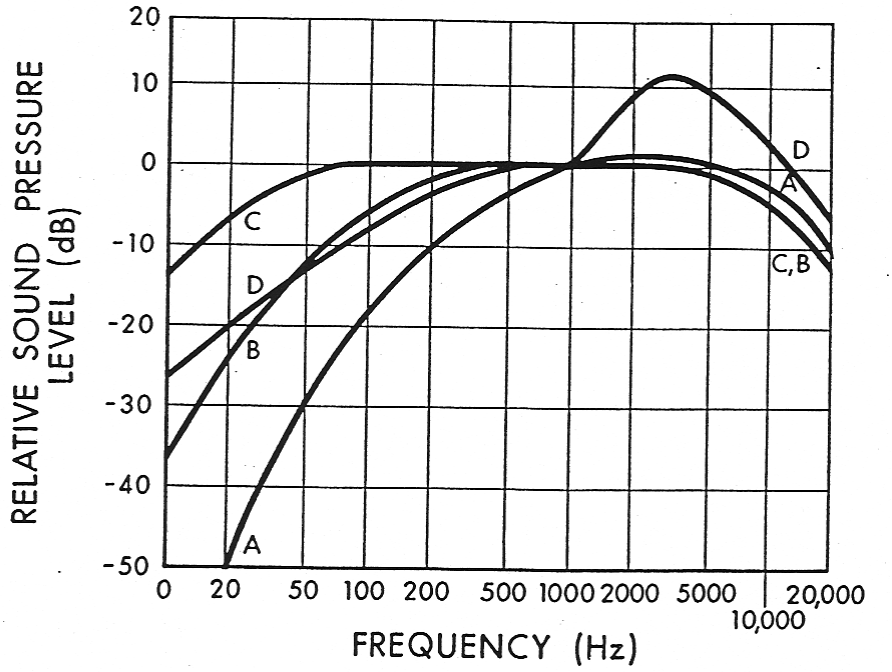
Frequency

The range of frequencies audible to the human ear ranges from approximately 20 Hz to 20 kHz. Within this range, the human ear does not hear equally at all frequencies. It is not very sensitive to low frequency sounds, is very sensitive to mid frequency sounds and is slightly less sensitive to high frequency sounds. Due to the large frequency range of human hearing, the entire spectrum is often divided into 31 bands, each known as a 1/3 octave band.

The internationally agreed upon center frequencies and upper and lower band limits for the 1/1 (whole octave) and 1/3 octave bands are as follows:

Whole Octave			1/3 Octave		
Lower Band Limit	Center Frequency	Upper Band Limit	Lower Band Limit	Center Frequency	Upper Band Limit
11	**16**	22	14.1	**16**	17.8
			17.8	**20**	22.4
22	**31.5**	44	22.4	**25**	28.2
			28.2	**31.5**	35.5
			35.5	**40**	44.7
44	**63**	88	44.7	**50**	56.2
			56.2	**63**	70.8
			70.8	**80**	89.1
88	**125**	177	89.1	**100**	112
			112	**125**	141
			141	**160**	178
177	**250**	355	178	**200**	224
			224	**250**	282
			282	**315**	355
355	**500**	710	355	**400**	447
			447	**500**	562
			562	**630**	708
710	**1000**	1420	708	**800**	891
			891	**1000**	1122
			1122	**1250**	1413
1420	**2000**	2840	1413	**1600**	1778
			1778	**2000**	2239
			2239	**2500**	2818
2840	**4000**	5680	2818	**3150**	3548
			3548	**4000**	4467
			4467	**5000**	5623
5680	**8000**	11360	5623	**6300**	7079
			7079	**8000**	8913
			8913	**10000**	11220
11360	**16000**	22720	11220	**12500**	14130
			14130	**16000**	17780
			17780	**20000**	22390

Human hearing is most sensitive at approximately 3500 Hz which corresponds to the ¼ wavelength of the ear canal (approximately 2.5 cm). Because of this range of sensitivity to various frequencies, we typically apply various weighting networks to the broadband measured sound to more appropriately account for the way humans hear. By default, the most common weighting network used is the so-called "A-weighting". It can be seen in the figure that the low frequency sounds are reduced significantly with the A-weighting.



Combination of Sounds

When combining multiple sound sources the general equation is:

$$\Sigma SPL_n = 10\log_{10}\left[\sum_{i=1}^{n} 10^{\frac{SPL_i}{10}}\right]$$

Examples:

- Two sources of 50 dB each add together to result in 53 dB.
- Three sources of 50 dB each add together to result in 55 dB.
- Ten sources of 50 dB each add together to result in 60 dB.
- One source of 50 dB added to another source of 40 dB results in 50.4 dB

It can be seen that, if multiple similar sources exist, removing or reducing only one source will have little effect.

