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Environmental Noise Impact Assessment

For The

Grassy Mountain Coal Project
2016

Prepared for:

Benga Mining Limited

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Executive Summary

aci Acoustical Consultants Inc., of Edmonton AB, was retained by Benga Mining Limited (Benga) to conduct an environmental noise impact assessment (NIA) for the Grassy Mountain Coal Project (the Project). The purpose of the NIA was to generate a computer noise model of the study area with the Project at various operational stages, to determine the noise levels at the surrounding residential and theoretical 1,500 m receptors, and to compare the noise levels to the permissible sound levels (PSLs) defined in the Alberta Energy Regulator (AER) Directive 038.

The noise modelling results indicate that the Project noise levels during the night-time and day-time, with the addition of the Ambient Sound Levels (ASLs), will be below the PSLs for all residential and theoretical 1,500 m receptors. The results also indicate that the C-weighted (dBC) sound levels will be less than 20 dB above the dBA sound levels for approximately half of the receptors. As specified in the AER 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. For the other half of the receptors, the dBC - dBA sound levels are greater than 20 dB. This elevated low frequency noise is associated with the locomotives operating at the rail loadout, at the southern portion of the Project. As per the AER Directive 038, the noise model did not account for the background noise associated with the current vehicle traffic or current rail line activity since these are not noise sources which are regulated by the AER or the Alberta Utilities Commission (AUC). The modelling results indicate the possibility of a low frequency tonal noise. Assessment of any actual low frequency tonal noise would require noise monitoring to be conducted during normal operations of the Project. If, upon start-up of the Project, a low frequency noise complaint is received, Benga will conduct a comprehensive sound level (CSL) survey in accordance with the requirements of the AER Directive 038.

Benga has also prepared a noise impact assessment summary for the Grassy Mountain Coal Project, particularly the rail siding and loadout components. The purpose of the NIA Summary was to conduct baseline noise monitoring within Blairmore and to generate a computer noise model with the focus on the rail siding and loadout components. The predicted noise levels of the rail siding and loadout were added to the existing baseline/measured levels to determine the total project noise levels. A number of residential receptors were identified around Blairmore and Coleman, and were used in the predictive noise model to determine the relative impact of the Project on the local noise climate. This report has been submitted under separate cover "*Environmental Noise Impact Assessment Summary for the Grassy Mountain Coal Project, Rail Siding and Loadout Components*".

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1.0 Introduction

aci Acoustical Consultants Inc., of Edmonton AB, was retained by Benga Mining Limited (Benga) to conduct an environmental noise impact assessment (NIA) for the Grassy Mountain Coal Project (the Project). The purpose of the NIA was to generate a computer noise model of the Project at various operational stages, to determine the noise levels at the surrounding residential and theoretical 1,500 m receptors, and to compare the noise levels to the permissible sound levels (PSLs) defined in the Alberta Energy Regulator (AER) Directive 038.

2.0 Description

2.1. Location

The Project is located in southwest Alberta, approximately 150 km south of Calgary in the Crowsnest Pass, and covers areas within Townships 08 and 09 and Ranges 03 and 04, West of the 5th Meridian. As indicated in Figure 1, the Grassy Mountain coal lease is predominantly situated to the north of Highway 3, with a small section to the south within the Town of Blairmore. The proposed Coal Handling and Processing Plant (CHPP) will be situated approximately 7 km north of Blairmore, and will be accessible via a high grade road, that will parallel a covered overland conveyor, which will convey coal product from the CHPP to the rail loadout. The majority of the Project's footprint will occur on Benga private land, with the remaining portions occurring on either Crown land or other private lands. The Project's proposed Mine Permit Boundary (MPB), (areas within which all activities will occur) is approximately 3,701 ha in size.

The area in and around the MPB, (local study area [LSA]), contains some small, non-operational well-sites; otherwise, there are no industrial noise sources close enough to the Project that would contribute to noise impacts. Nearby transportation facilities include Highway 3 which runs along the north-end of the Town of Blairmore and through the middle of Coleman. Information obtained from the Alberta Transportation website indicates that Highway 3 is a heavily traveled road[1] with an average summer daily traffic (ASDT) volume of 8,320 vehicles and

[1] A traffic volume of 8,320 vehicles per day equates to approximately 91 vehicles per hour during the night-time and 500 vehicles per hour during the day-time. As defined by the AER Directive 038, if a road has a traffic volume of 10 or more vehicles per hour, it is considered heavily traveled.

approximately 14% heavy vehicles. In addition, there is a Canadian Pacific (CP) Rail line that runs parallel to the south of Highway 3, through the middle of Blairmore and the southern portion of Coleman. Information from CP Rail indicates seven to eight trains per day (day-time and night-time), with each train being more than 25 cars. Thus, in accordance with the AER Directive 038, the existing rail line is also considered heavily traveled[2].

Currently, within the LSA, there are some residential receptors; however, for the purposes of the NIA, it was assumed that there will not be any residential receptors within the LSA prior to the start of mining activity. There is a single trapper's cabin located outside of the LSA, within 1,500 m (regional study area [RSA]), however, it is used less than 6-weeks per year and, in accordance with the requirements of the AER Directive 038, has not been included in the noise assessment. Outside of Blairmore and Coleman, there are two occupied residential dwellings within 1,500 m to the east of the LSA, as indicated in Figure 1. These are identified as MDRL009 (Res-301) and MDRL010 (Res-302). Both have been included in the noise assessment. All other residential receptors within 1,500 m of the LSA are located either within or directly adjacent to Blairmore and Coleman. The noise modelling assessment covers all residential receptors in these areas. Even if there is not a specific modelling noise receptor for each residential receptor, the color noise contours cover the entire area and all residential receptors contained within.

Topographically, the noise study area has substantial changes in elevation. Within the area formed by the 1,500 m noise boundary encompassing the LSA, there is a change in elevation of approximately 900 m; subsequently, detailed digital elevation contours have been incorporated into the noise model. Within the LSA and some of the areas adjacent to the LSA, the digital elevation contours have a vertical resolution of 5 m, which covers all of the noise modelling receptors of consequence. Farther beyond the 1,500 m noise boundary, the vertical resolution for the digital elevation contours is 50 m. Throughout the assessment area the ground is generally covered in vegetation (i.e., grasses, shrubs, and trees); however, throughout most of the previous legacy mine areas there are minimal trees. At the outer portions of the RSA (i.e. near the 1,500 m noise boundary), there are larger concentrations of trees. There are also larger

[2] As defined by the AER Directive 038, a rail passage with more than 25-cars is considered heavily traveled.

concentrations of dense trees near Coleman and Blairmore. Trees have been incorporated into the noise model, where present, based on review of the high-resolution aerial photos and observations during the site visit in the summer of 2014 and in March 2016.

2.2. Operations

It is understood that for mining operations, rock above the coal will be drilled and/or blasted, then excavated and hauled to either in-pit and ex-pit waste rock disposal locations. Coal from the open-pit mining operations will be trucked to the run of mine (ROM) raw coal dump station at the CHPP using large scale mining trucks. The overall CHPP will serve to remove excess rock and impurities from the raw coal. This will be accomplished by sizing the raw coal, then feeding it to the coal processing plant, where it will be processed through a series of screening, cleaning, and mechanically dewatering. The reject material from the CHPP will be trucked back into the mine for proper disposal. The final coal product will be sent to the product coal stockpiles, where it will then be conveyed overland (via a covered conveyor) to the rail loadout facility located near the existing CP Rail track in Blairmore.

The coal in the open pit mine will be extracted using standard surface mining techniques found in other operating mines located in western Canada. Topsoil and sub-soil materials will be salvaged ahead of drilling and blasting operations using bulldozers to push the topsoil into windrows. An excavator and truck fleet will then follow behind and pick the topsoil up and haul it to designated stockpile areas, which will then be reused as part of the final reclamation plan. Drilling and blasting activities will then begin to break up the waste rock ahead of excavation by diesel powered mining shovels and then hauled away in large haul trucks. Initially, the waste rock will be directed to ex-pit disposal areas until locations open up for in-pit backfill. Once the waste rock has been removed, the coal is mined and hauled down to the raw coal stockpile area located near the CHPP. Both coal and waste rock haul roads will be developed to allow access from the mining face to the disposal areas. The fine coal wastes will be largely dewatered in the CHPP and will be backhauled in trucks to the waste rock disposal areas. The pit area will be developed in multiple areas to allow waste rock to be removed from the top of the coal in some areas, and allowing the exposed coal to be hauled to the coal processing plant modules from others. The development will be carefully sequenced for the life of the Project to ensure reliable coal supply to the coal processing plant modules and to balance the waste rock disposal between ex-pit and in-pit disposal. All waste rock material is expected to require drilling and, if partings are large enough to be blasted, it too will be hauled away with waste rock.

The CHPP will consist of the raw coal, reject coal, and product coal material handling components the coal processing plant module. The ROM raw coal from the open pit mine will be dumped from the mining trucks into the raw coal ROM bin. The raw coal will then be fed into a feed breaker at the bottom of the ROM bin for initial primary sizing. From there, it is then fed onto a conveyor and into a secondary sizing station to ensure a top-size of 50 mm. From the secondary sizing station the material is fed to the surge bin, positioned prior to the coal processing plant module. The coal processing plant module will be contained within a housed area complete with a concrete floor.

Coal quality test work and process simulation modelling has shown the most efficient coal processing plant module design consists of a single stage dense medium cyclone (DMC) for processing coarse material, reflux classifiers for processing fine material, and two-stage flotation in a cleaner-scavenger cell arrangement for processing ultrafine material. Product coal dewatering will be completed via vibrating and scroll centrifuges for coarse and fine material, respectively, and a hyperbaric disc filter for ultrafine material. The coal processing plant module nominal throughput capacity is 1,120 tonnes per hour. This plant has been designed to run upwards of 7,500 hours per year. The plant's expected nominal clean coal capacity is 4.5 million clean tonnes per year at the life of mine average expected plant yield of 55%.

The enclosed overland conveyor will deliver product coal to a 300 tonne surge bin located at the proposed rail track alignment on the existing golf course, which is located immediately north of Highway 3 in Blairmore, Alberta. From the surge bin, the product coal will be transferred to a train loadout bin feed conveyor via a vibratory feeder. The loadout bin will be housed in a heated structure, and will have a capacity of 350 tonnes. At the bottom of the bin a hydraulic gate will control the flow of product coal into train railcars; an industry standard tackifier will be applied to mitigate dust during transport.

3.0 Modelling Methods

3.1. Computer Noise Modelling (General)

The computer noise modelling was conducted using the CADNA/A (version 4.6.153) software package. CADNA/A allows for the modelling of various noise sources such as road, rail, and various stationary sources. In addition, topographical features such as land contours, vegetation, and bodies of water can be included. Meteorological conditions such as temperature, relative humidity, wind-speed and wind-direction can be included in the calculations. Note that all modelling methods used, exceeded the general requirements of the AER Directive 038 on Noise Control.

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

As mentioned previously, trees have been incorporated into the noise model, where present, based on review of the high-resolution aerial photos and observations during the site visit in the summer of 2014 and in March 2016. In addition, the ground sound absorption has been assigned a value of 0.7, based on the density of ground vegetation cover. As a result, all sound level propagation calculations are considered representative of summertime conditions for all surrounding receptors.

The computer noise modelling results were calculated in two ways. First, sound levels were calculated at specific receiver locations (i.e. residential and theoretical 1,500 m receptors). Next, the sound levels were calculated using a 50 m x 50 m grid over the entire study area. This provided color noise contours for easier visualization of the results.

Refer to Appendix I for a detailed description of the noise modelling parameters, Appendix II for a description of the acoustical terminology, and Appendix III for a list of common noise sources.

3.2. Noise Modelling Sources

The noise sources for the equipment associated with the Mine, CHPP, Conveyors, and Rail Loadout are provided in Appendix I. The data were obtained from:

- Noise measurements conducted at other similar mines using similar or identical operating equipment,
- In-house information and calculations using methods presented in various texts or, and
- Sound level information provided by equipment suppliers/manufacturers.

Sound power levels for all noise sources were modeled using octave-band information. All sound power levels used in the modelling are considered conservative. The sound level data provided in Appendix I are the maximum sound levels produced for each piece of equipment. Based on discussions with mining operations personnel, the anticipated usage factor for each piece of equipment was determined and corrections were incorporated into the model. Information on the usage factor for each piece of equipment is provided in Appendix I.

With the exception of the haul trucks, graders, water trucks, other mobile utility vehicles, and conveyors, all noise sources have been modeled as point sources at their appropriate heights[3] and operating at the locations detailed in Section 3.3. The haul trucks, graders, water trucks, and other mobile utility vehicles have been modeled as traveling point sources, driving along the haul roads with appropriate speeds and cycle times. Within the CHPP, all equipment contained within the building, has been modeled with the appropriate building noise level reduction. The

[3]The heights for many of the sources are generally slightly higher than actual. This makes the model more conservative

large CHPP building was included in the modelling calculations because of the ability to provide shielding as well as reflection for noise[4]. Refer to Appendix I for building dimensions.

The AER Directive 038 also requires the assessment to include background ambient noise levels in the model. As specified in the AER 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 average ambient sound level (ASL). The ASL is adjusted depending on the location relative to heavily traveled roads and rail lines as well as the population density.

- For receptors with population densities less than 9 per quarter section and greater than 500 m from a heavily traveled road, the ASL is 35 dBA during the night-time and 45 dBA during the day-time. **This applies to Res-301, Res-302, R-017 to R-023, R-030, & R-031**.
- For receptors with population densities between 9 – 160 per quarter section and greater than 500 m from a heavily traveled road, the ASL is 38 dBA during the night-time and 48 dBA during the day-time. **This applies to R-001 to R-009, R-015, & R-024 to R-029**.
- For receptors with population densities less than 9 per quarter section and between 30 – 500 m from a heavily traveled road, the ASL is 40 dBA during the night-time and 50 dBA during the day-time. **This applies to R-016**.
- For receptors with population densities between 9 – 160 per quarter section and between 30 – 500 m from a heavily traveled road, the ASL is 43 dBA during the night-time and 53 dBA during the day-time. **This applies to R-010 to R-014, & R-032 to R-067**.
- For the theoretical 1,500 m receptors, the ASL of 35 dBA during the night-time and 45 dBA during the day-time was used.

These ASL values were used as the ambient condition in the modelling with the various Project related noise sources added.

[4] Exterior building and tank walls were modeled with an absorption coefficient of 0.21 which is generally highly reflective.

3.3. Noise Modelling Scenarios

The projected operating life of the Mine will span approximately 24 years. Each year, as the Mine progresses, the locations and quantities of the mining equipment will change. Generating a noise modelling scenario for all 24 years would be too onerous; subsequently, a detailed review of the yearly mine plan was conducted to determine mining years which are likely to result in representative noise levels for the surrounding receptors. A total of 3 different mining years were selected (Years 01, 06, 18), resulting in 3 different noise modelling scenarios. For each noise modelling scenario, the typical operational mining equipment includes:

- Komatsu PC360 Hoe (or equivalent) working in the pre-strip area.
- 37 ton Articulated Trucks (or equivalent) hauling from pre-strip area to reclamation areas or stockpile areas.
- P&H 250XPC Diesel Drills (or equivalent) operating in mining areas to prep for blasting.
- Komatsu PC8000 and PC4000 Waste Shovels (or equivalent) working at mining face to load rock haul trucks.
- Komatsu 930E Haul Trucks (or equivalent) operating between the mining areas and dump areas to haul waste material.
- Cat D-11 Dozers (or equivalent) operating in the dump areas.
- Komatsu PC1250 Coal Shovels (or equivalent) working at mining face to load Coal haul trucks.
- Komatsu 830E Haul Trucks (or equivalent) operating between the coal mining area and the ROM, hauling coal.
- Cat D-10 Dozers (or equivalent) operating near shovels.
- Komatsu WA1200-6 Wheel Loader (or equivalent) operating at ROM
- CAT 834K Wheel Dozer (or equivalent) operating near Coal Shovel
- Utility Backhoe operating at various mining locations.
- Skid Steer Loader operating at various mining locations.
- Diesel Driven Pumps operating in areas with standing water.
- Diesel Driven Light Plants operating at various mining locations.
- Graders and water trucks operating on haul roads to maintain road quality.
- Various utility vehicles such as fuel trucks, service trucks, crew vehicles, etc. operating at various mining locations.

3.4. Modelling Confidence

As mentioned previously, the algorithms used for the noise modelling 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. Professional experience based on similar noise models and measurements 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.

In addition, it is important to note that an open pit mine is a dynamic project with ever changing equipment locations and area topography. The noise modelling results represent a snapshot in time for the scenarios assessed. As mentioned, the modeled scenarios were selected to provide representative conditions with equipment operating under typical conditions. The noise modelling results do not account for non-typical or unforeseen events in terms of the locations and operational conditions of the equipment.

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.

The document which most directly relates to the Permissible Sound Levels (PSL's) for this NIA is the AER Directive 038 on Noise Control (2007). The AER 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 4.0-1.

- For locations greater than 500 m from a heavily traveled road or rail line and with population densities less than 9 per quarter section, 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). Note that the Project will not be temporary or seasonal in nature; therefore, none of the other PSL adjustments discussed in the AER Directive 038 apply. The PSLs are an **L_{eq}Night of 40 dBA and an L_{eq}Day of 50 dBA**. **This applies to Res-301, Res-302, R-017 to R-023, R-030, & R-031.**
- For locations greater than 500 m from a heavily traveled road or rail line and with population densities between 9 - 160 per quarter section, the PSLs are an **L_{eq}Night of 43 dBA and an L_{eq}Day of 53 dBA**. **This applies to R-001 to R-009, R-015, & R-024 to R-029.**
- For locations between 30 - 500 m from a heavily traveled road or rail line and with population densities less than 9 per quarter section, the PSLs are an **L_{eq}Night of 45 dBA and an L_{eq}Day of 55 dBA**. **This applies to R-016.**
- For locations between 30 - 500 m from a heavily traveled road or rail line and with population densities between 9 - 160 per quarter section, the PSLs are an **L_{eq}Night of 48 dBA and an L_{eq}Day of 58 dBA**. **This applies to R-010 to R-014, & R-032 to R-067.**
- Finally, the AER Directive 038 specifies that new or modified 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 from the MPB are an **L_{eq}Night of 40 dBA and an L_{eq}Day of 50 dBA.**

Refer to Appendix IV for a detailed determination of the permissible sound levels.

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; subsequently, an assessment of the noises related to vehicle traffic was not conducted. In addition, construction noise is not specifically regulated by the AER Directive 038.

Table 4.0-1. Basic Night-Time Sound Levels (as per the AER Directive 038)

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

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

In regards to ambient noise levels, although they were not measured at the Project location, they have been quantified as per the methods defined in the AER Directive 038 which define the average Ambient Sound Level (ASL) based on population density and proximity to heavily traveled roadways or rail lines. There are no relevant industrial noise sources within the study area, thus, the ambient noise levels are largely the result of the existing area roadways and the existing rail line. Currently, there are no Municipal (within Crowsnest Pass), Provincial, or Federal noise criteria for roadways or rail lines. In addition, there are no specific Municipal, Provincial, or Federal criteria for comparing the relative increase in noise levels (i.e. how much the noise levels will increase with the addition of the Project related noise). As such, the noise study focused on comparing the Project related noise levels plus the AER Directive 038 ASLs to the AER Directive 038 permissible sound levels to determine compliance. This meets the requirements of the Project Terms of Reference and the CEAA Guidelines for Preparation of the Environmental Impact Statement since neither document specifies how the ambient noise levels are to be obtained (i.e. how, when, where) and neither document specifies any assessment criteria for such noise levels or the relative increase in noise associated with the Project. Thus, it is common practice within Alberta to resort to the methods and criteria of the AER Directive 038 since the AER will be the regulating authority for the Project once it is operational.

5.0 Results and Discussion

5.1. Mining Year 01 Modelling Results

The noise modelling results for Mining Year 01 during the night-time for residential and 1,500 m receptors are provided in Tables 5.1-1 & 5.1-2, respectively and the color contour are provided in Figure 2. In addition, the noise modelling results for Mining Year 01 during the day-time for residential and 1,500 m receptors are provided in Tables 5.1-3 & 5.1-4, respectively, and represented in Figure 3. The noise modelling results indicate that the Project noise levels during the night-time and day-time, with the addition of the ASLs, will be below the PSLs for all residential and theoretical 1,500 m receptors. The order-ranked noise source contribution from the Project noise sources at the two residential receptors closest to the Mine (Res-301 & Res-302) are presented in Appendix V.

The results also indicate that the C-weighted (dBC) sound levels will be less than 20 dB above the dBA sound levels for approximately half of the receptors. As specified in the AER 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. For the other half of the receptors, the dBC - dBA sound levels are greater than 20 dB. This elevated low frequency noise is generally associated with the locomotives operating at the rail loadout, at the southern portion of the Project. As per the AER Directive 038, the noise model did not account for the background noise associated with the current vehicle traffic or current rail line activity since these are not noise sources which are regulated by the AER or the Alberta Utilities Commission (AUC). The modelling results only indicate the potential of a low frequency tonal noise. Assessment of any actual low frequency tonal noise would require noise monitoring to be conducted during normal operations of the Project. If, upon start-up of the Project, a low frequency noise complaint is received, Benga will conduct a comprehensive sound level (CSL) survey in accordance with the requirements of the AER Directive 038.

Table 5.1-1. Year 01 Noise Modelling Results For Residential Receptors (Night-Time)

Receptor (Distance From MPB)	ASL-Night (dBA)	Application Case L_{eq}Night (dBA)	ASL + Application Case L_{eq}Night (dBA)	PSL-Night (dBA)	Compliant		Application Case L_{eq}Night (dBC)	dBC - dBA	Tonal
Res-301 (200 m)	35.0	37.7	39.6	40.0	YES		52.5	14.8	NO
Res-302 (130 m)	35.0	38.2	39.9	40.0	YES		52.5	14.3	NO
R-001 (1,025 m)	38.0	31.2	38.8	43.0	YES		47.3	16.1	NO
R-002 (950 m)	38.0	31.9	39.0	43.0	YES		47.9	16.0	NO
R-003 (1,000 m)	38.0	31.0	38.8	43.0	YES		47.2	16.2	NO
R-004 (1,025 m)	38.0	31.0	38.8	43.0	YES		47.1	16.1	NO
R-005 (1,035 m)	38.0	31.0	38.8	43.0	YES		47.2	16.2	NO
R-006 (890 m)	38.0	31.9	39.0	43.0	YES		48.3	16.4	NO
R-007 (990 m)	38.0	28.6	38.5	43.0	YES		46.9	18.3	NO
R-008 (950 m)	38.0	28.1	38.4	43.0	YES		46.6	18.5	NO
R-009 (840 m)	38.0	29.8	38.6	43.0	YES		47.4	17.6	NO
R-010 (610 m)	43.0	31.4	43.3	48.0	YES		48.5	17.1	NO
R-011 (440 m)	43.0	31.6	43.3	48.0	YES		48.9	17.3	NO
R-012 (350 m)	43.0	32.7	43.4	48.0	YES		49.9	17.2	NO
R-013 (660 m)	43.0	31.4	43.3	48.0	YES		50.1	18.7	NO
R-014 (480 m)	43.0	32.1	43.3	48.0	YES		52.5	20.4	POSSIBLE
R-015 (550 m)	38.0	32.9	39.2	43.0	YES		53.9	21.0	POSSIBLE
R-016 (1,090 m)	40.0	31.2	40.5	45.0	YES		51.0	19.8	NO
R-017 (925 m)	35.0	32.0	36.8	40.0	YES		52.3	20.3	POSSIBLE
R-018 (750 m)	35.0	31.8	36.7	40.0	YES		49.6	17.8	NO
R-019 (1,050 m)	35.0	31.0	36.5	40.0	YES		49.1	18.1	NO
R-020 (1,090 m)	35.0	31.1	36.5	40.0	YES		49.4	18.3	NO
R-021 (890 m)	35.0	31.8	36.7	40.0	YES		49.9	18.1	NO
R-022 (960 m)	35.0	32.5	36.9	40.0	YES		50.8	18.3	NO
R-023 (840 m)	35.0	37.7	39.6	40.0	YES		60.8	23.1	POSSIBLE
R-024 (820 m)	38.0	39.2	41.7	43.0	YES		62.1	22.9	POSSIBLE
R-025 (870 m)	38.0	39.2	41.7	43.0	YES		62.2	23.0	POSSIBLE
R-026 (1,010 m)	38.0	38.5	41.3	43.0	YES		61.8	23.3	POSSIBLE
R-027 (1,100 m)	38.0	38.7	41.4	43.0	YES		61.8	23.1	POSSIBLE
R-028 (940 m)	38.0	38.8	41.4	43.0	YES		61.3	22.5	POSSIBLE
R-029 (980 m)	38.0	39.8	42.0	43.0	YES		62.9	23.1	POSSIBLE
R-030 (1,110 m)	35.0	37.9	39.7	40.0	YES		61.4	23.5	POSSIBLE
R-031 (1,190 m)	35.0	37.4	39.4	40.0	YES		61.0	23.6	POSSIBLE
R-032 (530 m)	43.0	42.3	45.7	48.0	YES		65.0	22.7	POSSIBLE
R-033 (600 m)	43.0	42.1	45.6	48.0	YES		64.9	22.8	POSSIBLE
R-034 (600 m)	43.0	42.4	45.7	48.0	YES		65.3	22.9	POSSIBLE
R-035 (670 m)	43.0	41.9	45.5	48.0	YES		64.8	22.9	POSSIBLE
R-036 (570 m)	43.0	43.1	46.1	48.0	YES		66.0	22.9	POSSIBLE
R-037 (720 m)	43.0	42.2	45.6	48.0	YES		65.2	23.0	POSSIBLE
R-038 (640 m)	43.0	43.0	46.0	48.0	YES		65.9	22.9	POSSIBLE
R-039 (380 m)	43.0	42.2	45.6	48.0	YES		63.2	21.0	POSSIBLE
R-040 (370 m)	43.0	44.2	46.7	48.0	YES		66.2	22.0	POSSIBLE
R-041 (370 m)	43.0	44.5	46.8	48.0	YES		66.7	22.2	POSSIBLE
R-042 (370 m)	43.0	44.6	46.9	48.0	YES		66.8	22.2	POSSIBLE
R-043 (370 m)	43.0	44.6	46.9	48.0	YES		66.9	22.3	POSSIBLE
R-044 (360 m)	43.0	44.6	46.9	48.0	YES		66.9	22.3	POSSIBLE
R-045 (350 m)	43.0	44.5	46.8	48.0	YES		66.9	22.4	POSSIBLE
R-046 (340 m)	43.0	44.5	46.8	48.0	YES		66.8	22.3	POSSIBLE
R-047 (380 m)	43.0	44.6	46.9	48.0	YES		66.9	22.3	POSSIBLE
R-048 (360 m)	43.0	44.2	46.7	48.0	YES		66.5	22.3	POSSIBLE
R-049 (350 m)	43.0	43.5	46.3	48.0	YES		65.6	22.1	POSSIBLE
R-050 (330 m)	43.0	43.1	46.1	48.0	YES		65.1	22.0	POSSIBLE
R-051 (280 m)	43.0	41.6	45.4	48.0	YES		63.3	21.7	POSSIBLE
R-052 (270 m)	43.0	40.3	44.9	48.0	YES		61.4	21.1	POSSIBLE
R-053 (260 m)	43.0	39.0	44.5	48.0	YES		59.9	20.9	POSSIBLE
R-054 (250 m)	43.0	38.1	44.2	48.0	YES		58.6	20.5	POSSIBLE
R-055 (240 m)	43.0	37.4	44.1	48.0	YES		58.3	20.9	POSSIBLE
R-056 (300 m)	43.0	38.5	44.3	48.0	YES		60.5	22.0	POSSIBLE
R-057 (250 m)	43.0	35.8	43.8	48.0	YES		55.5	19.7	NO
R-058 (210 m)	43.0	35.5	43.7	48.0	YES		55.3	19.8	NO
R-059 (110 m)	43.0	35.4	43.7	48.0	YES		55.9	20.5	POSSIBLE
R-060 (80 m)	43.0	35.0	43.6	48.0	YES		55.5	20.5	POSSIBLE
R-061 (110 m)	43.0	34.9	43.6	48.0	YES		55.0	20.1	POSSIBLE
R-062 (90 m)	43.0	34.9	43.6	48.0	YES		54.9	20.0	POSSIBLE
R-063 (90 m)	43.0	34.6	43.6	48.0	YES		54.6	20.0	POSSIBLE
R-064 (170 m)	43.0	34.7	43.6	48.0	YES		54.6	19.9	NO
R-065 (170 m)	43.0	34.4	43.6	48.0	YES		54.3	19.9	NO
R-066 (130 m)	43.0	34.3	43.5	48.0	YES		54.3	20.0	POSSIBLE
R-067 (130 m)	43.0	34.0	43.5	48.0	YES		53.9	19.9	NO

Table 5.1-2. Year 01 Noise Modelling Results For Theoretical 1,500 m Receptors (Night-Time)

Receptor (1,500 m From MPB)	ASL-Night (dBA)	Application Case L_{eq}Night (dBA)	ASL + Application Case L_{eq}Night (dBA)	PSL-Night (dBA)	Compliant		Application Case L_{eq}Night (dBC)	dBC - dBA	Tonal
R-01	35.0	12.1	35.0	40.0	YES		31.3	19.2	NO
R-02	35.0	7.3	35.0	40.0	YES		26.7	19.4	NO
R-03	35.0	22.7	35.2	40.0	YES		40.2	17.5	NO
R-04	35.0	19.1	35.1	40.0	YES		36.7	17.6	NO
R-05	35.0	15.9	35.1	40.0	YES		34.1	18.2	NO
R-06	35.0	20.1	35.1	40.0	YES		37.7	17.6	NO
R-07	35.0	14.0	35.0	40.0	YES		32.7	18.7	NO
R-08	35.0	15.4	35.0	40.0	YES		34.0	18.6	NO
R-09	35.0	10.7	35.0	40.0	YES		30.0	19.3	NO
R-10	35.0	29.8	36.1	40.0	YES		47.3	17.5	NO
R-11	35.0	29.5	36.1	40.0	YES		50.1	20.6	POSSIBLE
R-12	35.0	29.1	36.0	40.0	YES		49.4	20.3	POSSIBLE
R-13	35.0	22.3	35.2	40.0	YES		40.5	18.2	NO
R-14	35.0	25.9	35.5	40.0	YES		44.5	18.6	NO
R-15	35.0	20.6	35.2	40.0	YES		38.5	17.9	NO
R-16	35.0	14.8	35.0	40.0	YES		33.5	18.7	NO
R-17	35.0	23.5	35.3	40.0	YES		45.6	22.1	POSSIBLE
R-18	35.0	27.5	35.7	40.0	YES		47.3	19.8	NO
R-19	35.0	17.2	35.1	40.0	YES		40.1	22.9	POSSIBLE
R-20	35.0	34.7	37.9	40.0	YES		58.3	23.6	POSSIBLE
R-21	35.0	35.1	38.1	40.0	YES		58.6	23.5	POSSIBLE
R-22	35.0	30.2	36.2	40.0	YES		49.6	19.4	NO
R-23	35.0	32.4	36.9	40.0	YES		51.4	19.0	NO
R-24	35.0	37.1	39.2	40.0	YES		60.4	23.3	POSSIBLE
R-25	35.0	31.7	36.7	40.0	YES		51.2	19.5	NO
R-26	35.0	31.1	36.5	40.0	YES		50.5	19.4	NO
R-27	35.0	29.5	36.1	40.0	YES		48.1	18.6	NO
R-28	35.0	29.2	36.0	40.0	YES		46.9	17.7	NO
R-29	35.0	29.5	36.1	40.0	YES		46.5	17.0	NO
R-30	35.0	31.5	36.6	40.0	YES		47.5	16.0	NO
R-31	35.0	31.8	36.7	40.0	YES		48.1	16.3	NO
R-32	35.0	24.1	35.3	40.0	YES		42.7	18.6	NO
R-33	35.0	19.3	35.1	40.0	YES		39.1	19.8	NO
R-34	35.0	23.4	35.3	40.0	YES		41.6	18.2	NO
R-35	35.0	28.9	36.0	40.0	YES		45.2	16.3	NO
R-36	35.0	29.4	36.1	40.0	YES		48.1	18.7	NO
R-37	35.0	26.3	35.5	40.0	YES		45.0	18.7	NO
R-38	35.0	24.5	35.4	40.0	YES		43.3	18.8	NO
R-39	35.0	23.8	35.3	40.0	YES		42.7	18.9	NO
R-40	35.0	22.8	35.3	40.0	YES		41.9	19.1	NO
R-41	35.0	22.9	35.3	40.0	YES		40.1	17.2	NO
R-42	35.0	20.0	35.1	40.0	YES		37.5	17.5	NO
R-43	35.0	17.9	35.1	40.0	YES		35.9	18.0	NO

Table 5.1-3. Year 01 Noise Modelling Results For Residential Receptors (Day-Time)

Receptor (Distance From MPB)	ASL-Day (dBA)	Application Case L_{eq}Day (dBA)	ASL + Application Case L_{eq}Day (dBA)	PSL-Day (dBA)	Compliant		Application Case L_{eq}Day (dBC)	dBC - dBA	Tonal
Res-301 (200 m)	45.0	37.8	45.8	50.0	YES		52.8	15.0	NO
Res-302 (130 m)	45.0	38.2	45.8	50.0	YES		52.5	14.3	NO
R-001 (1,025 m)	48.0	31.9	48.1	53.0	YES		47.8	15.9	NO
R-002 (950 m)	48.0	32.5	48.1	53.0	YES		48.5	16.0	NO
R-003 (1,000 m)	48.0	31.6	48.1	53.0	YES		47.7	16.1	NO
R-004 (1,025 m)	48.0	31.6	48.1	53.0	YES		47.7	16.1	NO
R-005 (1,035 m)	48.0	31.6	48.1	53.0	YES		47.7	16.1	NO
R-006 (890 m)	48.0	32.4	48.1	53.0	YES		48.7	16.3	NO
R-007 (990 m)	48.0	29.4	48.1	53.0	YES		47.4	18.0	NO
R-008 (950 m)	48.0	28.9	48.1	53.0	YES		47.1	18.2	NO
R-009 (840 m)	48.0	30.5	48.1	53.0	YES		47.8	17.3	NO
R-010 (610 m)	53.0	31.8	53.0	58.0	YES		48.8	17.0	NO
R-011 (440 m)	53.0	32.0	53.0	58.0	YES		49.2	17.2	NO
R-012 (350 m)	53.0	33.0	53.0	58.0	YES		50.1	17.1	NO
R-013 (660 m)	53.0	31.8	53.0	58.0	YES		50.3	18.5	NO
R-014 (480 m)	53.0	32.4	53.0	58.0	YES		52.6	20.2	POSSIBLE
R-015 (550 m)	48.0	33.2	48.1	53.0	YES		54.0	20.8	POSSIBLE
R-016 (1,090 m)	50.0	31.5	50.1	55.0	YES		51.1	19.6	NO
R-017 (925 m)	45.0	32.2	45.2	50.0	YES		52.4	20.2	POSSIBLE
R-018 (750 m)	45.0	32.1	45.2	50.0	YES		49.7	17.6	NO
R-019 (1,050 m)	45.0	31.3	45.2	50.0	YES		49.3	18.0	NO
R-020 (1,090 m)	45.0	31.4	45.2	50.0	YES		49.6	18.2	NO
R-021 (890 m)	45.0	32.1	45.2	50.0	YES		50.1	18.0	NO
R-022 (960 m)	45.0	32.8	45.3	50.0	YES		51.2	18.4	NO
R-023 (840 m)	45.0	37.8	45.8	50.0	YES		60.8	23.0	POSSIBLE
R-024 (820 m)	48.0	39.3	48.5	53.0	YES		62.1	22.8	POSSIBLE
R-025 (870 m)	48.0	39.3	48.5	53.0	YES		62.3	23.0	POSSIBLE
R-026 (1,010 m)	48.0	38.6	48.5	53.0	YES		61.8	23.2	POSSIBLE
R-027 (1,100 m)	48.0	38.8	48.5	53.0	YES		61.8	23.0	POSSIBLE
R-028 (940 m)	48.0	38.9	48.5	53.0	YES		61.4	22.5	POSSIBLE
R-029 (980 m)	48.0	39.8	48.6	53.0	YES		62.9	23.1	POSSIBLE
R-030 (1,110 m)	45.0	38.0	45.8	50.0	YES		61.4	23.4	POSSIBLE
R-031 (1,190 m)	45.0	37.4	45.7	50.0	YES		61.0	23.6	POSSIBLE
R-032 (530 m)	53.0	42.3	53.4	58.0	YES		65.0	22.7	POSSIBLE
R-033 (600 m)	53.0	42.1	53.3	58.0	YES		64.9	22.8	POSSIBLE
R-034 (600 m)	53.0	42.4	53.4	58.0	YES		65.3	22.9	POSSIBLE
R-035 (670 m)	53.0	41.9	53.3	58.0	YES		64.8	22.9	POSSIBLE
R-036 (570 m)	53.0	43.1	53.4	58.0	YES		66.0	22.9	POSSIBLE
R-037 (720 m)	53.0	42.2	53.3	58.0	YES		65.2	23.0	POSSIBLE
R-038 (640 m)	53.0	43.0	53.4	58.0	YES		65.9	22.9	POSSIBLE
R-039 (380 m)	53.0	42.3	53.4	58.0	YES		63.2	20.9	POSSIBLE
R-040 (370 m)	53.0	44.2	53.5	58.0	YES		66.2	22.0	POSSIBLE
R-041 (370 m)	53.0	44.5	53.6	58.0	YES		66.7	22.2	POSSIBLE
R-042 (370 m)	53.0	44.6	53.6	58.0	YES		66.9	22.3	POSSIBLE
R-043 (370 m)	53.0	44.6	53.6	58.0	YES		66.9	22.3	POSSIBLE
R-044 (360 m)	53.0	44.6	53.6	58.0	YES		66.9	22.3	POSSIBLE
R-045 (350 m)	53.0	44.5	53.6	58.0	YES		66.9	22.4	POSSIBLE
R-046 (340 m)	53.0	44.5	53.6	58.0	YES		66.8	22.3	POSSIBLE
R-047 (380 m)	53.0	44.6	53.6	58.0	YES		66.9	22.3	POSSIBLE
R-048 (360 m)	53.0	44.2	53.5	58.0	YES		66.5	22.3	POSSIBLE
R-049 (350 m)	53.0	43.5	53.5	58.0	YES		65.6	22.1	POSSIBLE
R-050 (330 m)	53.0	43.1	53.4	58.0	YES		65.2	22.1	POSSIBLE
R-051 (280 m)	53.0	41.6	53.3	58.0	YES		63.3	21.7	POSSIBLE
R-052 (270 m)	53.0	40.4	53.2	58.0	YES		61.4	21.0	POSSIBLE
R-053 (260 m)	53.0	39.0	53.2	58.0	YES		59.9	20.9	POSSIBLE
R-054 (250 m)	53.0	38.1	53.1	58.0	YES		58.7	20.6	POSSIBLE
R-055 (240 m)	53.0	37.5	53.1	58.0	YES		58.3	20.8	POSSIBLE
R-056 (300 m)	53.0	38.6	53.2	58.0	YES		60.5	21.9	POSSIBLE
R-057 (250 m)	53.0	35.9	53.1	58.0	YES		55.6	19.7	NO
R-058 (210 m)	53.0	35.6	53.1	58.0	YES		55.4	19.8	NO
R-059 (110 m)	53.0	35.5	53.1	58.0	YES		56.0	20.5	POSSIBLE
R-060 (80 m)	53.0	35.1	53.1	58.0	YES		55.5	20.4	POSSIBLE
R-061 (110 m)	53.0	35.0	53.1	58.0	YES		55.0	20.0	POSSIBLE
R-062 (90 m)	53.0	35.0	53.1	58.0	YES		54.9	19.9	NO
R-063 (90 m)	53.0	34.7	53.1	58.0	YES		54.7	20.0	POSSIBLE
R-064 (170 m)	53.0	34.9	53.1	58.0	YES		54.7	19.8	NO
R-065 (170 m)	53.0	34.5	53.1	58.0	YES		54.4	19.9	NO
R-066 (130 m)	53.0	34.4	53.1	58.0	YES		54.3	19.9	NO
R-067 (130 m)	53.0	34.1	53.1	58.0	YES		54.0	19.9	NO

Table 5.1-4 Year 01 Noise Modelling Results For Theoretical 1,500 m Receptors (Day-Time)

Receptor (1,500 m From MPB)	ASL-Day (dBA)	Application Case L_{eq}Day (dBA)	ASL + Application Case L_{eq}Day (dBA)	PSL-Day (dBA)	Compliant		Application Case L_{eq}Day (dBC)	dBC - dBA	Tonal
R-01	45.0	12.5	45.0	50.0	YES		31.6	19.1	NO
R-02	45.0	7.6	45.0	50.0	YES		26.9	19.3	NO
R-03	45.0	23.1	45.0	50.0	YES		40.5	17.4	NO
R-04	45.0	20.2	45.0	50.0	YES		37.8	17.6	NO
R-05	45.0	16.2	45.0	50.0	YES		34.2	18.0	NO
R-06	45.0	20.2	45.0	50.0	YES		37.8	17.6	NO
R-07	45.0	14.2	45.0	50.0	YES		32.8	18.6	NO
R-08	45.0	15.7	45.0	50.0	YES		34.1	18.4	NO
R-09	45.0	11.0	45.0	50.0	YES		30.2	19.2	NO
R-10	45.0	30.1	45.1	50.0	YES		47.6	17.5	NO
R-11	45.0	29.9	45.1	50.0	YES		50.3	20.4	POSSIBLE
R-12	45.0	29.6	45.1	50.0	YES		49.6	20.0	POSSIBLE
R-13	45.0	22.4	45.0	50.0	YES		40.6	18.2	NO
R-14	45.0	26.6	45.1	50.0	YES		44.9	18.3	NO
R-15	45.0	20.7	45.0	50.0	YES		38.7	18.0	NO
R-16	45.0	15.7	45.0	50.0	YES		34.2	18.5	NO
R-17	45.0	23.6	45.0	50.0	YES		45.6	22.0	POSSIBLE
R-18	45.0	27.8	45.1	50.0	YES		47.5	19.7	NO
R-19	45.0	18.5	45.0	50.0	YES		40.5	22.0	POSSIBLE
R-20	45.0	34.8	45.4	50.0	YES		58.3	23.5	POSSIBLE
R-21	45.0	35.2	45.4	50.0	YES		58.6	23.4	POSSIBLE
R-22	45.0	30.4	45.1	50.0	YES		49.7	19.3	NO
R-23	45.0	32.5	45.2	50.0	YES		51.7	19.2	NO
R-24	45.0	37.2	45.7	50.0	YES		60.5	23.3	POSSIBLE
R-25	45.0	32.0	45.2	50.0	YES		51.5	19.5	NO
R-26	45.0	31.4	45.2	50.0	YES		50.9	19.5	NO
R-27	45.0	29.8	45.1	50.0	YES		48.3	18.5	NO
R-28	45.0	29.7	45.1	50.0	YES		47.2	17.5	NO
R-29	45.0	30.0	45.1	50.0	YES		46.9	16.9	NO
R-30	45.0	32.0	45.2	50.0	YES		48.0	16.0	NO
R-31	45.0	32.4	45.2	50.0	YES		48.6	16.2	NO
R-32	45.0	25.3	45.0	50.0	YES		43.5	18.2	NO
R-33	45.0	21.0	45.0	50.0	YES		40.2	19.2	NO
R-34	45.0	25.5	45.0	50.0	YES		43.1	17.6	NO
R-35	45.0	30.3	45.1	50.0	YES		46.5	16.2	NO
R-36	45.0	31.0	45.2	50.0	YES		50.2	19.2	NO
R-37	45.0	27.6	45.1	50.0	YES		45.8	18.2	NO
R-38	45.0	25.8	45.1	50.0	YES		44.1	18.3	NO
R-39	45.0	25.5	45.0	50.0	YES		45.2	19.7	NO
R-40	45.0	24.4	45.0	50.0	YES		43.6	19.2	NO
R-41	45.0	24.4	45.0	50.0	YES		41.4	17.0	NO
R-42	45.0	21.4	45.0	50.0	YES		38.8	17.4	NO
R-43	45.0	18.9	45.0	50.0	YES		36.7	17.8	NO

5.2. Mining Year 06 Modelling Results

The noise modelling results for Mining Year 06 during the night-time for residential and 1,500 m receptors are provided in Tables 5.2-1 & 5.2-2, respectively, and represented in Figure 4a for the entire study area and in Figure 4b for the communities of Blairmore and Coleman. In addition, the noise modelling results for Mining Year 06 during the day-time for residential and 1,500 m receptors are provided in Tables 5.2-3 & 5.2-4, respectively, and represented in Figure 5. The noise modelling results indicate that the Project noise levels during the night-time and day-time, with the addition of the ASLs, will be below the PSLs for all residential and theoretical 1,500 m receptors. The order-ranked noise source contribution from the Project noise sources at two of the Blairmore residential receptors with the highest modelled noise levels (R-030 with a PSL-Night of 40 dBA & R-042 with a PSL-Night of 48 dBA) and at the two residential receptors closest to the Mine (Res-301 & Res-302) are presented in Appendix V. The order ranked noise at the Blairmore residential receptors are only provided for the Mining Year 06 noise modelling results because these results were the highest relative to all of the modelled mining years.