Sound Level Measurements

Over the years a number of methods for measuring and describing environmental noise have been developed. The most widely used and accepted is the concept of the Energy Equivalent Sound Level (L_{eq}) which was developed in the US (1970's) to characterize noise levels near US Air-force bases. This is the level of a steady state sound which, for a given period of time, would contain the same energy as the time varying sound. The concept is that the same amount of annoyance occurs from a sound having a high level for a short period of time as from a sound at a lower level for a longer period of time.
The L_{eq} is defined as:

$$L_{eq} = 10\log_{10}\left[\frac{1}{T}\int_0^T 10^{\frac{dB}{10}}\,dT\right] = 10\log_{10}\left[\frac{1}{T}\int_0^T \frac{P^2}{P_{ref}^2}\,dT\right]$$

We must specify the time period over which to measure the sound. i.e. 1-second, 10-seconds, 15-seconds, 1-minute, 1-day, etc**. An L_{eq} is meaningless if there is no time period associated**.

In general there a few very common L_{eq} sample durations which are used in describing environmental noise measurements. These include:

- $L_{eq}24$ - Measured over a 24-hour period
- $L_{eq}Night$ - Measured over the night-time (typically 22:00 – 07:00)
- $L_{eq}Day$ - Measured over the day-time (typically 07:00 – 22:00)
- L_{DN} - Same as $L_{eq}24$ with a 10 dB penalty added to the night-time

Statistical Descriptor

Another method of conveying long term noise levels utilizes statistical descriptors. These are calculated from a cumulative distribution of the sound levels over the entire measurement duration and then determining the sound level at xx % of the time.

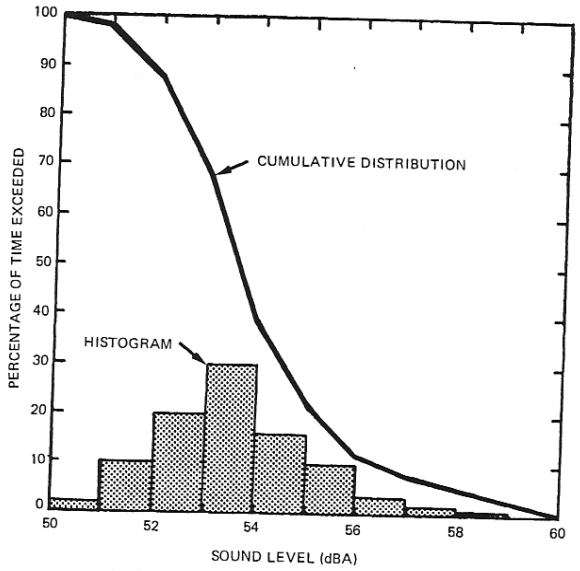


Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

Industrial Noise Control, Lewis Bell, Marcel Dekker, Inc. 1994

The most common statistical descriptors are:

L_{min} - minimum sound level measured
L_{01} - sound level that was exceeded only 1% of the time
L_{10} - sound level that was exceeded only 10% of the time.
- Good measure of intermittent or intrusive noise
- Good measure of Traffic Noise

L_{50} - sound level that was exceeded 50% of the time (arithmetic average)
- Good to compare to L_{eq} to determine steadiness of noise

L_{90} - sound level that was exceeded 90% of the time
- Good indicator of typical "ambient" noise levels

L_{99} - sound level that was exceeded 99% of the time
L_{max} - maximum sound level measured

These descriptors can be used to provide a more detailed analysis of the varying noise climate:

- If there is a large difference between the L_{eq} and the L_{50} (L_{eq} can never be any lower than the L_{50}) then it can be surmised that one or more short duration, high level sound(s) occurred during the time period.
- If the gap between the L_{10} and L_{90} is relatively small (less than 15 – 20 dBA) then it can be surmised that the noise climate was relatively steady.

Sound Propagation

In order to understand sound propagation, the nature of the source must first be discussed. In general, there are three types of sources. These are known as 'point', 'line', and 'area'. This discussion will concentrate on point and line sources since area sources are much more complex and can usually be approximated by point sources at large distances.