Similar to Mining Year 01, the results also indicate that the C-weighted (dBC) sound levels will be less than 20 dB above the dBA sound levels for approximately half of the receptors. As specified in the AER 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. For the other half of the receptors, the dBC - dBA sound levels are greater than 20 dB. This elevated low frequency noise is associated with the locomotives operating at the rail loadout, at the southern portion of the Project. The modelling results indicate the possibility of a low frequency tonal noise.

Table 5.2-1. Year 06 Noise Modelling Results For Residential Receptors (Night-Time)

Receptor (Distance From MPB)	ASL-Night (dBA)	Application Case L_{eq}Night (dBA)	ASL + Application Case L_{eq}Night (dBA)	PSL-Night (dBA)	Compliant		Application Case L_{eq}Night (dBC)	dBC - dBA	Tonal
Res-301 (200 m)	35.0	36.1	38.6	40.0	YES		52.3	16.2	NO
Res-302 (130 m)	35.0	37.9	39.7	40.0	YES		52.5	14.6	NO
R-001 (1,025 m)	38.0	32.3	39.0	43.0	YES		48.3	16.0	NO
R-002 (950 m)	38.0	32.8	39.1	43.0	YES		48.8	16.0	NO
R-003 (1,000 m)	38.0	32.0	39.0	43.0	YES		48.2	16.2	NO
R-004 (1,025 m)	38.0	32.0	39.0	43.0	YES		48.2	16.2	NO
R-005 (1,035 m)	38.0	32.1	39.0	43.0	YES		48.2	16.1	NO
R-006 (890 m)	38.0	32.7	39.1	43.0	YES		49.1	16.4	NO
R-007 (990 m)	38.0	29.3	38.5	43.0	YES		47.4	18.1	NO
R-008 (950 m)	38.0	29.0	38.5	43.0	YES		47.2	18.2	NO
R-009 (840 m)	38.0	30.5	38.7	43.0	YES		47.9	17.4	NO
R-010 (610 m)	43.0	31.9	43.3	48.0	YES		48.9	17.0	NO
R-011 (440 m)	43.0	31.9	43.3	48.0	YES		49.2	17.3	NO
R-012 (350 m)	43.0	33.0	43.4	48.0	YES		50.1	17.1	NO
R-013 (660 m)	43.0	32.0	43.3	48.0	YES		50.5	18.5	NO
R-014 (480 m)	43.0	32.6	43.4	48.0	YES		52.7	20.1	POSSIBLE
R-015 (550 m)	38.0	33.3	39.3	43.0	YES		54.1	20.8	POSSIBLE
R-016 (1,090 m)	40.0	31.8	40.6	45.0	YES		51.3	19.5	NO
R-017 (925 m)	35.0	32.5	36.9	40.0	YES		52.7	20.2	POSSIBLE
R-018 (750 m)	35.0	32.3	36.9	40.0	YES		50.0	17.7	NO
R-019 (1,050 m)	35.0	31.6	36.6	40.0	YES		49.9	18.3	NO
R-020 (1,090 m)	35.0	31.9	36.7	40.0	YES		50.6	18.7	NO
R-021 (890 m)	35.0	32.5	36.9	40.0	YES		51.1	18.6	NO
R-022 (960 m)	35.0	33.1	37.2	40.0	YES		51.7	18.6	NO
R-023 (840 m)	35.0	37.9	39.7	40.0	YES		60.9	23.0	POSSIBLE
R-024 (820 m)	38.0	39.3	41.7	43.0	YES		62.2	22.9	POSSIBLE
R-025 (870 m)	38.0	39.3	41.7	43.0	YES		62.3	23.0	POSSIBLE
R-026 (1,010 m)	38.0	38.7	41.4	43.0	YES		61.8	23.1	POSSIBLE
R-027 (1,100 m)	38.0	38.8	41.4	43.0	YES		61.8	23.0	POSSIBLE
R-028 (940 m)	38.0	38.9	41.5	43.0	YES		61.4	22.5	POSSIBLE
R-029 (980 m)	38.0	39.8	42.0	43.0	YES		62.9	23.1	POSSIBLE
R-030 (1,110 m)	35.0	38.1	39.8	40.0	YES		61.5	23.4	POSSIBLE
R-031 (1,190 m)	35.0	37.5	39.4	40.0	YES		61.0	23.5	POSSIBLE
R-032 (530 m)	43.0	42.3	45.7	48.0	YES		65.0	22.7	POSSIBLE
R-033 (600 m)	43.0	42.1	45.6	48.0	YES		64.9	22.8	POSSIBLE
R-034 (600 m)	43.0	42.5	45.8	48.0	YES		65.3	22.8	POSSIBLE
R-035 (670 m)	43.0	42.0	45.5	48.0	YES		64.8	22.8	POSSIBLE
R-036 (570 m)	43.0	43.1	46.1	48.0	YES		66.0	22.9	POSSIBLE
R-037 (720 m)	43.0	42.3	45.7	48.0	YES		65.2	22.9	POSSIBLE
R-038 (640 m)	43.0	43.0	46.0	48.0	YES		65.9	22.9	POSSIBLE
R-039 (380 m)	43.0	42.3	45.7	48.0	YES		63.2	20.9	POSSIBLE
R-040 (370 m)	43.0	44.2	46.7	48.0	YES		66.2	22.0	POSSIBLE
R-041 (370 m)	43.0	44.5	46.8	48.0	YES		66.7	22.2	POSSIBLE
R-042 (370 m)	43.0	44.6	46.9	48.0	YES		66.9	22.3	POSSIBLE
R-043 (370 m)	43.0	44.7	46.9	48.0	YES		66.9	22.2	POSSIBLE
R-044 (360 m)	43.0	44.6	46.9	48.0	YES		66.9	22.3	POSSIBLE
R-045 (350 m)	43.0	44.5	46.8	48.0	YES		66.9	22.4	POSSIBLE
R-046 (340 m)	43.0	44.5	46.8	48.0	YES		66.8	22.3	POSSIBLE
R-047 (380 m)	43.0	44.6	46.9	48.0	YES		66.9	22.3	POSSIBLE
R-048 (360 m)	43.0	44.2	46.7	48.0	YES		66.5	22.3	POSSIBLE
R-049 (350 m)	43.0	43.5	46.3	48.0	YES		65.6	22.1	POSSIBLE
R-050 (330 m)	43.0	43.1	46.1	48.0	YES		65.2	22.1	POSSIBLE
R-051 (280 m)	43.0	41.6	45.4	48.0	YES		63.3	21.7	POSSIBLE
R-052 (270 m)	43.0	40.4	44.9	48.0	YES		61.4	21.0	POSSIBLE
R-053 (260 m)	43.0	39.0	44.5	48.0	YES		59.9	20.9	POSSIBLE
R-054 (250 m)	43.0	38.1	44.2	48.0	YES		58.7	20.6	POSSIBLE
R-055 (240 m)	43.0	37.5	44.1	48.0	YES		58.3	20.8	POSSIBLE
R-056 (300 m)	43.0	38.5	44.3	48.0	YES		60.5	22.0	POSSIBLE
R-057 (250 m)	43.0	35.9	43.8	48.0	YES		55.6	19.7	NO
R-058 (210 m)	43.0	35.6	43.7	48.0	YES		55.4	19.8	NO
R-059 (110 m)	43.0	35.5	43.7	48.0	YES		56.0	20.5	POSSIBLE
R-060 (80 m)	43.0	35.1	43.7	48.0	YES		55.5	20.4	POSSIBLE
R-061 (110 m)	43.0	35.1	43.7	48.0	YES		55.1	20.0	POSSIBLE
R-062 (90 m)	43.0	35.0	43.6	48.0	YES		55.0	20.0	POSSIBLE
R-063 (90 m)	43.0	34.8	43.6	48.0	YES		54.7	19.9	NO
R-064 (170 m)	43.0	34.9	43.6	48.0	YES		54.7	19.8	NO
R-065 (170 m)	43.0	34.6	43.6	48.0	YES		54.4	19.8	NO
R-066 (130 m)	43.0	34.5	43.6	48.0	YES		54.4	19.9	NO
R-067 (130 m)	43.0	34.2	43.5	48.0	YES		54.1	19.9	NO

Table 5.2-2. Year 06 Noise Modelling Results For Theoretical 1,500 m Receptors (Night-Time)

Receptor (1,500 m From MPB)	ASL-Night (dBA)	Application Case L_{eq}Night (dBA)	ASL + Application Case L_{eq}Night (dBA)	PSL-Night (dBA)	Compliant		Application Case L_{eq}Night (dBC)	dBC - dBA	Tonal
R-01	35.0	21.9	35.2	40.0	YES		39.4	17.5	NO
R-02	35.0	12.9	35.0	40.0	YES		32.0	19.1	NO
R-03	35.0	29.3	36.0	40.0	YES		47.3	18.0	NO
R-04	35.0	27.5	35.7	40.0	YES		46.3	18.8	NO
R-05	35.0	22.0	35.2	40.0	YES		39.4	17.4	NO
R-06	35.0	26.9	35.6	40.0	YES		43.7	16.8	NO
R-07	35.0	14.8	35.0	40.0	YES		33.8	19.0	NO
R-08	35.0	17.8	35.1	40.0	YES		36.4	18.6	NO
R-09	35.0	21.3	35.2	40.0	YES		39.1	17.8	NO
R-10	35.0	31.2	36.5	40.0	YES		49.2	18.0	NO
R-11	35.0	30.2	36.2	40.0	YES		50.1	19.9	NO
R-12	35.0	29.8	36.1	40.0	YES		49.6	19.8	NO
R-13	35.0	22.6	35.2	40.0	YES		41.0	18.4	NO
R-14	35.0	27.0	35.6	40.0	YES		46.2	19.2	NO
R-15	35.0	23.2	35.3	40.0	YES		40.9	17.7	NO
R-16	35.0	20.8	35.2	40.0	YES		38.8	18.0	NO
R-17	35.0	23.6	35.3	40.0	YES		45.6	22.0	POSSIBLE
R-18	35.0	28.2	35.8	40.0	YES		47.8	19.6	NO
R-19	35.0	20.4	35.1	40.0	YES		41.4	21.0	POSSIBLE
R-20	35.0	34.8	37.9	40.0	YES		58.3	23.5	POSSIBLE
R-21	35.0	35.2	38.1	40.0	YES		58.7	23.5	POSSIBLE
R-22	35.0	30.4	36.3	40.0	YES		49.8	19.4	NO
R-23	35.0	32.7	37.0	40.0	YES		52.0	19.3	NO
R-24	35.0	37.2	39.2	40.0	YES		60.5	23.3	POSSIBLE
R-25	35.0	32.1	36.8	40.0	YES		51.7	19.6	NO
R-26	35.0	31.5	36.6	40.0	YES		50.9	19.4	NO
R-27	35.0	30.1	36.2	40.0	YES		48.7	18.6	NO
R-28	35.0	30.0	36.2	40.0	YES		47.6	17.6	NO
R-29	35.0	30.5	36.3	40.0	YES		47.5	17.0	NO
R-30	35.0	32.4	36.9	40.0	YES		48.4	16.0	NO
R-31	35.0	32.6	37.0	40.0	YES		48.9	16.3	NO
R-32	35.0	25.6	35.5	40.0	YES		43.8	18.2	NO
R-33	35.0	22.1	35.2	40.0	YES		41.2	19.1	NO
R-34	35.0	26.5	35.6	40.0	YES		44.2	17.7	NO
R-35	35.0	31.5	36.6	40.0	YES		47.8	16.3	NO
R-36	35.0	33.5	37.3	40.0	YES		52.0	18.5	NO
R-37	35.0	31.3	36.5	40.0	YES		49.7	18.4	NO
R-38	35.0	29.6	36.1	40.0	YES		48.3	18.7	NO
R-39	35.0	29.4	36.1	40.0	YES		47.9	18.5	NO
R-40	35.0	28.0	35.8	40.0	YES		45.8	17.8	NO
R-41	35.0	30.1	36.2	40.0	YES		48.8	18.7	NO
R-42	35.0	26.3	35.5	40.0	YES		43.3	17.0	NO
R-43	35.0	26.0	35.5	40.0	YES		43.1	17.1	NO

Table 5.2-3. Year 06 Noise Modelling Results For Residential Receptors (Day-Time)

Receptor (Distance From MPB)	ASL-Day (dBA)	Application Case L_{eq}Day (dBA)	ASL + Application Case L_{eq}Day (dBA)	PSL-Day (dBA)	Compliant		Application Case L_{eq}Day (dBC)	dBC - dBA	Tonal
Res-301 (200 m)	45.0	36.1	45.5	50.0	YES		52.4	16.3	NO
Res-302 (130 m)	45.0	38.0	45.8	50.0	YES		52.5	14.5	NO
R-001 (1,025 m)	48.0	32.4	48.1	53.0	YES		48.4	16.0	NO
R-002 (950 m)	48.0	32.9	48.1	53.0	YES		48.9	16.0	NO
R-003 (1,000 m)	48.0	32.1	48.1	53.0	YES		48.3	16.2	NO
R-004 (1,025 m)	48.0	32.1	48.1	53.0	YES		48.3	16.2	NO
R-005 (1,035 m)	48.0	32.2	48.1	53.0	YES		48.3	16.1	NO
R-006 (890 m)	48.0	32.8	48.1	53.0	YES		49.1	16.3	NO
R-007 (990 m)	48.0	29.3	48.1	53.0	YES		47.4	18.1	NO
R-008 (950 m)	48.0	29.1	48.1	53.0	YES		47.3	18.2	NO
R-009 (840 m)	48.0	30.5	48.1	53.0	YES		48.0	17.5	NO
R-010 (610 m)	53.0	32.0	53.0	58.0	YES		48.9	16.9	NO
R-011 (440 m)	53.0	31.9	53.0	58.0	YES		49.2	17.3	NO
R-012 (350 m)	53.0	33.0	53.0	58.0	YES		50.1	17.1	NO
R-013 (660 m)	53.0	32.0	53.0	58.0	YES		50.5	18.5	NO
R-014 (480 m)	53.0	32.6	53.0	58.0	YES		52.7	20.1	POSSIBLE
R-015 (550 m)	48.0	33.3	48.1	53.0	YES		54.1	20.8	POSSIBLE
R-016 (1,090 m)	50.0	31.8	50.1	55.0	YES		51.3	19.5	NO
R-017 (925 m)	45.0	32.5	45.2	50.0	YES		52.7	20.2	POSSIBLE
R-018 (750 m)	45.0	32.3	45.2	50.0	YES		50.0	17.7	NO
R-019 (1,050 m)	45.0	31.6	45.2	50.0	YES		49.9	18.3	NO
R-020 (1,090 m)	45.0	31.9	45.2	50.0	YES		50.6	18.7	NO
R-021 (890 m)	45.0	32.5	45.2	50.0	YES		51.1	18.6	NO
R-022 (960 m)	45.0	33.0	45.3	50.0	YES		51.7	18.7	NO
R-023 (840 m)	45.0	37.9	45.8	50.0	YES		60.9	23.0	POSSIBLE
R-024 (820 m)	48.0	39.3	48.5	53.0	YES		62.2	22.9	POSSIBLE
R-025 (870 m)	48.0	39.3	48.5	53.0	YES		62.3	23.0	POSSIBLE
R-026 (1,010 m)	48.0	38.7	48.5	53.0	YES		61.8	23.1	POSSIBLE
R-027 (1,100 m)	48.0	38.8	48.5	53.0	YES		61.8	23.0	POSSIBLE
R-028 (940 m)	48.0	38.9	48.5	53.0	YES		61.4	22.5	POSSIBLE
R-029 (980 m)	48.0	39.8	48.6	53.0	YES		62.9	23.1	POSSIBLE
R-030 (1,110 m)	45.0	38.1	45.8	50.0	YES		61.5	23.4	POSSIBLE
R-031 (1,190 m)	45.0	37.5	45.7	50.0	YES		61.0	23.5	POSSIBLE
R-032 (530 m)	53.0	42.3	53.4	58.0	YES		65.0	22.7	POSSIBLE
R-033 (600 m)	53.0	42.1	53.3	58.0	YES		64.9	22.8	POSSIBLE
R-034 (600 m)	53.0	42.5	53.4	58.0	YES		65.3	22.8	POSSIBLE
R-035 (670 m)	53.0	42.0	53.3	58.0	YES		64.8	22.8	POSSIBLE
R-036 (570 m)	53.0	43.1	53.4	58.0	YES		66.0	22.9	POSSIBLE
R-037 (720 m)	53.0	42.3	53.4	58.0	YES		65.2	22.9	POSSIBLE
R-038 (640 m)	53.0	43.0	53.4	58.0	YES		65.9	22.9	POSSIBLE
R-039 (380 m)	53.0	42.3	53.4	58.0	YES		63.2	20.9	POSSIBLE
R-040 (370 m)	53.0	44.2	53.5	58.0	YES		66.2	22.0	POSSIBLE
R-041 (370 m)	53.0	44.5	53.6	58.0	YES		66.7	22.2	POSSIBLE
R-042 (370 m)	53.0	44.6	53.6	58.0	YES		66.9	22.3	POSSIBLE
R-043 (370 m)	53.0	44.7	53.6	58.0	YES		66.9	22.2	POSSIBLE
R-044 (360 m)	53.0	44.6	53.6	58.0	YES		66.9	22.3	POSSIBLE
R-045 (350 m)	53.0	44.5	53.6	58.0	YES		66.9	22.4	POSSIBLE
R-046 (340 m)	53.0	44.5	53.6	58.0	YES		66.8	22.3	POSSIBLE
R-047 (380 m)	53.0	44.6	53.6	58.0	YES		66.9	22.3	POSSIBLE
R-048 (360 m)	53.0	44.2	53.5	58.0	YES		66.5	22.3	POSSIBLE
R-049 (350 m)	53.0	43.5	53.5	58.0	YES		65.6	22.1	POSSIBLE
R-050 (330 m)	53.0	43.1	53.4	58.0	YES		65.2	22.1	POSSIBLE
R-051 (280 m)	53.0	41.6	53.3	58.0	YES		63.3	21.7	POSSIBLE
R-052 (270 m)	53.0	40.4	53.2	58.0	YES		61.4	21.0	POSSIBLE
R-053 (260 m)	53.0	39.0	53.2	58.0	YES		59.9	20.9	POSSIBLE
R-054 (250 m)	53.0	38.1	53.1	58.0	YES		58.7	20.6	POSSIBLE
R-055 (240 m)	53.0	37.5	53.1	58.0	YES		58.3	20.8	POSSIBLE
R-056 (300 m)	53.0	38.5	53.2	58.0	YES		60.5	22.0	POSSIBLE
R-057 (250 m)	53.0	35.9	53.1	58.0	YES		55.6	19.7	NO
R-058 (210 m)	53.0	35.6	53.1	58.0	YES		55.4	19.8	NO
R-059 (110 m)	53.0	35.5	53.1	58.0	YES		56.0	20.5	POSSIBLE
R-060 (80 m)	53.0	35.1	53.1	58.0	YES		55.5	20.4	POSSIBLE
R-061 (110 m)	53.0	35.1	53.1	58.0	YES		55.1	20.0	POSSIBLE
R-062 (90 m)	53.0	35.0	53.1	58.0	YES		55.0	20.0	POSSIBLE
R-063 (90 m)	53.0	34.8	53.1	58.0	YES		54.7	19.9	NO
R-064 (170 m)	53.0	34.9	53.1	58.0	YES		54.7	19.8	NO
R-065 (170 m)	53.0	34.6	53.1	58.0	YES		54.4	19.8	NO
R-066 (130 m)	53.0	34.5	53.1	58.0	YES		54.4	19.9	NO
R-067 (130 m)	53.0	34.2	53.1	58.0	YES		54.1	19.9	NO

Table 5.2-4. Year 06 Noise Modelling Results For Theoretical 1,500 m Receptors (Day-Time)

Receptor (1,500 m From MPB)	ASL-Day (dBA)	Application Case L_{eq}Day (dBA)	ASL + Application Case L_{eq}Day (dBA)	PSL-Day (dBA)	Compliant		Application Case L_{eq}Day (dBC)	dBC - dBA	Tonal
R-01	45.0	24.4	45.0	50.0	YES		41.5	17.1	NO
R-02	45.0	14.3	45.0	50.0	YES		33.1	18.8	NO
R-03	45.0	29.9	45.1	50.0	YES		47.7	17.8	NO
R-04	45.0	28.2	45.1	50.0	YES		46.7	18.5	NO
R-05	45.0	22.0	45.0	50.0	YES		39.5	17.5	NO
R-06	45.0	27.7	45.1	50.0	YES		44.4	16.7	NO
R-07	45.0	14.8	45.0	50.0	YES		33.8	19.0	NO
R-08	45.0	17.8	45.0	50.0	YES		36.4	18.6	NO
R-09	45.0	21.5	45.0	50.0	YES		39.3	17.8	NO
R-10	45.0	31.2	45.2	50.0	YES		49.2	18.0	NO
R-11	45.0	30.3	45.1	50.0	YES		50.2	19.9	NO
R-12	45.0	29.9	45.1	50.0	YES		49.6	19.7	NO
R-13	45.0	23.1	45.0	50.0	YES		41.3	18.2	NO
R-14	45.0	27.2	45.1	50.0	YES		46.3	19.1	NO
R-15	45.0	23.6	45.0	50.0	YES		41.2	17.6	NO
R-16	45.0	21.4	45.0	50.0	YES		39.2	17.8	NO
R-17	45.0	23.7	45.0	50.0	YES		45.7	22.0	POSSIBLE
R-18	45.0	28.2	45.1	50.0	YES		47.8	19.6	NO
R-19	45.0	20.4	45.0	50.0	YES		41.4	21.0	POSSIBLE
R-20	45.0	34.8	45.4	50.0	YES		58.3	23.5	POSSIBLE
R-21	45.0	35.2	45.4	50.0	YES		58.7	23.5	POSSIBLE
R-22	45.0	30.4	45.1	50.0	YES		49.8	19.4	NO
R-23	45.0	32.7	45.2	50.0	YES		52.0	19.3	NO
R-24	45.0	37.2	45.7	50.0	YES		60.5	23.3	POSSIBLE
R-25	45.0	32.1	45.2	50.0	YES		51.7	19.6	NO
R-26	45.0	31.5	45.2	50.0	YES		50.9	19.4	NO
R-27	45.0	30.1	45.1	50.0	YES		48.6	18.5	NO
R-28	45.0	30.0	45.1	50.0	YES		47.6	17.6	NO
R-29	45.0	30.6	45.2	50.0	YES		47.6	17.0	NO
R-30	45.0	32.5	45.2	50.0	YES		48.5	16.0	NO
R-31	45.0	32.7	45.2	50.0	YES		49.0	16.3	NO
R-32	45.0	25.7	45.1	50.0	YES		43.8	18.1	NO
R-33	45.0	22.3	45.0	50.0	YES		41.4	19.1	NO
R-34	45.0	26.7	45.1	50.0	YES		44.4	17.7	NO
R-35	45.0	31.7	45.2	50.0	YES		48.0	16.3	NO
R-36	45.0	33.8	45.3	50.0	YES		52.2	18.4	NO
R-37	45.0	31.8	45.2	50.0	YES		50.0	18.2	NO
R-38	45.0	29.9	45.1	50.0	YES		48.4	18.5	NO
R-39	45.0	29.6	45.1	50.0	YES		48.0	18.4	NO
R-40	45.0	28.2	45.1	50.0	YES		45.9	17.7	NO
R-41	45.0	30.6	45.2	50.0	YES		49.0	18.4	NO
R-42	45.0	26.6	45.1	50.0	YES		43.5	16.9	NO
R-43	45.0	26.4	45.1	50.0	YES		43.4	17.0	NO

5.3. Mining Year 18 Modelling Results

The noise modelling results for Mining Year 18 during the night-time for residential and 1,500 m receptors are provided in Tables 5.3-1 & 5.3-2, respectively, and represented in Figure 6. In addition, the noise modelling results for Mining Year 18 during the day-time for residential and 1,500 m receptors are provided in Tables 5.3-3 & 5.3-4 and represented in Figure 7. The noise modelling results indicate that the Project noise levels during the night-time and day-time, with the addition of the ASLs, will be below the PSLs for all residential and theoretical 1,500 m receptors. The order-ranked noise source contribution from the Project noise sources at the two residential receptors closest to the Mine (Res-301 & Res-302) are presented in Appendix V.

Similar to Mining Years 01 and 06, the results also indicate that the C-weighted (dBC) sound levels will be less than 20 dB above the dBA sound levels for approximately half of the receptors. As specified in the AER 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. For the other half of the receptors, the dBC - dBA sound levels are greater than 20 dB. This elevated low frequency noise is associated with the locomotives operating at the rail loadout, at the southern portion of the Project. The modelling results indicate the possibility of a low frequency tonal noise.

Table 5.3-1. Year 18 Noise Modelling Results For Residential Receptors (Night-Time)

Receptor (Distance From MPB)	ASL-Night (dBA)	Application Case L_{eq}Night (dBA)	ASL + Application Case L_{eq}Night (dBA)	PSL-Night (dBA)	Compliant		Application Case L_{eq}Night (dBC)	dBC - dBA	Tonal
Res-301 (200 m)	35.0	33.5	37.3	40.0	YES		49.2	15.7	NO
Res-302 (130 m)	35.0	36.2	38.7	40.0	YES		51.6	15.4	NO
R-001 (1,025 m)	38.0	31.3	38.8	43.0	YES		47.7	16.4	NO
R-002 (950 m)	38.0	31.8	38.9	43.0	YES		48.2	16.4	NO
R-003 (1,000 m)	38.0	31.1	38.8	43.0	YES		47.7	16.6	NO
R-004 (1,025 m)	38.0	31.2	38.8	43.0	YES		47.7	16.5	NO
R-005 (1,035 m)	38.0	31.2	38.8	43.0	YES		47.8	16.6	NO
R-006 (890 m)	38.0	31.7	38.9	43.0	YES		48.4	16.7	NO
R-007 (990 m)	38.0	27.1	38.3	43.0	YES		46.3	19.2	NO
R-008 (950 m)	38.0	27.0	38.3	43.0	YES		46.2	19.2	NO
R-009 (840 m)	38.0	28.8	38.5	43.0	YES		47.0	18.2	NO
R-010 (610 m)	43.0	31.1	43.3	48.0	YES		48.4	17.3	NO
R-011 (440 m)	43.0	31.1	43.3	48.0	YES		48.7	17.6	NO
R-012 (350 m)	43.0	32.2	43.3	48.0	YES		49.5	17.3	NO
R-013 (660 m)	43.0	31.3	43.3	48.0	YES		50.2	18.9	NO
R-014 (480 m)	43.0	32.0	43.3	48.0	YES		52.5	20.5	POSSIBLE
R-015 (550 m)	38.0	32.8	39.1	43.0	YES		53.9	21.1	POSSIBLE
R-016 (1,090 m)	40.0	31.1	40.5	45.0	YES		51.1	20.0	POSSIBLE
R-017 (925 m)	35.0	31.9	36.7	40.0	YES		52.4	20.5	POSSIBLE
R-018 (750 m)	35.0	31.6	36.6	40.0	YES		49.1	17.5	NO
R-019 (1,050 m)	35.0	30.8	36.4	40.0	YES		48.7	17.9	NO
R-020 (1,090 m)	35.0	30.9	36.4	40.0	YES		49.0	18.1	NO
R-021 (890 m)	35.0	31.6	36.6	40.0	YES		49.6	18.0	NO
R-022 (960 m)	35.0	32.3	36.9	40.0	YES		50.3	18.0	NO
R-023 (840 m)	35.0	37.6	39.5	40.0	YES		60.8	23.2	POSSIBLE
R-024 (820 m)	38.0	39.2	41.7	43.0	YES		62.1	22.9	POSSIBLE
R-025 (870 m)	38.0	39.2	41.7	43.0	YES		62.2	23.0	POSSIBLE
R-026 (1,010 m)	38.0	38.5	41.3	43.0	YES		61.7	23.2	POSSIBLE
R-027 (1,100 m)	38.0	38.7	41.4	43.0	YES		61.8	23.1	POSSIBLE
R-028 (940 m)	38.0	38.8	41.4	43.0	YES		61.3	22.5	POSSIBLE
R-029 (980 m)	38.0	39.7	41.9	43.0	YES		62.9	23.2	POSSIBLE
R-030 (1,110 m)	35.0	37.9	39.7	40.0	YES		61.4	23.5	POSSIBLE
R-031 (1,190 m)	35.0	37.3	39.3	40.0	YES		61.0	23.7	POSSIBLE
R-032 (530 m)	43.0	42.2	45.6	48.0	YES		65.0	22.8	POSSIBLE
R-033 (600 m)	43.0	42.1	45.6	48.0	YES		64.9	22.8	POSSIBLE
R-034 (600 m)	43.0	42.4	45.7	48.0	YES		65.3	22.9	POSSIBLE
R-035 (670 m)	43.0	41.9	45.5	48.0	YES		64.8	22.9	POSSIBLE
R-036 (570 m)	43.0	43.1	46.1	48.0	YES		66.0	22.9	POSSIBLE
R-037 (720 m)	43.0	42.2	45.6	48.0	YES		65.2	23.0	POSSIBLE
R-038 (640 m)	43.0	43.0	46.0	48.0	YES		65.9	22.9	POSSIBLE
R-039 (380 m)	43.0	42.2	45.6	48.0	YES		63.2	21.0	POSSIBLE
R-040 (370 m)	43.0	44.2	46.7	48.0	YES		66.2	22.0	POSSIBLE
R-041 (370 m)	43.0	44.5	46.8	48.0	YES		66.7	22.2	POSSIBLE
R-042 (370 m)	43.0	44.6	46.9	48.0	YES		66.8	22.2	POSSIBLE
R-043 (370 m)	43.0	44.6	46.9	48.0	YES		66.9	22.3	POSSIBLE
R-044 (360 m)	43.0	44.6	46.9	48.0	YES		66.9	22.3	POSSIBLE
R-045 (350 m)	43.0	44.5	46.8	48.0	YES		66.9	22.4	POSSIBLE
R-046 (340 m)	43.0	44.4	46.8	48.0	YES		66.8	22.4	POSSIBLE
R-047 (380 m)	43.0	44.6	46.9	48.0	YES		66.9	22.3	POSSIBLE
R-048 (360 m)	43.0	44.2	46.7	48.0	YES		66.5	22.3	POSSIBLE
R-049 (350 m)	43.0	43.5	46.3	48.0	YES		65.6	22.1	POSSIBLE
R-050 (330 m)	43.0	43.1	46.1	48.0	YES		65.1	22.0	POSSIBLE
R-051 (280 m)	43.0	41.6	45.4	48.0	YES		63.3	21.7	POSSIBLE
R-052 (270 m)	43.0	40.3	44.9	48.0	YES		61.3	21.0	POSSIBLE
R-053 (260 m)	43.0	38.9	44.4	48.0	YES		59.9	21.0	POSSIBLE
R-054 (250 m)	43.0	38.0	44.2	48.0	YES		58.6	20.6	POSSIBLE
R-055 (240 m)	43.0	37.3	44.0	48.0	YES		58.3	21.0	POSSIBLE
R-056 (300 m)	43.0	38.4	44.3	48.0	YES		60.4	22.0	POSSIBLE
R-057 (250 m)	43.0	35.6	43.7	48.0	YES		55.5	19.9	NO
R-058 (210 m)	43.0	35.4	43.7	48.0	YES		55.3	19.9	NO
R-059 (110 m)	43.0	35.1	43.7	48.0	YES		55.9	20.8	POSSIBLE
R-060 (80 m)	43.0	34.8	43.6	48.0	YES		55.4	20.6	POSSIBLE
R-061 (110 m)	43.0	34.7	43.6	48.0	YES		54.9	20.2	POSSIBLE
R-062 (90 m)	43.0	34.7	43.6	48.0	YES		54.9	20.2	POSSIBLE
R-063 (90 m)	43.0	34.5	43.6	48.0	YES		54.6	20.1	POSSIBLE
R-064 (170 m)	43.0	34.6	43.6	48.0	YES		54.6	20.0	POSSIBLE
R-065 (170 m)	43.0	34.2	43.5	48.0	YES		54.3	20.1	POSSIBLE
R-066 (130 m)	43.0	34.2	43.5	48.0	YES		54.2	20.0	POSSIBLE
R-067 (130 m)	43.0	33.8	43.5	48.0	YES		53.9	20.1	POSSIBLE

Table 5.3-2. Year 18 Noise Modelling Results For Theoretical 1,500 m Receptors (Night-Time)

Receptor (1,500 m From MPB)	ASL-Night (dBA)	Application Case L_{eq}Night (dBA)	ASL + Application Case L_{eq}Night (dBA)	PSL-Night (dBA)	Compliant		Application Case L_{eq}Night (dBC)	dBC - dBA	Tonal
R-01	35.0	27.4	35.7	40.0	YES		44.3	16.9	NO
R-02	35.0	26.7	35.6	40.0	YES		43.9	17.2	NO
R-03	35.0	34.3	37.7	40.0	YES		53.1	18.8	NO
R-04	35.0	31.8	36.7	40.0	YES		51.9	20.1	POSSIBLE
R-05	35.0	25.6	35.5	40.0	YES		43.0	17.4	NO
R-06	35.0	31.8	36.7	40.0	YES		48.1	16.3	NO
R-07	35.0	11.2	35.0	40.0	YES		28.5	17.3	NO
R-08	35.0	14.4	35.0	40.0	YES		32.7	18.3	NO
R-09	35.0	24.0	35.3	40.0	YES		41.2	17.2	NO
R-10	35.0	28.5	35.9	40.0	YES		45.5	17.0	NO
R-11	35.0	28.8	35.9	40.0	YES		46.8	18.0	NO
R-12	35.0	28.4	35.9	40.0	YES		45.7	17.3	NO
R-13	35.0	22.1	35.2	40.0	YES		40.7	18.6	NO
R-14	35.0	25.9	35.5	40.0	YES		43.4	17.5	NO
R-15	35.0	22.4	35.2	40.0	YES		40.2	17.8	NO
R-16	35.0	21.8	35.2	40.0	YES		39.5	17.7	NO
R-17	35.0	23.5	35.3	40.0	YES		45.6	22.1	POSSIBLE
R-18	35.0	27.6	35.7	40.0	YES		47.4	19.8	NO
R-19	35.0	18.4	35.1	40.0	YES		40.6	22.2	POSSIBLE
R-20	35.0	34.5	37.8	40.0	YES		58.2	23.7	POSSIBLE
R-21	35.0	34.9	38.0	40.0	YES		58.6	23.7	POSSIBLE
R-22	35.0	29.5	36.1	40.0	YES		49.3	19.8	NO
R-23	35.0	32.0	36.8	40.0	YES		51.2	19.2	NO
R-24	35.0	37.0	39.1	40.0	YES		60.4	23.4	POSSIBLE
R-25	35.0	31.3	36.5	40.0	YES		50.7	19.4	NO
R-26	35.0	30.6	36.3	40.0	YES		49.4	18.8	NO
R-27	35.0	29.1	36.0	40.0	YES		47.2	18.1	NO
R-28	35.0	29.2	36.0	40.0	YES		47.1	17.9	NO
R-29	35.0	29.9	36.2	40.0	YES		47.2	17.3	NO
R-30	35.0	31.3	36.5	40.0	YES		47.7	16.4	NO
R-31	35.0	31.6	36.6	40.0	YES		48.3	16.7	NO
R-32	35.0	22.9	35.3	40.0	YES		42.2	19.3	NO
R-33	35.0	21.2	35.2	40.0	YES		40.7	19.5	NO
R-34	35.0	24.7	35.4	40.0	YES		42.9	18.2	NO
R-35	35.0	30.5	36.3	40.0	YES		47.1	16.6	NO
R-36	35.0	34.0	37.5	40.0	YES		51.5	17.5	NO
R-37	35.0	31.8	36.7	40.0	YES		49.3	17.5	NO
R-38	35.0	31.0	36.5	40.0	YES		49.8	18.8	NO
R-39	35.0	30.9	36.4	40.0	YES		49.4	18.5	NO
R-40	35.0	29.0	36.0	40.0	YES		45.7	16.7	NO
R-41	35.0	31.9	36.7	40.0	YES		50.5	18.6	NO
R-42	35.0	28.0	35.8	40.0	YES		45.0	17.0	NO
R-43	35.0	28.2	35.8	40.0	YES		45.3	17.1	NO

Table 5.3-3. Year 18 Noise Modelling Results For Residential Receptors (Day-Time)