Point Source

As sound radiates from a point source, it dissipates through geometric spreading. The basic relationship between the sound levels at two distances from a point source is:

$$\therefore SPL_1 - SPL_2 = 20\log_{10}\left(\frac{r_2}{r_1}\right)$$

Where: SPL_1 = sound pressure level at location 1, SPL_2 = sound pressure level at location 2
r_1 = distance from source to location 1, r_2 = distance from source to location 2

Thus, the reduction in sound pressure level for a point source radiating in a free field is **6 dB per doubling of distance**. This relationship is independent of reflectivity factors provided they are always present. Note that this only considers geometric spreading and does not take into account atmospheric effects. Point sources still have some physical dimension associated with them, and typically do not radiate sound equally in all directions in all frequencies. The directionality of a source is also highly dependent on frequency. As frequency increases, directionality increases.

Examples (note no atmospheric absorption):

- A point source measuring 50 dB at 100m will be 44 dB at 200m.
- A point source measuring 50 dB at 100m will be 40.5 dB at 300m.
- A point source measuring 50 dB at 100m will be 38 dB at 400m.
- A point source measuring 50 dB at 100m will be 30 dB at 1000m.

Line Source

A line source is similar to a point source in that it dissipates through geometric spreading. The difference is that a line source is equivalent to a long line of many point sources. The basic relationship between the sound levels at two distances from a line source is:

$$SPL_1 - SPL_2 = 10\log_{10}\left(\frac{r_2}{r_1}\right)$$

The difference from the point source is that the '20' term in front of the 'log' is now only 10. Thus, the reduction in sound pressure level for a line source radiating in a free field is **3 dB per doubling of distance**.

Examples (note no atmospheric absorption):

- A line source measuring 50 dB at 100m will be 47 dB at 200m.
- A line source measuring 50 dB at 100m will be 45 dB at 300m.
- A line source measuring 50 dB at 100m will be 34 dB at 400m.
- A line source measuring 50 dB at 100m will be 40 dB at 1000m.

Atmospheric Absorption

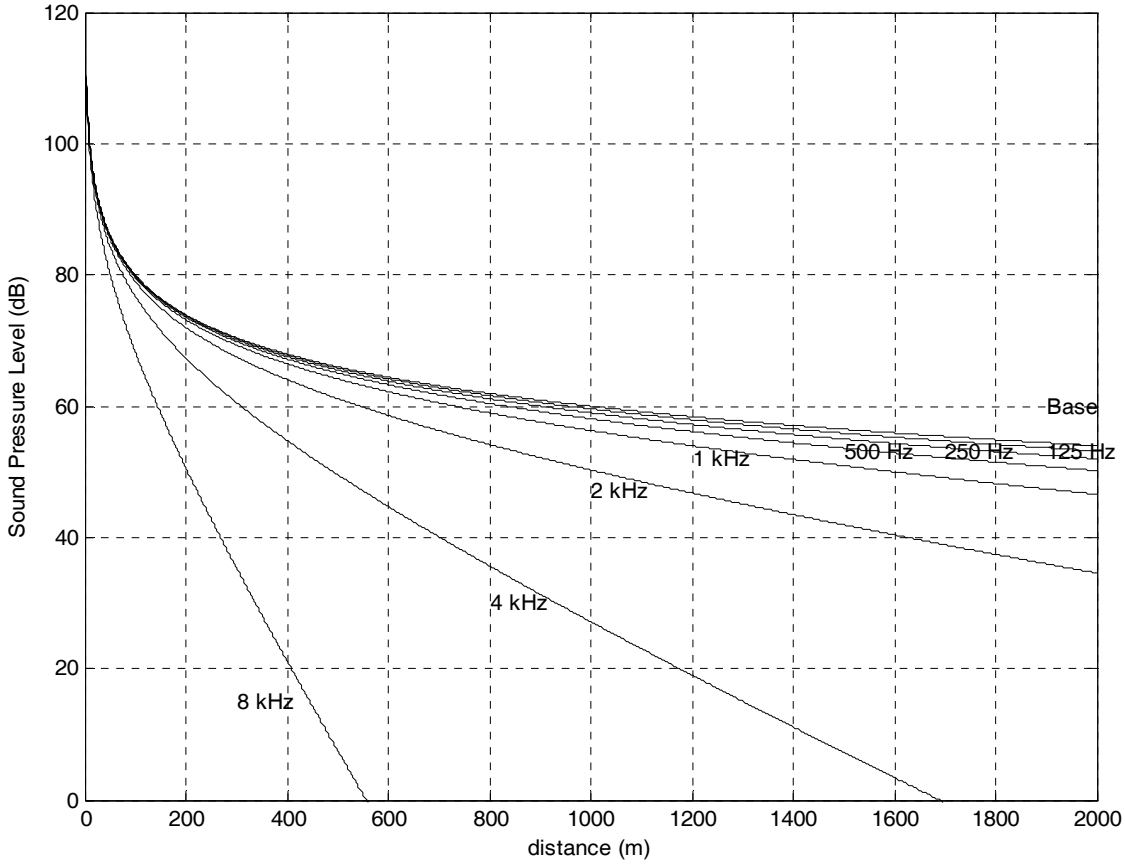
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

1) **Viscous Effects** - Dissipation of acoustic energy due to fluid friction which results in thermodynamically irreversible propagation of sound.
2) **Heat Conduction Effects** - Heat transfer between high and low temperature regions in the wave which result in non-adiabatic propagation of the sound.
3) **Inter Molecular Energy Interchanges** - Molecular energy relaxation effects which result in a time lag between changes in translational kinetic energy and the energy associated with rotation and vibration of the molecules.

The following table illustrates the attenuation coefficient of sound at standard pressure (101.325 kPa) in units of dB/100m.

Temperature	Relative Humidity	Frequency (Hz)					
^{o}C	(%)	125	250	500	1000	2000	4000
30	20	0.06	0.18	0.37	0.64	1.40	4.40
	50	0.03	0.10	0.33	0.75	1.30	2.50
	90	0.02	0.06	0.24	0.70	1.50	2.60
20	20	0.07	0.15	0.27	0.62	1.90	6.70
	50	0.04	0.12	0.28	0.50	1.00	2.80
	90	0.02	0.08	0.26	0.56	0.99	2.10
10	20	0.06	0.11	0.29	0.94	3.20	9.00
	50	0.04	0.11	0.20	0.41	1.20	4.20
	90	0.03	0.10	0.21	0.38	0.81	2.50
0	20	0.05	0.15	0.50	1.60	3.70	5.70
	50	0.04	0.08	0.19	0.60	2.10	6.70
	90	0.03	0.08	0.15	0.36	1.10	4.10

- As frequency increases, absorption increases
- As Relative Humidity increases, absorption decreases
- There is no direct relationship between absorption and temperature
- **The net result of atmospheric absorption is to modify the sound propagation of a point source from 6 dB/doubling-of-distance to approximately 7 – 8 dB/doubling-of-distance (based on anecdotal experience)**



Atmospheric Absorption at 10°C and 70% RH

Meteorological Effects

There are many meteorological factors which can affect how sound propagates over large distances. These various phenomena must be considered when trying to determine the relative impact of a noise source either after installation or during the design stage.

Wind

- Can greatly alter the noise climate away from a source depending on direction
- Sound levels downwind from a source can be increased due to refraction of sound back down towards the surface. This is due to the generally higher velocities as altitude increases.
- Sound levels upwind from a source can be decreased due to a "bending" of the sound away from the earth's surface.
- Sound level differences of ±10dB are possible depending on severity of wind and distance from source.
- Sound levels crosswind are generally not disturbed by an appreciable amount
- Wind tends to generate its own noise, however, and can provide a high degree of masking relative to a noise source of particular interest.

Temperature

- Temperature effects can be similar to wind effects
- Typically, the temperature is warmer at ground level than it is at higher elevations.
- If there is a very large difference between the ground temperature (very warm) and the air aloft (only a few hundred meters) then the transmitted sound refracts upward due to the changing speed of sound.
- If the air aloft is warmer than the ground temperature (known as an *inversion*) the resulting higher speed of sound aloft tends to refract the transmitted sound back down towards the ground. This essentially works on Snell's law of reflection and refraction.
- Temperature inversions typically happen early in the morning and are most common over large bodies of water or across river valleys.
- Sound level differences of ±10dB are possible depending on gradient of temperature and distance from source.

Rain

- Rain does not affect sound propagation by an appreciable amount unless it is very heavy
- The larger concern is the noise generated by the rain itself. A heavy rain striking the ground can cause a significant amount of highly broadband noise. The amount of noise generated is difficult to predict.
- Rain can also affect the output of various noise sources such as vehicle traffic.

Summary

- In general, these wind and temperature effects are difficult to predict
- Empirical models (based on measured data) have been generated to attempt to account for these effects.
- Environmental noise measurements must be conducted with these effects in mind. Sometimes it is desired to have completely calm conditions, other times a "worst case" of downwind noise levels are desired.

Topographical Effects

Similar to the various atmospheric effects outlined in the previous section, the effect of various geographical and vegetative factors must also be considered when examining the propagation of noise over large distances.

Topography

- One of the most important factors in sound propagation.
- Can provide a natural barrier between source and receiver (i.e. if berm or hill in between).
- Can provide a natural amplifier between source and receiver (i.e. large valley in between or hard reflective surface in between).
- Must look at location of topographical features relative to source and receiver to determine importance (i.e. small berm 1km away from source and 1km away from receiver will make negligible impact).