Receptor (Distance From MPB)	ASL-Day (dBA)	Application Case L_{eq}Day (dBA)	ASL + Application Case L_{eq}Day (dBA)	PSL-Day (dBA)	Compliant		Application Case L_{eq}Day (dBC)	dBC - dBA	Tonal
Res-301 (200 m)	45.0	33.9	45.3	50.0	YES		49.6	15.7	NO
Res-302 (130 m)	45.0	36.3	45.5	50.0	YES		51.6	15.3	NO
R-001 (1,025 m)	48.0	31.7	48.1	53.0	YES		48.0	16.3	NO
R-002 (950 m)	48.0	32.3	48.1	53.0	YES		48.6	16.3	NO
R-003 (1,000 m)	48.0	31.6	48.1	53.0	YES		48.0	16.4	NO
R-004 (1,025 m)	48.0	31.6	48.1	53.0	YES		48.0	16.4	NO
R-005 (1,035 m)	48.0	31.7	48.1	53.0	YES		48.1	16.4	NO
R-006 (890 m)	48.0	32.1	48.1	53.0	YES		48.7	16.6	NO
R-007 (990 m)	48.0	27.9	48.0	53.0	YES		46.7	18.8	NO
R-008 (950 m)	48.0	27.7	48.0	53.0	YES		46.6	18.9	NO
R-009 (840 m)	48.0	29.4	48.1	53.0	YES		47.3	17.9	NO
R-010 (610 m)	53.0	31.5	53.0	58.0	YES		48.7	17.2	NO
R-011 (440 m)	53.0	31.4	53.0	58.0	YES		48.9	17.5	NO
R-012 (350 m)	53.0	32.4	53.0	58.0	YES		49.7	17.3	NO
R-013 (660 m)	53.0	31.6	53.0	58.0	YES		50.3	18.7	NO
R-014 (480 m)	53.0	32.2	53.0	58.0	YES		52.6	20.4	POSSIBLE
R-015 (550 m)	48.0	33.0	48.1	53.0	YES		54.0	21.0	POSSIBLE
R-016 (1,090 m)	50.0	31.3	50.1	55.0	YES		51.1	19.8	NO
R-017 (925 m)	45.0	32.1	45.2	50.0	YES		52.4	20.3	POSSIBLE
R-018 (750 m)	45.0	31.8	45.2	50.0	YES		49.2	17.4	NO
R-019 (1,050 m)	45.0	31.0	45.2	50.0	YES		48.8	17.8	NO
R-020 (1,090 m)	45.0	31.2	45.2	50.0	YES		49.1	17.9	NO
R-021 (890 m)	45.0	31.9	45.2	50.0	YES		49.7	17.8	NO
R-022 (960 m)	45.0	32.5	45.2	50.0	YES		50.6	18.1	NO
R-023 (840 m)	45.0	37.7	45.7	50.0	YES		60.8	23.1	POSSIBLE
R-024 (820 m)	48.0	39.2	48.5	53.0	YES		62.1	22.9	POSSIBLE
R-025 (870 m)	48.0	39.2	48.5	53.0	YES		62.2	23.0	POSSIBLE
R-026 (1,010 m)	48.0	38.6	48.5	53.0	YES		61.8	23.2	POSSIBLE
R-027 (1,100 m)	48.0	38.7	48.5	53.0	YES		61.8	23.1	POSSIBLE
R-028 (940 m)	48.0	38.8	48.5	53.0	YES		61.4	22.6	POSSIBLE
R-029 (980 m)	48.0	39.8	48.6	53.0	YES		62.9	23.1	POSSIBLE
R-030 (1,110 m)	45.0	37.9	45.8	50.0	YES		61.4	23.5	POSSIBLE
R-031 (1,190 m)	45.0	37.4	45.7	50.0	YES		61.0	23.6	POSSIBLE
R-032 (530 m)	53.0	42.3	53.4	58.0	YES		65.0	22.7	POSSIBLE
R-033 (600 m)	53.0	42.1	53.3	58.0	YES		64.9	22.8	POSSIBLE
R-034 (600 m)	53.0	42.4	53.4	58.0	YES		65.3	22.9	POSSIBLE
R-035 (670 m)	53.0	41.9	53.3	58.0	YES		64.8	22.9	POSSIBLE
R-036 (570 m)	53.0	43.1	53.4	58.0	YES		66.0	22.9	POSSIBLE
R-037 (720 m)	53.0	42.2	53.3	58.0	YES		65.2	23.0	POSSIBLE
R-038 (640 m)	53.0	43.0	53.4	58.0	YES		65.9	22.9	POSSIBLE
R-039 (380 m)	53.0	42.2	53.3	58.0	YES		63.2	21.0	POSSIBLE
R-040 (370 m)	53.0	44.2	53.5	58.0	YES		66.2	22.0	POSSIBLE
R-041 (370 m)	53.0	44.5	53.6	58.0	YES		66.7	22.2	POSSIBLE
R-042 (370 m)	53.0	44.6	53.6	58.0	YES		66.8	22.2	POSSIBLE
R-043 (370 m)	53.0	44.6	53.6	58.0	YES		66.9	22.3	POSSIBLE
R-044 (360 m)	53.0	44.6	53.6	58.0	YES		66.9	22.3	POSSIBLE
R-045 (350 m)	53.0	44.5	53.6	58.0	YES		66.9	22.4	POSSIBLE
R-046 (340 m)	53.0	44.5	53.6	58.0	YES		66.8	22.3	POSSIBLE
R-047 (380 m)	53.0	44.6	53.6	58.0	YES		66.9	22.3	POSSIBLE
R-048 (360 m)	53.0	44.2	53.5	58.0	YES		66.5	22.3	POSSIBLE
R-049 (350 m)	53.0	43.5	53.5	58.0	YES		65.6	22.1	POSSIBLE
R-050 (330 m)	53.0	43.1	53.4	58.0	YES		65.1	22.0	POSSIBLE
R-051 (280 m)	53.0	41.6	53.3	58.0	YES		63.3	21.7	POSSIBLE
R-052 (270 m)	53.0	40.3	53.2	58.0	YES		61.4	21.1	POSSIBLE
R-053 (260 m)	53.0	38.9	53.2	58.0	YES		59.9	21.0	POSSIBLE
R-054 (250 m)	53.0	38.0	53.1	58.0	YES		58.6	20.6	POSSIBLE
R-055 (240 m)	53.0	37.4	53.1	58.0	YES		58.3	20.9	POSSIBLE
R-056 (300 m)	53.0	38.4	53.1	58.0	YES		60.5	22.1	POSSIBLE
R-057 (250 m)	53.0	35.7	53.1	58.0	YES		55.5	19.8	NO
R-058 (210 m)	53.0	35.4	53.1	58.0	YES		55.3	19.9	NO
R-059 (110 m)	53.0	35.2	53.1	58.0	YES		55.9	20.7	POSSIBLE
R-060 (80 m)	53.0	34.9	53.1	58.0	YES		55.4	20.5	POSSIBLE
R-061 (110 m)	53.0	34.8	53.1	58.0	YES		55.0	20.2	POSSIBLE
R-062 (90 m)	53.0	34.8	53.1	58.0	YES		54.9	20.1	POSSIBLE
R-063 (90 m)	53.0	34.5	53.1	58.0	YES		54.6	20.1	POSSIBLE
R-064 (170 m)	53.0	34.7	53.1	58.0	YES		54.6	19.9	NO
R-065 (170 m)	53.0	34.3	53.1	58.0	YES		54.3	20.0	POSSIBLE
R-066 (130 m)	53.0	34.3	53.1	58.0	YES		54.3	20.0	POSSIBLE
R-067 (130 m)	53.0	33.9	53.1	58.0	YES		53.9	20.0	POSSIBLE

Table 5.3-4. Year 18 Noise Modelling Results For Theoretical 1,500 m Receptors (Day-Time)

Receptor (1,500 m From MPB)	ASL-Day (dBA)	Application Case L_{eq}Day (dBA)	ASL + Application Case L_{eq}Day (dBA)	PSL-Day (dBA)	Compliant		Application Case L_{eq}Day (dBC)	dBC - dBA	Tonal
R-01	45.0	27.4	45.1	50.0	YES		44.3	16.9	NO
R-02	45.0	26.7	45.1	50.0	YES		43.9	17.2	NO
R-03	45.0	34.3	45.4	50.0	YES		53.2	18.9	NO
R-04	45.0	31.9	45.2	50.0	YES		51.9	20.0	POSSIBLE
R-05	45.0	25.7	45.1	50.0	YES		43.0	17.3	NO
R-06	45.0	31.7	45.2	50.0	YES		48.1	16.4	NO
R-07	45.0	11.6	45.0	50.0	YES		28.7	17.1	NO
R-08	45.0	14.8	45.0	50.0	YES		32.8	18.0	NO
R-09	45.0	23.9	45.0	50.0	YES		41.2	17.3	NO
R-10	45.0	28.9	45.1	50.0	YES		45.8	16.9	NO
R-11	45.0	29.2	45.1	50.0	YES		47.0	17.8	NO
R-12	45.0	28.9	45.1	50.0	YES		46.0	17.1	NO
R-13	45.0	22.2	45.0	50.0	YES		40.7	18.5	NO
R-14	45.0	26.4	45.1	50.0	YES		43.7	17.3	NO
R-15	45.0	22.5	45.0	50.0	YES		40.4	17.9	NO
R-16	45.0	21.9	45.0	50.0	YES		39.6	17.7	NO
R-17	45.0	23.6	45.0	50.0	YES		45.6	22.0	POSSIBLE
R-18	45.0	27.8	45.1	50.0	YES		47.5	19.7	NO
R-19	45.0	19.0	45.0	50.0	YES		40.8	21.8	POSSIBLE
R-20	45.0	34.6	45.4	50.0	YES		58.3	23.7	POSSIBLE
R-21	45.0	35.0	45.4	50.0	YES		58.6	23.6	POSSIBLE
R-22	45.0	29.7	45.1	50.0	YES		49.4	19.7	NO
R-23	45.0	32.2	45.2	50.0	YES		51.4	19.2	NO
R-24	45.0	37.1	45.7	50.0	YES		60.4	23.3	POSSIBLE
R-25	45.0	31.5	45.2	50.0	YES		50.9	19.4	NO
R-26	45.0	30.8	45.2	50.0	YES		49.8	19.0	NO
R-27	45.0	29.4	45.1	50.0	YES		47.3	17.9	NO
R-28	45.0	29.6	45.1	50.0	YES		47.3	17.7	NO
R-29	45.0	30.4	45.1	50.0	YES		47.4	17.0	NO
R-30	45.0	31.8	45.2	50.0	YES		48.0	16.2	NO
R-31	45.0	32.0	45.2	50.0	YES		48.6	16.6	NO
R-32	45.0	23.9	45.0	50.0	YES		42.7	18.8	NO
R-33	45.0	21.8	45.0	50.0	YES		41.1	19.3	NO
R-34	45.0	25.8	45.1	50.0	YES		43.6	17.8	NO
R-35	45.0	31.2	45.2	50.0	YES		47.7	16.5	NO
R-36	45.0	34.3	45.4	50.0	YES		51.7	17.4	NO
R-37	45.0	32.0	45.2	50.0	YES		49.5	17.5	NO
R-38	45.0	31.2	45.2	50.0	YES		49.9	18.7	NO
R-39	45.0	31.0	45.2	50.0	YES		49.5	18.5	NO
R-40	45.0	29.2	45.1	50.0	YES		45.9	16.7	NO
R-41	45.0	32.0	45.2	50.0	YES		50.6	18.6	NO
R-42	45.0	28.0	45.1	50.0	YES		45.1	17.1	NO
R-43	45.0	28.2	45.1	50.0	YES		45.3	17.1	NO

5.4. Mitigation

5.4.1. Rock Disposal Area Sequencing Noise Mitigation

At approximately Mining Year 02, there will be increased equipment operating in the south disposal area (Figure 1). As the Mining years progress, the elevation of the south disposal area will increase and the activity will move closer to the two residential receptor locations to the east of the MPB. For these two receptors, the dominant Project noise sources will be the haul trucks accessing the south disposal area as well as the dozers operating on the disposal area. In order to achieve noise levels below the PSLs for these two residential receptor locations, there are two recommended operational noise mitigation measures. These include:

- Where feasible, route the haul trucks (conveying waste rock and coal) along the western slope of the south disposal area such that the south disposal area itself provides noise shielding between the operating equipment and the residential receptors to the east; and,
- Construct the waste rock piles such that the eastern-most areas are built-up during the day-time and then the night-time waste rock activities are further to the west and at lower elevations, using the eastern-most piles as a natural noise barrier.

5.4.2. Blasting Noise and Vibration Mitigation

A portion of the mining operations will involve use of explosive charges to loosen the raw materials. The noise and vibration levels associated with blasting can have a potential impact on nearby residents and can cause sensory disturbance to wildlife. There are no specific noise or vibration level limits for blasting in the AER Directive 038, nor are there any specific other provincial or federal criteria.

Despite the lack of specific criteria or guidelines, the following blasting procedures will be adhered to in order to minimize potential noise and vibration impacts associated with blasting:

- blasting will occur only on weekdays during typical day-time hours
- Minimal blasting during cloud cover.
- Blasting will be limited to smaller more localized blasts, which reduces the amount of explosives used at any one time.

5.4.3. Low Frequency Noise Mitigation

The equipment used for the mining operations is comprised essentially of internal combustion engine driven machinery. Similarly, the noise from the rail loadout activity will be largely comprised of diesel locomotives; subsequently, the frequency content generally contains a relatively high level of low frequency engine noise with typical peaks near 63 – 125 Hz. The measurement data obtained for each of the different types of operational equipment did not indicate a specific low frequency tonal component as defined in the AER Directive 038.

5.4.4. Light Duty Vehicle Back-up Alarm Mitigation

Common sources of industrial noise for local residents are safety back-up alarms used on industrial equipment. As with the low frequency noise, the relative impact of the back-up alarms is difficult to predict since the orientation of the trucks and surrounding topography, both of which are constantly changing, will have a substantial impact on the noise levels. If, during active operations at the mine, concerns are raised by local residents, specific noise mitigation measures can be put in place. For example, the alarm noise can be replaced during night-time activities with a flashing light, which provides the necessary safety warning while eliminating the noise. During the day-time there are directional back-up alarms available that focus the noise to areas directly behind the vehicle and minimize the omni-directional noise radiation or back-up alarms with varying tones which provide the necessary safety warnings while minimizing the impact on receptors further away.

5.4.5. Equipment Mechanical Condition Mitigation

The operational sound level measurements conducted for equipment similar to the Project involved equipment which was in good working condition and good mechanical repair. In general, as equipment is used and general 'wear and tear' occurs, the noise levels tend to increase. There will be on-site maintenance shops to ensure that equipment is kept in good repair. When new equipment is purchased, it is also important to consider the noise levels of the equipment during the procurement process and to consider manufacturers options which result in lower noise levels.

6.0 Significance of Project Effects

6.1. Valued Component

Ambient noise levels were considered a valued component in the EIA as they have the potential to impact wildlife and use and enjoyment of the land surrounding the Project.

6.2. Potential Adverse Effect

Noise will be generated by the equipment associated with the Mine, CHPP, Conveyors and Rail Loadout. The potential adverse effect caused by the project is an increase in noise levels.

6.3. Evaluation of Significance

During the Noise Impact Assessment the noise levels at the surrounding residential and theoretical 1,500 m receptors were modelled for various operational stages and compared to the permissible sound levels defined in AER Directive 038: Noise Control.

It was predicted that, after mitigation, noise levels will be below the permissible sound levels for all residential and theoretical 1,500 m receptors. The modelling results indicate the possibility of a low frequency tonal noise at some receptors. If, upon start-up of the Project, a low frequency noise complaint is received, Benga will conduct a comprehensive sound level survey in accordance with the requirements of Directive 038.

Overall the increase in noise levels will not be significant (Table 6.3-1). The increase in noise will occur in close proximity (i.e. generally within 1,500 m) to the proposed Mine Permit Boundary, therefore will be Local in extent. These increases will be Continuous and will occur over a Long duration throughout construction, operation and reclamation of the Mine, but will cease (i.e. reverse) once the mine has been reclaimed.

Table 6.3-1. Summary of Impacts on Noise

VC	Nature of Potential Impact or Effect	Mitigation/ Protection Plan	Type of Impact or Effect	Geographical Extent of Impact[1]	Duration of Impact[2]	Frequency of Impact[3]	Ability for Recovery[4]	Magnitude[5]	Project Contribution[6]	Confidence Rating[7]	Probability Occurrence – Ecological Context[8]	Significance[9]
Ambient sound levels	Mine equipment increasing sound levels	See E.2.5 and CR#2	Application	Local	Long	Continuous	Reversible in short term	Moderate Impact	Negative	Moderate	Medium	Not Significant

1 Local, Regional, Provincial, National, Global
2 Short, Long, Extended, Residual
3 Continuous, Isolated, Periodic, Occasional, Accidental, Seasonal
4 Reversible in short term, Reversible in long term, Irreversible – rare
5 No Impact, Low Impact, Moderate Impact, High Impact
6 Neutral, Positive, Negative
7 Low, Moderate, High
8 Low, Medium, High
9 Significant, Not Significant

7.0 Summary

The noise modelling results indicate that the Project noise levels during the night-time and day-time, with the addition of the ASLs, will be below the PSLs for all residential and theoretical 1,500 m receptors.

The results also indicate that the C-weighted (dBC) sound levels will be less than 20 dB above the dBA sound levels for approximately half of the receptors. As specified in the AER 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. For the other half of the receptors, the dBC - dBA sound levels are greater than 20 dB. This elevated low frequency noise is associated with the locomotives operating at the rail loadout, at the southern portion of the Project. The noise model did not account for the background noise associated with the current vehicle traffic or current rail line activity since these are not noise sources which are regulated by the AER or the Alberta Utilities Commission (AUC). The modelling results indicate the possibility of a low frequency tonal noise. Assessment of any actual low frequency tonal noise would require a noise monitoring to be conducted during normal operations of the Project. If, upon start-up of the Project, a low frequency noise complaint is received, Benga will conduct a comprehensive sound level (CSL) survey in accordance with the requirements of the AER Directive 038.

Benga has also prepared a noise impact assessment summary for the Grassy Mountain Coal Project, particularly the rail siding and loadout components. The purpose of the NIA Summary was to conduct baseline noise monitoring within Blairmore and to generate a computer noise model with the focus on the rail siding and loadout components. The predicted noise levels of the rail siding and loadout were added to the existing baseline/measured levels to determine the total project noise levels. A number of residential receptors were identified around Blairmore and Coleman, and were used in the predictive noise model to determine the relative impact of the Project on the local noise climate. This report has been submitted under separate cover "*Environmental Noise Impact Assessment Summary for the Grassy Mountain Coal Project, Rail Siding and Loadout Components*".

8.0 References

- Alberta Energy Regulator (AER), *Directive 038 on Noise Control, 2007*, Calgary, Alberta
- *Environmental Noise Impact Assessment Summary for the Grassy Mountain Coal Project, Rail Siding and Loadout Components*. Prepared for Benga Mining Limited by **aci** Acoustical Consultants Inc., May 2016.
- 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.
- *Engineering Noise Control, Theory and Practice*. David A. Bies and Colin H. Hansen, 2003, Spon Press
- *Noise and Vibration Control Engineering, Principles and Applications*. Istvan L. Ver and Leo L. Beranek, 2006, John Wiley & Sons Inc.
- *Industrial Noise Control and Acoustics*. Randall F. Barron, 2003, Marcel Dekker Inc.

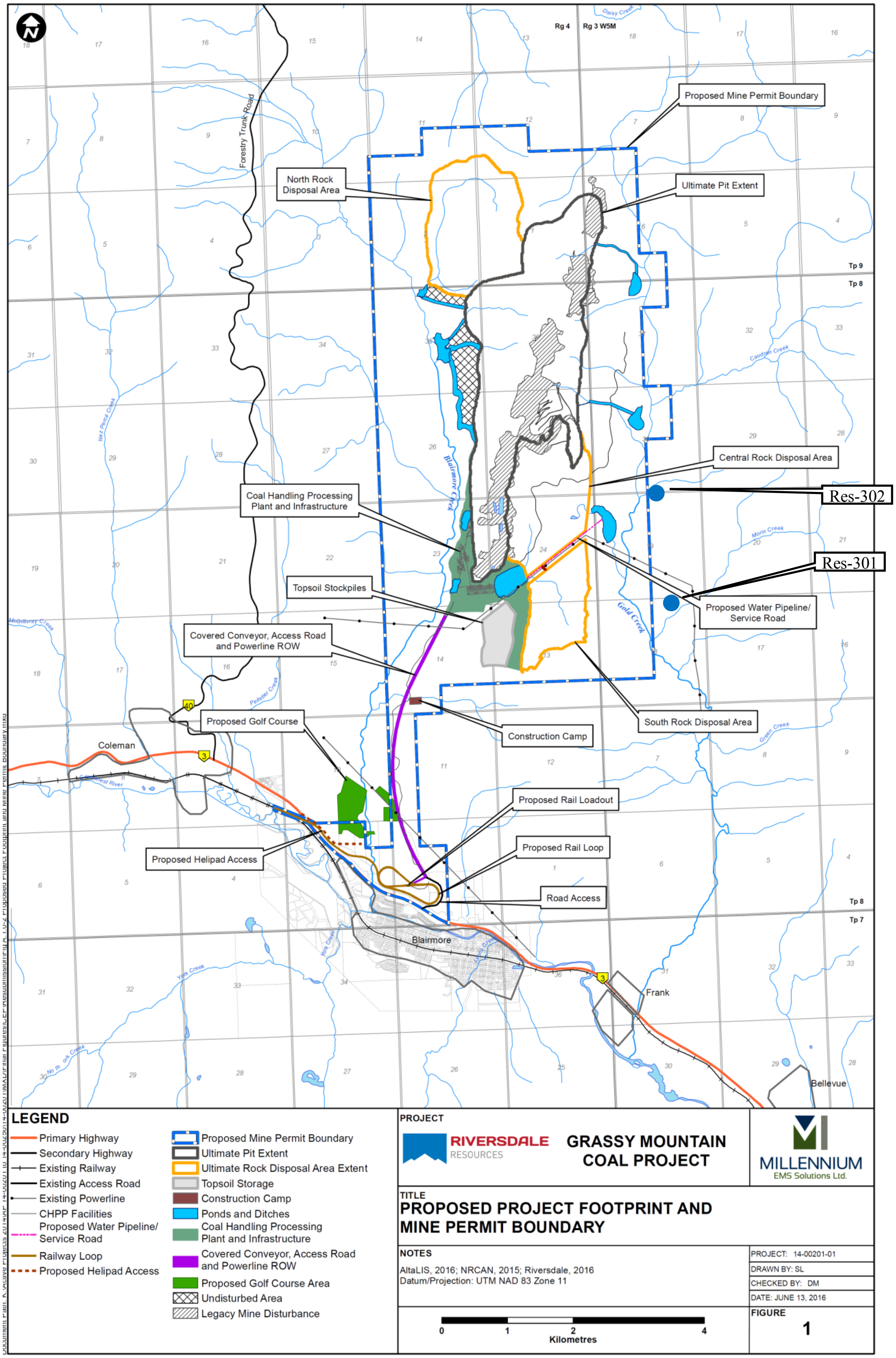


Figure 1. Study Area

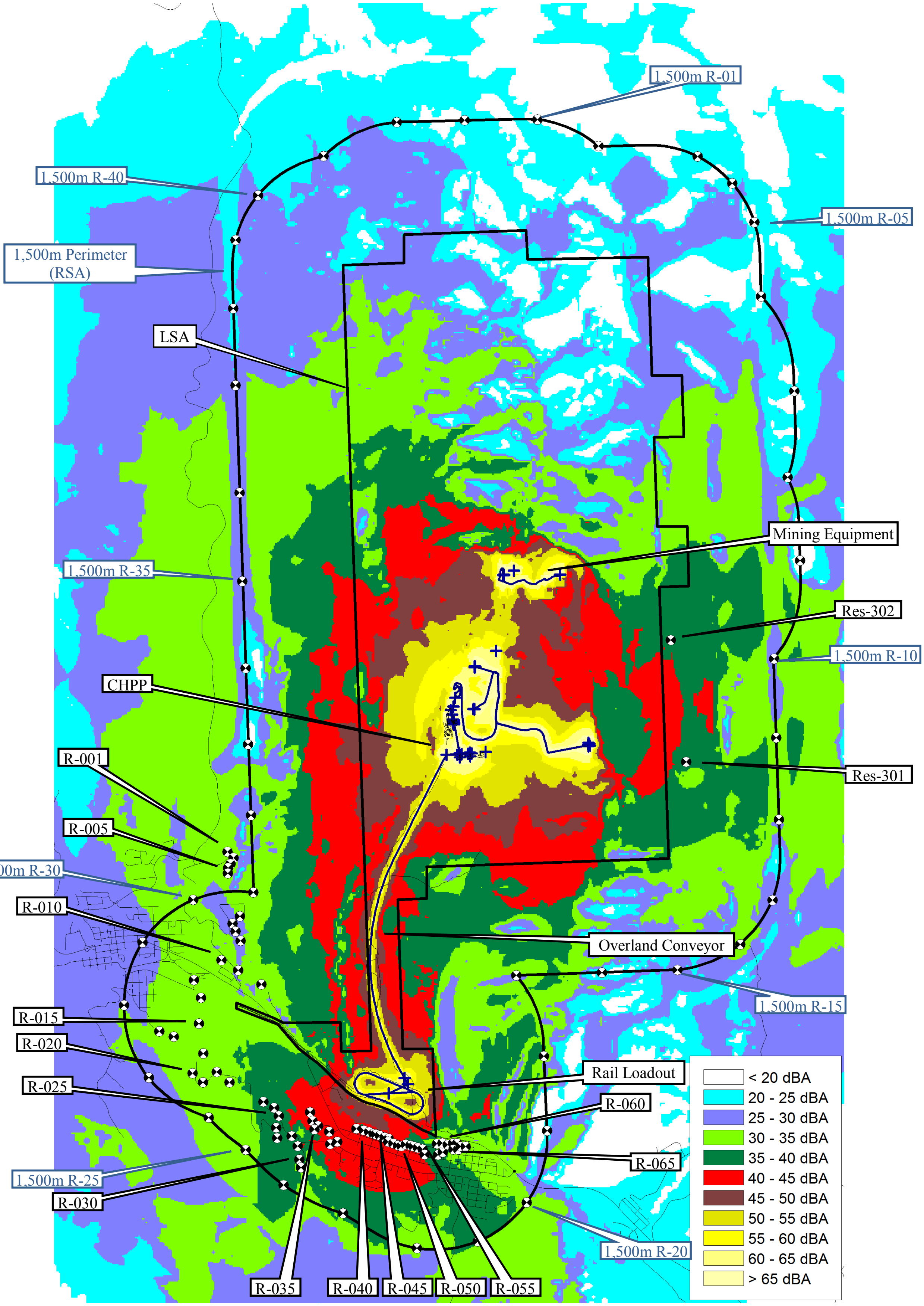


Figure 2. Year 01 Noise Modelling Results (Night-Time)

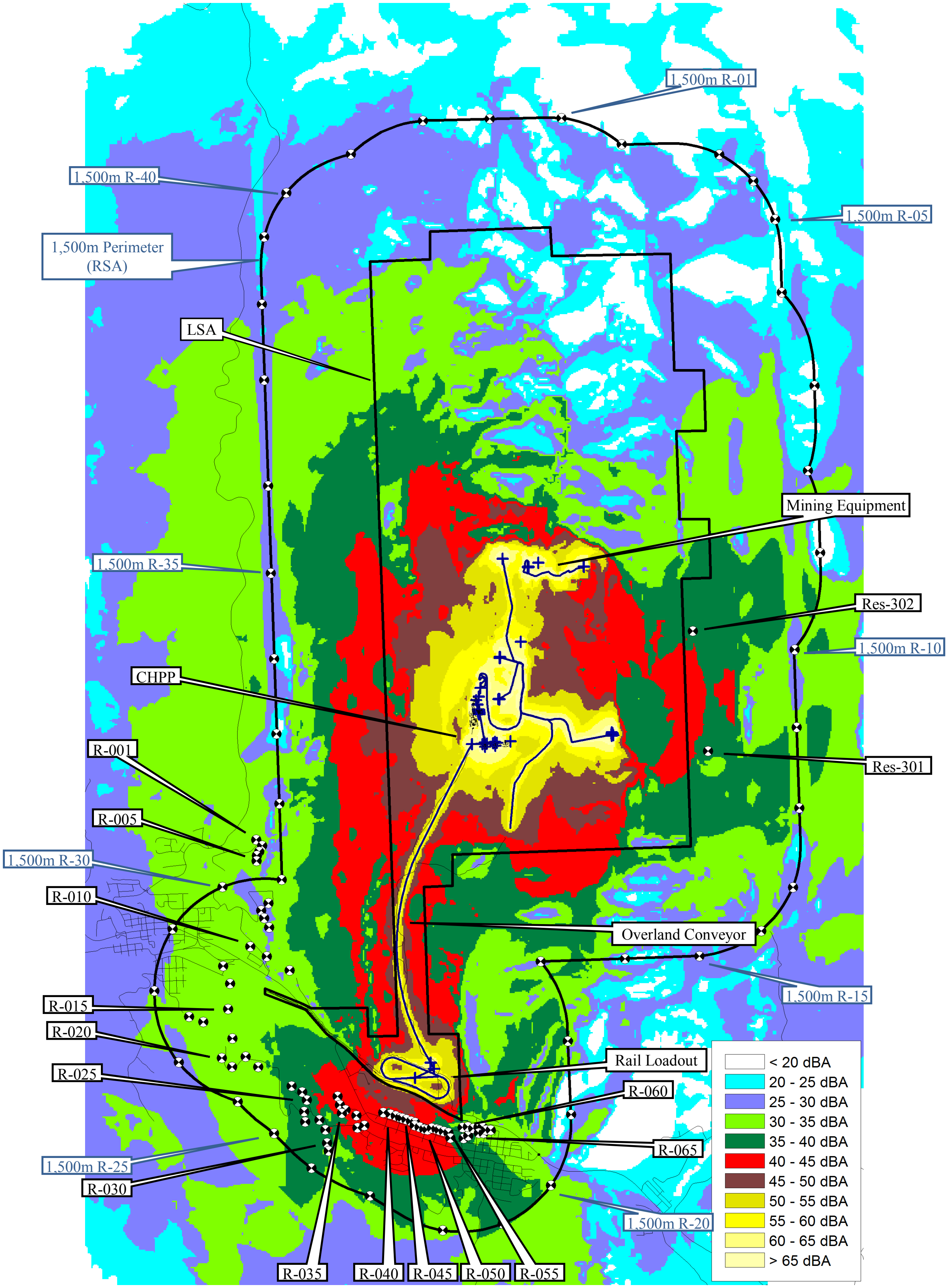


Figure 3. Year 01 Noise Modelling Results (Day-Time)

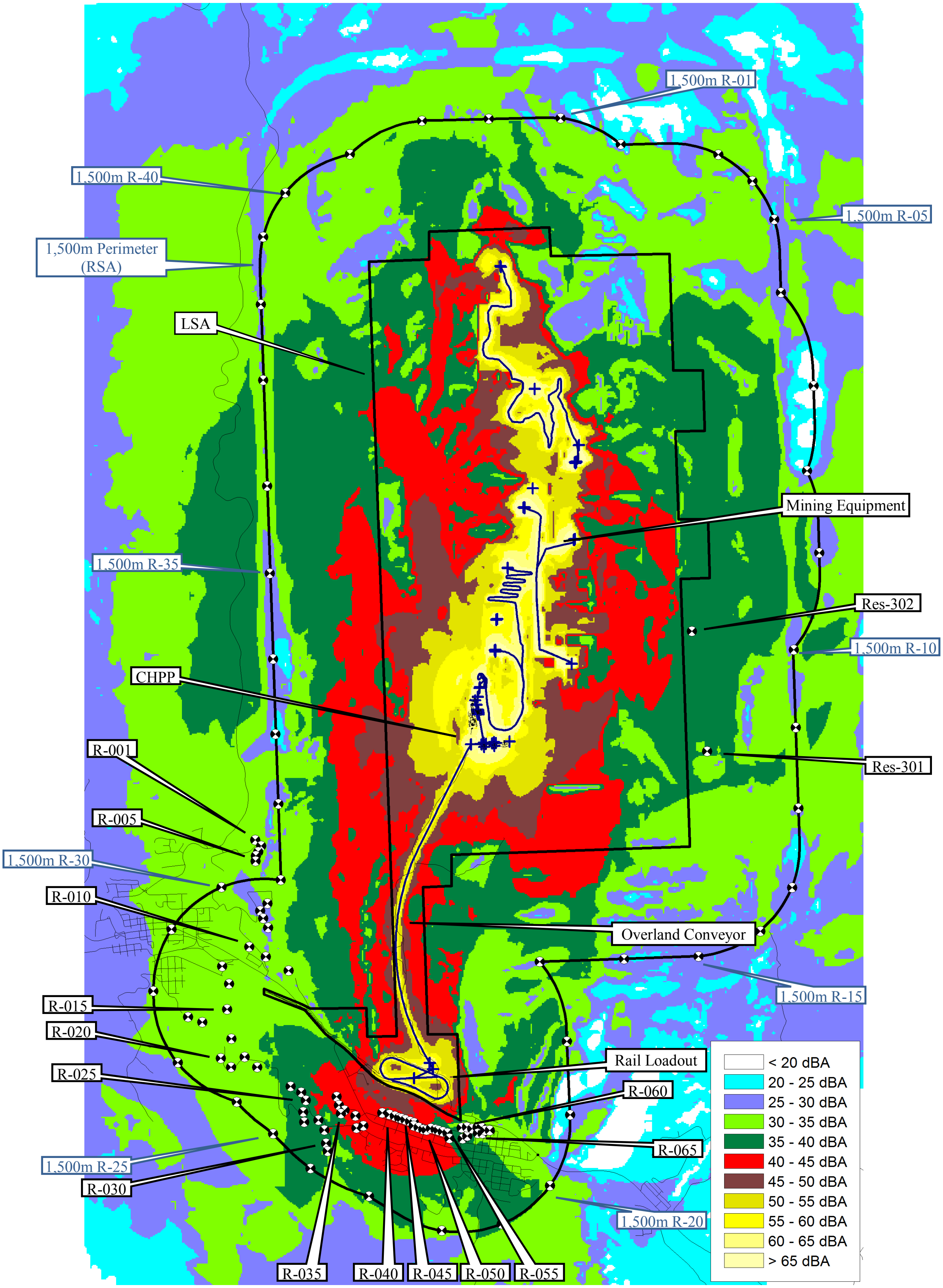


Figure 4a. Year 06 Noise Modelling Results (Night-Time)

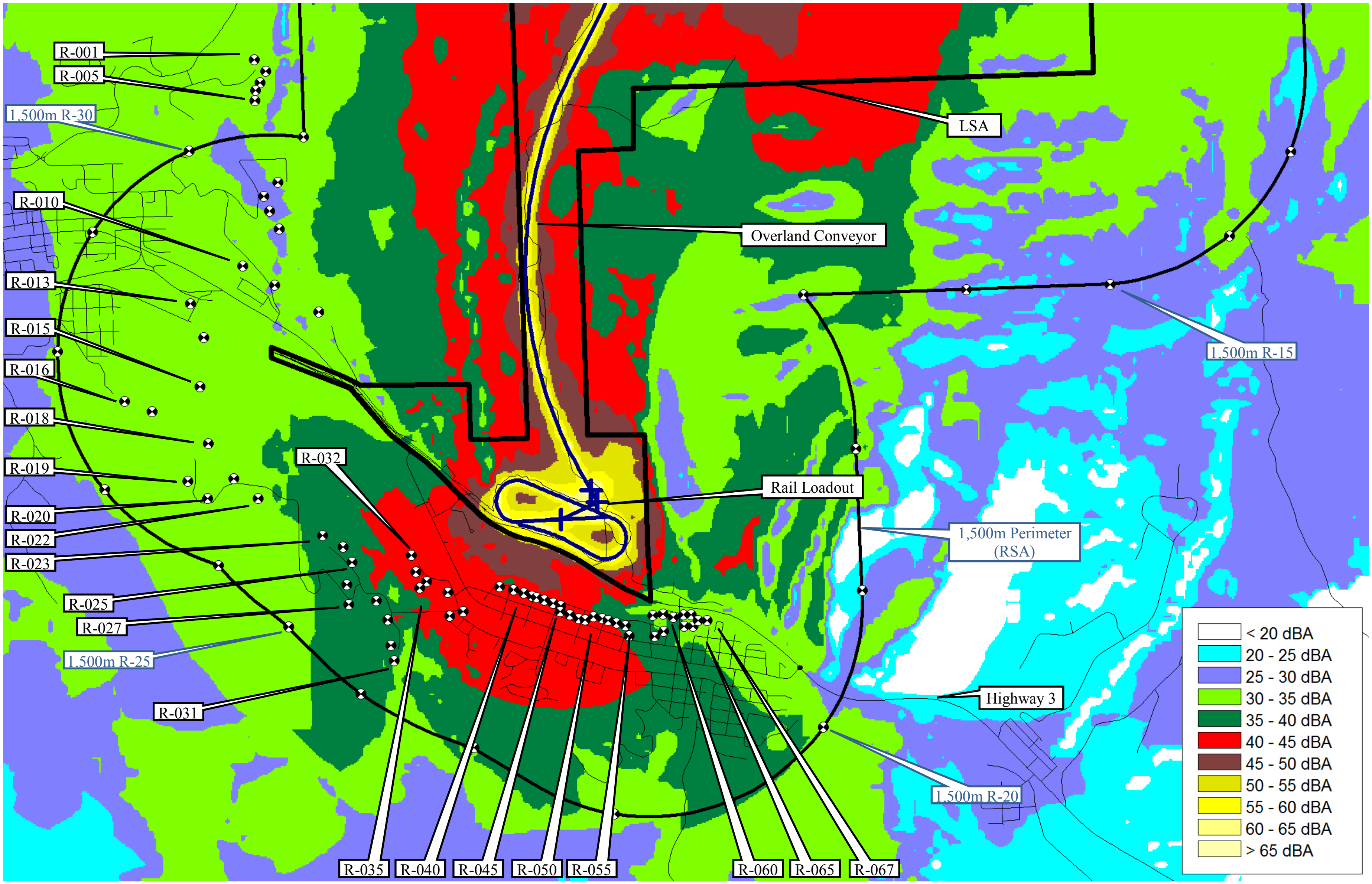


Figure 4b. Year 06 Noise Modelling Results (Night-Time, Blairmore and Coleman)

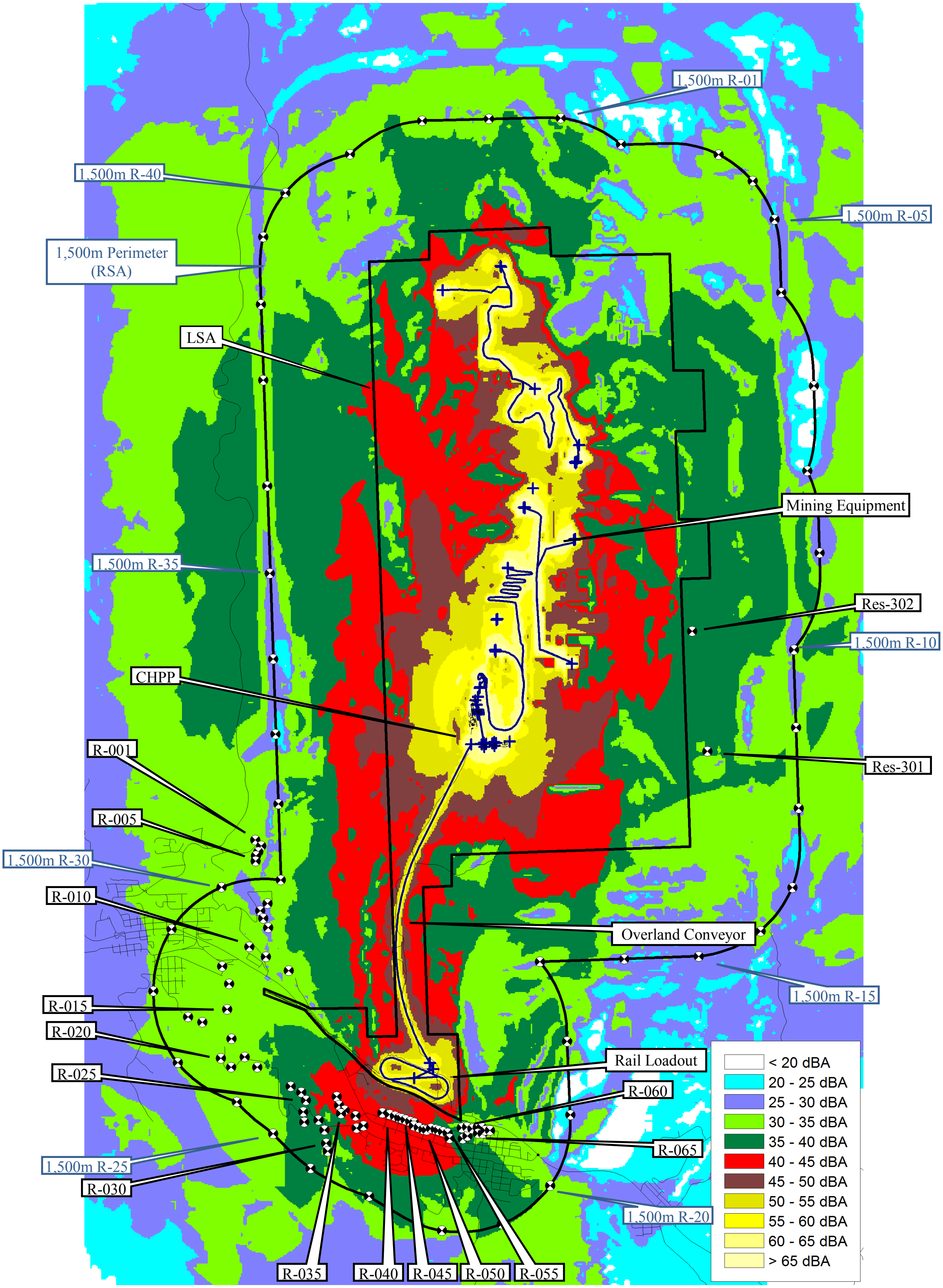


Figure 5. Year 06 Noise Modelling Results (Day-Time)

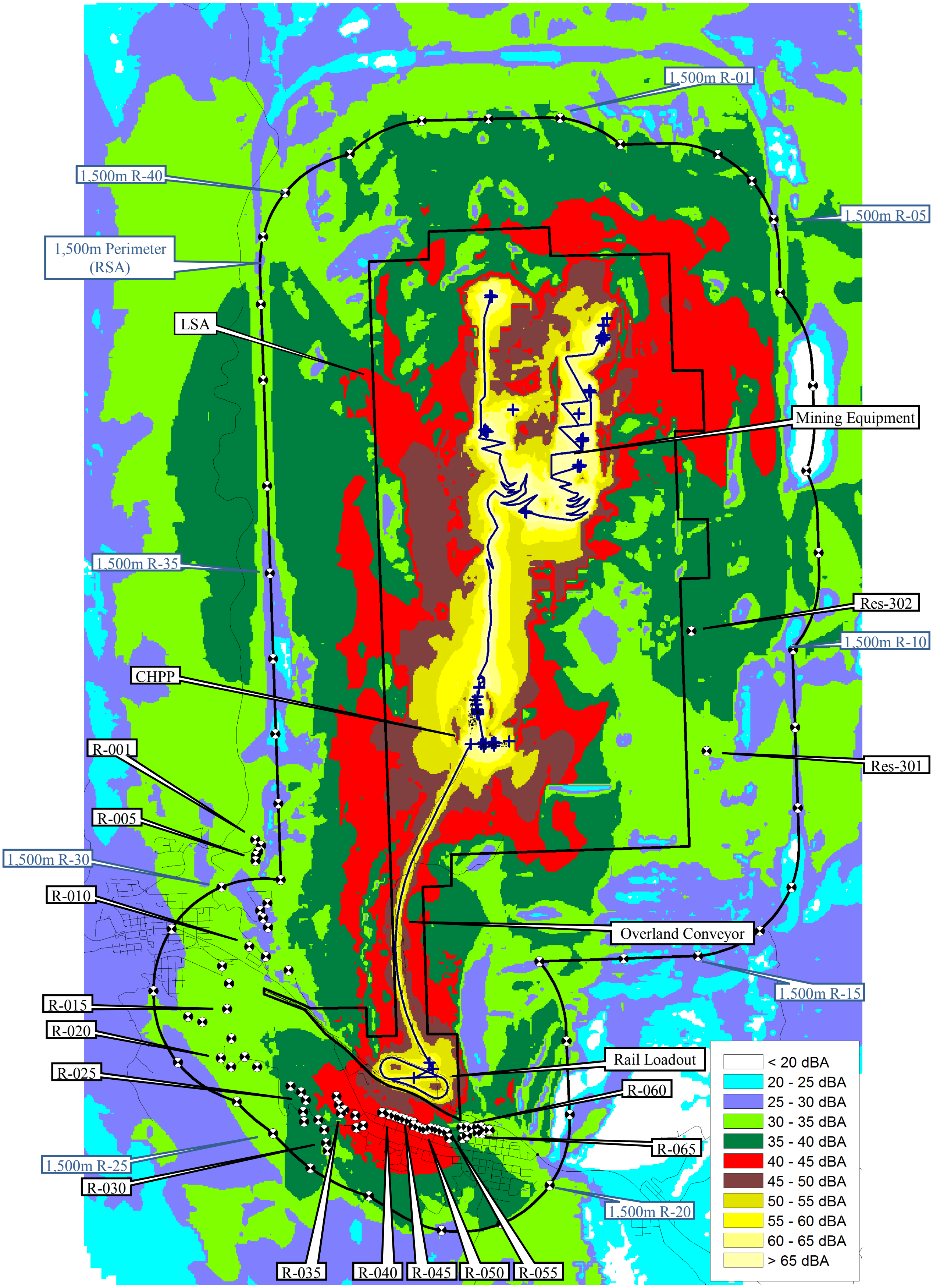


Figure 6. Year 18 Noise Modelling Results (Night-Time)

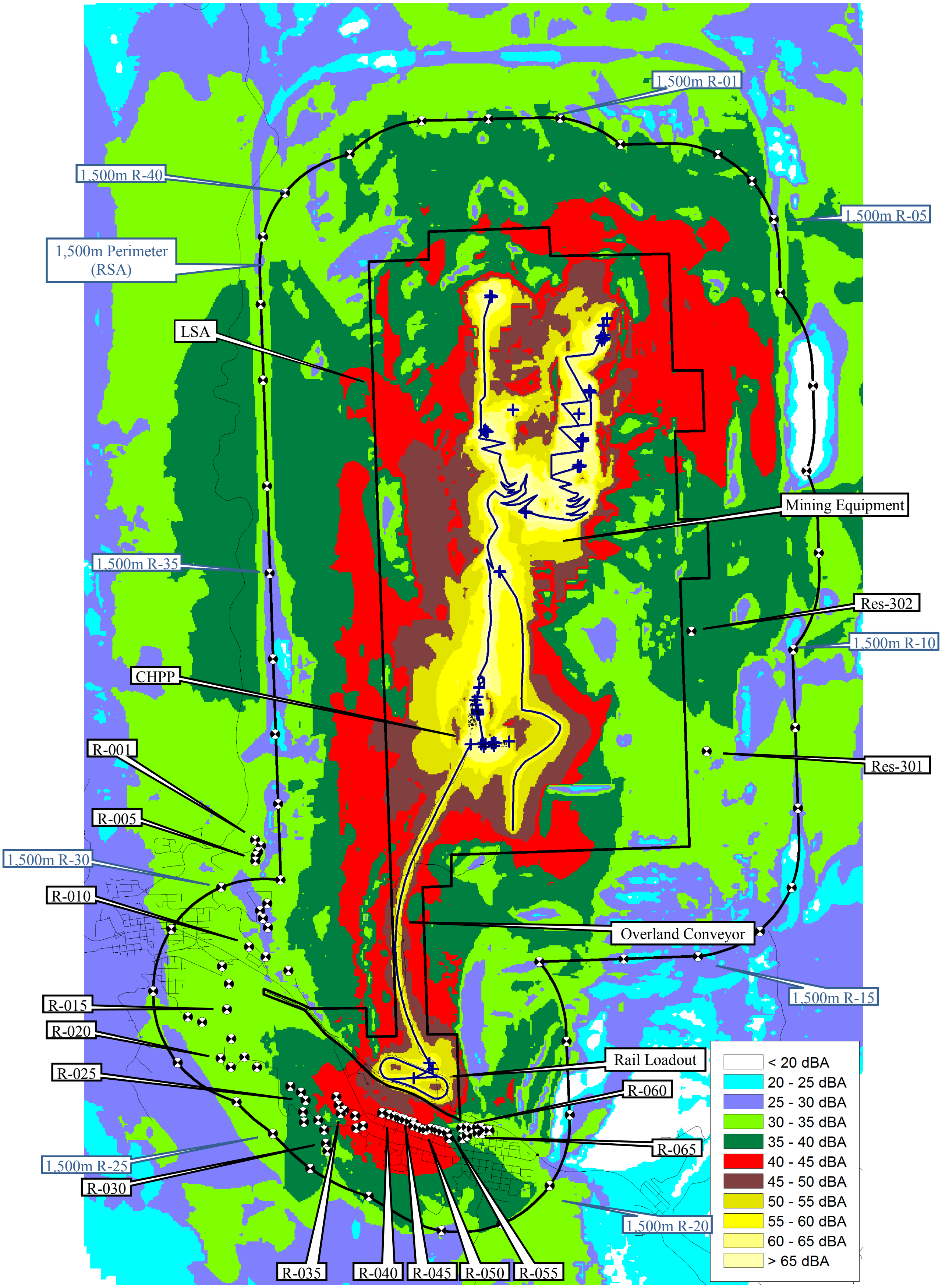


Figure 7. Year 18 Noise Modelling Results (Day-Time)

Appendix I NOISE MODELLING PARAMETERS

CHPP Equipment Broadband Sound Power Levels (Re 10^{-12} Watts)

Tag	Description	Location	Height (m)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
PP-111	ROM Bin Sump Pump 1	BN-101	2	Pump	37.0	1	102.5	0.0	**102.5**
PP-112	ROM Bin Sump Pump 2	BN-101	2	Pump	37.0	1	102.5	0.0	**102.5**
FB-101-a	Feeder Breaker - Breaker drive	BN-101	2	Motor	150.0	1	108.3	0.0	**108.3**
FB-101-b	Feeder Breaker - Chain drive	BN-101	2	Motor	220.0	1	110.0	0.0	**110.0**
FB-101-c	Feeder Breaker - cooling fan	BN-101	2	Fan	5.0	1	96.8	0.0	**96.8**
CV-101	Raw Coal Conveyor	CV-101	17	Motor	185.0	1	109.2	0.0	**109.2**
MG-101-b	Tramp Iron Magnet Heat exchanger fan motor	CV-101	17	Fan	0.8	1	90.2	0.0	**90.2**
SC-101	Raw Coal Screen	ST-101	12	Screen	90	1	114.9	0	**114.9**
CR-101-a	Secondary Sizer Drive 1	ST-101	7	Motor	150.0	1	108.3	0.0	**108.3**
CR-101-b	Secondary Sizer Drive 2	ST-101	7	Motor	150.0	1	108.3	0.0	**108.3**
CV-102	Sized Coal Conveyor	CV-102	17	Motor	185.0	1	109.2	0.0	**109.2**
FE-201-a	Plant Feed Feeder Drive 1	BN-102	3	Motor	5.5	1	93.9	0.0	**93.9**
FE-201-b	Plant Feed Feeder Drive 2	BN-102	3	Motor	5.5	1	93.9	0.0	**93.9**
CV-201	Plant Feed Conveyor	CV-201	17	Motor	110.0	1	106.9	0.0	**106.9**
FE-401-a	Deslime Screen Feeder - Vibrating Motor 1	CPP Building	5	Motor	4.5	1	93.1	19.3	**73.8**
FE-401-b	Deslime Screen Feeder - Vibrating Motor 2	CPP Building	5	Motor	4.5	1	93.1	19.3	**73.8**
SC-401	Desliming Screen	CPP Building	5	Screen	45	1	114.9	18.7	**96.2**
PP-401	DMC Feed Pump	CPP Building	5	Pump	355.0	1	105.5	18.8	**86.7**
SC-402	Product Drain & Rinse Screen	CPP Building	5	Screen	45	1	114.9	18.7	**96.2**
CF-401-a	Coarse Coal Centrifuge - Rotation Drive	CPP Building	5	Motor	45.0	1	103.1	19.3	**83.8**
CF-401-b	Coarse Coal Centrifuge - Vibration Drive	CPP Building	5	Motor	5.5	1	93.9	19.3	**74.6**
CF-401-c	Coarse Coal Centrifuge - Vibration Drive	CPP Building	5	Motor	5.5	1	93.9	19.3	**74.6**
SC-403	Reject Drain & Rinse Screen	CPP Building	5	Screen	30	1	114.9	18.7	**96.2**
PP-402	Correct Medium Pump	CPP Building	5	Pump	55.0	1	103.0	18.8	**84.2**
FE-421-a	Deslime Screen Feeder - Vibrating Motor 1	CPP Building	5	Motor	4.5	1	93.1	19.3	**73.8**
FE-421-b	Deslime Screen Feeder - Vibrating Motor 2	CPP Building	5	Motor	4.5	1	93.1	19.3	**73.8**
SC-421	Desliming Screen	CPP Building	5	Screen	45	1	114.9	18.7	**96.2**
PP-421	DMC Feed Pump	CPP Building	5	Pump	355.0	1	105.5	18.8	**86.7**
SC-422	Product Drain & Rinse Screen	CPP Building	5	Screen	45	1	114.9	18.7	**96.2**
CF-421-a	Coarse Coal Centrifuge - Rotation Drive	CPP Building	5	Motor	45.0	1	103.1	19.3	**83.8**
CF-421-b	Coarse Coal Centrifuge - Vibration Drive	CPP Building	5	Motor	5.5	1	93.9	19.3	**74.6**
CF-421-c	Coarse Coal Centrifuge - Vibration Drive	CPP Building	5	Motor	5.5	1	93.9	19.3	**74.6**
SC-423	Reject Drain & Rinse Screen	CPP Building	5	Screen	30	1	114.9	18.7	**96.2**
PP-422	Correct Medium Pump	CPP Building	5	Pump	55.0	1	103.0	18.8	**84.2**
PP-403	Dilute Medium Pump	CPP Building	5	Pump	150.0	1	104.3	18.8	**85.5**
PP-405	Desliming Cyclone Feed Pump	CPP Building	5	Pump	500.0	1	105.9	18.8	**87.1**
PP-410	DMC Area Floor Sump Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-501	Fines Feed Pump	CPP Building	5	Pump	110.0	1	103.9	18.8	**85.1**
PP-502	Fines Product Pump	CPP Building	5	Pump	315.0	1	105.3	18.8	**86.5**
CF-501-a	Fine Coal Centrifuge - Rotation Drive	CPP Building	5	Motor	75.0	1	105.3	19.3	**86.0**
CF-502-a	Fine Coal Centrifuge - Rotation Drive	CPP Building	5	Motor	75.0	1	105.3	19.3	**86.0**
CF-503-a	Fine Coal Centrifuge - Rotation Drive	CPP Building	5	Motor	75.0	1	105.3	19.3	**86.0**
CF-504-a	Fine Coal Centrifuge - Rotation Drive	CPP Building	5	Motor	75.0	1	105.3	19.3	**86.0**
SC-501-a	Fines Reject Dewatering Screen Drive A	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**
SC-501-b	Fines Reject Dewatering Screen Drive B	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**

CHPP Equipment Broadband Sound Power Levels (Re 10^{-12} Watts) Cont.

Tag	Description	Location	Height (m)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
SC-502-a	Fines Reject Dewatering Screen Drive A	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**
SC-502-b	Fines Reject Dewatering Screen Drive B	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**
SC-503-a	Fines Reject Dewatering Screen Drive A	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**
SC-503-b	Fines Reject Dewatering Screen Drive B	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**
SC-504-a	Fines Reject Dewatering Screen Drive A	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**
SC-504-b	Fines Reject Dewatering Screen Drive B	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**
PP-503	Fines Effluent Pump	CPP Building	5	Pump	185.0	1	104.6	18.8	**85.8**
PP-601	Flotation Feed Pump	CPP Building	5	Pump	500.0	1	105.9	18.8	**87.1**
PP-621	Sec Flotation Feed Pump	CPP Building	5	Pump	500.0	1	105.9	18.8	**87.1**
PP-610	Flotation Area Floor Sump Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-605	Coal Clarified Water Pump	CPP Building	5	Pump	337.5	1	105.4	18.8	**86.6**
PP-602	Coal Thickener Underflow Pump	CPP Building	5	Pump	265.0	1	105.1	18.8	**86.3**
PF-601-b	HDF Rotation Drive	CPP Building	5	Motor	18.5	1	99.2	19.3	**79.9**
PF-601-c	Discharge Conveyor	CPP Building	5	Motor	18.5	1	99.2	19.3	**79.9**
PF-601-i	HDF Hydraulic Pack Motor 1	CPP Building	5	Hydraulic Pump	22.0	1	101.8	18.8	**83.0**
PP-603	HDF High Pressure Water Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-604	HDF High Pressure Water Pump	CPP Building	5	Pump	45.0	1	102.8	18.8	**84.0**
AC-601	HDF Compressor (Duty)	CPP Building	5	Compressor	1118.6	1	121.4	22.6	**98.8**
AD-601	HDF Compressed Air Dryer	CPP Building	5	Fan	28.0	1	102.8	15.0	**87.8**
AC-602	HDF Compressor (Duty)	CPP Building	5	Compressor	1118.6	1	121.4	22.6	**98.8**
AD-602	HDF Compressed Air Dryer	CPP Building	5	Fan	28.0	1	102.8	15.0	**87.8**
CV-601-a	HDF Screw Conveyor Screw 1	CPP Building	5	Motor	7.5	1	95.3	19.3	**76.0**
CV-601-b	HDF Screw Conveyor Screw 2	CPP Building	5	Motor	7.5	1	95.3	19.3	**76.0**
CV-601-c	HDF Screw Conveyor Screw 3	CPP Building	5	Motor	7.5	1	95.3	19.3	**76.0**
PF-621-b	HDF Rotation Drive	CPP Building	5	Motor	18.5	1	99.2	19.3	**79.9**
PF-621-c	Discharge Conveyor	CPP Building	5	Motor	18.5	1	99.2	19.3	**79.9**
PF-621-i	HDF Hydraulic Pack Motor 1	CPP Building	5	Hydraulic Pump	22.0	1	101.8	18.8	**83.0**
PP-623	HDF High Pressure Water Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-624	HDF High Pressure Water Pump	CPP Building	5	Pump	45.0	1	102.8	18.8	**84.0**
AC-621	HDF Compressor (Duty)	CPP Building	5	Compressor	1118.6	1	121.4	22.6	**98.8**
AD-621	HDF Compressed Air Dryer	CPP Building	5	Fan	28.0	1	102.8	15.0	**87.8**
AC-622	HDF Compressor (Duty)	CPP Building	5	Compressor	1118.6	1	121.4	22.6	**98.8**
AD-622	HDF Compressed Air Dryer	CPP Building	5	Fan	28.0	1	102.8	15.0	**87.8**
CV-621-a	HDF Screw Conveyor Screw 1	CPP Building	5	Motor	7.5	1	95.3	19.3	**76.0**
CV-621-b	HDF Screw Conveyor Screw 2	CPP Building	5	Motor	7.5	1	95.3	19.3	**76.0**
CV-621-c	HDF Screw Conveyor Screw 3	CPP Building	5	Motor	7.5	1	95.3	19.3	**76.0**
PP-611	Coal Thickener Floor Sump Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-700	Tailings Thickener Underflow Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-710	Tailings Thickener Floor Sump Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-701	BPF 1 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-702	BPF 2 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-703	BPF 3 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-704	BPF 4 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-705	BPF 5 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-706	BPF 6 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**

CHPP Equipment Broadband Sound Power Levels (Re 10^{-12} Watts) Cont.

Tag	Description	Location	Height (m)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
PP-707	BPF 7 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-708	BPF 8 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-709	Filtrate Pump	CPP Building	5	Pump	75.0	1	103.4	18.8	**84.6**
PP-711	BPF Wash Water Pump	CPP Building	5	Pump	110.0	1	103.9	18.8	**85.1**
PP-712	Gland Water Pump	CPP Building	5	Pump	56.3	1	103.1	18.8	**84.3**
PP-713	BPF Area Floor Sump Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-901	Clarified Water Pump	CPP Building	5	Pump	500.0	1	105.9	18.8	**87.1**
PP-903	Reflux Classifier Fluidising Water Pump	CPP Building	5	Pump	30.0	1	102.2	18.8	**83.4**
AC-901	Compressed Air System	CPP Building	5	Compressor	37.8	1	106.7	22.6	**84.1**
PP-980	Magnetite Addition Pump	CPP Building	5	Pump	45.0	1	102.8	18.8	**84.0**
CV-701	Ultrafine Rejects Collection Conveyor	CPP Building	5	Motor	22.0	1	100.0	19.3	**80.7**
PP-9190	Raw Water Pump	Raw Water Pump Shed	2	Pump	110.0	1	103.9	18.8	**85.1**
PP-9191	Raw Water Pump	Raw Water Pump Shed	2	Pump	110.0	1	103.9	18.8	**85.1**
CV-702	Reject Collection Conveyor	CV-702	10	Motor	45.0	1	103.1	0.0	**103.1**
HY-701	Rejects Bin Hydraulic System	BN-701	10	Hydraulic Pump	36.0	1	102.5	0.0	**102.5**
CV-801	Product Conveyor	CV-801	12	Motor	185.0	1	109.2	0.0	**109.2**
PK-820	Bifurcated chute Diverter Gate Hydraulic Power Pack	ST-801	12	Hydraulic Pump	7.5	1	100.4	0.0	**100.4**
SK-801	Product Radial Stacker 1	SK-801	10	Motor	100.0	1	106.5	0.0	**106.5**
CV-802	Product Stackout Conveyor	CV-802	12	Motor	75.0	1	105.3	0.0	**105.3**
SK-802	Product Radial Stacker 2	SK-802	10	Motor	100.0	1	106.5	0.0	**106.5**
CV-805	Product Stockpile Reclaim Conveyor	CV-805	18	Motor	355.0	1	112.0	0.0	**112.0**
RC-801-a	Feeder Breaker - Breaker drive	RC-801	2	Motor	150.0	1	108.3	0.0	**108.3**
RC-801-b	Feeder Breaker - Chain drive	RC-801	2	Motor	220.0	1	110.0	0.0	**110.0**
RC-801-c	Feeder Breaker - cooling fan	RC-801	2	Fan	5.0	1	96.8	0.0	**96.8**
RC-802-a	Feeder Breaker - Breaker drive	RC-802	2	Motor	150.0	1	108.3	0.0	**108.3**
RC-802-b	Feeder Breaker - Chain drive	RC-802	2	Motor	220.0	1	110.0	0.0	**110.0**
RC-802-c	Feeder Breaker - cooling fan	RC-802	2	Fan	5.0	1	96.8	0.0	**96.8**
RC-803-a	Feeder Breaker - Breaker drive	RC-803	2	Motor	150.0	1	108.3	0.0	**108.3**
RC-803-b	Feeder Breaker - Chain drive	RC-803	2	Motor	220.0	1	110.0	0.0	**110.0**
RC-803-c	Feeder Breaker - cooling fan	RC-803	2	Fan	5.0	1	96.8	0.0	**96.8**
RC-804-a	Feeder Breaker - Breaker drive	RC-804	2	Motor	150.0	1	108.3	0.0	**108.3**
RC-804-b	Feeder Breaker - Chain drive	RC-804	2	Motor	220.0	1	110.0	0.0	**110.0**
RC-804-c	Feeder Breaker - cooling fan	RC-804	2	Fan	5.0	1	96.8	0.0	**96.8**
FE-801-a	OLC Vibrating Feeder Drive 1	BN-801	18	Motor	5.5	1	93.9	0.0	**93.9**
FE-801-b	OLC Vibrating Feeder Drive 2	BN-801	18	Motor	5.5	1	93.9	0.0	**93.9**
CV-807-a	Product overland conveyor Motor A	BN-801	2	Motor	380.0	1	112.3	19.3	**93.0**
CV-807-b	Product overland conveyor Motor B	BN-801	2	Motor	380.0	1	112.3	19.3	**93.0**
CV-807-c	Product overland conveyor Motor C	North of BN-851	5	Motor	380.0	1	112.3	0.0	**112.3**
CV-807-d	Product overland conveyor Motor D	North of BN-851	5	Motor	380.0	1	112.3	0.0	**112.3**
CV-807-e	Product overland conveyor Motor E	North of BN-851	5	Motor	380.0	1	112.3	0.0	**112.3**
FE-851-a	OLC Surge Bin Discharge Feeder Drive 1	BN-851	5	Motor	5.5	1	93.9	0.0	**93.9**
FE-851-b	OLC Surge Bin Discharge Feeder Drive 2	BN-851	15	Motor	5.5	1	93.9	0.0	**93.9**
CV-851	TLO bin feed conveyor	CV-851	25	Motor	315.0	1	111.5	19.3	**92.2**
HY-804	Train Loadout Conveyor Hydraulic System	BN-852	5	Hydraulic Pump	36.0	1	102.5	18.8	**83.7**
	Conveyor Belt (Per Meter of Length)	Various	Various	Conveyor	Varies	Each	88.6 per meter	0	**88.6 per meter**

CHPP Equipment Octave Band Sound Power Levels (Re 10^{-12} Watts)

Description	31.5 Hz	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
ROM Bin Sump Pump 1	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
ROM Bin Sump Pump 2	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Feeder Breaker - Breaker drive	95.6	95.6	98.6	100.6	103.6	103.6	102.6	97.6	89.6
Feeder Breaker - Chain drive	97.3	97.3	100.3	102.3	105.3	105.3	104.3	99.3	91.3
Feeder Breaker - cooling fan	97.6	100.6	100.6	97.6	94.6	90.6	87.6	84.6	76.6
Raw Coal Conveyor	96.5	96.5	99.5	101.5	104.5	104.5	103.5	98.5	90.5
Tramp Iron Magnet Heat exchanger fan motor	91.0	94.0	94.0	91.0	88.0	84.0	81.0	78.0	70.0
Raw Coal Screen	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Secondary Sizer Drive 1	95.6	95.6	98.6	100.6	103.6	103.6	102.6	97.6	89.6
Secondary Sizer Drive 2	95.6	95.6	98.6	100.6	103.6	103.6	102.6	97.6	89.6
Sized Coal Conveyor	96.5	96.5	99.5	101.5	104.5	104.5	103.5	98.5	90.5
Plant Feed Feeder Drive 1	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
Plant Feed Feeder Drive 2	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
Plant Feed Conveyor	94.2	94.2	97.2	99.2	102.2	102.2	101.2	96.2	88.2
Deslime Screen Feeder - Vibrating Motor 1	80.4	80.4	83.4	85.4	88.4	88.4	87.4	82.4	74.4
Deslime Screen Feeder - Vibrating Motor 2	80.4	80.4	83.4	85.4	88.4	88.4	87.4	82.4	74.4
Desliming Screen	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
DMC Feed Pump	97.7	98.7	99.7	100.7	99.7	101.7	98.7	94.7	88.7
Product Drain & Rinse Screen	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Coarse Coal Centrifuge - Rotation Drive	90.4	90.4	93.4	95.4	98.4	98.4	97.4	92.4	84.4
Coarse Coal Centrifuge - Vibration Drive	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
Coarse Coal Centrifuge - Vibration Drive	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
Reject Drain & Rinse Screen	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Correct Medium Pump	95.2	96.2	97.2	98.2	97.2	99.2	96.2	92.2	86.2
Deslime Screen Feeder - Vibrating Motor 1	80.4	80.4	83.4	85.4	88.4	88.4	87.4	82.4	74.4
Deslime Screen Feeder - Vibrating Motor 2	80.4	80.4	83.4	85.4	88.4	88.4	87.4	82.4	74.4
Desliming Screen	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
DMC Feed Pump	97.7	98.7	99.7	100.7	99.7	101.7	98.7	94.7	88.7
Product Drain & Rinse Screen	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Coarse Coal Centrifuge - Rotation Drive	90.4	90.4	93.4	95.4	98.4	98.4	97.4	92.4	84.4
Coarse Coal Centrifuge - Vibration Drive	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
Coarse Coal Centrifuge - Vibration Drive	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
Reject Drain & Rinse Screen	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Correct Medium Pump	95.2	96.2	97.2	98.2	97.2	99.2	96.2	92.2	86.2
Dilute Medium Pump	96.5	97.5	98.5	99.5	98.5	100.5	97.5	93.5	87.5
Desliming Cyclone Feed Pump	98.1	99.1	100.1	101.1	100.1	102.1	99.1	95.1	89.1
DMC Area Floor Sump Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Fines Feed Pump	96.1	97.1	98.1	99.1	98.1	100.1	97.1	93.1	87.1
Fines Product Pump	97.5	98.5	99.5	100.5	99.5	101.5	98.5	94.5	88.5
Fine Coal Centrifuge - Rotation Drive	92.6	92.6	95.6	97.6	100.6	100.6	99.6	94.6	86.6
Fine Coal Centrifuge - Rotation Drive	92.6	92.6	95.6	97.6	100.6	100.6	99.6	94.6	86.6
Fine Coal Centrifuge - Rotation Drive	92.6	92.6	95.6	97.6	100.6	100.6	99.6	94.6	86.6
Fine Coal Centrifuge - Rotation Drive	92.6	92.6	95.6	97.6	100.6	100.6	99.6	94.6	86.6
Fines Reject Dewatering Screen Drive A	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Fines Reject Dewatering Screen Drive B	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0

CHPP Equipment Octave Band Sound Power Levels (Re 10^{-12} Watts) Cont.

Description	31.5 Hz	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Fines Reject Dewatering Screen Drive A	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Fines Reject Dewatering Screen Drive B	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Fines Reject Dewatering Screen Drive A	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Fines Reject Dewatering Screen Drive B	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Fines Reject Dewatering Screen Drive A	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Fines Reject Dewatering Screen Drive B	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Fines Effluent Pump	96.8	97.8	98.8	99.8	98.8	100.8	97.8	93.8	87.8
Flotation Feed Pump	98.1	99.1	100.1	101.1	100.1	102.1	99.1	95.1	89.1
Sec Flotation Feed Pump	98.1	99.1	100.1	101.1	100.1	102.1	99.1	95.1	89.1
Flotation Area Floor Sump Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Coal Clarified Water Pump	97.6	98.6	99.6	100.6	99.6	101.6	98.6	94.6	88.6
Coal Thickener Underflow Pump	97.3	98.3	99.3	100.3	99.3	101.3	98.3	94.3	88.3
HDF Rotation Drive	86.5	86.5	89.5	91.5	94.5	94.5	93.5	88.5	80.5
Discharge Conveyor	86.5	86.5	89.5	91.5	94.5	94.5	93.5	88.5	80.5
HDF Hydraulic Pack Motor 1	94.0	95.0	96.0	97.0	96.0	98.0	95.0	91.0	85.0
HDF High Pressure Water Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
HDF High Pressure Water Pump	95.0	96.0	97.0	98.0	97.0	99.0	96.0	92.0	86.0
HDF Compressor (Duty)	111.5	107.5	112.5	111.5	109.5	112.5	117.5	114.5	107.5
HDF Compressed Air Dryer	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
HDF Compressor (Duty)	111.5	107.5	112.5	111.5	109.5	112.5	117.5	114.5	107.5
HDF Compressed Air Dryer	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
HDF Screw Conveyor Screw 1	82.6	82.6	85.6	87.6	90.6	90.6	89.6	84.6	76.6
HDF Screw Conveyor Screw 2	82.6	82.6	85.6	87.6	90.6	90.6	89.6	84.6	76.6
HDF Screw Conveyor Screw 3	82.6	82.6	85.6	87.6	90.6	90.6	89.6	84.6	76.6
HDF Rotation Drive	86.5	86.5	89.5	91.5	94.5	94.5	93.5	88.5	80.5
Discharge Conveyor	86.5	86.5	89.5	91.5	94.5	94.5	93.5	88.5	80.5
HDF Hydraulic Pack Motor 1	94.0	95.0	96.0	97.0	96.0	98.0	95.0	91.0	85.0
HDF High Pressure Water Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
HDF High Pressure Water Pump	95.0	96.0	97.0	98.0	97.0	99.0	96.0	92.0	86.0
HDF Compressor (Duty)	111.5	107.5	112.5	111.5	109.5	112.5	117.5	114.5	107.5
HDF Compressed Air Dryer	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
HDF Compressor (Duty)	111.5	107.5	112.5	111.5	109.5	112.5	117.5	114.5	107.5
HDF Compressed Air Dryer	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
HDF Screw Conveyor Screw 1	82.6	82.6	85.6	87.6	90.6	90.6	89.6	84.6	76.6
HDF Screw Conveyor Screw 2	82.6	82.6	85.6	87.6	90.6	90.6	89.6	84.6	76.6
HDF Screw Conveyor Screw 3	82.6	82.6	85.6	87.6	90.6	90.6	89.6	84.6	76.6
Coal Thickener Floor Sump Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Tailings Thickener Underflow Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Tailings Thickener Floor Sump Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
BPF 1 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
BPF 2 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
BPF 3 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
BPF 4 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
BPF 5 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
BPF 6 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7

CHPP Equipment Octave Band Sound Power Levels (Re 10^{-12} Watts) Cont.

Description	31.5 Hz	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
BPF 7 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
BPF 8 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Filtrate Pump	95.6	96.6	97.6	98.6	97.6	99.6	96.6	92.6	86.6
BPF Wash Water Pump	96.1	97.1	98.1	99.1	98.1	100.1	97.1	93.1	87.1
Gland Water Pump	95.3	96.3	97.3	98.3	97.3	99.3	96.3	92.3	86.3
BPF Area Floor Sump Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Clarified Water Pump	98.1	99.1	100.1	101.1	100.1	102.1	99.1	95.1	89.1
Reflux Classifier Fluidising Water Pump	94.4	95.4	96.4	97.4	96.4	98.4	95.4	91.4	85.4
Compressed Air System	96.8	92.8	97.8	96.8	94.8	97.8	102.8	99.8	92.8
Magnetite Addition Pump	95.0	96.0	97.0	98.0	97.0	99.0	96.0	92.0	86.0
Ultrafine Rejects Collection Conveyor	87.3	87.3	90.3	92.3	95.3	95.3	94.3	89.3	81.3
Raw Water Pump	96.1	97.1	98.1	99.1	98.1	100.1	97.1	93.1	87.1
Raw Water Pump	96.1	97.1	98.1	99.1	98.1	100.1	97.1	93.1	87.1
Reject Collection Conveyor	90.4	90.4	93.4	95.4	98.4	98.4	97.4	92.4	84.4
Rejects Bin Hydraulic System	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Product Conveyor	96.5	96.5	99.5	101.5	104.5	104.5	103.5	98.5	90.5
Bifurcated chute Diverter Gate Hydraulic Power Pack	92.6	93.6	94.6	95.6	94.6	96.6	93.6	89.6	83.6
Product Radial Stacker 1	93.8	93.8	96.8	98.8	101.8	101.8	100.8	95.8	87.8
Product Stackout Conveyor	92.6	92.6	95.6	97.6	100.6	100.6	99.6	94.6	86.6
Product Radial Stacker 2	93.8	93.8	96.8	98.8	101.8	101.8	100.8	95.8	87.8
Product Stockpile Reclaim Conveyor	99.3	99.3	102.3	104.3	107.3	107.3	106.3	101.3	93.3
Feeder Breaker - Breaker drive	95.6	95.6	98.6	100.6	103.6	103.6	102.6	97.6	89.6
Feeder Breaker - Chain drive	97.3	97.3	100.3	102.3	105.3	105.3	104.3	99.3	91.3
Feeder Breaker - cooling fan	97.6	100.6	100.6	97.6	94.6	90.6	87.6	84.6	76.6
Feeder Breaker - Breaker drive	95.6	95.6	98.6	100.6	103.6	103.6	102.6	97.6	89.6
Feeder Breaker - Chain drive	97.3	97.3	100.3	102.3	105.3	105.3	104.3	99.3	91.3
Feeder Breaker - cooling fan	97.6	100.6	100.6	97.6	94.6	90.6	87.6	84.6	76.6
Feeder Breaker - Breaker drive	95.6	95.6	98.6	100.6	103.6	103.6	102.6	97.6	89.6
Feeder Breaker - Chain drive	97.3	97.3	100.3	102.3	105.3	105.3	104.3	99.3	91.3
Feeder Breaker - cooling fan	97.6	100.6	100.6	97.6	94.6	90.6	87.6	84.6	76.6
Feeder Breaker - Breaker drive	95.6	95.6	98.6	100.6	103.6	103.6	102.6	97.6	89.6
Feeder Breaker - Chain drive	97.3	97.3	100.3	102.3	105.3	105.3	104.3	99.3	91.3
Feeder Breaker - cooling fan	97.6	100.6	100.6	97.6	94.6	90.6	87.6	84.6	76.6
OLC Vibrating Feeder Drive 1	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
OLC Vibrating Feeder Drive 2	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
Product overland conveyor Motor A	99.6	99.6	102.6	104.6	107.6	107.6	106.6	101.6	93.6
Product overland conveyor Motor B	99.6	99.6	102.6	104.6	107.6	107.6	106.6	101.6	93.6
Product overland conveyor Motor C	99.6	99.6	102.6	104.6	107.6	107.6	106.6	101.6	93.6
Product overland conveyor Motor D	99.6	99.6	102.6	104.6	107.6	107.6	106.6	101.6	93.6
Product overland conveyor Motor E	99.6	99.6	102.6	104.6	107.6	107.6	106.6	101.6	93.6
OLC Surge Bin Discharge Feeder Drive 1	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
OLC Surge Bin Discharge Feeder Drive 2	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
TLO bin feed conveyor	98.8	98.8	101.8	103.8	106.8	106.8	105.8	100.8	92.8
Train Loadout Conveyor Hydraulic System	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Conveyor Belt (Per Meter of Length)	74.9	82.7	85.2	87.6	85.9	85.7	76.4	69.8	61.1

CPP Building Dimensions

Tag	Building Name	Length (m)	Width (m)	Height (m)
CPP	CPP Process Building	75.0	22.0	26.0

Building Sound Level Attenuation

	31.5 Hz	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Building Attenuation (dB)	3	6	9	12	15	20	25	30	30

Mine Equipment Sound Power Levels (Re 10^{-12} Watts)

Equipment	dBA		32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz		Height (m)
Waste Shovel (Komatsu PC5500)	123.9		121.4	129.7	131.1	123.4	121.3	117.8	115.3	108.6	100.5		7
Waste Backhoe (Komatsu PC4000)	120.9		118.4	126.7	128.1	120.4	118.3	114.8	112.3	105.6	97.5		7
Backhoe, 122 ton (Komatsu PC1250)	117.9		115.4	123.7	125.1	117.4	115.3	111.8	109.3	102.6	94.5		4
Backhoe, 71 ton (Komatsu PC650)	116.9		114.4	122.7	124.1	116.4	114.3	110.8	108.3	101.6	93.5		4
Backhoe, 34 ton (Komatsu)	116.9		114.4	122.7	124.1	116.4	114.3	110.8	108.3	101.6	93.5		4
Haul Truck (Komatsu)	123.3		113.4	125.1	124.8	120.6	119.2	115.7	116.0	115.2	114.0		4
Wheel Loader (Komatsu WA1200-6)	125.0		118.4	121.2	127.4	120.4	118.6	119.7	119.6	114.6	106.9		4
Bulldozer (CAT D11)	121.4		111.4	126.3	128.4	114.9	118.8	115.8	114.0	108.0	100.3		3
Bulldozer (CAT D10)	118.0		112.0	123.7	133.0	110.1	107.6	106.7	104.3	95.8	94.2		3
Bulldozer (CAT D9)	118.0		112.0	123.7	133.0	110.1	107.6	106.7	104.3	95.8	94.2		3
Blast Hole Drill (P&H 250XPC)	114.3		112.2	110.6	123.4	114.5	107.6	107.9	106.3	103.5	97.8		3
Wheel dozer (CAT 834K)	118.0		112.0	123.7	133.0	110.1	107.6	106.7	104.3	95.8	94.2		3
Articulated Trucks	118.3		108.8	110.1	118.7	122.3	113.6	112.2	108.9	104.6	97.5		3
Diesel Driven Pump	110.8		104.5	104.5	109.5	112.5	107.5	105.5	102.5	96.5	90.5		1.5
Light Plant	103.1		96.8	96.8	101.8	104.8	99.8	97.8	94.8	88.8	82.8		1
Motor Grader (Cat 20M) + other service vehicles on haul roads	118.2		108.0	111.4	122.1	121.6	115.2	111.6	108.7	102.2	93.4		3
Locomotives at Train Loadout (each)	107.9		108.1	126.4	111.6	104.0	103.1	99.9	99.5	99.3	95.6		5

Notes:

- The mining equipment sound power levels indicated above are the maximum levels measured.
- For equipment such as Dozers, Loaders, Shovels, Rock Haul Trucks, etc. the maximum noise levels are not achieved 100% of the time. To take into account the fact that the noise levels are lower during low-idle operations and that there is minimal noise during coffee and lunch breaks, re-fueling, etc., each of these noise sources have been reduced by 6 dB.
- The Haul Trucks (Waste and Coal) have been modeled as traveling point sources. The traveling speed and distance has been used along with loading/unloading and other usage time to determine the round-trip time for each of the haul routes. This has been used to calculate the quantity of Haul Trucks per hour and then multiplied by the number of Haul Trucks on each route to determine the number of Haul Truck passages per hour for each route.
- Noise levels for the Diesel Driven Pumps and Light Plants have been left at the maximum values.
- Noise levels for the Diesel Locomotives have been left at the maximum values.
- The Articulated Trucks and Reclamation Loader only operate during the day-time hours.
- The Light Plants only operate during the night-time hours

General Noise Modelling Parameters

Parameter	Value
Modelling Software	CADNA/A (Version 4.6.153)
Standard Followed	ISO 9613-2
Ground Sound Absorption Coefficient	0.7
Wind Speed	1 - 5 m/s (3.6 - 18 km/hr)
Wind Direction	Downwind from all sources to all receptors
Temperature	10 °C
Humidity	70%
Topography	Used Digital Terrain Model Contours Provided by Client

Appendix II THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

Sound Pressure Level

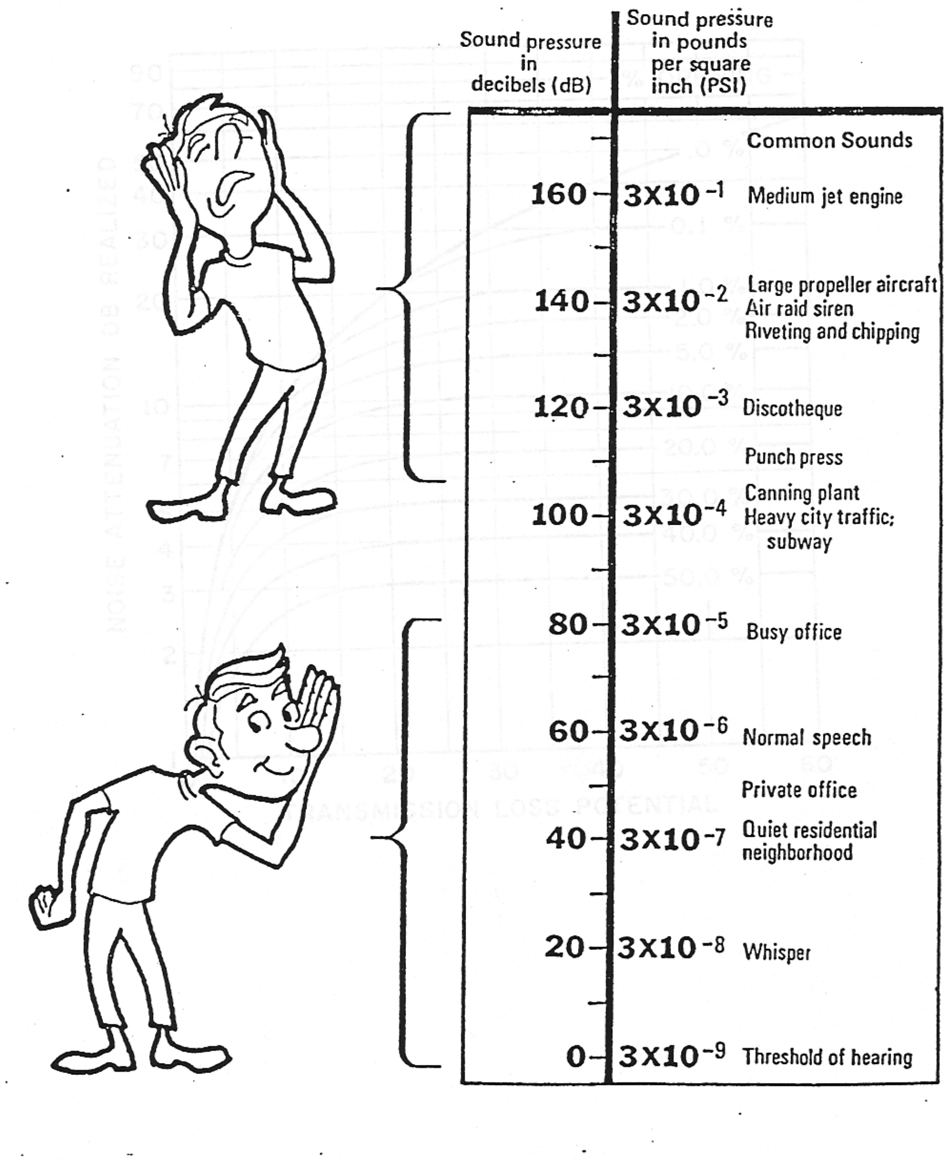
Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we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

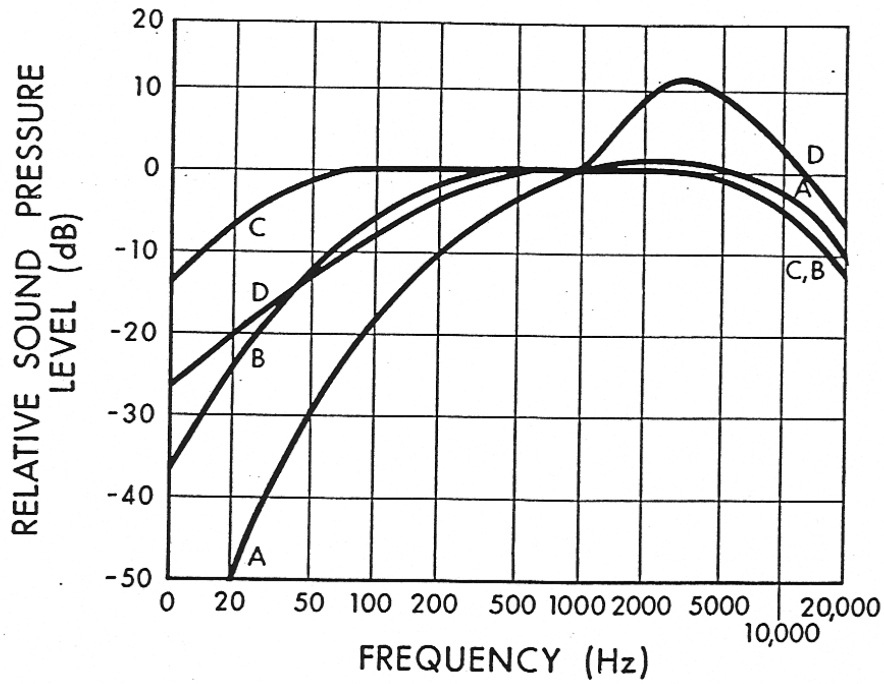
Frequency

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
			22.4	**25**	28.2
22	**31.5**	44	28.2	**31.5**	35.5
			35.5	**40**	44.7
			44.7	**50**	56.2
44	**63**	88	56.2	**63**	70.8
			70.8	**80**	89.1
			89.1	**100**	112
88	**125**	177	112	**125**	141
			141	**160**	178
			178	**200**	224
177	**250**	355	224	**250**	282
			282	**315**	355
			355	**400**	447
355	**500**	710	447	**500**	562
			562	**630**	708
			708	**800**	891
710	**1000**	1420	891	**1000**	1122
			1122	**1250**	1413
			1413	**1600**	1778
1420	**2000**	2840	1778	**2000**	2239
			2239	**2500**	2818
			2818	**3150**	3548
2840	**4000**	5680	3548	**4000**	4467
			4467	**5000**	5623
			5623	**6300**	7079
5680	**8000**	11360	7079	**8000**	8913
			8913	**10000**	11220
			11220	**12500**	14130
11360	**16000**	22720	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.