Grass

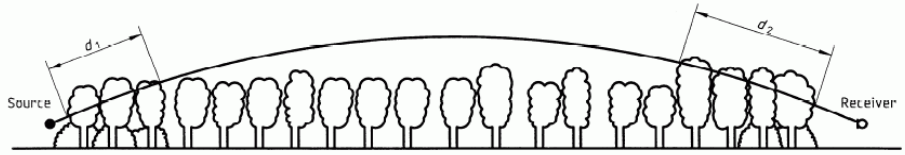
- Can be an effective absorber due to large area covered
- Only effective at low height above ground. Does not affect sound transmitted direct from source to receiver if there is line of sight.
- Typically less absorption than atmospheric absorption when there is line of sight.
- Approximate rule of thumb based on empirical data is:

$$A_g = 18\log_{10}(f) - 31 \qquad (dB/100m)$$

Where: A_g is the absorption amount

Trees

- Provide absorption due to foliage
- Deciduous trees are essentially ineffective in the winter
- Absorption depends heavily on density and height of trees
- No data found on absorption of various kinds of trees
- Large spans of trees are required to obtain even minor amounts of sound reduction
- In many cases, trees can provide an effective visual barrier, even if the noise attenuation is negligible.



NOTE — $d_f = d_1 + d_2$

For calculating d_1 and d_2, the curved path radius may be assumed to be 5 km.

Figure A.1 — Attenuation due to propagation through foliage increases linearly with propagation distance d_f through the foliage

Table A.1 — Attenuation of an octave band of noise due to propagation a distance d_f through dense foliage

Propagation distance d_f	Nominal midband frequency Hz							
m	63	125	250	500	1 000	2 000	4 000	8 000
	Attenuation, dB:							
$10 \leq d_f \leq 20$	0	0	1	1	1	1	2	3
	Attenuation, dB/m:							
$20 \leq d_f \leq 200$	0,02	0,03	0,04	0,05	0,06	0,08	0,09	0,12

Tree/Foliage attenuation from ISO 9613-2:1996

Bodies of Water

- Large bodies of water can provide the opposite effect to grass and trees.
- Reflections caused by small incidence angles (grazing) can result in larger sound levels at great distances (increased reflectivity, Q).
- Typically air temperatures are warmer high aloft since air temperatures near water surface tend to be more constant. Result is a high probability of temperature inversion.
- Sound levels can "carry" much further.

Snow

- Covers the ground for much of the year in northern climates.
- Can act as an absorber or reflector (and varying degrees in between).
- Freshly fallen snow can be quite absorptive.
- Snow which has been sitting for a while and hard packed due to wind can be quite reflective.
- Falling snow can be more absorptive than rain, but does not tend to produce its own noise.
- Snow can cover grass which might have provided some means of absorption.
- Typically sound propagates with less impedance in winter due to hard snow on ground and no foliage on trees/shrubs.

Appendix III

SOUND LEVELS OF FAMILIAR NOISE SOURCES

Used with Permission Obtained from ERCB Directive 038 (January, 2007)

Source[1]	Sound Level (dBA)
Bedroom of a country home	30
Soft whisper at 1.5 m	30
Quiet office or living room	40
Moderate rainfall	50
Inside average urban home	50
Quiet street	50
Normal conversation at 1 m	60
Noisy office	60
Noisy restaurant	70
Highway traffic at 15 m	75
Loud singing at 1 m	75
Tractor at 15 m	78-95
Busy traffic intersection	80
Electric typewriter	80
Bus or heavy truck at 15 m	88-94
Jackhammer	88-98
Loud shout	90
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
Air-raid siren	130

[1] Cottrell, Tom, 1980, *Noise in Alberta*, Table 1, p.8, ECA80 - 16/1B4 (Edmonton: Environment Council of Alberta).

SOUND LEVELS GENERATED BY COMMON APPLIANCES

Used with Permission Obtained from ERCB Directive 038 (January, 2007)

Source[1]	Sound level at 3 feet (dBA)
Freezer	38-45
Refrigerator	34-53
Electric heater	47
Hair clipper	50
Electric toothbrush	48-57
Humidifier	41-54
Clothes dryer	51-65
Air conditioner	50-67
Electric shaver	47-68
Water faucet	62
Hair dryer	58-64
Clothes washer	48-73
Dishwasher	59-71
Electric can opener	60-70
Food mixer	59-75
Electric knife	65-75
Electric knife sharpener	72
Sewing machine	70-74
Vacuum cleaner	65-80
Food blender	65-85
Coffee mill	75-79
Food waste disposer	69-90
Edger and trimmer	81
Home shop tools	64-95
Hedge clippers	85
Electric lawn mower	80-90

[1] Reif, Z. F., and Vermeulen, P. J., 1979, "Noise from domestic appliances, construction, and industry," Table 1, p.166, in Jones, H. W., ed., *Noise in the Human Environment*, vol. 2, ECA79-SP/1 (Edmonton: Environment Council of Alberta).

Appendix IV

PERMISSIBLE SOUND LEVEL DETERMINATION

1,500 m Receptors

Basic Sound Level

	Dwelling Density (Per Quarter Section of Land)			Night-Time	Day-Time
Proximity to Transportation	1 - 8 Dwellings	9 - 160 Dwellings	> 160 Dwellings		
Category 1	40	43	46	40	40
Category 2	45	48	51		
Category 3	50	53	56		
			Basic Sound Level (dBA)	40	40

Time of Day Adjustment

Time of Day	Adjustment (dBA)		
Night-time adjustment for hours 22:00 - 07:00	0	0	n/a
Day-time adjustment for hours 07:00 - 22:00	+10	n/a	+10
	Time of day adjustment (dBA)	0	+ 10

Class A Adjustments

Class	Reason for Adjustment	Adjustment (dBA)		
A1	Seasonal Adjustment (Winter)	0 to +5	0	0
A2	Ambient Monitoring Adjustment	-10 to +10	0	0
Sum of A1 and A2 cannot exceed maximum of 10 dBA Leq				
		Class A Adjustment (dBA)	0	0

Class B Adjustments

Class	Duration of Activity	Adjustment (dBA)		
B1	≤ 1 Day	+ 15	0	0
B2	≤ 7 Days	+ 10	0	0
B3	≤ 60 Days	+ 5	0	0
B4	> 60 Days	0	0	0
Can only apply one of B1, B2, B3, or B4				
		Class B Adjustment (dBA)	0	0

Total Permissible Sound Level (PSL) [dBA]	40	50

Trapper's Cabin

Basic Sound Level

Proximity to Transportation	Dwelling Density (Per Quarter Section of Land) 1 - 8 Dwellings	9 - 160 Dwellings	> 160 Dwellings	Night-Time	Day-Time
Category 1	40	43	46		
Category 2	45	48	51	45	45
Category 3	50	53	56		
			Basic Sound Level (dBA)	45	45

Time of Day Adjustment

Time of Day	Adjustment (dBA)	Night-Time	Day-Time
Night-time adjustment for hours 22:00 - 07:00	0	0	n/a
Day-time adjustment for hours 07:00 - 22:00	+10	n/a	+10
	Time of day adjustment (dBA)	0	+ 10

Class A Adjustments

Class	Reason for Adjustment	Adjustment (dBA)	Night-Time	Day-Time
A1	Seasonal Adjustment (Winter)	0 to +5	0	0
A2	Ambient Monitoring Adjustment	-10 to +10	0	0
Sum of A1 and A2 cannot exceed maximum of 10 dBA Leq				
		Class A Adjustment (dBA)	0	0

Class B Adjustments

Class	Duration of Activity	Adjustment (dBA)	Night-Time	Day-Time
B1	≤ 1 Day	+ 15	0	0
B2	≤ 7 Days	+ 10	0	0
B3	≤ 60 Days	+ 5	0	0
B4	> 60 Days	0	0	0
Can only apply one of B1, B2, B3, or B4				
		Class B Adjustment (dBA)	0	0