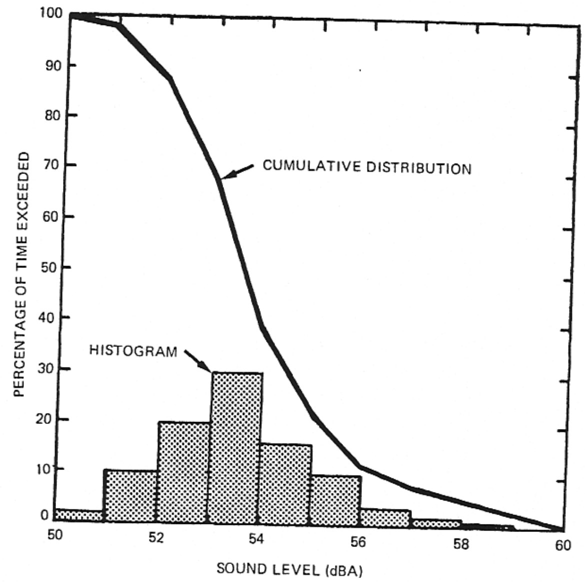


Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

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 44 dB at 400m.
- A line source measuring 50 dB at 100m will be 40 dB at 1000m.

Atmospheric Absorption

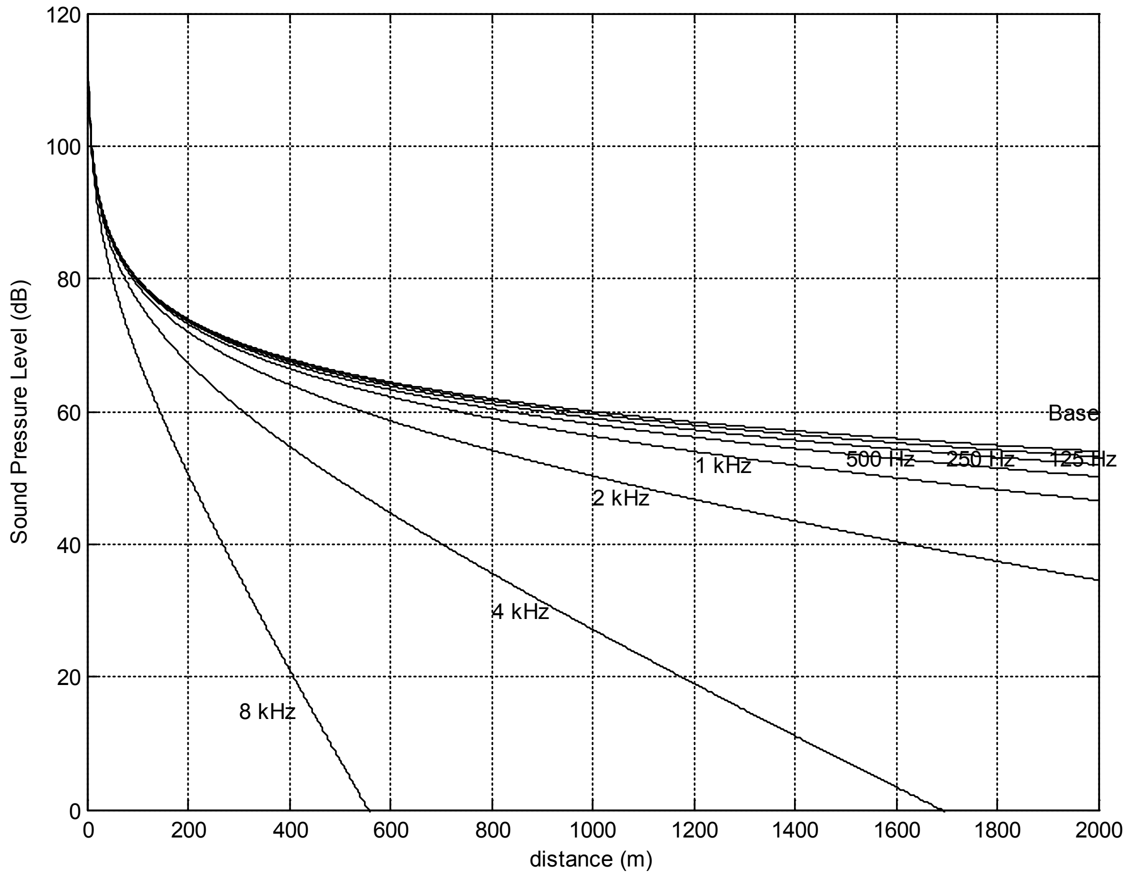
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

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 °C	Relative Humidity (%)	Frequency (Hz) 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 tends to increase
- As Relative Humidity increases, absorption tends to decrease
- 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

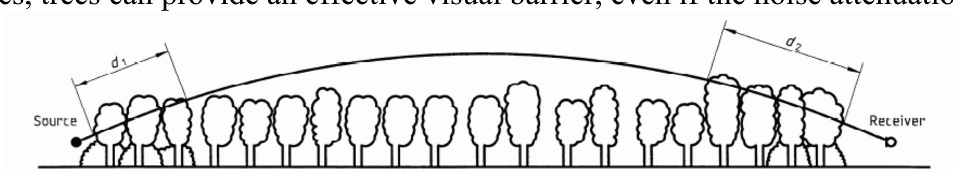
- Can be an effective absorber due to large area covered
- Only effective at low height above ground. Does not affect sound transmitted direct from source to receiver if there is line of sight.
- Typically less absorption than atmospheric absorption when there is line of sight.
- Approximate rule of 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 m	Nominal midband frequency Hz							
	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 approximately 1/2 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 the Alberta Energy Regulator Directive 038 (February, 2007)

Source[5]	**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

[5] 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 the Alberta Energy Regulator Directive 038 (February, 2007)

Source[6]	**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

[6] 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

Permissible Sound Levels at Residential Receptors Greater Than 500 m From Highway 3 and Rail Line and Population Density Less Than 9 Per Quarter Section and at Theoretical 1,500 m Receptors

Res-301, Res-302, R-017 to R-023, R-030, & R-031

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	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	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

	Night-Time	Day-Time
Total Permissible Sound Level (PSL) [dBA]	40	50

Permissible Sound Levels at Residential Receptors Greater Than 500 m From Highway 3 and Rail Line and Population Density Between 9 - 160 Per Quarter Section

R-001 to R-009, R-015, & R-024 to R-029

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	43	43
Category 2	45	48	51		
Category 3	50	53	56		
Basic Sound Level (dBA)				43	43

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]	Night-Time	Day-Time
	43	53

Permissible Sound Levels at Residential Receptors Between 30 - 500 m From Highway 3 and Rail Line and Population Density Less Than 9 Per Quarter Section

R-016

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		
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

	Night-Time	Day-Time
Total Permissible Sound Level (PSL) [dBA]	45	55

Permissible Sound Levels at Residential Receptors Between 30 - 500 m From Highway 3 and Rail Line and Population Density Between 9 - 160 Per Quarter Section

R-010 to R-014, & R-032 to R-067

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		
Category 2	45	48	51	48	48
Category 3	50	53	56		
			Basic Sound Level (dBA)	48	48

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

	Night-Time	Day-Time
Total Permissible Sound Level (PSL) [dBA]	48	58

Appendix V NOISE SOURCE ORDER-RANKING

Blairmore Resident R-30 [PSL-Night = 40 dBA]

Noise Source	dBA		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Locomotives for Train Loading	36.6		43.9	62.1	35.9	27.0	27.2	24.0	14.5	-17.6
CV-807 (Overland Conveyour)	27.3		29.4	37.0	28.2	28.1	25.9	23.7	0.4	-51.1
Product overland conveyor Motor C	23.0		27.2	27.1	18.4	18.9	21.5	20.4	7.2	-40.0
Product overland conveyor Motor E	22.8		27.2	27.0	18.2	18.8	21.3	20.2	6.9	-40.4
Product overland conveyor Motor D	22.6		27.1	27.0	18.2	18.7	21.2	20.1	6.7	-40.6
CV-851 (Rail Loadout)	20.5		18.6	26.2	20.5	20.4	18.3	17.9	-1.5	-46.2
Coal Haul	17.7		20.9	32.0	29.8	21.4	14.2	-0.7	-39.1	-100.0
Coal Haul	17.4		23.7	34.7	29.4	20.7	13.3	-1.9	-41.6	-100.0
Waste Haul	16.1		25.8	36.8	27.4	18.3	10.9	-4.9	-51.4	-100.0
Waste Haul	15.9		25.2	36.2	27.3	18.2	10.8	-5.2	-51.9	-100.0
391kw Dozer	15.1		13.0	24.0	31.0	2.9	-4.9	-18.0	-63.0	-100.0
391kw Dozer	14.2		22.4	33.3	29.3	0.4	-5.4	-17.4	-68.7	-100.0
394t Hoe	14.0		28.7	36.3	26.1	13.3	5.4	-9.3	-60.8	-100.0
391kw Dozer	13.3		11.7	22.8	29.3	0.4	-6.8	-19.5	-70.5	-100.0
394t Hoe	13.0		28.0	35.5	25.1	11.9	3.4	-12.4	-68.0	-100.0
394t Hoe	13.0		28.0	35.5	25.1	11.9	3.4	-12.5	-68.1	-100.0
Wheel Loader	13.0		20.1	22.3	26.6	15.4	7.8	-2.4	-41.9	-100.0
391 kw Dozer	12.1		10.8	21.7	28.1	-1.4	-10.9	-27.5	-84.5	-100.0
Wheel Dozer	12.1		10.8	21.7	28.1	-1.3	-10.8	-27.5	-84.4	-100.0
664 kw Dozer	11.3		12.1	26.3	26.0	7.1	5.5	-10.2	-56.1	-100.0
664 kw Dozer	11.3		12.1	26.3	26.0	7.1	5.5	-10.2	-56.1	-100.0
Wheel Dozer	11.0		10.0	20.8	27.0	-3.0	-13.2	-31.2	-100.0	-100.0
490t Hoe	10.8		19.4	26.8	25.3	11.4	0.5	-20.1	-82.1	-100.0
TLO bin feed conveyor	10.5		24.9	21.8	14.1	10.6	10.3	5.3	-10.0	-54.9
CV-801	10.4		9.3	16.6	17.3	15.8	8.9	-1.8	-47.2	-100.0
CV-805	10.0		8.6	15.9	16.7	15.4	8.5	-1.8	-46.3	-100.0
122t Hoe	9.4		16.4	24.0	23.4	11.2	2.8	-13.0	-58.2	-100.0
122t Hoe	9.4		16.4	24.0	23.4	11.2	2.8	-13.0	-58.1	-100.0
394t Hoe	9.1		17.2	24.7	23.5	10.1	0.0	-19.1	-75.8	-100.0
664 kw Dozer	8.8		10.4	24.6	23.7	3.8	2.3	-13.8	-68.1	-100.0
OLC Surge Bin Discharge Feeder Drive 1	8.2		10.2	10.0	1.9	3.1	6.3	5.9	-6.0	-52.4
OLC Surge Bin Discharge Feeder Drive 2	8.2		9.7	9.5	4.3	3.7	6.2	5.8	-6.1	-52.3
Raw Coal Screen	7.4		15.9	20.3	18.4	10.4	5.7	-6.4	-45.0	-100.0
Grader/Water	6.5		9.4	12.2	18.0	12.2	0.8	-14.5	-57.3	-100.0
CV-802	6.4		5.1	12.3	13.1	11.8	4.9	-5.5	-50.2	-100.0
Drill	5.7		12.7	10.4	20.8	6.3	-6.2	-18.8	-65.5	-100.0
CV-702	4.9		4.1	11.4	12.0	10.3	3.2	-8.0	-55.2	-100.0
Product Stockpile Reclaim Conveyor	4.5		8.1	7.6	8.9	7.3	5.2	-4.8	-40.6	-100.0
Grader/Water	4.5		4.5	7.3	15.7	10.3	-1.0	-15.9	-57.5	-100.0
CV-102	4.1		3.4	10.6	11.2	9.6	2.3	-9.0	-56.5	-100.0
CV-101	3.7		3.5	10.7	11.2	9.4	1.7	-10.3	-59.4	-100.0
Diesel Pump	3.4		11.5	10.8	12.9	9.0	0.6	-13.2	-58.9	-100.0
Diesel Pump	3.4		11.5	10.8	12.9	9.0	0.6	-13.3	-58.9	-100.0
Drill	2.7		10.7	8.3	18.1	2.5	-11.7	-27.6	-85.5	-100.0
Train Loadout Conveyor Hydraulic System	2.6		21.9	19.8	6.7	4.1	0.4	-2.6	-19.9	-63.9
CV-201	2.2		1.4	8.6	9.3	7.7	0.5	-10.6	-57.7	-100.0
Feeder Breaker - Chain drive	1.7		6.0	5.4	6.1	2.5	2.9	-7.2	-43.3	-100.0
Feeder Breaker - Chain drive	1.6		5.9	5.4	6.0	2.4	2.8	-7.3	-43.5	-100.0
Feeder Breaker - Chain drive	1.5		5.9	5.3	6.0	2.3	2.7	-7.5	-44.0	-100.0
Product Conveyor	1.4		5.2	4.7	6.0	4.2	2.1	-8.1	-44.3	-100.0
Feeder Breaker - Chain drive	1.4		5.8	5.3	5.9	2.3	2.6	-7.7	-44.3	-100.0
Grader/Water	1.1		8.1	10.9	12.8	6.5	-4.8	-20.9	-70.8	-100.0
Diesel Pump	0.9		10.2	9.4	11.1	6.6	-2.8	-18.6	-71.0	-100.0
Diesel Pump	0.9		10.2	9.4	11.1	6.6	-2.8	-18.6	-71.0	-100.0
Grader/Water	0.8		8.2	10.9	12.5	6.3	-5.1	-21.0	-70.8	-100.0
Sized Coal Conveyor	0.0		4.5	3.9	5.1	3.1	0.5	-10.4	-49.4	-100.0
Feeder Breaker - Breaker drive	0.0		4.3	3.7	4.4	0.8	1.2	-9.0	-45.2	-100.0
Feeder Breaker - Breaker drive	0.0		4.3	3.8	4.4	0.8	1.2	-8.9	-44.9	-100.0

Notes:

- Octave band sound levels are linear (i.e. not A-weighted)
- Only those noise sources which result in a contribution greater than 0.0 dBA at the receptor are shown

Blairmore Resident R-42 [PSL-Night = 48 dBA]

Noise Source	dBA		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Locomotives for Train Loading	43.2		49.3	67.5	45.6	35.9	36.1	34.0	30.4	17.3
Product overland conveyor Motor C	31.7		33.1	33.0	25.1	25.7	28.9	29.4	21.5	-4.3
CV-851 (Rail Loadout)	31.6		25.7	33.5	30.1	29.0	28.1	29.8	16.8	-6.7
CV-807 (Overland Conveyour)	31.4		30.9	38.6	31.2	31.3	29.3	28.5	11.0	-17.9
Product overland conveyor Motor E	31.2		32.9	32.8	24.9	25.4	28.5	28.8	20.8	-5.2
Product overland conveyor Motor D	30.9		32.8	32.7	24.7	25.2	28.2	28.5	20.4	-5.6
TLO bin feed conveyor	21.8		32.5	29.5	24.7	19.9	20.8	17.9	8.8	-15.6
OLC Surge Bin Discharge Feeder Drive 2	20.4		16.2	16.2	12.8	12.6	16.3	17.9	12.5	-11.1
OLC Surge Bin Discharge Feeder Drive 1	19.7		17.3	17.2	10.6	11.3	15.6	17.2	11.8	-12.9
Coal Haul	18.5		21.5	32.5	30.3	22.2	15.4	1.6	-32.8	-100.0
Coal Haul	18.0		21.3	32.3	30.1	21.7	14.5	0.0	-35.3	-100.0
391kw Dozer	16.1		13.8	24.8	32.0	4.3	-3.3	-15.7	-57.6	-100.0
Waste Haul	15.5		19.5	30.5	27.9	19.0	11.0	-5.1	-47.3	-100.0
Waste Haul	15.5		19.5	30.5	27.9	19.0	11.1	-4.9	-46.9	-100.0
Wheel Loader	14.4		20.9	23.2	27.6	16.9	9.8	0.6	-35.4	-100.0
391kw Dozer	14.2		12.3	23.3	30.2	1.6	-6.6	-20.7	-69.0	-100.0
391kw Dozer	14.2		12.3	23.3	30.2	1.7	-6.6	-20.7	-69.0	-100.0
Train Loadout Conveyor Hydraulic System	14.0		30.4	28.4	17.9	13.8	11.3	10.4	-0.7	-24.0
391 kw Dozer	12.9		11.4	22.3	28.9	-0.2	-9.2	-24.8	-78.3	-100.0
Wheel Dozer	12.9		11.4	22.3	28.9	-0.2	-9.1	-24.7	-78.2	-100.0
664 kw Dozer	12.6		13.0	27.3	27.2	8.7	7.8	-6.6	-48.2	-100.0
664 kw Dozer	12.6		13.0	27.3	27.2	8.7	7.8	-6.6	-48.2	-100.0
CV-801	11.9		10.0	17.2	18.1	17.1	10.6	1.1	-40.7	-100.0
Wheel Dozer	11.8		10.6	21.5	27.8	-1.7	-11.4	-28.3	-86.4	-100.0
490t Hoe	11.7		20.0	27.5	26.2	12.6	2.3	-17.2	-75.5	-100.0
CV-805	11.5		9.6	16.9	17.8	16.7	10.1	0.4	-41.2	-100.0
394t Hoe	11.4		18.7	26.3	25.5	13.0	4.1	-12.6	-61.1	-100.0
122t Hoe	10.5		17.1	24.8	24.3	12.4	4.4	-10.7	-52.8	-100.0
122t Hoe	10.5		17.1	24.8	24.3	12.4	4.4	-10.6	-52.7	-100.0
394t Hoe	10.4		18.0	25.6	24.6	11.7	2.3	-15.5	-67.5	-100.0
394t Hoe	10.3		18.0	25.6	24.6	11.7	2.3	-15.5	-67.6	-100.0
394t Hoe	9.9		17.8	25.3	24.2	11.2	1.5	-16.7	-70.3	-100.0
664 kw Dozer	9.7		11.0	25.2	24.7	5.2	2.8	-14.5	-65.8	-100.0
Waste Haul	9.4		14.9	25.8	22.6	12.3	2.3	-17.9	-75.4	-100.0
Raw Coal Screen	9.0		16.7	21.2	19.5	11.8	7.7	-3.4	-38.5	-100.0
Grader/Water	7.5		7.5	10.3	18.7	13.3	2.0	-12.5	-51.1	-100.0
CV-802	7.0		5.9	13.1	13.8	12.4	5.3	-5.3	-48.0	-100.0
Drill	6.7		13.4	11.2	21.7	7.7	-4.3	-16.0	-59.2	-100.0
Product Stockpile Reclaim Conveyor	6.4		9.1	8.6	10.1	8.7	7.1	-2.1	-34.6	-100.0
CV-102	5.7		4.2	11.5	12.3	11.1	4.3	-6.0	-50.0	-100.0
Grader/Water	5.4		4.9	7.7	16.3	11.2	0.2	-13.7	-51.3	-100.0
Diesel Pump	4.9		12.2	11.6	13.9	10.4	2.5	-11.0	-53.7	-100.0
Diesel Pump	4.9		12.2	11.6	13.9	10.4	2.5	-11.0	-53.6	-100.0
CV-702	4.8		4.0	10.9	11.5	10.1	3.3	-6.8	-50.4	-100.0
CV-201	3.9		2.3	9.6	10.4	9.2	2.5	-7.6	-51.1	-100.0
Drill	3.6		11.3	8.9	18.9	3.7	-10.0	-24.9	-79.2	-100.0
Feeder Breaker - Chain drive	3.4		6.9	6.4	7.3	4.1	4.6	-4.9	-38.0	-100.0
Product Conveyor	3.3		6.2	5.7	7.1	5.7	4.0	-5.3	-38.3	-100.0
Drill	2.5		10.6	8.1	17.9	2.2	-12.1	-28.2	-86.9	-100.0
Feeder Breaker - Chain drive	2.4		6.8	6.2	7.3	4.1	3.4	-6.9	-41.0	-100.0
Diesel Pump	2.2		10.8	10.1	12.0	7.8	-1.1	-15.9	-64.7	-100.0
Diesel Pump	2.2		10.8	10.1	12.0	7.8	-1.1	-15.9	-64.8	-100.0
Sized Coal Conveyor	1.9		5.4	4.9	6.2	4.6	2.5	-7.4	-42.8	-100.0
Feeder Breaker - Breaker drive	1.8		5.3	4.8	5.6	2.5	2.9	-6.6	-39.7	-100.0
Feeder Breaker - Chain drive	1.7		6.7	6.0	7.1	4.0	2.4	-8.2	-42.9	-100.0
Grader/Water	1.7		2.5	5.3	13.4	7.4	-4.6	-20.8	-66.2	-100.0
Raw Coal Conveyor	1.5		5.2	4.7	6.0	4.3	2.1	-8.0	-44.0	-100.0
Grader/Water	1.5		2.2	5.0	13.1	7.2	-4.8	-20.9	-66.0	-100.0
Feeder Breaker - Breaker drive	0.8		5.2	4.6	5.6	2.4	1.7	-8.5	-42.6	-100.0
Diesel Pump	0.3		9.9	9.1	10.7	6.0	-3.6	-19.9	-74.0	-100.0
Diesel Pump	0.3		9.9	9.1	10.7	6.0	-3.6	-19.9	-73.9	-100.0
Feeder Breaker - Breaker drive	0.0		5.0	4.4	5.5	2.4	0.8	-9.9	-44.5	-100.0

Notes:

- Octave band sound levels are linear (i.e. not A-weighted)
- Only those noise sources which result in a contribution greater than 0.0 dBA at the receptor are shown

Resident R-301 (Project Year 01)

Noise Source	dBA		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
664 kw Dozer	30.7		26.2	40.9	41.9	26.2	29.6	23.8	13.1	-24.1
664 kw Dozer	30.6		26.1	40.9	41.8	26.1	29.5	23.7	12.8	-24.6
Waste Haul	27.6		26.4	37.6	36.0	30.1	26.6	19.6	9.1	-28.9
34t Hoe	26.6		29.0	37.2	37.4	27.6	24.9	18.6	7.0	-31.1
Waste Haul	26.0		32.5	43.9	32.9	26.8	25.0	18.7	0.2	-73.4
394t Hoe	24.8		36.1	44.1	35.4	25.5	21.8	15.2	-8.0	-100.0
664 kw Dozer	22.9		19.9	34.5	35.4	19.2	21.5	13.2	-6.8	-83.1
Coal Haul	22.5		24.0	34.8	32.8	25.8	20.9	11.4	-6.7	-72.2
394t Hoe	22.1		26.1	34.1	34.4	24.4	19.3	10.1	-11.7	-100.0
197 kw Dozer	22.1		18.7	30.2	38.0	12.1	7.6	1.1	-20.6	-100.0
Wheel Dozer	21.7		18.2	29.6	37.6	11.6	7.4	0.7	-22.1	-100.0
664kw Dozer	21.5		19.1	33.7	34.4	17.9	19.8	11.1	-9.9	-88.1
391kw Dozer	20.4		19.0	29.6	36.4	9.4	1.7	-7.2	-30.6	-100.0
CV-805	17.8		13.8	21.2	22.3	22.2	16.8	9.9	-19.9	-100.0
CV-801	17.3		12.8	20.0	21.2	21.3	16.4	10.4	-18.3	-100.0
Drill	16.3		30.2	28.3	29.1	17.2	11.2	8.7	-13.3	-100.0
Light Plant	16.3		17.7	17.5	20.6	19.5	13.6	11.9	0.1	-36.7
Light Plant	16.2		17.6	17.4	20.4	19.3	13.4	11.7	-0.2	-37.3
Grader/Water	15.1		11.1	14.1	23.2	20.2	12.7	5.6	-8.1	-51.7
Diesel Pump	15.0		18.2	17.9	20.8	19.2	14.1	6.8	-15.4	-100.0
Diesel Pump	15.0		18.2	18.0	20.8	19.2	14.1	6.8	-15.4	-100.0
Diesel Pump	14.6		17.7	17.4	20.4	18.9	13.6	6.4	-17.2	-100.0
Diesel Pump	14.5		17.7	17.4	20.4	18.8	13.6	5.9	-18.2	-100.0
Diesel Pump	14.5		17.7	17.4	20.4	18.8	13.6	5.9	-18.3	-100.0
CV-802	14.4		10.5	17.9	19.0	18.8	13.4	6.5	-23.0	-100.0
122t Hoe	14.0		22.1	29.0	27.7	15.7	8.3	-3.3	-26.9	-100.0
Drill	13.5		19.8	17.3	28.1	15.6	3.9	-3.5	-26.0	-100.0
Product Stockpile Reclaim Conveyor	13.2		12.9	12.6	14.3	14.0	13.7	7.4	-14.1	-100.0
Grader/Water	11.5		15.7	19.0	19.1	15.7	9.8	3.4	-18.3	-100.0
CV-807 (Overland Conveyour)	10.8		12.1	18.2	17.6	15.5	9.3	1.9	-28.7	-100.0
Product Conveyor	10.6		10.5	10.1	11.9	11.4	11.0	4.7	-16.3	-100.0
Feeder Breaker - Chain drive	10.6		11.1	10.7	12.1	10.1	11.4	4.8	-16.6	-100.0
Locomotives for Train Loading	10.5		19.0	35.8	17.9	4.7	-3.7	-19.9	-59.1	-100.0
Feeder Breaker - Chain drive	10.4		11.2	10.8	12.3	10.3	11.1	4.4	-17.0	-100.0
Grader/Water	10.1		8.3	10.8	19.5	15.9	6.4	-3.2	-24.7	-100.0
Feeder Breaker - Chain drive	9.8		11.3	10.8	12.3	10.6	10.4	3.4	-17.8	-100.0
Feeder Breaker - Chain drive	9.3		11.4	10.8	12.1	10.7	9.9	2.7	-18.5	-100.0
Diesel Pump	9.3		16.8	15.2	17.2	15.8	5.3	-4.8	-28.9	-100.0
Feeder Breaker - Breaker drive	8.9		9.4	9.1	10.5	8.4	9.7	3.2	-18.2	-100.0
Feeder Breaker - Breaker drive	8.7		9.5	9.1	10.6	8.6	9.5	2.7	-18.6	-100.0
Feeder Breaker - Breaker drive	8.1		9.7	9.2	10.7	8.9	8.8	1.8	-19.5	-100.0
Light Plant	7.8		11.3	11.0	14.0	12.3	5.4	1.3	-20.0	-100.0
Light Plant	7.8		11.3	11.0	14.0	12.4	5.4	1.3	-19.9	-100.0
Product Radial Stacker 1	7.7		7.8	7.4	9.1	8.7	8.2	1.7	-19.5	-100.0
Feeder Breaker - Breaker drive	7.7		9.7	9.1	10.5	9.1	8.2	1.1	-20.1	-100.0
Product Radial Stacker 2	6.7		8.0	7.5	9.0	8.2	7.2	0.3	-20.8	-100.0
Light Plant	6.2		10.5	10.2	12.9	11.0	3.7	-0.9	-23.1	-100.0
Light Plant	6.2		10.5	10.3	12.9	11.0	3.7	-0.8	-23.0	-100.0
Product Stackout Conveyor	5.9		6.8	6.3	7.9	7.2	6.4	-0.4	-21.3	-100.0
Light Plant	5.9		10.1	9.8	12.6	10.7	3.4	-1.2	-24.8	-100.0
Light Plant	5.7		10.0	9.7	12.5	10.6	3.2	-1.8	-25.9	-100.0
Light Plant	5.7		10.0	9.7	12.5	10.6	3.2	-1.7	-25.9	-100.0
Raw Coal Screen	5.2		17.6	20.2	16.7	7.7	2.8	-6.9	-29.7	-100.0
Light Plant	5.2		10.3	9.4	12.3	11.6	1.7	-8.0	-31.9	-100.0
CV-702	4.8		7.0	13.0	12.3	10.1	2.7	-6.1	-38.0	-100.0
CV-102	3.3		6.1	11.8	11.0	8.6	1.1	-7.8	-39.7	-100.0
Light Plant	3.1		9.6	8.3	10.7	9.5	-0.8	-10.8	-34.9	-100.0
Bifurcated chute Diverter Gate Hydraulic Power Pack	2.4		6.6	7.2	7.0	5.6	1.2	-3.2	-26.2	-100.0
CV-201	2.4		4.4	10.5	9.9	7.7	0.4	-8.4	-40.2	-100.0
Sized Coal Conveyor	2.3		8.6	7.2	7.4	5.1	2.5	-6.0	-29.5	-100.0
Feeder Breaker - cooling fan	2.2		11.4	14.1	12.5	5.4	0.7	-9.8	-33.2	-100.0
Feeder Breaker - cooling fan	2.1		11.5	14.1	12.6	5.6	0.4	-10.3	-33.6	-100.0
Feeder Breaker - cooling fan	2.0		11.7	14.2	12.6	5.9	-0.3	-11.3	-34.5	-100.0
Light Plant	1.9		9.2	7.6	9.7	8.3	-2.1	-12.3	-36.3	-100.0
Feeder Breaker - cooling fan	1.8		11.7	14.1	12.5	6.1	-0.8	-12.0	-35.1	-100.0
Plant Feed Conveyor	0.1		6.3	4.9	5.2	2.8	0.3	-8.2	-31.8	-100.0

Notes:

- Octave band sound levels are linear (i.e. not A-weighted)
- Only those noise sources which result in a contribution greater than 0.0 dBA at the receptor are shown

Resident R-302 (Project Year 01)

Noise Source	dBA		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Waste Haul	29.0		31.9	43.4	36.0	30.3	27.9	22.5	10.9	-34.0
664 kw Dozer	28.5		24.2	38.9	39.9	24.3	27.4	21.2	8.3	-38.3
Waste Haul	27.7		26.9	38.2	36.7	30.5	26.7	18.8	5.2	-43.9
664 kw Dozer	27.6		23.7	38.5	39.3	23.5	26.5	20.0	6.6	-41.1
664 kw Dozer	27.5		23.6	38.4	39.2	23.4	26.4	19.9	6.4	-41.7
394t Hoe	25.4		28.4	36.5	37.0	27.5	23.1	15.4	-1.8	-64.1
Coal Haul	25.3		26.3	37.4	35.4	28.6	23.8	14.6	-2.8	-64.0
Wheel Dozer	24.7		21.0	32.5	40.5	15.1	11.3	5.9	-11.5	-76.4
34t Hoe	23.9		26.8	35.0	35.1	25.1	22.1	15.1	1.1	-47.1
391kw Dozer	23.8		20.4	31.8	39.7	13.8	9.4	3.1	-17.2	-100.0
394t Hoe	23.5		27.3	35.3	35.6	25.8	20.9	12.5	-6.8	-75.3
197 kw Dozer	23.4		19.9	31.4	39.2	13.5	9.3	3.4	-15.7	-85.8
664kw Dozer	22.9		20.3	34.9	35.6	19.2	21.4	13.4	-5.1	-72.9
122t Hoe	19.8		23.8	31.8	32.0	22.1	17.1	8.2	-12.2	-84.5
Drill	18.8		22.6	20.7	32.3	21.0	12.8	8.8	-7.4	-64.4
Diesel Pump	18.6		20.5	20.3	23.4	22.3	17.8	11.8	-6.3	-68.6
Diesel Pump	18.6		20.5	20.3	23.4	22.3	17.8	11.7	-6.3	-68.6
Diesel Pump	18.6		20.5	20.3	23.4	22.3	17.8	11.8	-6.2	-68.4
Drill	18.0		22.1	20.3	31.7	20.1	11.7	7.4	-9.4	-67.2
CV-805	17.0		13.1	20.5	21.6	21.4	16.0	9.1	-21.6	-100.0
CV-801	16.8		13.1	20.2	21.1	20.9	15.8	9.6	-19.6	-100.0
Diesel Pump	16.7		19.4	19.1	22.0	20.6	15.7	9.1	-10.6	-78.4
Diesel Pump	16.6		19.4	19.1	22.0	20.6	15.7	9.1	-10.7	-78.5
Diesel Pump	15.9		18.9	18.7	21.5	20.0	15.0	8.0	-12.9	-84.3
CV-807 (Overland Conveyour)	15.4		14.7	21.8	22.0	20.4	13.8	5.3	-28.3	-100.0
Grader/Water	15.3		11.6	14.7	23.8	20.6	12.6	4.7	-12.1	-66.9
Raw Coal Screen	15.0		21.5	26.0	24.3	17.3	14.1	5.8	-15.3	-100.0
Grader/Water	14.9		15.4	18.7	22.2	19.3	12.9	7.3	-7.5	-58.1
CV-802	14.1		9.8	17.3	18.4	18.3	13.1	6.6	-23.4	-100.0
Light Plant	13.9		15.6	15.4	18.5	17.4	11.3	9.1	-4.9	-51.6
Light Plant	13.9		15.6	15.5	18.5	17.4	11.4	9.2	-4.9	-51.5
CV-702	13.5		9.6	17.0	18.1	17.8	12.5	5.6	-24.4	-100.0
Light Plant	13.0		15.2	15.0	18.0	16.7	10.5	8.0	-6.6	-54.1
Light Plant	13.0		15.1	15.0	17.9	16.6	10.4	8.0	-6.5	-54.2
Grader/Water	12.9		10.8	13.6	22.4	18.7	9.4	0.0	-20.8	-88.4
Product Stockpile Reclaim Conveyor	12.4		12.2	11.9	13.6	13.2	12.8	6.6	-15.5	-100.0
CV-102	12.3		8.9	16.3	17.3	16.8	11.2	4.0	-26.4	-100.0
Locomotives for Train Loading	12.0		19.8	37.1	19.9	7.3	-0.5	-16.7	-61.0	-100.0
CV-201	10.9		6.9	14.3	15.4	15.2	10.0	3.2	-26.8	-100.0
Sized Coal Conveyor	10.8		10.1	9.8	11.6	11.3	11.2	5.5	-14.8	-100.0
Feeder Breaker - Chain drive	10.4		10.4	10.2	11.2	8.9	11.2	5.1	-16.3	-100.0
Light Plant	10.3		13.1	12.9	15.9	14.5	7.9	4.4	-13.5	-74.1
Product Conveyor	10.2		9.8	9.5	11.2	10.8	10.6	4.7	-16.5	-100.0
Feeder Breaker - Chain drive	10.1		10.5	10.2	11.3	9.1	10.9	4.6	-17.1	-100.0
Feeder Breaker - Chain drive	10.0		10.7	10.4	11.6	9.3	10.8	4.2	-17.6	-100.0
Light Plant	9.8		12.8	12.6	15.5	14.0	7.4	4.0	-14.0	-76.3
Light Plant	9.8		12.8	12.6	15.5	14.0	7.4	4.1	-13.9	-76.1
CV-101	9.4		8.8	15.7	15.9	14.5	7.8	-0.5	-31.3	-100.0
Raw Coal Conveyor	9.3		10.1	9.7	11.3	10.6	9.8	3.1	-18.6	-100.0
Feeder Breaker - Chain drive	9.3		10.8	10.3	11.7	9.5	10.1	3.1	-19.0	-100.0
Light Plant	8.9		12.6	12.3	15.2	13.6	6.8	1.5	-17.7	-80.2
Feeder Breaker - Breaker drive	8.7		8.8	8.5	9.5	7.2	9.5	3.4	-18.0	-100.0
Plant Feed Conveyor	8.6		7.9	7.6	9.3	9.0	9.0	3.2	-17.1	-100.0
Feeder Breaker - Breaker drive	8.5		8.9	8.6	9.7	7.4	9.3	2.9	-18.8	-100.0
Feeder Breaker - Breaker drive	8.3		9.1	8.7	9.9	7.7	9.1	2.5	-19.2	-100.0
Product Radial Stacker 2	8.1		7.4	7.1	8.9	8.5	8.4	2.7	-17.7	-100.0
Light Plant	7.9		11.7	11.5	14.1	12.3	5.4	1.5	-18.3	-85.9
Light Plant	7.8		11.7	11.4	14.1	12.3	5.3	1.4	-18.4	-86.1
Feeder Breaker - Breaker drive	7.7		9.1	8.7	10.0	7.8	8.5	1.5	-20.5	-100.0
Product Radial Stacker 1	7.5		7.1	6.8	8.5	8.1	7.9	2.0	-19.2	-100.0
Light Plant	7.1		11.2	11.0	13.6	11.7	4.6	0.1	-20.9	-100.0
Light Plant	7.1		11.2	11.0	13.6	11.8	4.6	0.3	-20.5	-100.0
Product Stackout Conveyor	5.9		6.1	5.8	7.4	6.9	6.4	0.0	-21.4	-100.0
Secondary Sizer Drive 1	5.5		8.8	8.1	9.1	7.6	5.9	-1.9	-24.5	-100.0
Secondary Sizer Drive 2	5.4		8.8	8.1	9.1	7.6	5.8	-2.1	-24.6	-100.0
Rejects Bin Hydraulic System	3.2		8.2	8.8	8.3	6.7	1.9	-2.9	-26.8	-100.0
Reject Collection Conveyor	3.0		3.8	3.5	5.0	4.3	3.5	-3.3	-25.3	-100.0
Desliming Screen	2.1		18.2	19.6	14.7	4.4	-2.3	-16.0	-42.8	-100.0
Bifurcated chute Diverter Gate Hydraulic Power Pack	2.0		5.9	6.6	6.3	5.0	0.7	-3.2	-26.3	-100.0

Notes:

- Octave band sound levels are linear (i.e. not A-weighted)
- Only those noise sources which result in a contribution greater than 0.0 dBA at the receptor are shown

Resident R-302 (Project Year 01) Cont.