Total Permissible Sound Level (PSL) [dBA]	45	55

Appendix V

RANKED NOISE SOURCES

Ranked noise sources for Receptor R15

Equipment	Associated Section	SPL Contribution (dBA)
H-808 Glycol Heater Stack	Algar_Expansion	25.6
H-808 GLycol Heater Stack	Algar 10k bpd	25.5
Gas Turbine Exhaust	Algar 10k bpd	25.3
Gas Turbine Exhaust	Algar_Expansion	25.2
H-821 HP Steam Boiler Stack	Algar_Expansion	24.6
H-822 HP Steam Boiler Stack	Algar_Expansion	24.6
H-823 HP Steam Boiler Stack	Algar_Expansion	24.6
H-802 HP Steam Boiler Stack	Algar 10k bpd	24.5
E-421 Glycol Cooler	Algar_Expansion	23.3
E-421 Glycol Cooler	Algar_Expansion	23.1
E-421 Glycol Cooler	Algar_Expansion	23.1
E-421 Glycol Cooler	Algar_Expansion	22.9
E-411 Seal Water Cooler	Algar 10k bpd	22.8
E-421 Glycol Cooler	Algar 10k bpd	22.7
E-421 Glycol Cooler	Algar 10k bpd	22.7
E-421 Glycol Cooler	Algar 10k bpd	22.6
E-421 Glycol Cooler	Algar 10k bpd	22.5
K-654 Steam Generator Combustion Fan	Algar_Expansion	22.4
K-655 Steam Generator Combustion Fan	Algar_Expansion	22.4
K-656 Steam Generator Combustion Fan	Algar_Expansion	22.4
K-605 Steam Generator Combustion Fan	Algar 10k bpd	21
E-411 Seal Water Cooler	Algar_Expansion	21
H-824 HP Steam Boiler Stack	Algar_Expansion	20.8
H-825 HP Steam Boiler Stack	Algar_Expansion	20.8
H-801 HP Steam Boiler Stack	Algar 10k bpd	20.7
Lube Oil Cooler	Algar 10k bpd	19.1
Gas Turbine Casing	Algar 10k bpd	17.9
K-657 Steam Generator Combustion Fan	Algar_Expansion	17.6
K-658 Steam Generator Combustion Fan	Algar_Expansion	17.6
K-656A Vapour Compressor	Algar_Expansion	16.5
K-656B Vapour Compressor	Algar_Expansion	16.4
H-807 Utility Steam Boiler Stack	Algar_Expansion	16
Transformer	Algar_Expansion	16
H-807 Utility Steam Boiler Stack	Algar 10k bpd	15.9
K-610 Glycol Heater Blower	Algar_Expansion	15.9
Gas Turbine Inlet	Algar 10k bpd	14.7
K-603 Recycle Treater Blower	Algar_Expansion	14.1
K-603 Recycle Treater Blower	Algar 10k bpd	13.4
K-610 Glycol Heater Blower	Algar 10k bpd	12.7
Transformer	Algar 10k bpd	11.6
HRSG Casing	Algar 10k bpd	10.1
Gas Turbine Casing	Algar_Expansion	10
K-666 2nd Stage Vapour Compressor	Algar_Expansion	9.9
H-808 Glycol Heater Casing	Algar_Expansion	8.8
K-647 Seal Air Fan	Algar_Expansion	7.4
K-617 Seal Air Fan	Algar_Expansion	6.9
K-627 Seal Air Fan	Algar_Expansion	6.9
K-606 Vapour Compressor	Algar 10k bpd	6.8
K-616 Vapour Compressor	Algar 10k bpd	6.5
H-808 Glycol Heater Casing	Algar 10k bpd	6.2
K-607 Seal Air Fan	Algar_Expansion	5.6
HRSG Casing	Algar_Expansion	5.6
K-617 Seal Air Fan	Algar 10k bpd	5.5
H-808 Glycol Heater Stack	GD_Site	5.5
K-607 Seal Air Fan	Algar 10k bpd	5.3
H-824 HP Steam Boiler Casing	Algar_Expansion	4.9
H-825 HP Steam Boiler Casing	Algar_Expansion	4.9
Lube Oil Cooler	Algar_Expansion	4.4
H-822 HP Steam Boiler Casing	Algar_Expansion	4.2
K-650 VRU Compressor	Algar_Expansion	4.1
H-823 HP Steam Boiler Casing	Algar_Expansion	4
K-651 VRU Compressor	Algar_Expansion	3.9
H-821 HP Steam Boiler Casing	Algar_Expansion	3.6
H-801 HP Steam Boiler Casing	Algar 10k bpd	3.4
E-421 Glycol Cooler	GD_Site	3.4
H-802 HP Steam Boiler Casing	Algar 10k bpd	3.2
K-604 Steam Generator Combustion Fan	Algar 10k bpd	2.5
Gas Turbine Inlet	Algar_Expansion	2.1
K-609 Air Compressor	Algar_Expansion	2
K-667 Vent Condensor Compressor	Algar_Expansion	1
E-421 Glycol Cooler	GD_Site	0.9
E-421 Glycol Cooler	GD_Site	0.9
E-421 Glycol Cooler	GD_Site	0.9
P-541 HP BFW Pumps	Algar_Expansion	0.9
P-553 Cooling Glycol Circ Pump	Algar_Expansion	0.8
K-582 Evaporator Recirc Pump	Algar_Expansion	0.6
K-605 Steam Generator Combustion Air Fan	GD_Site	0.2

Note: There were many more noise sources included in the model. All other sources resulted in negative dBA values, indicating no contribution to the total broadband dBA sound level at this receptor.

Appendix VI

NOISE IMPACT ASSESSMENT

Licensee: **Connacher Oil and Gas Limited**

Facility name: **Great Divide Expansion Project** Type: **SAGD**

Legal location: **Townships 81 – 82 and Ranges 11 – 12, W4M**

Contact: **Bill Betts (Connacher)** Telephone: **(403) 536-4711**

1. Permissible Sound Level (PSL) Determination (*Directive 038,* Section 2.1)

(Note that the PSL for a pre-1988 facility undergoing modifications may be the sound pressure level (SPL) that currently exists at the residence if no complaint exists and the current SPL exceeds the calculated PSL from Section 2.1.)

Complete the following for the nearest or most impacted residence(s):

Distance from facility	Direction from facility	BSL (dBA)	Daytime adjustment (dBA)	Class A adjustment (dBA)	Class B adjustment (dBA)	Nighttime PSL (dBA)	Daytime PSL(dBA)
1,500 m	West	40	10	0	0	40	50
750 m	West	45	10	0	0	45	55

2. Sound Source Identification

For the new and existing equipment, identify major sources of noise from the facility, their associated sound power level (PWL) or sound pressure level (SPL), the distance (far or free field) at which it was calculated or measured, and whether the sound data are from vendors, field measurement, theoretical estimates, etc.

New Equipment	Predicted X PWL (dBA) X SPL (dBA)	OR	Measured X PWL (dBA) X SPL (dBA)	Data source	Distance calculated or measured (m)
Listed in Appendix I				**Measurements / Calculations**	

Existing Equipment/Facility	Predicted X PWL (dBA) X SPL (dBA)	OR	Measured X PWL (dBA) X SPL (dBA)	Data source	Distance calculated or measured (m)
Listed in Appendix I				**Measurements / Calculations**	

3. Operating Conditions

When using manufacturer's data for expected performance, it may be necessary to modify the data to account for actual operating conditions (for example, indicate conditions such as operating with window/doors open or closed). Describe any considerations and assumptions used in conducting engineering estimates:

Equipment assumed to be operating at all times at maximum capacity

4. Modelling Parameters

If modelling was conducted, identify the parameters used (see Section 3.5.1):

Ground absorption 0.5, Temperature 10^0C, Relative Humitidy 70%, all receptors downwind, Following ISO 9613

5. Predicted Sound Level/Compliance Determination

Identify the predicted overall (cumulative) sound level at the nearest of most impacted residence. Typically, only the nighttime sound level is necessary, as levels do not often change from daytime to nighttime. However, if there are differences between day and night operations, both levels must be calculated.

Predicted sound level to the nearest or most impacted residence from new facility (including any existing facilities):

Trapper's Cabin

Modeled Leq-Night = **34.2 dBA,** ASL = **40.0 dBA**, Overall Night-Time Sound Level = **41.0 dBA**

Permissible sound level: **45 dBA (night)**

If applicable: **34.2** dBA (day) ASL = **40.0 dBA**, Overall Day-Time Sound Level = **41.0 dBA**

Permissible sound level: **55 dBA (day)**

1,500 m Receptors

Modeled Leq-Night = **37.9 dBA,** ASL = **35.0 dBA**, Overall Night-Time Sound Level = **39.7 dBA**

Permissible sound level: **40 dBA (night)**

If applicable: **37.9** dBA (day) ASL = **35.0 dBA**, Overall Day-Time Sound Level = **39.7 dBA**

Permissible sound level: **50 dBA (day)**

Is the predicted sound level less than the permissible sound level? **NO** If **YES**, go to number 7

6. Compliance Determination/Attenuation Measures

(a) If 5 is **NO**, identify the noise attenuation measures the licensee is committing to:

Mitigation items listed in Section 5.4.1. of report

Predicted sound level to the nearest or most impacted residence from the facility (**with** noise attenuation measures):

N/A

Is the predicted sound level less than the permissible sound level? **YES** If **YES**, go to number 7

(b) If 6 (a) is **NO** or the licensee is not committing to any noise attenuation measures, the facility is not in compliance. If further attenuation measures are not practical, provide the reasons why the measures proposed to reduce the impacts are not practical.

Note: If 6 (a) is NO, the Noise Impact Assessment must be included with the application filed as non-routine.

7. Explain what measures have been taken to address construction noise.

Limiting construction to day-time hours only (07:00 – 22:00)
Advising nearby residents of significant noise sources and appropriately scheduling
Mufflers on all internal combustion engines
Taking advantage of acoustical screening
Limiting vehicle access during night-time

8. Analyst's Name : Steven Bilawchuk, M.Sc., P.Eng.

Company: **ACI Acoustical Consultants Inc.**

Title: **Director**

Telephone: **(780) 414-6373** Date: **April 15, 2010**