Noise Source	dBA		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Product Drain & Rinse Screen	1.8		18.1	19.4	14.4	4.0	-2.8	-16.7	-43.6	-100.0
Desliming Screen	1.5		18.0	19.3	14.2	3.6	-3.3	-17.3	-44.3	-100.0
Reject Drain & Rinse Screen	1.5		18.0	19.3	14.2	3.6	-3.3	-17.3	-44.3	-100.0
Feeder Breaker - cooling fan	1.5		11.1	13.7	11.9	4.7	0.1	-10.5	-34.3	-100.0
Feeder Breaker - cooling fan	1.5		10.9	13.6	11.7	4.4	0.3	-10.1	-33.8	-100.0
Feeder Breaker - cooling fan	1.5		10.8	13.5	11.5	4.3	0.5	-9.5	-32.9	-100.0
Fines Reject Dewatering Screen Drive B	1.4		18.0	19.2	14.1	3.5	-3.5	-17.5	-44.5	-100.0
Feeder Breaker - cooling fan	1.3		11.1	13.7	12.0	4.8	-0.7	-11.7	-35.7	-100.0
Product Drain & Rinse Screen	1.2		18.0	19.1	13.9	3.2	-3.8	-17.9	-44.9	-100.0
Fines Reject Dewatering Screen Drive A	1.1		17.9	19.1	13.9	3.2	-3.9	-18.0	-45.0	-100.0
HDF Compressor (Duty)	1.1		21.4	13.5	13.3	5.5	-4.6	-14.7	-36.8	-100.0
Reject Drain & Rinse Screen	1.0		17.9	19.0	13.8	3.0	-4.1	-18.2	-45.2	-100.0
Fines Reject Dewatering Screen Drive B	1.0		17.9	19.0	13.8	3.0	-4.0	-18.1	-45.2	-100.0
Fines Reject Dewatering Screen Drive A	0.9		17.9	19.0	13.7	2.9	-4.2	-18.4	-45.4	-100.0
HDF Compressor (Duty)	0.9		21.3	13.4	13.2	5.3	-4.8	-15.0	-37.0	-100.0
Fines Reject Dewatering Screen Drive B	0.8		17.8	18.9	13.6	2.8	-4.3	-18.5	-45.6	-100.0
Fines Reject Dewatering Screen Drive A	0.8		17.8	18.9	13.6	2.7	-4.5	-18.6	-45.7	-100.0
HDF Compressor (Duty)	0.8		21.3	13.4	13.0	5.2	-5.0	-15.2	-37.3	-100.0
Fines Reject Dewatering Screen Drive B	0.7		17.8	18.8	13.5	2.6	-4.6	-18.8	-45.8	-100.0
Fines Reject Dewatering Screen Drive A	0.6		17.8	18.8	13.4	2.5	-4.8	-19.0	-46.1	-100.0
HDF Compressor (Duty)	0.6		21.2	13.2	12.9	4.9	-5.3	-15.5	-37.6	-100.0

Notes:
- Octave band sound levels are linear (i.e. not A-weighted)
- Only those noise sources which result in a contribution greater than 0.0 dBA at the receptor are shown

Resident R-301 (Project Year 06)

Noise Source	dBA		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
664 kw Dozer	25.9		22.3	37.0	37.9	22.0	24.8	17.8	2.3	-54.7
664 kw Dozer	25.9		22.2	37.0	37.9	22.0	24.8	17.8	2.3	-54.8
Waste Haul	25.7		28.7	39.9	34.5	28.2	24.6	16.8	0.8	-55.3
394t Hoe	25.2		36.4	44.4	35.6	25.9	22.2	15.8	-6.8	-100.0
394t Hoe	25.1		36.4	44.3	35.6	25.8	22.2	15.8	-6.9	-100.0
Waste Haul	23.9		24.5	35.2	33.3	26.8	22.6	14.5	-0.2	-55.5
391kw Dozer	22.2		18.8	30.1	38.1	12.1	7.3	0.0	-24.7	-100.0
391kw Dozer	22.2		18.8	30.1	38.1	12.1	7.3	0.0	-24.7	-100.0
490t Hoe	22.0		26.7	34.6	34.8	24.4	18.5	7.7	-20.6	-100.0
Coal Haul	22.0		24.8	35.4	33.0	25.4	19.6	8.8	-12.3	-80.3
664 kw Dozer	21.3		18.8	33.4	34.3	17.8	19.7	10.8	-11.5	-100.0
394t Hoe	21.0		25.2	33.1	33.4	23.4	18.0	8.1	-16.7	-100.0
391 kw Dozer	20.8		17.6	28.8	36.7	10.6	4.0	-5.2	-34.2	-100.0
Wheel Dozer	20.8		17.6	28.8	36.8	10.6	4.0	-5.1	-34.0	-100.0
Wheel Dozer	20.5		17.3	28.6	36.4	10.0	4.7	-3.7	-32.2	-100.0
Waste Haul	20.4		24.1	35.2	31.6	23.8	17.7	5.7	-23.3	-100.0
Coal Haul	20.0		23.7	34.0	31.3	23.4	17.4	6.7	-12.6	-77.9
394t Hoe	18.9		24.0	31.9	31.9	21.3	15.0	3.4	-25.4	-100.0
Wheel Loader	15.6		24.4	25.8	29.2	17.8	10.4	3.0	-19.8	-100.0
CV-801	14.1		12.1	19.1	19.8	19.0	12.8	5.1	-25.4	-100.0
Diesel Pump	13.8		17.3	16.9	19.9	18.3	12.9	4.8	-20.5	-100.0
Diesel Pump	13.8		17.3	16.9	19.9	18.3	12.9	4.8	-20.4	-100.0
CV-805	13.4		13.0	19.8	20.0	18.6	11.8	3.5	-27.3	-100.0
Drill	11.9		17.1	15.1	26.3	13.8	3.9	-3.6	-32.5	-100.0
664 kw Dozer	11.9		13.8	27.4	26.7	8.1	4.9	-10.1	-47.5	-100.0
664 kw Dozer	11.6		12.3	26.5	26.3	7.5	6.1	-9.3	-54.2	-100.0
Grader/Water	11.6		10.9	13.2	21.7	17.6	7.0	-3.9	-28.2	-100.0
Diesel Pump	11.4		16.1	15.6	18.7	16.7	9.8	-0.6	-30.2	-100.0
Diesel Pump	11.4		16.1	15.6	18.7	16.7	9.8	-0.5	-30.1	-100.0
Diesel Pump	11.3		15.8	15.4	18.2	16.1	10.2	1.0	-28.1	-100.0
Diesel Pump	11.3		15.8	15.4	18.2	16.1	10.1	1.0	-28.1	-100.0
Light Plant	11.1		13.7	13.5	16.4	15.1	8.7	5.8	-10.9	-68.0
Light Plant	11.1		13.6	13.4	16.4	15.1	8.7	5.7	-10.9	-68.0
Grader/Water	11.0		11.4	14.4	19.6	16.2	8.6	0.8	-18.4	-80.1
Locomotives for Train Loading	10.5		19.0	35.8	17.9	4.7	-3.7	-19.9	-59.1	-100.0
Drill	10.4		17.0	14.5	25.2	12.2	-0.3	-9.8	-39.9	-100.0
Grader/Water	9.9		7.4	9.9	18.8	15.3	7.0	-1.2	-19.1	-80.1
CV-802	9.7		9.6	16.3	16.3	14.8	7.9	-0.2	-30.6	-100.0
Product Stockpile Reclaim Conveyor	9.5		12.5	11.8	13.0	11.6	10.0	2.1	-21.1	-100.0
Grader/Water	9.4		10.0	12.9	20.0	15.2	4.9	-7.3	-39.6	-100.0
Drill	9.1		17.6	14.2	24.1	9.7	-2.8	-11.2	-36.0	-100.0
CV-807 (Overland Conveyour)	8.9		11.8	17.8	16.9	14.2	6.7	-2.4	-35.1	-100.0
391kw Dozer	8.8		10.8	19.5	24.7	-3.4	-12.1	-19.0	-41.2	-100.0
Grader/Water	7.1		7.1	9.3	17.4	13.2	2.2	-8.6	-31.1	-100.0
Feeder Breaker - Chain drive	6.1		10.4	9.5	10.2	8.5	6.4	-1.5	-24.1	-100.0
Light Plant	6.1		10.2	9.9	12.8	10.9	3.6	-1.2	-24.8	-100.0
Product Conveyor	5.8		9.8	8.9	9.8	8.1	6.2	-1.7	-24.1	-100.0
122t Hoe	5.8		16.8	22.3	19.7	6.8	-1.3	-13.7	-36.3	-100.0
122t Hoe	5.7		16.7	22.2	19.7	6.8	-1.4	-13.7	-36.3	-100.0
Feeder Breaker - Chain drive	5.5		10.4	9.3	9.9	8.0	5.8	-2.2	-24.5	-100.0
Feeder Breaker - Chain drive	4.6		10.2	8.9	9.2	7.1	4.8	-3.2	-25.1	-100.0
Feeder Breaker - Breaker drive	4.4		8.8	7.8	8.6	6.8	4.8	-3.2	-25.8	-100.0
Feeder Breaker - Chain drive	4.0		10.1	8.6	8.8	6.5	4.2	-3.8	-25.5	-100.0
Feeder Breaker - Breaker drive	3.9		8.7	7.6	8.2	6.3	4.2	-3.8	-26.2	-100.0
Feeder Breaker - Breaker drive	2.9		8.6	7.2	7.6	5.4	3.2	-4.8	-26.8	-100.0
Light Plant	2.9		8.4	7.9	10.8	8.4	0.5	-8.1	-37.6	-100.0
Product Radial Stacker 1	2.7		7.1	6.1	6.8	5.0	3.0	-4.9	-27.3	-100.0
Light Plant	2.6		8.1	7.8	10.4	7.9	-0.2	-6.6	-35.6	-100.0
Feeder Breaker - Breaker drive	2.3		8.4	6.9	7.1	4.9	2.5	-5.4	-27.1	-100.0
Light Plant	1.9		7.7	7.3	9.9	7.3	-1.0	-7.8	-38.1	-100.0
CV-702	1.8		5.3	10.8	9.7	7.2	-0.4	-9.3	-41.1	-100.0
Product Radial Stacker 2	1.1		6.8	5.4	5.7	3.6	1.3	-6.7	-28.4	-100.0
CV-102	1.0		4.7	10.1	8.9	6.4	-1.3	-10.2	-42.1	-100.0
Product Stackout Conveyor	0.4		5.8	4.5	4.9	2.9	0.7	-7.2	-29.0	-100.0

Notes:

- Octave band sound levels are linear (i.e. not A-weighted)
- Only those noise sources which result in a contribution greater than 0.0 dBA at the receptor are shown

Resident R-302 (Project Year 06)

Noise Source	dBA	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Waste Haul	28.9	30.9	42.3	36.6	30.7	27.9	21.9	9.9	-35.7
664 kw Dozer	28.2	24.1	38.9	39.8	24.0	27.1	20.7	7.9	-37.8
664 kw Dozer	28.1	24.1	38.9	39.7	24.0	27.0	20.7	7.8	-37.9
394t Hoe	27.2	29.8	37.9	38.5	29.3	25.2	17.9	2.5	-52.3
394t Hoe	27.2	29.8	37.9	38.5	29.3	25.2	17.9	2.5	-52.4
490t Hoe	26.8	30.5	38.5	39.1	28.6	24.0	15.6	-3.9	-77.0
664 kw Dozer	26.8	22.9	37.6	38.6	22.8	25.7	18.9	4.3	-49.6
Waste Haul	25.5	24.6	35.6	34.0	28.1	24.6	17.4	5.8	-37.2
Wheel Dozer	24.9	21.1	32.6	40.8	14.3	10.4	4.6	-14.7	-100.0
Waste Haul	22.4	24.7	35.5	33.1	25.4	20.4	10.9	-8.1	-78.8
Coal Haul	21.9	24.5	35.0	32.5	25.1	20.0	10.6	-6.8	-69.9
391kw Dozer	20.9	19.7	30.1	36.8	9.9	2.4	-6.1	-27.8	-100.0
391kw Dozer	20.9	19.7	30.1	36.8	9.9	2.4	-6.1	-27.8	-100.0
Coal Haul	19.9	23.3	33.4	30.6	23.1	17.8	8.5	-8.7	-70.3
394t Hoe	18.8	26.3	33.4	32.3	20.7	13.6	2.6	-19.2	-100.0
Diesel Pump	16.7	19.6	19.3	22.6	20.4	15.8	9.3	-10.7	-83.2
Diesel Pump	16.7	19.6	19.3	22.6	20.4	15.8	9.3	-10.7	-83.1
Drill	16.4	20.8	18.9	30.6	18.0	9.5	4.6	-15.0	-88.1
CV-801	16.1	12.0	19.3	20.4	20.3	15.2	8.8	-20.9	-100.0
Wheel Loader	15.8	24.7	26.0	29.3	17.9	10.6	3.4	-18.3	-100.0
CV-807 (Overland Conveyour)	15.2	14.6	21.8	21.9	20.3	13.6	5.0	-29.1	-100.0
CV-805	15.1	12.9	20.1	20.8	20.0	13.8	5.8	-25.9	-100.0
664 kw Dozer	14.7	14.4	28.8	29.1	11.2	10.4	-3.0	-39.6	-100.0
Grader/Water	14.1	13.6	16.8	21.7	18.8	12.0	5.8	-9.5	-61.0
Light Plant	13.5	15.5	15.4	18.3	17.1	10.9	8.7	-5.4	-51.1
Light Plant	13.5	15.5	15.4	18.3	17.1	10.9	8.7	-5.4	-51.1
Wheel Dozer	13.4	14.8	23.8	29.3	1.6	-6.6	-15.6	-36.1	-100.0
391 kw Dozer	13.2	14.7	23.6	29.2	1.4	-6.8	-15.8	-36.1	-100.0
Light Plant	12.0	14.2	14.0	17.1	15.9	9.6	6.6	-9.8	-64.7
Locomotives for Train Loading	12.0	19.8	37.1	19.8	7.2	-0.7	-17.1	-61.7	-100.0
CV-802	12.0	9.6	16.9	17.6	16.9	10.8	3.0	-28.2	-100.0
Product Stockpile Reclaim Conveyor	11.9	12.2	11.9	13.5	12.9	12.4	5.8	-17.0	-100.0
Diesel Pump	11.8	18.2	16.8	19.2	18.2	8.1	-1.5	-23.8	-100.0
Diesel Pump	11.7	18.2	16.8	19.1	18.1	8.0	-1.6	-23.9	-100.0
Grader/Water	11.3	10.5	13.1	21.4	16.9	7.6	-2.0	-24.1	-100.0
Grader/Water	11.3	7.5	10.4	19.4	16.5	8.9	1.6	-13.2	-62.2
394t Hoe	11.0	21.5	27.1	24.8	12.3	4.5	-7.1	-28.2	-100.0
Feeder Breaker - Chain drive	9.7	10.4	10.1	11.2	8.9	10.5	3.9	-18.3	-100.0
Product Conveyor	9.5	9.7	9.4	11.1	10.5	10.0	3.5	-18.5	-100.0
Grader/Water	9.2	9.4	11.3	19.2	15.0	5.1	-4.4	-24.8	-100.0
391kw Dozer	8.9	11.6	19.8	24.8	-3.2	-10.4	-16.4	-35.8	-100.0
Grader/Water	8.6	7.9	10.2	18.5	14.4	4.7	-4.8	-25.4	-100.0
Feeder Breaker - Chain drive	8.3	10.4	9.9	11.3	9.1	9.1	1.6	-21.3	-100.0
Product Radial Stacker 2	8.1	7.4	7.1	8.9	8.5	8.4	2.7	-17.7	-100.0
Feeder Breaker - Chain drive	8.1	10.5	10.0	11.3	9.3	8.8	1.3	-21.4	-100.0
Feeder Breaker - Breaker drive	8.0	8.7	8.4	9.5	7.2	8.8	2.2	-20.0	-100.0
Light Plant	8.0	11.9	11.7	14.7	12.2	5.5	1.7	-18.2	-100.0
Product Radial Stacker 1	7.5	7.1	6.8	8.5	8.1	7.9	2.0	-19.2	-100.0
Feeder Breaker - Chain drive	7.5	10.5	9.9	11.0	9.5	8.0	0.2	-22.4	-100.0
CV-702	7.4	8.4	14.9	14.6	12.7	5.5	-3.1	-34.6	-100.0
Feeder Breaker - Breaker drive	6.7	8.7	8.2	9.6	7.4	7.4	0.0	-22.9	-100.0
Light Plant	6.6	11.3	10.8	14.1	11.5	4.6	-2.6	-25.4	-100.0
Feeder Breaker - Breaker drive	6.5	8.9	8.3	9.6	7.7	7.1	-0.4	-23.1	-100.0
CV-102	6.1	7.5	13.8	13.4	11.3	4.0	-4.6	-35.9	-100.0
Feeder Breaker - Breaker drive	5.9	8.9	8.2	9.3	7.8	6.4	-1.4	-24.0	-100.0
664 kw Dozer	5.9	10.6	22.6	20.8	0.9	-1.6	-13.6	-39.1	-100.0
CV-201	5.3	5.9	12.5	12.3	10.5	3.4	-5.1	-36.5	-100.0
Drill	4.3	14.6	10.2	19.3	5.5	-7.2	-15.1	-35.0	-100.0
Product Stackout Conveyor	3.6	5.9	5.4	6.6	5.5	4.0	-3.5	-26.0	-100.0
Diesel Pump	3.4	13.2	10.4	11.7	9.8	-0.8	-10.9	-31.9	-100.0
Diesel Pump	3.3	13.1	10.3	11.6	9.7	-1.0	-11.1	-31.8	-100.0
Sized Coal Conveyor	3.1	9.0	7.7	8.0	5.8	3.3	-5.0	-28.1	-100.0
122t Hoe	2.2	13.3	18.4	15.6	2.8	-2.7	-11.3	-30.8	-100.0
122t Hoe	2.1	13.2	18.3	15.5	2.7	-2.7	-11.3	-30.8	-100.0
Raw Coal Conveyor	1.9	8.6	7.1	7.1	4.6	2.0	-6.3	-29.2	-100.0
Bifurcated chute Diverter Gate Hydraulic Power Pack	1.4	5.9	6.5	6.2	4.6	0.1	-4.4	-28.3	-100.0
Feeder Breaker - cooling fan	1.2	10.7	13.4	11.5	4.3	-0.1	-10.7	-35.0	-100.0
Plant Feed Conveyor	0.9	6.7	5.5	5.8	3.6	1.1	-7.2	-30.3	-100.0
Feeder Breaker - cooling fan	0.7	10.9	13.3	11.6	4.7	-1.9	-13.4	-38.1	-100.0
Feeder Breaker - cooling fan	0.7	10.7	13.2	11.6	4.4	-1.6	-13.1	-38.0	-100.0
Drill	0.6	11.5	6.7	15.4	1.4	-10.2	-14.9	-33.4	-100.0
Feeder Breaker - cooling fan	0.4	10.8	13.2	11.3	4.8	-2.8	-14.5	-39.1	-100.0

Notes:

- Octave band sound levels are linear (i.e. not A-weighted)
- Only those noise sources which result in a contribution greater than 0.0 dBA at the receptor are shown

Resident R-301 (Project Year 18)

Noise Source	dBA		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Waste_Haul	23.1		25.0	35.8	33.8	26.6	21.1	10.1	-13.9	-100.0
Coal Haul	22.7		25.4	36.1	33.8	26.2	20.4	9.1	-15.5	-100.0
Coal Haul	22.1		25.2	35.7	33.3	25.6	19.7	8.5	-15.3	-100.0
490t Hoe	21.3		26.3	34.2	34.3	23.7	17.5	6.1	-23.8	-100.0
391 kw Dozer	20.7		17.5	28.8	36.6	10.2	4.9	-3.4	-31.5	-100.0
391 kw Dozer	20.7		17.5	28.8	36.6	10.2	5.0	-3.3	-31.2	-100.0
Waste_Haul	20.1		22.5	33.4	31.3	23.7	17.8	6.2	-19.1	-100.0
394t Hoe	19.2		23.9	31.8	32.0	21.6	15.7	4.9	-23.2	-100.0
664 kw Dozer	18.9		17.2	31.7	32.4	15.5	16.6	6.4	-20.4	-100.0
664 kw Dozer	18.9		17.2	31.7	32.4	15.5	16.7	6.4	-20.4	-100.0
391 kw Dozer	18.6		15.8	27.0	34.6	7.6	1.6	-8.2	-41.6	-100.0
Wheel Dozer	18.4		15.5	26.7	34.3	7.3	0.4	-10.3	-45.5	-100.0
490t Hoe	18.1		24.1	31.9	31.6	20.2	12.9	-0.7	-38.2	-100.0
Waste_Haul	17.7		19.5	30.5	28.6	21.2	15.6	4.2	-20.7	-100.0
664 kw Dozer	17.5		16.2	30.7	31.2	14.1	14.9	4.0	-25.4	-100.0
391 kw Dozer	17.4		14.8	26.0	33.3	6.0	-0.6	-11.5	-48.6	-100.0
Wheel Dozer	17.3		14.7	25.9	33.3	5.9	-0.7	-11.7	-49.0	-100.0
394t Hoe	16.6		22.2	30.0	29.9	18.9	12.2	-0.2	-33.8	-100.0
394t Hoe	16.0		21.9	29.7	29.5	18.3	11.2	-2.0	-37.3	-100.0
Waste_Haul	16.0		20.9	30.9	27.9	19.4	12.6	0.1	-26.4	-100.0
664 kw Dozer	15.3		14.9	29.3	29.7	12.1	11.3	-1.7	-36.7	-100.0
CV-801	13.7		12.0	19.0	19.6	18.6	12.3	4.5	-26.1	-100.0
Grader/Water	13.1		12.2	14.8	23.4	18.9	8.7	-3.1	-32.0	-100.0
122t Hoe	12.9		18.9	26.6	26.4	15.1	7.8	-5.6	-41.3	-100.0
CV-805	12.9		12.9	19.6	19.7	18.1	11.2	2.9	-28.0	-100.0
Grader/Water	12.5		11.9	14.3	22.8	18.4	8.1	-3.5	-31.6	-100.0
664 kw Dozer	12.2		12.7	26.9	26.8	8.2	7.0	-7.9	-51.0	-100.0
664 kw Dozer	12.1		12.6	26.9	26.8	8.1	7.0	-7.9	-51.1	-100.0
Grader/Water	12.0		10.7	13.4	22.2	17.9	7.9	-3.7	-32.2	-100.0
Grader/Water	11.9		14.3	25.1	22.9	15.0	10.0	-1.1	-25.4	-100.0
Diesel Pump	11.7		16.0	15.6	18.5	16.4	10.6	1.6	-26.9	-100.0
Grader/Water	11.2		11.0	13.2	21.6	17.2	6.6	-4.8	-32.2	-100.0
34t Hoe	11.1		17.1	24.9	24.6	13.3	6.0	-7.6	-45.0	-100.0
Diesel Pump	10.6		15.4	15.0	17.7	15.5	9.3	-0.1	-30.5	-100.0
Diesel Pump	10.5		15.3	14.9	17.7	15.4	9.2	-0.3	-30.9	-100.0
Locomotives for Train Loading	10.5		19.0	35.8	17.9	4.7	-3.7	-19.9	-59.1	-100.0
Drill	9.5		16.0	13.6	24.3	11.2	-1.7	-12.0	-45.6	-100.0
CV-802	9.1		9.5	16.0	16.0	14.3	7.4	-0.9	-31.3	-100.0
Product Stockpile Reclaim Conveyor	8.9		12.4	11.6	12.7	11.2	9.4	1.4	-21.9	-100.0
Drill	8.9		14.7	12.6	23.6	10.9	-1.3	-11.3	-48.9	-100.0
Drill	8.8		14.6	12.4	23.5	10.7	-1.5	-11.7	-49.7	-100.0
Diesel Pump	8.7		14.3	13.8	16.4	13.8	7.1	-3.4	-37.5	-100.0
Diesel Pump	8.7		14.3	13.9	16.5	13.9	7.2	-3.3	-37.2	-100.0
Wheel Loader	8.6		20.0	20.1	22.4	10.3	2.5	-5.2	-25.7	-100.0
CV-807 (Overland Conveyour)	8.5		11.6	17.6	16.6	13.8	6.1	-3.0	-35.9	-100.0
Drill	8.4		15.2	12.7	23.3	9.9	-3.4	-14.5	-50.8	-100.0
Diesel Pump	8.0		14.0	13.5	16.2	13.5	5.9	-6.2	-42.3	-100.0
Diesel Pump	6.8		13.3	12.8	15.2	12.2	4.9	-6.7	-44.4	-100.0
Diesel Pump	6.7		13.2	12.7	15.1	12.0	4.7	-7.0	-45.1	-100.0
Feeder Breaker - Chain drive	5.6		10.3	9.2	9.9	8.0	5.9	-2.2	-24.8	-100.0
Product Conveyor	5.3		9.7	8.7	9.5	7.6	5.6	-2.4	-24.8	-100.0
Feeder Breaker - Chain drive	5.0		10.3	9.0	9.5	7.5	5.2	-2.8	-25.2	-100.0
Feeder Breaker - Chain drive	4.0		10.1	8.6	8.8	6.6	4.2	-3.8	-25.7	-100.0
Feeder Breaker - Breaker drive	3.9		8.7	7.6	8.2	6.4	4.2	-3.9	-26.5	-100.0
Raw Coal Screen	3.8		16.6	19.0	15.3	6.3	1.3	-8.4	-30.1	-100.0
391 kw Dozer	3.7		6.3	14.7	19.6	-9.6	-19.3	-29.4	-63.9	-100.0
Feeder Breaker - Chain drive	3.4		9.9	8.3	8.4	6.0	3.6	-4.4	-26.1	-100.0
Light Plant	3.4		8.7	8.3	11.0	8.7	0.8	-5.7	-33.7	-100.0
Light Plant	3.4		8.6	8.3	11.0	8.7	0.8	-5.7	-33.8	-100.0
Feeder Breaker - Breaker drive	3.3		8.6	7.4	7.9	5.8	3.6	-4.5	-26.8	-100.0
Grader/Water	3.3		4.7	6.4	14.3	9.2	-2.5	-15.2	-45.1	-100.0
Light Plant	2.9		8.3	7.9	10.6	8.2	0.2	-6.1	-34.6	-100.0
Feeder Breaker - Breaker drive	2.4		8.4	6.9	7.2	4.9	2.6	-5.5	-27.4	-100.0
Product Radial Stacker 1	2.1		6.9	5.8	6.4	4.5	2.4	-5.7	-28.1	-100.0
Feeder Breaker - Breaker drive	1.8		8.3	6.6	6.7	4.4	2.0	-6.0	-27.7	-100.0
Light Plant	1.8		7.7	7.3	9.8	7.2	-1.1	-7.8	-38.2	-100.0
CV-702	1.5		5.1	10.5	9.4	6.9	-0.7	-9.6	-41.3	-100.0
CV-102	0.7		4.4	9.8	8.6	6.0	-1.6	-10.5	-42.1	-100.0
Product Radial Stacker 2	0.5		6.7	5.1	5.3	3.1	0.7	-7.3	-29.0	-100.0
Light Plant	0.3		6.7	6.0	9.0	6.2	-2.6	-14.9	-49.8	-100.0

Notes:

- Octave band sound levels are linear (i.e. not A-weighted)
- Only those noise sources which result in a contribution greater than 0.0 dBA at the receptor are shown

Resident R-302 (Project Year 18)

Noise Source	dBA		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Waste_Haul	26.2		27.7	38.5	36.5	29.4	24.5	15.2	-1.6	-60.1
Coal Haul	25.3		26.7	37.5	35.6	28.4	23.7	14.5	-3.1	-62.7
391 kw Dozer	24.6		20.9	32.3	40.5	14.8	9.8	3.1	-17.4	-100.0
391 kw Dozer	24.5		20.9	32.3	40.4	14.8	9.8	3.2	-17.3	-100.0
Coal Haul	23.5		25.8	36.2	33.9	26.7	21.7	12.3	-4.3	-62.1
Waste_Haul	23.4		24.7	35.6	33.8	26.5	21.7	12.1	-6.1	-65.9
394t Hoe	23.3		27.4	35.3	35.6	25.7	20.5	11.2	-9.4	-81.2
490t Hoe	23.0		29.4	36.9	36.6	24.6	18.0	7.0	-16.2	-100.0
391 kw Dozer	22.6		19.1	30.5	38.4	12.5	7.9	0.8	-23.0	-100.0
490t Hoe	22.4		27.0	34.9	35.1	24.7	18.9	8.1	-19.7	-100.0
394t Hoe	21.4		25.4	33.4	33.8	23.8	18.5	8.8	-15.2	-100.0
Waste_Haul	21.4		22.4	33.3	31.6	24.5	19.8	10.3	-7.7	-67.4
391 kw Dozer	21.0		17.7	29.1	36.9	10.6	5.5	-2.6	-30.0	-100.0
664 kw Dozer	20.9		19.7	34.1	34.9	17.7	17.7	7.8	-14.4	-100.0
Wheel Dozer	20.9		17.6	29.0	36.8	10.5	5.3	-2.9	-30.4	-100.0
391 kw Dozer	18.5		17.2	27.6	34.4	6.2	-2.1	-12.3	-40.8	-100.0
Diesel Pump	16.5		19.4	19.1	22.4	21.1	15.4	7.5	-13.8	-84.9
CV-801	16.2		12.2	19.5	20.5	20.3	15.2	8.8	-21.0	-100.0
Grader/Water	16.1		14.3	17.0	25.9	21.8	12.6	2.8	-18.8	-85.4
Diesel Pump	15.8		19.1	18.8	22.0	19.8	15.0	7.7	-13.8	-100.0
Grader/Water	15.6		13.5	16.2	25.2	21.2	12.1	2.5	-18.9	-85.4
664 kw Dozer	15.5		14.9	29.3	29.6	11.9	12.1	-0.1	-34.1	-100.0
664 kw Dozer	15.5		14.9	29.3	29.6	12.0	12.2	0.0	-33.9	-100.0
34t Hoe	15.4		20.0	28.0	28.1	17.8	12.0	1.3	-26.4	-100.0
Drill	15.4		27.8	25.8	29.6	16.7	7.3	3.0	-24.7	-100.0
CV-807 (Overland Conveyour)	15.2		14.6	21.8	21.9	20.3	13.6	5.0	-29.1	-100.0
CV-805	15.1		12.9	20.1	20.8	20.0	13.8	5.8	-25.9	-100.0
Wheel Dozer	15.0		15.4	25.0	31.0	2.1	-6.6	-17.2	-46.0	-100.0
Grader/Water	15.0		16.9	27.6	25.5	17.9	13.4	4.1	-13.0	-72.4
Grader/Water	14.9		13.2	15.7	24.5	20.5	11.3	2.0	-19.0	-85.4
664 kw Dozer	14.7		17.3	30.2	29.1	11.1	9.5	-1.4	-23.5	-100.0
664 kw Dozer	14.6		17.2	30.1	29.0	11.0	9.4	-1.5	-23.6	-100.0
Diesel Pump	14.4		17.6	17.3	20.4	18.8	13.5	5.7	-18.7	-100.0
Diesel Pump	14.3		17.6	17.2	20.3	18.7	13.4	5.2	-19.6	-100.0
Drill	12.9		17.5	15.5	27.1	15.4	4.6	-2.6	-30.4	-100.0
Diesel Pump	12.5		18.3	17.3	20.3	18.8	9.0	-0.7	-24.6	-100.0
Grader/Water	12.4		11.6	13.7	22.1	18.3	8.4	-1.1	-21.1	-85.4
394t Hoe	12.3		22.0	28.3	26.5	12.9	4.6	-8.6	-37.7	-100.0
CV-802	12.1		9.6	16.9	17.6	16.9	10.8	3.0	-28.1	-100.0
Diesel Pump	12.0		16.2	15.8	18.7	16.7	10.9	2.1	-25.8	-100.0
Locomotives for Train Loading	12.0		19.8	37.1	19.8	7.2	-0.7	-17.1	-61.7	-100.0
Waste_Haul	11.9		18.7	27.8	23.9	14.7	8.6	-1.6	-20.7	-100.0
Product Stockpile Reclaim Conveyor	11.8		12.2	11.9	13.5	12.9	12.3	5.6	-17.2	-100.0
Diesel Pump	11.8		16.1	15.7	18.6	16.5	10.7	1.8	-26.5	-100.0
664 kw Dozer	11.5		14.8	27.6	26.4	6.9	4.6	-8.1	-36.3	-100.0
Drill	9.8		17.4	14.6	24.9	10.7	-2.0	-11.0	-38.7	-100.0
Feeder Breaker - Chain drive	9.7		10.4	10.1	11.2	8.9	10.5	3.9	-18.3	-100.0
Product Conveyor	9.5		9.7	9.4	11.1	10.5	10.0	3.5	-18.5	-100.0
122t Hoe	9.1		18.9	25.2	23.4	9.7	1.4	-11.8	-40.8	-100.0
Feeder Breaker - Chain drive	8.3		10.4	9.9	11.3	9.1	9.1	1.7	-21.3	-100.0
Feeder Breaker - Chain drive	8.2		10.5	10.0	11.3	9.3	8.8	1.3	-21.3	-100.0
Product Radial Stacker 2	8.1		7.4	7.1	8.9	8.5	8.4	2.7	-17.7	-100.0
Feeder Breaker - Breaker drive	8.0		8.7	8.4	9.5	7.2	8.9	2.2	-20.0	-100.0
Light Plant	7.9		11.7	11.4	14.5	12.8	6.0	-0.6	-22.0	-100.0
Feeder Breaker - Chain drive	7.6		10.5	9.9	11.0	9.5	8.1	0.3	-22.3	-100.0
Product Radial Stacker 1	7.5		7.1	6.8	8.5	8.1	7.9	2.0	-19.2	-100.0
Feeder Breaker - Breaker drive	6.7		8.7	8.2	9.6	7.4	7.4	0.0	-22.9	-100.0
Wheel Loader	6.7		18.4	18.2	20.4	8.2	0.4	-5.0	-23.8	-100.0
Drill	6.6		16.1	12.2	21.7	7.0	-5.7	-14.1	-38.8	-100.0
Feeder Breaker - Breaker drive	6.5		8.9	8.3	9.6	7.7	7.2	-0.3	-23.0	-100.0
Feeder Breaker - Breaker drive	6.0		8.9	8.2	9.4	7.8	6.5	-1.2	-23.8	-100.0
Light Plant	5.8		11.0	10.3	13.6	11.5	3.2	-6.2	-29.7	-100.0
Light Plant	5.5		9.9	9.6	12.4	10.4	3.0	-2.1	-26.6	-100.0
Diesel Pump	3.8		13.7	11.5	13.2	10.1	-1.1	-12.7	-42.0	-100.0
Product Stackout Conveyor	3.6		5.9	5.4	6.6	5.5	4.1	-3.4	-25.9	-100.0
Light Plant	3.1		8.5	8.1	10.7	8.4	0.4	-5.7	-33.8	-100.0
Light Plant	2.6		8.1	7.7	10.3	7.9	-0.2	-6.6	-35.7	-100.0
Light Plant	2.3		8.0	7.6	10.2	7.7	-0.5	-7.0	-36.6	-100.0
Raw Coal Screen	2.1		15.4	17.6	13.6	4.5	-0.5	-10.0	-29.1	-100.0
CV-702	1.5		5.3	10.7	9.5	6.8	-0.8	-9.7	-40.8	-100.0
Bifurcated chute Diverter Gate Hydraulic Power Pack	1.4		5.9	6.5	6.2	4.6	0.1	-4.4	-28.3	-100.0
Feeder Breaker - cooling fan	1.2		10.7	13.4	11.5	4.3	-0.1	-10.7	-35.0	-100.0
Feeder Breaker - cooling fan	0.7		10.9	13.3	11.6	4.7	-1.8	-13.4	-38.0	-100.0
Feeder Breaker - cooling fan	0.7		10.7	13.2	11.6	4.4	-1.6	-13.0	-38.0	-100.0
Feeder Breaker - cooling fan	0.4		10.9	13.2	11.3	4.8	-2.7	-14.4	-39.0	-100.0

Notes:

- Octave band sound levels are linear (i.e. not A-weighted)
- Only those noise sources which result in a contribution greater than 0.0 dBA at the receptor are shown

Appendix VI AER NOISE IMPACT ASSESSMENT SHORT FORM

Licensee: **Benga Mining Limited**

Facility name: **Grassy Mountain Coal Project** Type: **Open Pit Coal Mine and Processing**

Legal location: **Townships 08 & 09, Ranges 03 & 04, W5M**

Contact: **Benga Mining: Steve Mallyon** Telephone: **(403) 753-5160**

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)
200 m	**East**	**40**	**10**	**0**	**0**	**40**	**50**
130 m	**East**	**40**	**10**	**0**	**0**	**40**	**50**
1,110 m	**Southwest**	**40**	**10**	**0**	**0**	**40**	**50**
370 m	**South**	**48**	**10**	**0**	**0**	**48**	**58**

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			

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)
N/A			

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:

All equipment at Central Processing Plant assumed operating at full load all the time. Mining equipment operations vary depending on specific piece of equipment. Refer to Appendix I for more details.

4. Modelling Parameters

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

Ground absorption 0.7, Temperature 10^{0}C, 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):

Resident R-301 (200 m East of Mine Permit Boundary)
Modeled L_{eq}-Night = **37.7 dBA**, ASL-Night = **35.0 dBA**, Overall L_{eq}-Night = **39.6 dBA**, PSL-Night: **40 dBA**
Modeled L_{eq}-Day = **37.8 dBA**, ASL-Day = **45.0 dBA**, Overall L_{eq}-Day = **45.8 dBA**, PSL-Day: **50 dBA**

Resident R-302 (130 m East of Mine Permit Boundary)
Modeled L_{eq}-Night = **38.2 dBA**, ASL-Night = **35.0 dBA**, Overall L_{eq}-Night = **39.9 dBA**, PSL-Night: **40 dBA**
Modeled L_{eq}-Day = **38.2 dBA**, ASL-Day = **45.0 dBA**, Overall L_{eq}-Day = **45.8 dBA**, PSL-Day: **50 dBA**

Resident R-030 (1,110 m Southwest of Mine Permit Boundary)
Modeled L_{eq}-Night = **38.1 dBA**, ASL-Night = **35.0 dBA**, Overall L_{eq}-Night = **39.8 dBA**, PSL-Night: **40 dBA**
Modeled L_{eq}-Day = **38.1 dBA**, ASL-Day = **45.0 dBA**, Overall L_{eq}-Day = **45.8 dBA**, PSL-Day: **50 dBA**

Resident R-042 (370 m South of Mine Permit Boundary)
Modeled L_{eq}-Night = **44.6 dBA**, ASL-Night = **43.0 dBA**, Overall L_{eq}-Night = **46.9 dBA**, PSL-Night: **48 dBA**
Modeled L_{eq}-Day = **44.6 dBA**, ASL-Day = **53.0 dBA**, Overall L_{eq}-Day = **53.6 dBA**, PSL-Day: **58 dBA**

Is the predicted sound level less than the permissible sound level? **YES** 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:
- **Routing of Haul Trucks on west side of southern Waste Area to take advantage of shielding**
- **Construct the waste rock piles such that the eastern-most areas are built-up during the day-time and then the night-time waste rock activities are further to the west and at lower elevations, using the eastern-most piles as a natural noise barrier.**

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 nonroutine.

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

Advising nearby residents of significant noise sources and appropriately scheduling
Mufflers on all internal combustion engines
Taking advantage of acoustical screening

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

Company: **ACI Acoustical Consultants Inc.**

Title: **Director**

Telephone: **(780) 414-6373** Date: **June 28, 2016**

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www.aciacoustical.com

Environmental Noise Impact Assessment Summary

For The

Grassy Mountain Coal Project
Rail Alignment and Loadout Components

Prepared for:

Benga Mining Limited

Prepared by:
S. Bilawchuk, M.Sc., P.Eng.
aci Acoustical Consultants Inc.
Edmonton, Alberta
APEGA Permit to Practice #P7735

aci Project #: 14-037
June 28, 2016

Executive Summary

aci Acoustical Consultants Inc., of Edmonton AB, was retained by Benga Mining Limited (Benga) to prepare a Noise Impact Assessment Summary (NIA Summary) for the Grassy Mountain Coal Project, particularly the rail alignment and loadout components (the Project). The purpose of the NIA Summary was to conduct Baseline noise monitoring within Blairmore and to generate a computer noise model of the study area. The predicted noise levels of the rail alignment and loadout were added to the existing baseline/measured levels to determine the total project noise levels. A number of residential receptors were identified around Blairmore and Coleman, and were used in the predictive noise model to determine the relative impact of the Project on the local noise climate.

The background noise monitoring results for night-time ranged from 47.1 – 51.6 dBA. The predicted background noise results generated by the model matched very well with actual measurements. The night time modeling results for the 68 receptors varied from 30.0 – 53.7 dBA, due primarily to their relative proximity to the area roadways (in particular Highway 3) and the rail line. Similarly, the modeled day-time noise levels ranged from 34.8 – 56.4 dBA.

The existing noise levels are expected to increase slightly at each receptor when the rail alignment and loadout are operational. For most of the receptors, the predicted night time noise increase is less than 2.0 dBA which is considered a minimal increase. The maximum increase was predicted to be +4.1 dBA. For most of the receptors, the predicted day time noise increase is less than 2.0 dBA which is considered a minimal increase. The maximum increase was predicted to be +2.5 dBA.

It is common and generally accepted practice to set +5.0 dBA as a maximum tolerable increase in noise levels for residential receptors. Any increase in noise levels above 5 dBA are expected to be noticed by the residential receptors. This guidance is provided by the Alberta Energy Regulator (AER) in Directive 038. All the relative night-time increase in noise levels are considered to be within acceptable limits.

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1.0 Introduction

aci Acoustical Consultants Inc., of Edmonton AB, was retained by Benga Mining Limited (Benga) to prepare a project component specific Noise Impact Assessment Summary (NIA Summary) for the Grassy Mountain Coal Project; particularly the proposed rail alignment and associated loadout components (for the purposes of this summary these components are herein referred to as 'the Project'). The purpose of the NIA Summary was to conduct Baseline noise monitoring within Blairmore and to generate a computer noise model of the study area. The predicted noise levels of the rail alignment and loadout were added to the existing baseline/measured levels to determine the total project noise levels. A number of residential receptors were identified around Blairmore and Coleman, and were used in the predictive noise model to determine the relative impact of the Project on the local noise climate. It is important to note that this NIA Summary is not mandated under the Alberta Energy Regulatory (AER) Directive 038, rather a standalone study.

2.0 Description

2.1. Location

The Project is located in southwest Alberta, approximately 150 km south of Calgary in the Crowsnest Pass, near the town of Blairmore. The proposed Grassy Mountain Coal Project, which includes the mining development and Coal Handling and Processing Plant (CHPP) is located approximately 7 km north of Blairmore. Coal from the mine will be transported by a covered overland conveyor to a rail alignment and loadout facility located immediately north of Highway 3 in Blairmore (Figure 1).

Highway 3 runs along the north-end of the Town of Blairmore and through the middle of Coleman. Information obtained from the Alberta Transportation website indicates that Highway 3 has an average summer daily traffic (ASDT) volume of 8,320 vehicles with approximately 14% heavy vehicles. In addition, the Canadian Pacific (CP) Rail line runs parallel to the south of Highway 3, through the middle of Blairmore and the southern portion of Coleman. Information from CP Rail indicates eight to ten trains per day (day-time and night-time)

The noise modeling results cover all of the residential receptors (Figure 1) within Blairmore and the eastern half of Coleman. The noise modeling results are shown on Figures 2 to 6. Even if there is not a specific modeling noise receptor for each residential receptor, the colour noise contours cover the entire area and all residential receptors contained within (Figures 2 to 6).

The noise study has incorporated digital elevation contours into the noise model. Trees have also been incorporated into the noise model as they are able to attenuate noise. This was determined with the use of the high-resolution aerial photos and observations during the site visits.

2.2. Operations

The most significant components of the rail alignment and loadout that have noise sources are:

- enclosed overland conveyor;
- 300 tonne surge bin that transfers coal with a vibratory feeder to the loadout bin (loadout); and
- rail alignment with locomotives hauling train cars.

The primary sources of background noise in the area are from the Highway 3 traffic and the existing rail traffic.

3.0 Monitoring and Modeling Methods

3.1. Baseline/Background Noise Monitoring

As part of the study, long-term Baseline noise monitoring was conducted within the area surrounding the Project, at three locations (Figure 7). The purpose for the noise monitoring was to determine the Baseline noise levels associated with the existing area noise sources (i.e. roads and Rail Line). This information was also used as a calibration/verification for the computer noise model for the Baseline conditions. Note that the noise monitoring was conducted in late winter (March 2016). There was no snow cover on the ground and there was no foliage on the trees.

The *East* noise monitor was located near the east end within the Municipal Yard (south of Highway 3 and in between the Hospital and 129 Street) (Figure 7) The noise monitor was placed in-line with 123 Street, approximately 52 m north of 22 Avenue (Figure 8). This placed the noise monitor approximately 175 m south of Highway 3 and 335 m north of the Rail Line and approximately 73 m from the nearest residential structure. The noise monitor was located in this spot to keep it open towards Highway 3 without having a significant influence from local traffic and other activity at the houses along 22 Avenue. The noise monitor was started at 15:00 on March 02, 2016 and ran for approximately 15-days until 13:00 on March 17, 2016.

The *West* noise monitor was located near the west end within the Municipal Yard (south of Highway 3 and in between the Hospital and 129 Street) (Figure 7). The noise monitor was placed in between 113 and 115 Streets, approximately 42 m north of 22 Avenue (Figure 9). This placed the noise monitor approximately 300 m south of Highway 3 and 300 m northeast of the Rail Line and approximately 57 m from the nearest residential structure. The noise monitor was located in this spot to keep it open towards Highway 3 without having a significant influence from local traffic and other activity at the houses along 22 Avenue. The noise monitor was started at 15:00 on March 02, 2016 and ran for approximately 15-days until 12:00 on March 17, 2016. In addition, a portable weather monitoring station was placed adjacent to the noise monitor to obtain accurate local weather data for the study area for the duration of the noise monitoring.

The *Hospital* noise monitor was located directly adjacent to the Hospital, in the northeast corner (Figure 7). The noise monitor was placed approximately 6 m north of the Hospital in an open area beside the northeast wing (Figure 10). This placed the noise monitor approximately 53 m south of Highway 3 and 350 m northeast of the Rail Line. The noise monitor was located in this spot to keep it open towards Highway 3 which is the dominant Baseline noise source for the Hospital. The noise monitor was started at 15:00 on March 02, 2016 and ran for approximately 15-days until 14:00 on March 17, 2016.

Refer to Appendix I for a detailed description of the measurement equipment used, Appendix II for a description of the acoustical terminology, and Appendix III for a list of common noise sources. All noise measurement instrumentation was calibrated at the start of the measurements and then checked afterwards to ensure that there had been no calibration drift over the duration of the measurements.

3.2. Computer Noise Modeling

The computer noise Modeling was conducted using the CADNA/A (version 4.6.153) software package. CADNA/A allows for the Modeling of various noise sources such as road, rail, and various stationary sources. In addition, topographical features such as land contours, vegetation, and bodies of water can be included. Meteorological conditions such as temperature, relative humidity, wind-speed and wind-direction can be included in the calculations.

The noise sources for the equipment associated with Project were obtained from:

- Noise measurements conducted at other similar mines using similar or identical operating equipment,
- In-house information and calculations using methods presented in various texts or, and
- Sound level information provided by equipment suppliers/manufacturers.

The noise sources for the area road traffic were obtained from the Alberta Transportation website. It is important to note that the noise model uses average annual daily traffic (AADT) traffic volumes which would have been present during the noise monitoring. Information from Alberta Transportation indicates that the typical average summer daily traffic (ASDT) is approximately 25% greater than the AADT. In the summer months, the noise levels associated with Highway 3 will be approximately 1.0 dBA higher than what was measured during the baseline noise monitoring. The noise sources for the Rail Line were obtained from information provided by CP Rail. Refer to Appendix IV for a detailed list of the noise modeling parameters.

As part of the NIA Summary, three noise modeling scenarios were conducted, including:

- Baseline/background: all existing area noise sources associated with Highway 3, the Rail Line, 20 Avenue in Blairmore, and other associated noise.
- Project-only: all noise sources associated with the Project for Year 01 including the Mining activity to the north as well as the Overland Conveyor and all noise sources associated with the Rail Loadout, without any of the existing area noise sources.
- Combined: all noise sources associated with the baseline/background combined with the Project noise sources.

The computer noise Modeling results were calculated in two ways. First, sound levels were calculated at specific residential receiver locations. Next, the sound levels were calculated using a 20 m x 20 m grid over the entire study area. This provided color noise contours for easier visualization of the results (Figures 2 to 6).

The noise associated with the proposed re-building of the displaced sections of the golf course (located to the northwest of the existing golf course area) has not been included in the updated predictions. The golf course construction noises will largely be associated with earth moving equipment that will operate during the day-time only and will occur for a short period of time (relative to the operation of the Project). Relative to the day-time noise associated with area vehicle and train traffic, the construction associated with the golf course will be minimal and it is not common practice to consider environmental noise associated with such construction activities.

4.0 Results and Discussion

4.1. Baseline Noise Monitoring

The Baseline noise monitoring was conducted for 15 days. Out of the 15 days, a total of six different periods were selected in which the weather conditions were considered acceptable to use the noise monitoring data. This included periods with relatively low wind speeds and no precipitation which resulted in a total of 30 day-time hours and 49 night-time hours that were used for the assessment. In addition to the measured noise level data, each of the noise monitors simultaneously recorded digital audio for the entire monitoring period. This audio was used to identify, isolate, and remove non-typical events such as excessively loud vehicles passing by on nearby roads, and mechanical activity near the Hospital (likely associated with an emergency generator). Refer to Appendix V for a list of the isolated noise monitoring data and Appendix VI for the weather monitoring data during the assessed periods. Relative to the entire 30 day-time and 49 night-time hours of assessed data, only minimal data was removed resulting in the difference between the non-isolated and the isolated data ranging between 0.0 to 0.1 dBA. In addition, the audio was used to identify and separate the noise associated with train passages. The isolated Energy Equivalent Sound Level (L_{eq}) average results for the day-time and night-time assessed periods with and without the Trains are provided in Table 1. The contribution from the Trains was isolated so that the specific noise impacts associated with the Highway and Trains could be determined independently for more accurate noise modeling. The isolated noise monitoring traces for each of the three locations for all of the 30 day-time and 49 night-time hours are provided in Figures 11 to 16.

Table 1. Baseline Noise Monitoring Results

	L_{eq}Day (dBA)	L_{eq}Day (dBC)		L_{eq}Night (dBA)	L_{eq}Night (dBC)
Noise Monitor East					
Overall Leq (Isolated Data)	49.2	58.5		47.1	54.5
Overall Leq (Trains Removed)	47.1	57.5		44.3	52.8
Difference (With - Without Trains)	2.1	1.0		2.9	1.7
Noise Monitor West					
Overall Leq (Isolated Data)	52.8	61.5		50.4	58.0
Overall Leq (Trains Removed)	49.7	58.9		47.3	54.1
Difference (With - Without Trains)	3.1	2.5		3.1	3.9
Noise Monitor Hospital					
Overall Leq (Isolated Data)	56.8	66.6		51.6	62.0
Overall Leq (Trains Removed)	56.6	66.3		50.9	61.6
Difference (With - Without Trains)	0.2	0.3		0.8	0.4

For both the day-time and night-time periods, the monitored dBA noise levels with the Trains removed were lower than those with the Trains intact by 0.2 to 3.1 dBA. The differences at each of the noise monitoring stations are as follows:

- West noise monitoring station – 3.1 dBA
- East noise monitoring station – 2.1 dBA
- Hospital monitoring station – 0.2 dBA

The typical A-weighted (dBA) sound levels and the C-weighted (dBC) sound levels were also measured. When measuring sound levels, the A-weighting is used to correspond to how the human ear perceives broadband sounds, particularly those within the amplitude range associated with environmental noise. The human ear significantly reduces low frequency sounds (under 200 Hz) relative to middle and high frequency sounds. The A-weighting does the same thing to the measured sound levels. Alternatively, the C-weighting does not reduce the low frequency noise as much as the A-weighting and is often used, along with the A-weighting results to determine if there is a significant low frequency component to the measured sound levels. If the difference between the dBC and the dBA sound levels are substantial (approximately 15 – 20 dB) then there is a likelihood of a notable low frequency component to the sound levels. Low frequency sounds tend to have a higher annoyance factor because they travel farther with less distance attenuation and transmit through walls/windows into residential structures easier than middle to high frequency sounds.

For the monitored results in this instance, the difference between the monitored dBC – dBA sound levels ranged from approximately 7 – 10 dB (largely associated with heavy trucks on the Highway and diesel locomotives on the Rail Line). This is important because it indicates that there is already a notable amount of low frequency noise within the area without having a dominant low frequency noise. The noise sources associated with the Project also have a notable amount of low frequency noise which will be less intrusive relative to the existing conditions than if there was very little existing low frequency noise.

In addition to the broadband dBA and dBC noise data, the 1/3-Octave band frequency noise levels were also monitored. 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. As mentioned previously, human hearing is not very sensitive to low frequency sounds, is very sensitive to middle frequency sounds and is slightly less sensitive to very 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 1/3-Octave band noise monitoring results for all three locations are provided in Figures 17 to 19. The results indicate notable low frequency noise (near 63 – 80 Hz) associated with heavy truck engine/exhaust noise on the Highway and the diesel locomotive noise on the rail line as well as notable mid frequency noise (near 800 – 1,000 Hz) associated with tire noise from all vehicles on the highway. This is important because it indicates that there is already a notable amount of low frequency noise within the area.

4.2. Noise Modeling Results

The baseline noise modeling and monitoring results at the three noise monitoring locations are provided in Table 2. There is good corroboration between the modeled and monitored results with the modeled noise levels generally being slightly lower than the modeled results (i.e. more conservative). A lower baseline noise level will indicate a larger impact associated with the Project than a higher baseline noise level. There is generally a larger difference between modelled and monitored results when the trains are included because the train horn is more variable and random than the train passages themselves and the vehicle traffic on the roadways (in particular, as it pertains to the length of time the horn sounds, the number of blasts, etc.).

Table 2. Baseline Noise Modeling Results at Noise Monitoring Locations

	Monitored L_{eq}Night (dBA)	Modeled L_{eq}Night (dBA)	Difference (dBA)		Monitored L_{eq}Day (dBA)	Modeled L_{eq}Day (dBA)	Difference (dBA)
***East* Noise Monitor**							
Overall Leq (Isolated Data)	47.1	47.1	0.0		49.2	49.3	0.1
Overall Leq (Trains Removed)	44.3	44.3	0.0		47.1	47.6	0.5
***West* Noise Monitor**							
Overall Leq (Isolated Data)	50.4	49.6	-0.8		52.8	51.2	-1.6
Overall Leq (Trains Removed)	47.3	47.3	0.0		49.7	49.5	-0.2
***Hospital* Noise Monitor**							
Overall Leq (Isolated Data)	51.6	51.4	-0.2		56.8	55.8	-1.0
Overall Leq (Trains Removed)	50.9	50.9	0.0		56.6	55.6	-1.0

The predicted noise modeling results for each of the 68 receptors are provided in Table 3 and shown on Figures 2 to 6. The information within Table 3 is divided into night-time results (left half of table) and day-time results (right half of table). For each receptor, the noise model predicted the existing noise levels, the noise levels from the project only and then the combined noise levels of the background conditions with the project contributions added. Predictions were made for both night time and day time conditions. During the night-time, the existing baseline noise levels at most locations are greater than the Project-only. The exceptions to this are highlighted in orange in Table 3. There are five locations where the Project-only noise will be higher than the Baseline noise due to the mine, rail alignment and loadout. The existing noise levels are expected to increase slightly at each receptor when the rail alignment and loadout are operational. For most of the receptors, the predicted noise increase is less than 2.0 dBA which is considered a minimal increase. The receptors with relative increases higher than 2.0 dBA are highlighted in yellow (11). The maximum increase was predicted to be +4.1 dBA.

During the day-time, the predicted background noise levels at each receptor are greater than noise predictions from the Project-only. The existing noise levels are expected to increase slightly at each receptor when the rail alignment and loadout are operational. For most of the receptors, the predicted noise increase is less than 2.0 dBA which is considered a minimal increase. The receptors with relative increases higher than 2.0 dBA are highlighted in yellow (4). The maximum increase was predicted to be +2.5 dBA.

It is common and generally accepted practice to set +5.0 dBA as a maximum tolerable increase in noise levels for residential receptors. Any increase in noise levels above 5 dBA are expected to be noticed by the residential receptors. This guidance is provided by the Alberta Energy Regulator (AER) in Directive 038. All the relative night-time increase in noise levels are considered to be within acceptable limits. Subsequently, the noise modeling results indicate that the noise levels associated with the Project will be below the permissible sound levels prescribed by the AER Directive 038.

Table 3. Baseline, Project-only and Combined Case Noise Modeling Results

Receptor (Distance From MPB)	Night Time					Day-Time				
	Baseline Case L_{eq}Night (dBA)	Project-only Case L_{eq}Night (dBA)	Difference (dBA)	Combined L_{eq}Night (dBA)	Relative Increase (dBA)	Baseline Case L_{eq}Day (dBA)	Project – only Case L_{eq}Day (dBA)	Difference (dBA)	Combined L_{eq}Day (dBA)	Relative Increase (dBA)
R-001 (1,025 m)	30.3	32.3	2.0	34.4	4.1	34.8	32.4	-2.4	36.8	2.0
R-002 (950 m)	30.8	32.8	2.0	34.9	4.1	35.2	32.9	-2.3	37.2	2.0
R-003 (1,000 m)	31.5	32.0	0.5	34.8	3.3	36.0	32.1	-3.9	37.5	1.5
R-004 (1,025 m)	32.0	32.0	0.0	35.0	3.0	36.6	32.1	-4.5	37.9	1.3
R-005 (1,035 m)	32.7	32.1	-0.6	35.4	2.7	37.2	32.2	-5.0	38.4	1.2
R-006 (890 m)	38.3	32.7	-5.6	39.4	1.1	42.6	32.8	-9.8	43.0	0.4
R-007 (990 m)	39.8	29.3	-10.5	40.2	0.4	44.2	29.3	-14.9	44.3	0.1
R-008 (950 m)	39.8	29.0	-10.8	40.1	0.3	44.3	29.1	-15.2	44.4	0.1
R-009 (840 m)	42.2	30.5	-11.7	42.5	0.3	46.5	30.5	-16.0	46.6	0.1
R-010 (610 m)	49.1	31.9	-17.2	49.2	0.1	53.4	32.0	-21.4	53.4	0.0
R-011 (440 m)	48.8	31.9	-16.9	48.9	0.1	53.0	31.9	-21.1	53.0	0.0
R-012 (350 m)	46.1	33.0	-13.1	46.3	0.2	49.5	33.0	-16.5	49.6	0.1
R-013 (660 m)	53.7	32.0	-21.7	53.7	0.0	56.2	32.0	-24.2	56.2	0.0
R-014 (480 m)	52.6	32.6	-20.0	52.6	0.0	54.3	32.6	-21.7	54.3	0.0
R-015 (550 m)	44.8	33.3	-11.5	45.1	0.3	47.4	33.3	-14.1	47.6	0.2
R-016 (1,090 m)	41.1	31.8	-9.3	41.6	0.5	43.6	31.8	-11.8	43.9	0.3
R-017 (925 m)	41.1	32.5	-8.6	41.7	0.6	43.7	32.5	-11.2	44.0	0.3
R-018 (750 m)	41.0	32.3	-8.7	41.5	0.5	43.8	32.3	-11.5	44.1	0.3
R-019 (1,050 m)	38.1	31.6	-6.5	39.0	0.9	40.9	31.6	-9.3	41.4	0.5
R-020 (1,090 m)	37.8	31.9	-5.9	38.8	1.0	40.6	31.9	-8.7	41.1	0.5
R-021 (890 m)	39.9	32.5	-7.4	40.6	0.7	42.8	32.5	-10.3	43.2	0.4
R-022 (960 m)	39.7	33.1	-6.6	40.6	0.9	42.5	33.0	-9.5	43.0	0.5
R-023 (840 m)	40.4	37.9	-2.5	42.3	1.9	43.6	37.9	-5.7	44.6	1.0
R-024 (820 m)	41.8	39.3	-2.5	43.7	1.9	44.5	39.3	-5.2	45.6	1.1
R-025 (870 m)	40.0	39.3	-0.7	42.7	2.7	43.0	39.3	-3.7	44.5	1.5
R-026 (1,010 m)	39.2	38.7	-0.5	42.0	2.8	41.9	38.7	-3.2	43.6	1.7
R-027 (1,100 m)	39.6	38.8	-0.8	42.2	2.6	41.8	38.8	-3.0	43.6	1.8
R-028 (940 m)	41.3	38.9	-2.4	43.3	2.0	43.3	38.9	-4.4	44.6	1.3
R-029 (980 m)	41.1	39.8	-1.3	43.5	2.4	43.0	39.8	-3.2	44.7	1.7
R-030 (1,110 m)	37.0	38.1	1.1	40.6	3.6	39.7	38.1	-1.6	42.0	2.3
R-031 (1,190 m)	35.6	37.5	1.9	39.7	4.1	38.5	37.5	-1.0	41.0	2.5
R-032 (530 m)	49.1	42.3	-6.8	49.9	0.8	50.6	42.3	-8.3	51.2	0.6
R-033 (600 m)	48.2	42.1	-6.1	49.2	1.0	49.7	42.1	-7.6	50.4	0.7
R-034 (600 m)	49.3	42.5	-6.8	50.1	0.8	50.7	42.5	-8.2	51.3	0.6
R-035 (670 m)	47.3	42.0	-5.3	48.4	1.1	48.7	42.0	-6.7	49.5	0.8
R-036 (570 m)	53.3	43.1	-10.2	53.7	0.4	54.4	43.1	-11.3	54.7	0.3
R-037 (720 m)	48.2	42.3	-5.9	49.2	1.0	49.5	42.3	-7.2	50.3	0.8
R-038 (640 m)	52.9	43.0	-9.9	53.3	0.4	53.9	43.0	-10.9	54.2	0.3
R-039 (380 m)	49.1	42.3	-6.8	49.9	0.8	50.9	42.3	-8.6	51.5	0.6
R-040 (370 m)	48.7	44.2	-4.5	50.0	1.3	50.5	44.2	-6.3	51.4	0.9
R-041 (370 m)	48.4	44.5	-3.9	49.9	1.5	50.4	44.5	-5.9	51.4	1.0
R-042 (370 m)	48.3	44.6	-3.7	49.8	1.5	50.3	44.6	-5.7	51.3	1.0
R-043 (370 m)	48.3	44.7	-3.6	49.9	1.6	50.3	44.7	-5.6	51.4	1.1
R-044 (360 m)	48.3	44.6	-3.7	49.8	1.5	50.3	44.6	-5.7	51.3	1.0
R-045 (350 m)	48.2	44.5	-3.7	49.7	1.5	50.3	44.5	-5.8	51.3	1.0
R-046 (340 m)	48.3	44.5	-3.8	49.8	1.5	50.3	44.5	-5.8	51.3	1.0
R-047 (380 m)	48.9	44.6	-4.3	50.3	1.4	50.9	44.6	-6.3	51.8	0.9
R-048 (360 m)	48.9	44.2	-4.7	50.2	1.3	50.9	44.2	-6.7	51.7	0.8
R-049 (350 m)	49.0	43.5	-5.5	50.1	1.1	51.0	43.5	-7.5	51.7	0.7
R-050 (330 m)	48.9	43.1	-5.8	49.9	1.0	51.0	43.1	-7.9	51.7	0.7
R-051 (280 m)	48.4	41.6	-6.8	49.2	0.8	50.4	41.6	-8.8	50.9	0.5
R-052 (270 m)	48.4	40.4	-8.0	49.0	0.6	50.4	40.4	-10.0	50.8	0.4
R-053 (260 m)	48.5	39.0	-9.5	49.0	0.5	50.4	39.0	-11.4	50.7	0.3
R-054 (250 m)	48.5	38.1	-10.4	48.9	0.4	50.5	38.1	-12.4	50.7	0.2
R-055 (240 m)	48.5	37.5	-11.0	48.8	0.3	50.6	37.5	-13.1	50.8	0.2
R-056 (300 m)	49.8	38.5	-11.3	50.1	0.3	51.7	38.5	-13.2	51.9	0.2
R-057 (250 m)	49.5	35.9	-13.6	49.7	0.2	51.6	35.9	-15.7	51.7	0.1
R-058 (210 m)	49.2	35.6	-13.6	49.4	0.2	51.6	35.6	-16.0	51.7	0.1
R-059 (110 m)	48.9	35.5	-13.4	49.1	0.2	52.5	35.5	-17.0	52.6	0.1
R-060 (80 m)	50.3	35.1	-15.2	50.4	0.1	54.5	35.1	-19.4	54.5	0.0
R-061 (110 m)	49.7	35.1	-14.6	49.8	0.1	53.6	35.1	-18.5	53.7	0.1
R-062 (90 m)	51.3	35.0	-16.3	51.4	0.1	55.6	35.0	-20.6	55.6	0.0
R-063 (90 m)	52.0	34.8	-17.2	52.1	0.1	56.4	34.8	-21.6	56.4	0.0
R-064 (170 m)	49.2	34.9	-14.3	49.4	0.2	52.2	34.9	-17.3	52.3	0.1
R-065 (170 m)	49.3	34.6	-14.7	49.4	0.1	52.5	34.6	-17.9	52.6	0.1
R-066 (130 m)	50.2	34.5	-15.7	50.3	0.1	54.0	34.5	-19.5	54.0	0.0
R-067 (130 m)	51.5	34.2	-17.3	51.6	0.1	54.8	34.2	-20.6	54.8	0.0
Hospital (70 m)	51.1	44.0	-7.1	51.9	0.8	55.0	44.4	-10.6	55.4	0.4

5.0 Summary

The background noise monitoring results for night-time ranged from 47.1 – 51.6. The predicted background noise results generated by the model matched very well with actual measurements. The night time modeling results for the 68 receptors varied from 30.0 – 53.7 dBA, due primarily to their relative proximity to the area roadways (in particular Highway 3) and the rail line. Similarly, the modeled day-time noise levels ranged from 34.8 – 56.4 dBA.

The existing noise levels are expected to increase slightly at each receptor when the rail alignment and loadout are operational. For most of the receptors, the predicted night time noise increase is less than 2.0 dBA which is considered a minimal increase. The maximum increase was predicted to be +4.1 dBA. For most of the receptors, the predicted day time noise increase is less than 2.0 dBA which is considered a minimal increase. The maximum increase was predicted to be +2.5 dBA.

It is common and generally accepted practice to set +5.0 dBA as a maximum tolerable increase in noise levels for residential receptors. Any increase in noise levels above 5 dBA are expected to be noticed by the residential receptors. This guidance is provided by the Alberta Energy Regulator (AER) in Directive 038. All the relative night-time increase in noise levels are considered to be within acceptable limits.

6.0 References

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- 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.
- *Engineering Noise Control, Theory and Practice*. David A. Bies and Colin H. Hansen, 2003, Spon Press
- *Noise and Vibration Control Engineering, Principles and Applications*. Istvan L. Ver and Leo L. Beranek, 2006, John Wiley & Sons Inc.
- *Industrial Noise Control and Acoustics*. Randall F. Barron, 2003, Marcel Dekker Inc.

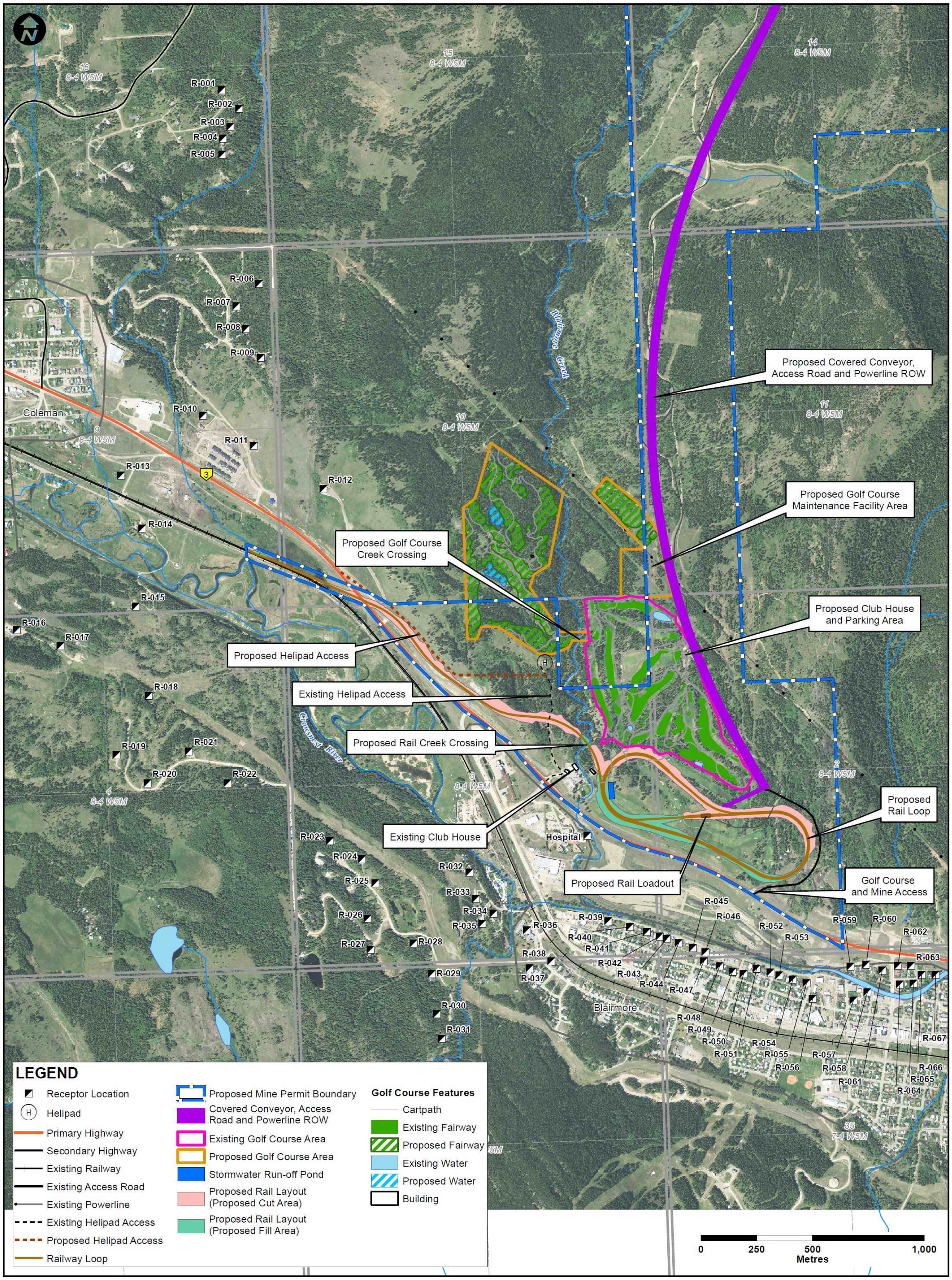


Figure 1. Overall Study Area and Receptor Locations

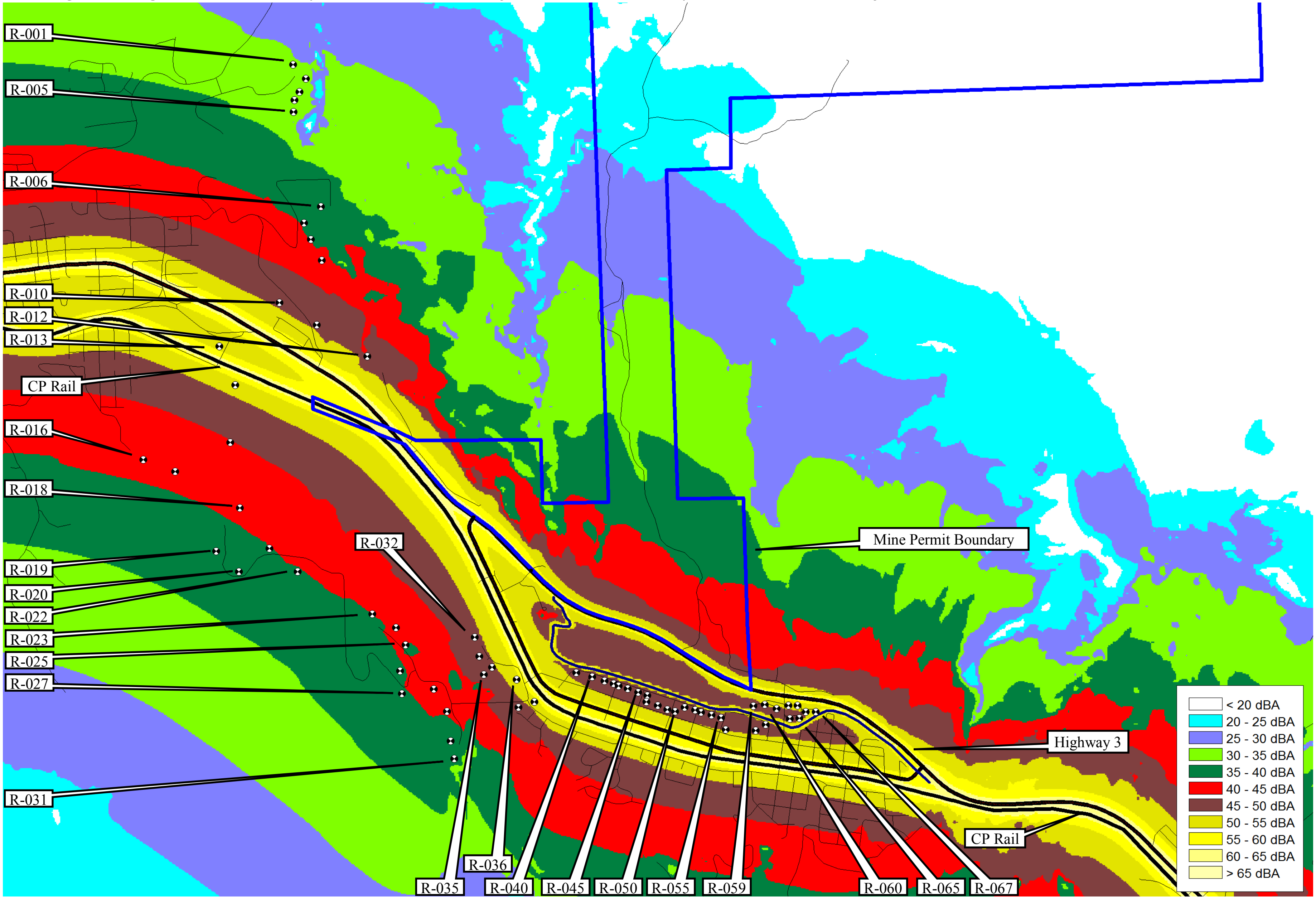


Figure 2. Baseline Case Noise Modeling Results (Night-Time)

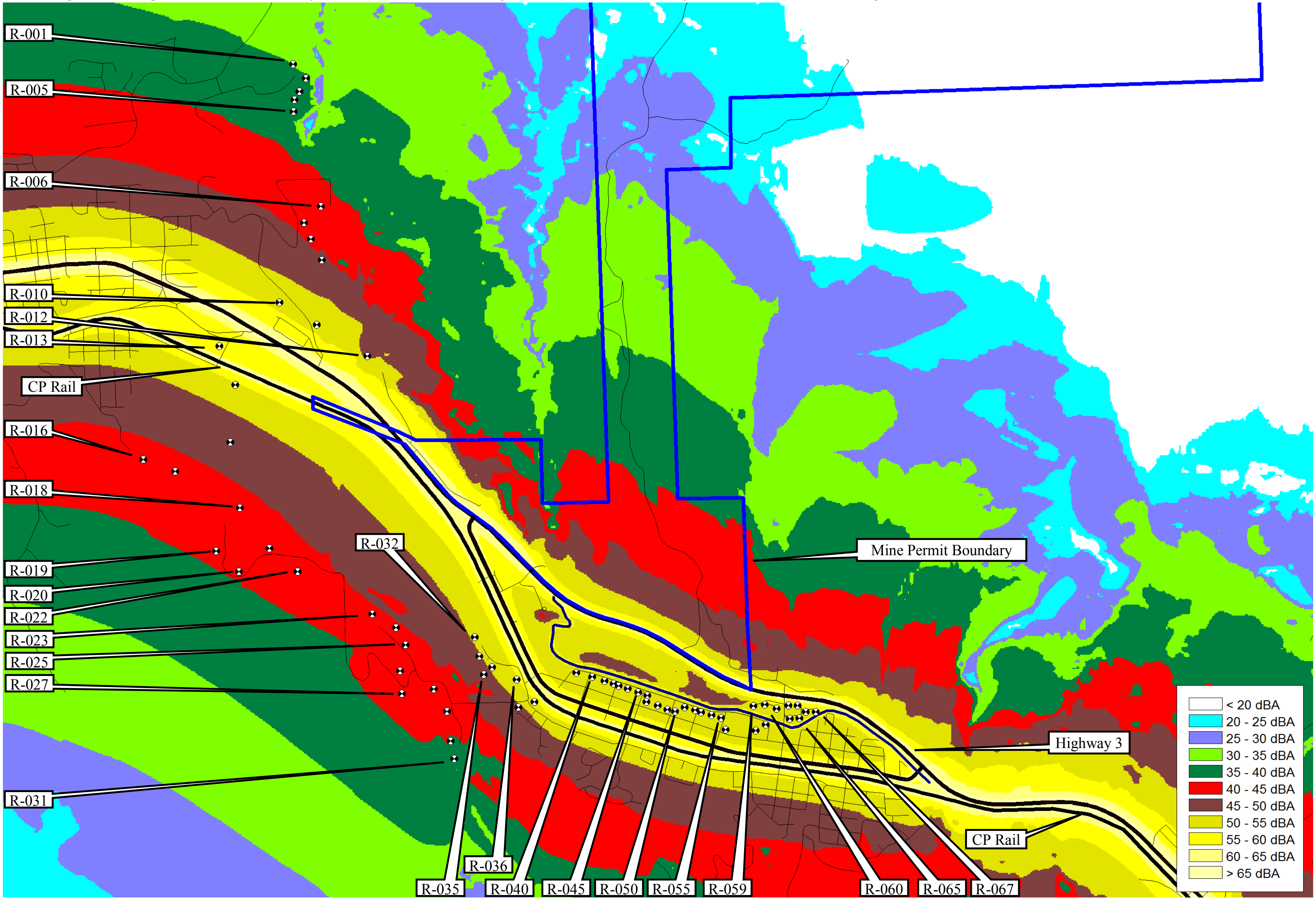


Figure 3. Baseline Case Noise Modeling Results (Day-Time)

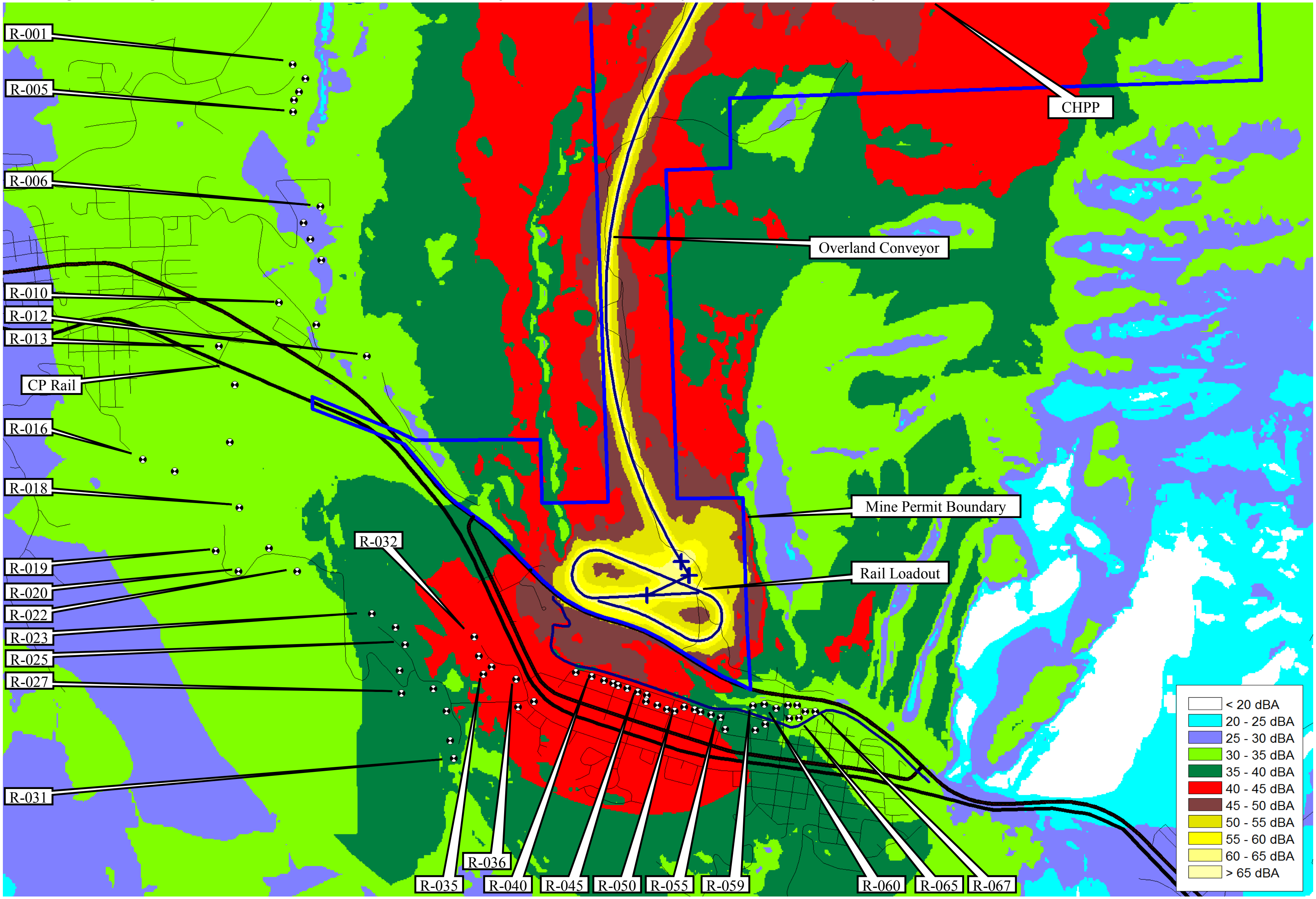


Figure 4. Project Case Noise Modeling Results (Day/Night-Time)

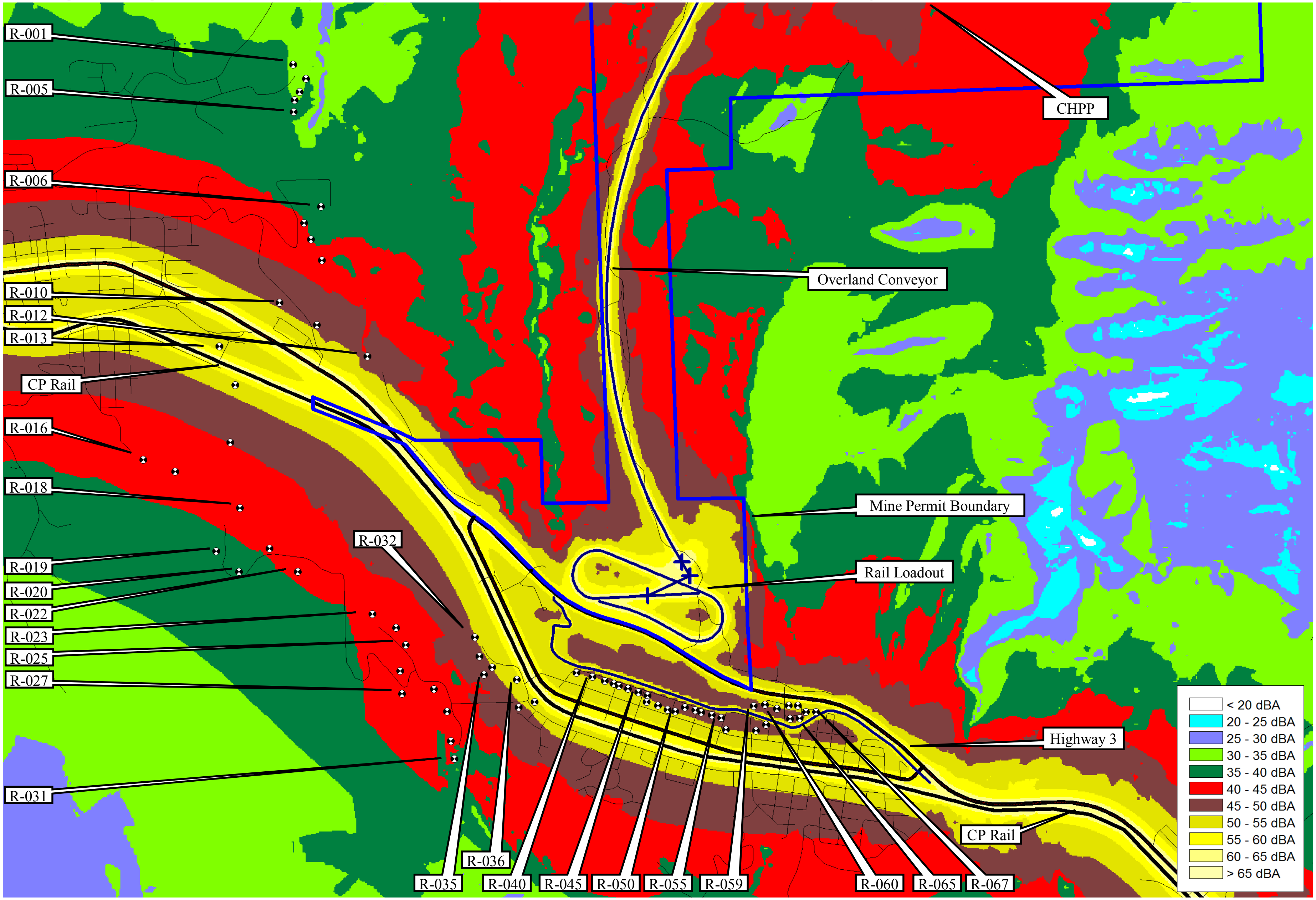


Figure 5. Combined Case Noise Modeling Results (Night-Time)

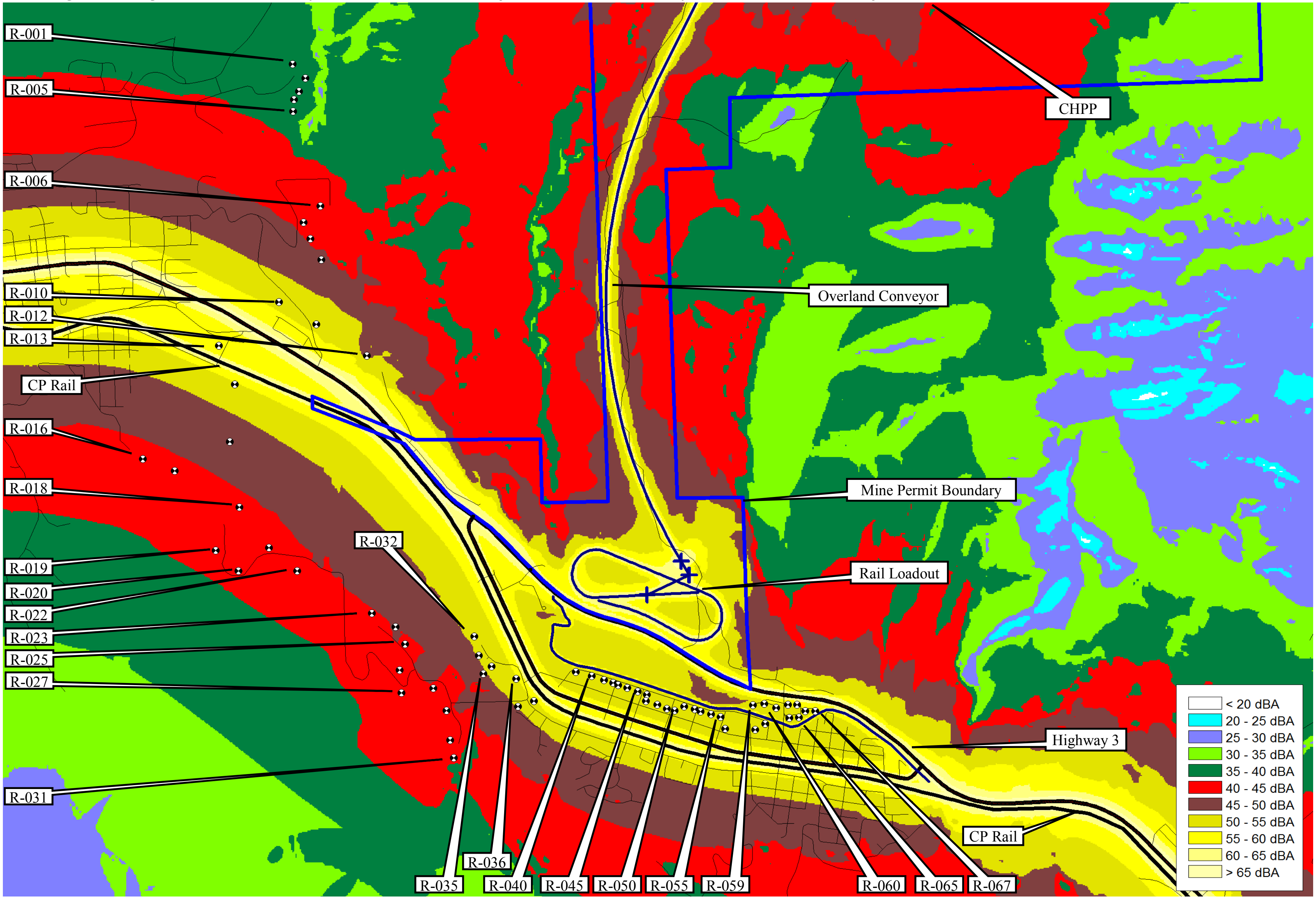


Figure 6. Combined Case Noise Modeling Results (Day-Time)

Figure 7. Noise Monitoring Locations

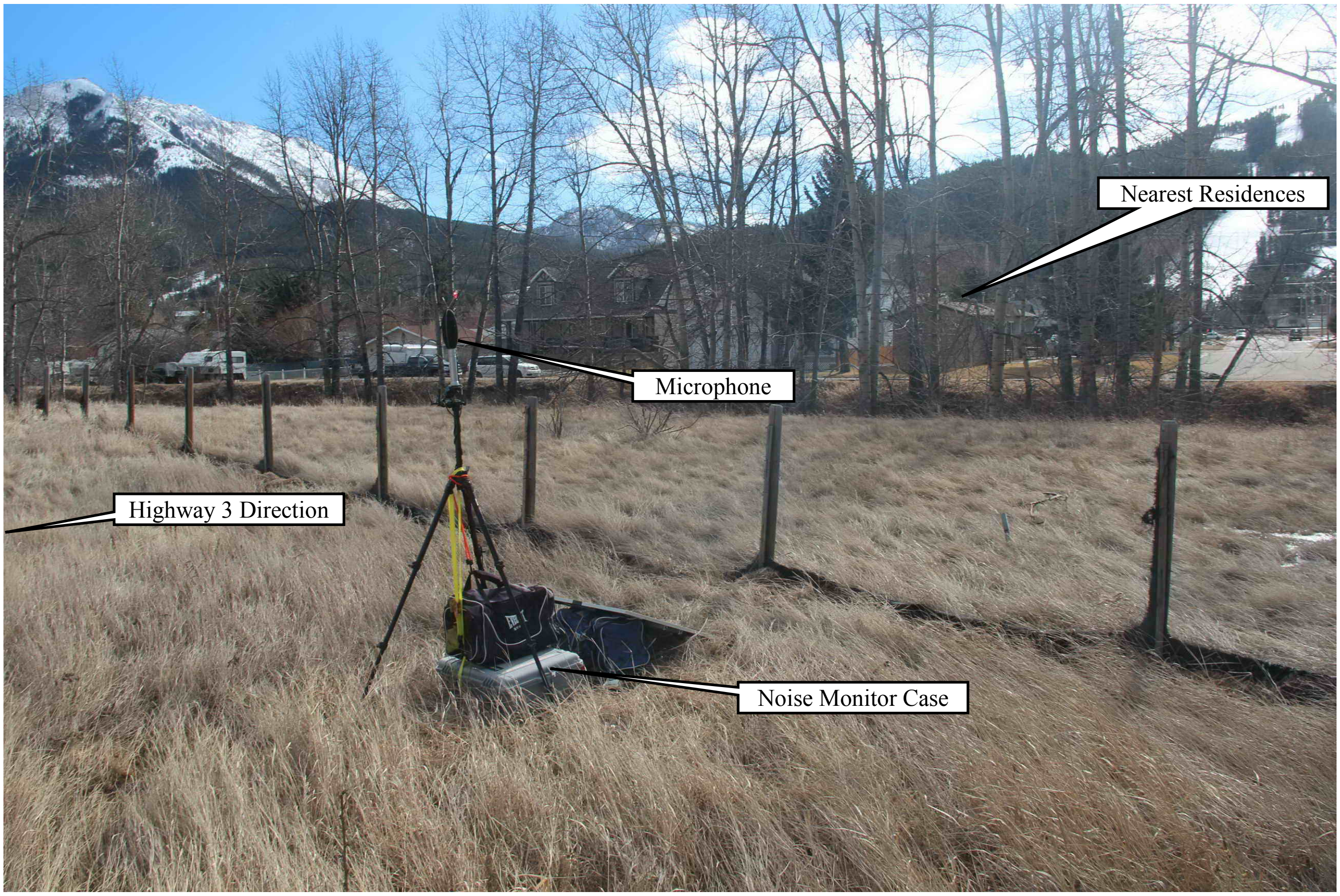


Figure 8. Image of *East* Noise Monitor

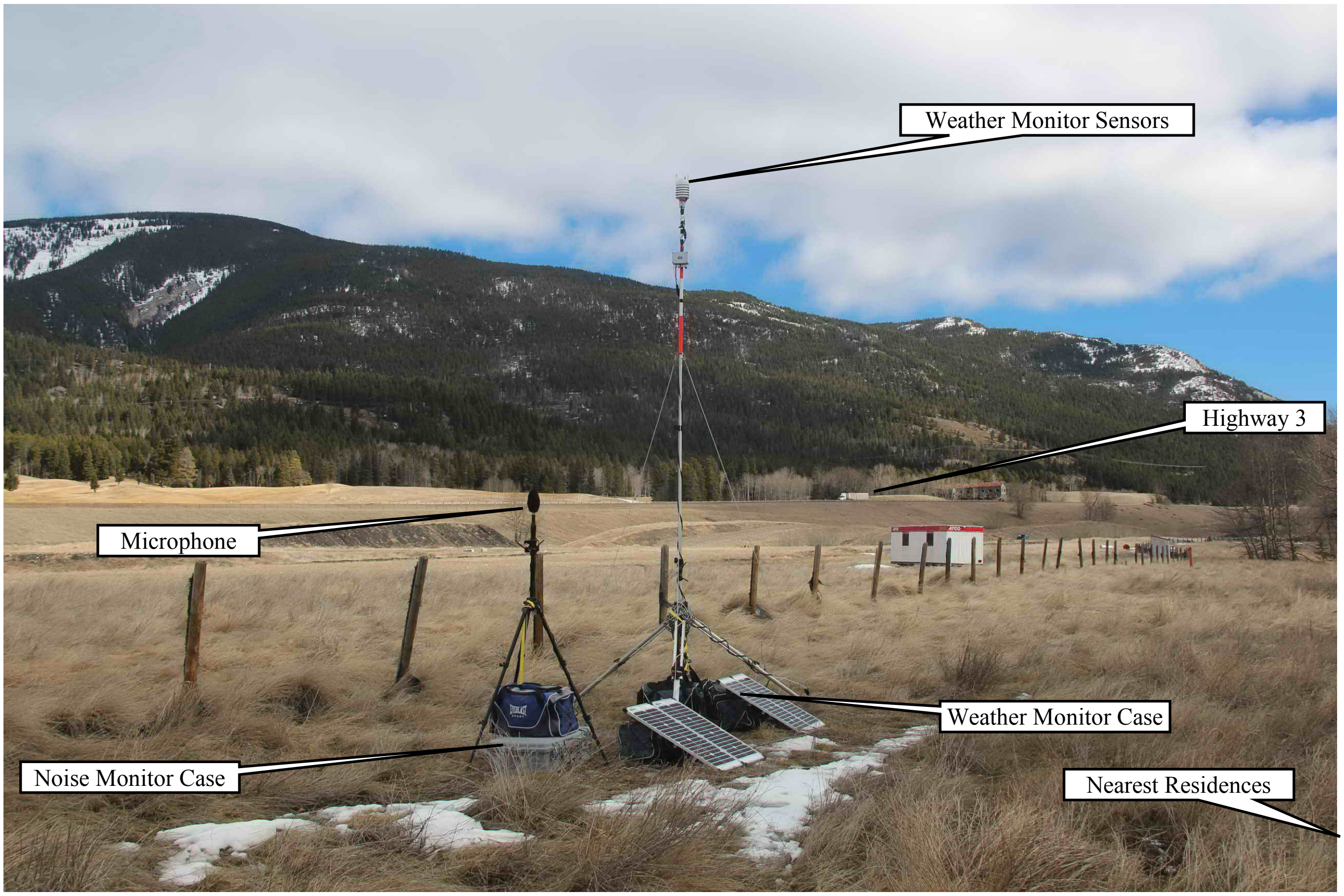


Figure 9. Image of *West* Noise Monitor and Weather Monitor

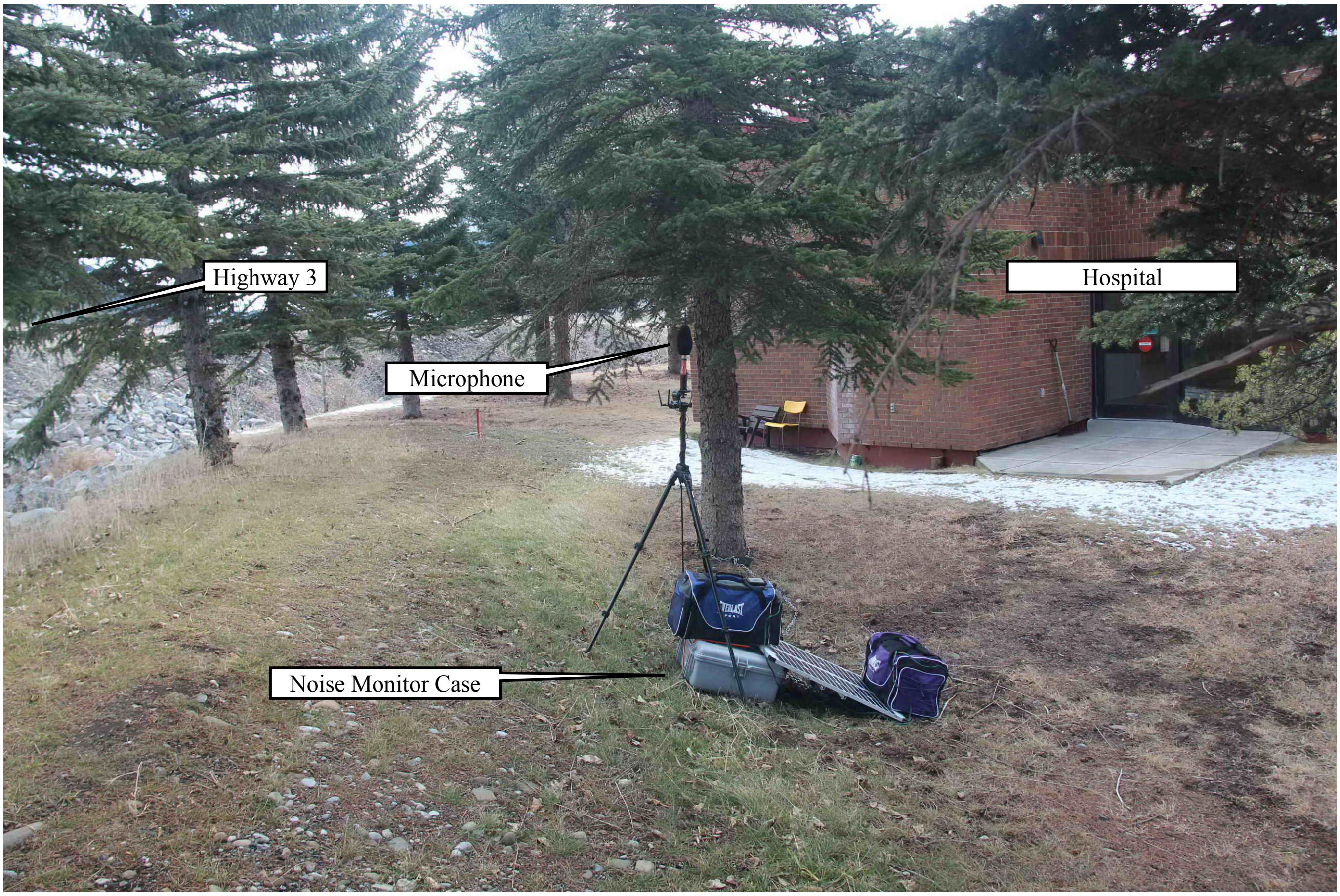


Figure 10. Image of *Hospital* Noise Monitor

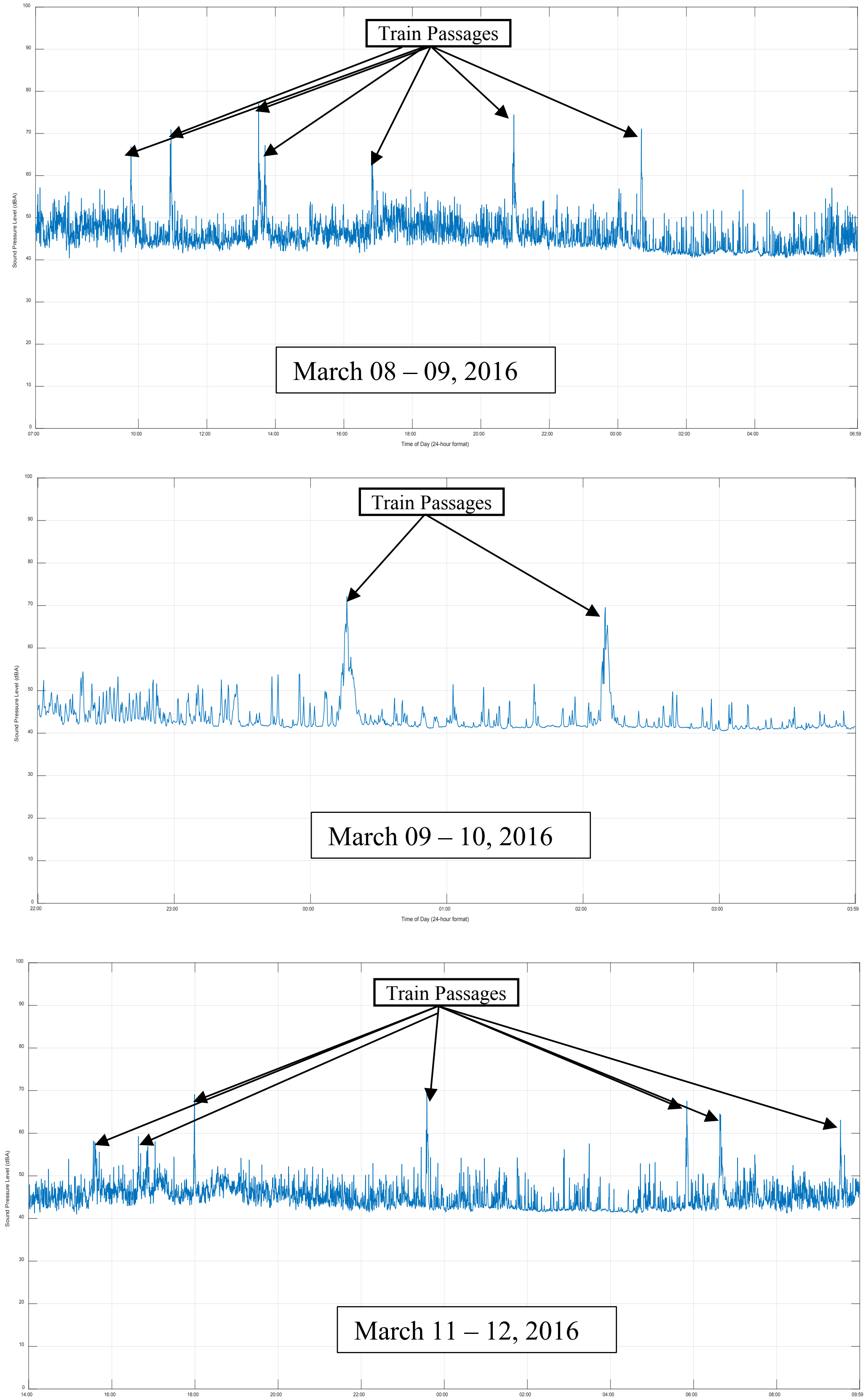
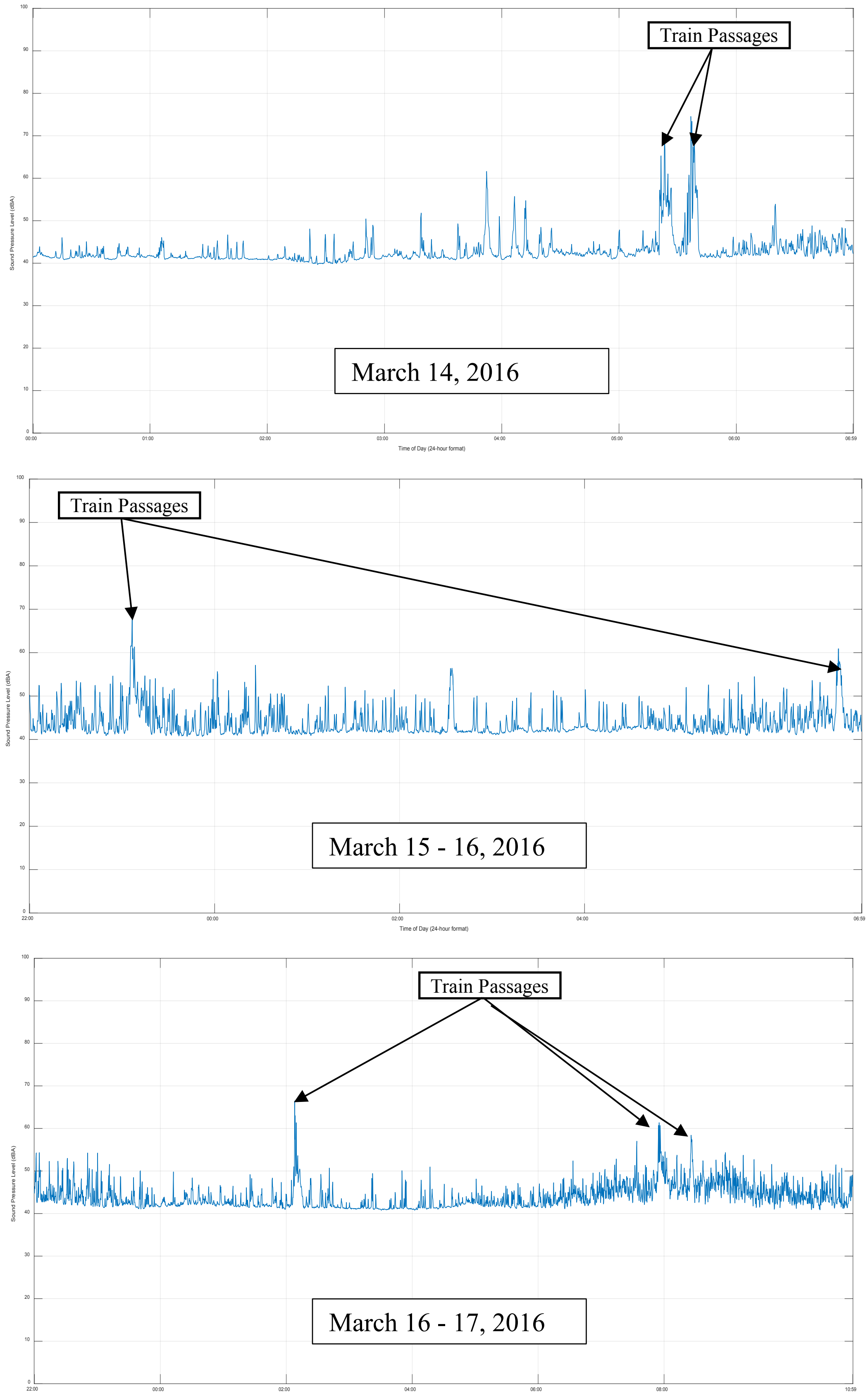
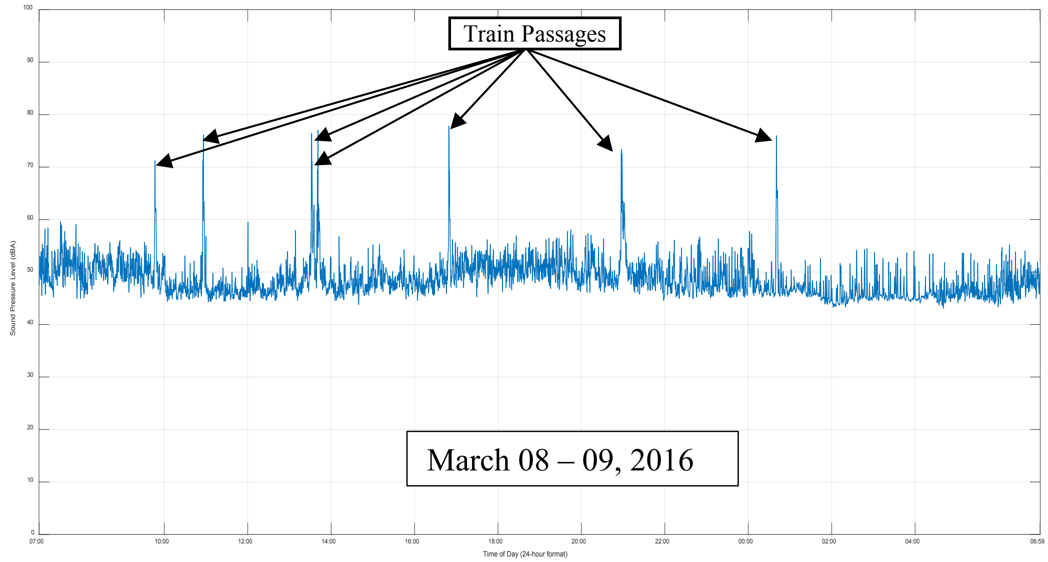
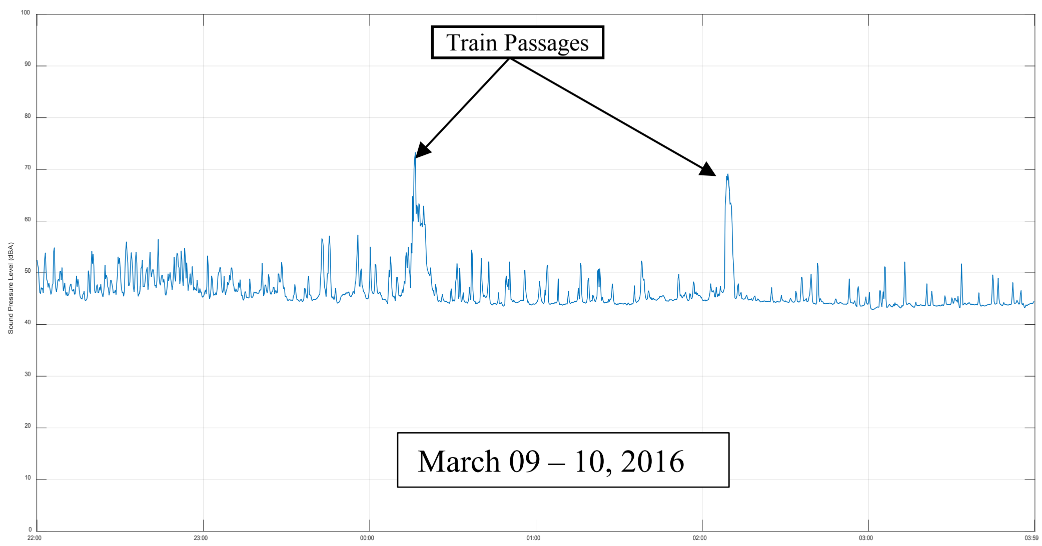


Figure 11. *East* Noise Monitor Isolated Results March 08 – 12, 2016



<u>Figure 12. *East* Noise Monitor Isolated Results March 14 – 17, 2016</u>





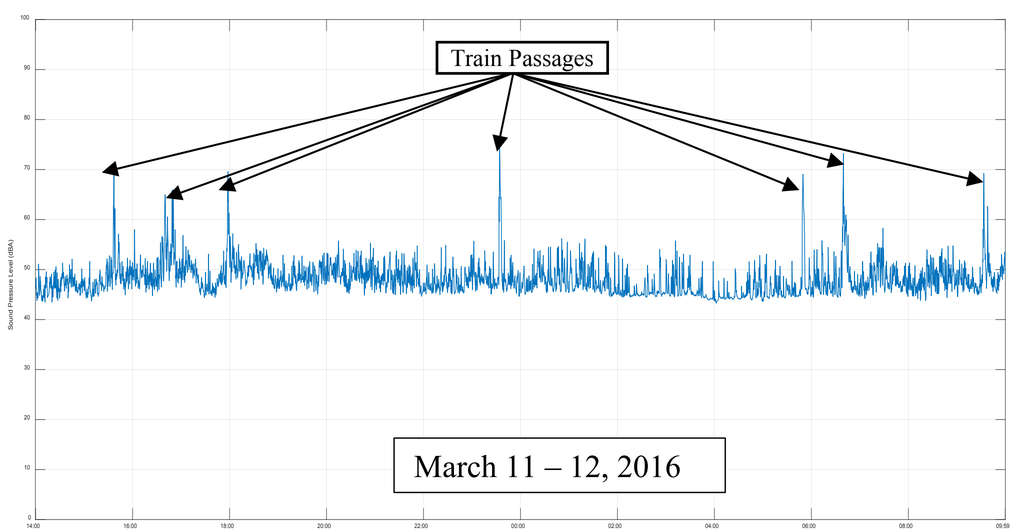


Figure 13. *West* Noise Monitor Isolated Results March 08 – 12, 2016

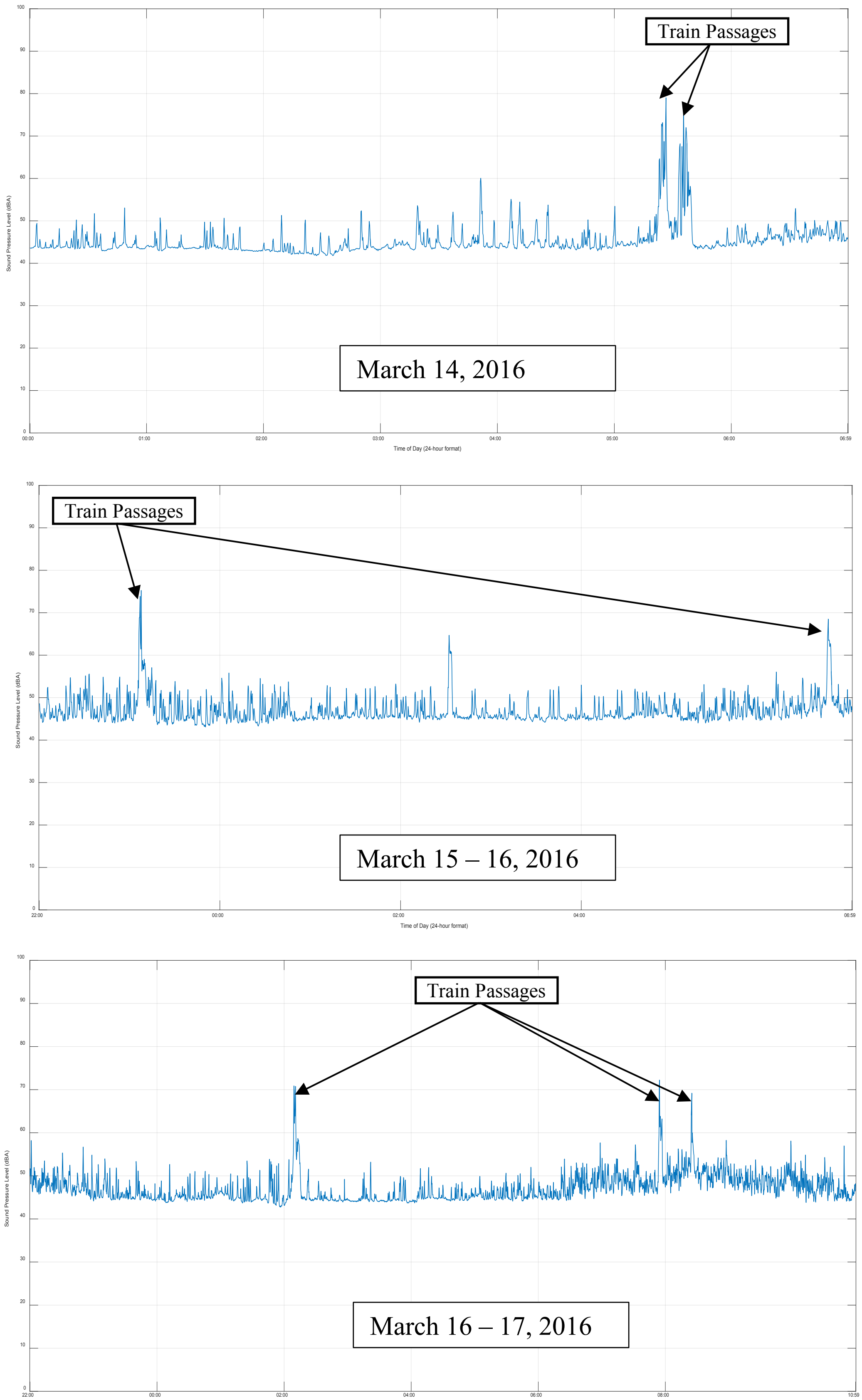


Figure 14. *West* Noise Monitor Isolated Results March 14 – 17, 2016

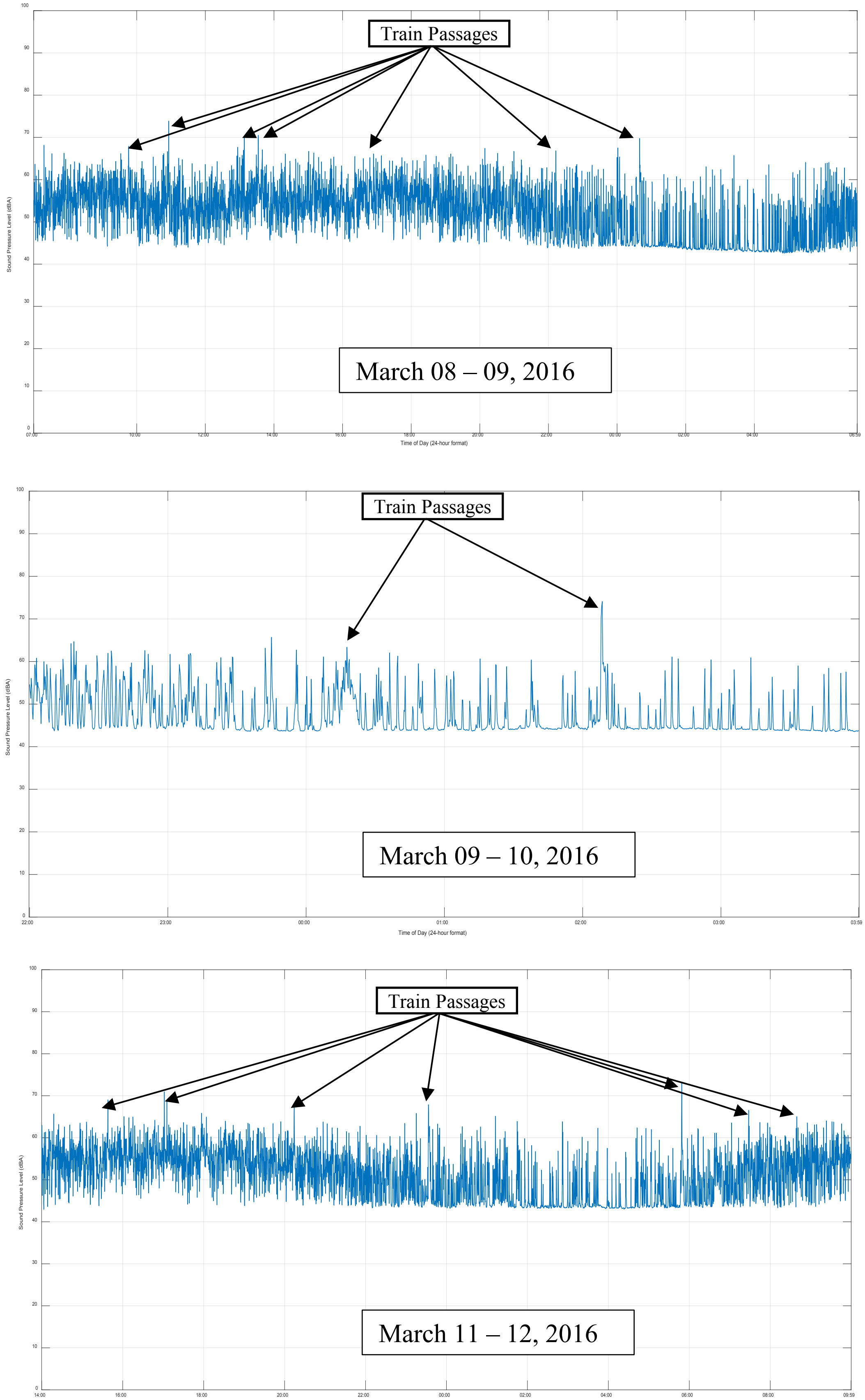


Figure 15. *Hospital* Noise Monitor Isolated Results March 08 – 12, 2016

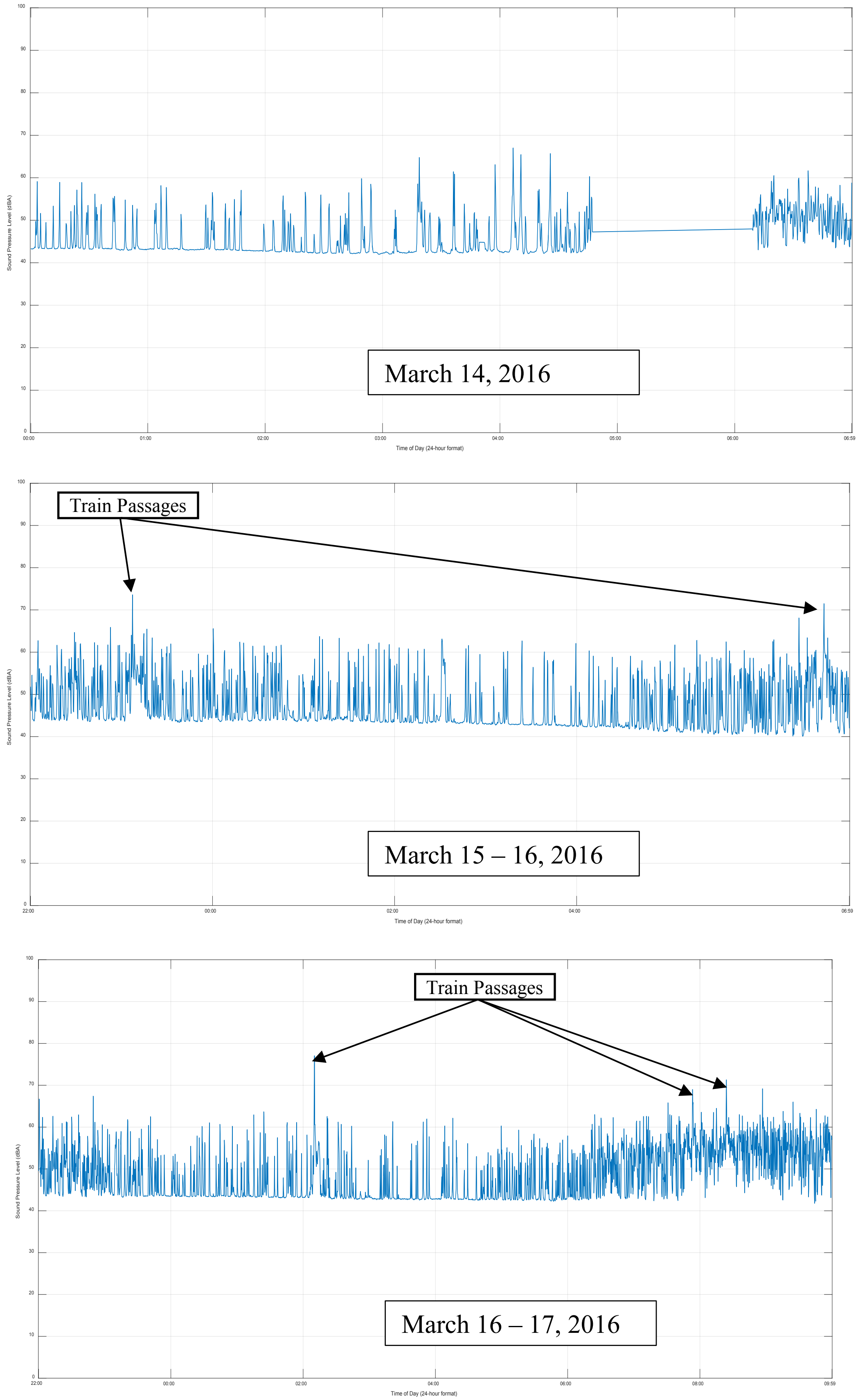


Figure 16. *Hospital* Noise Monitor Isolated Results March 14 – 17, 2016

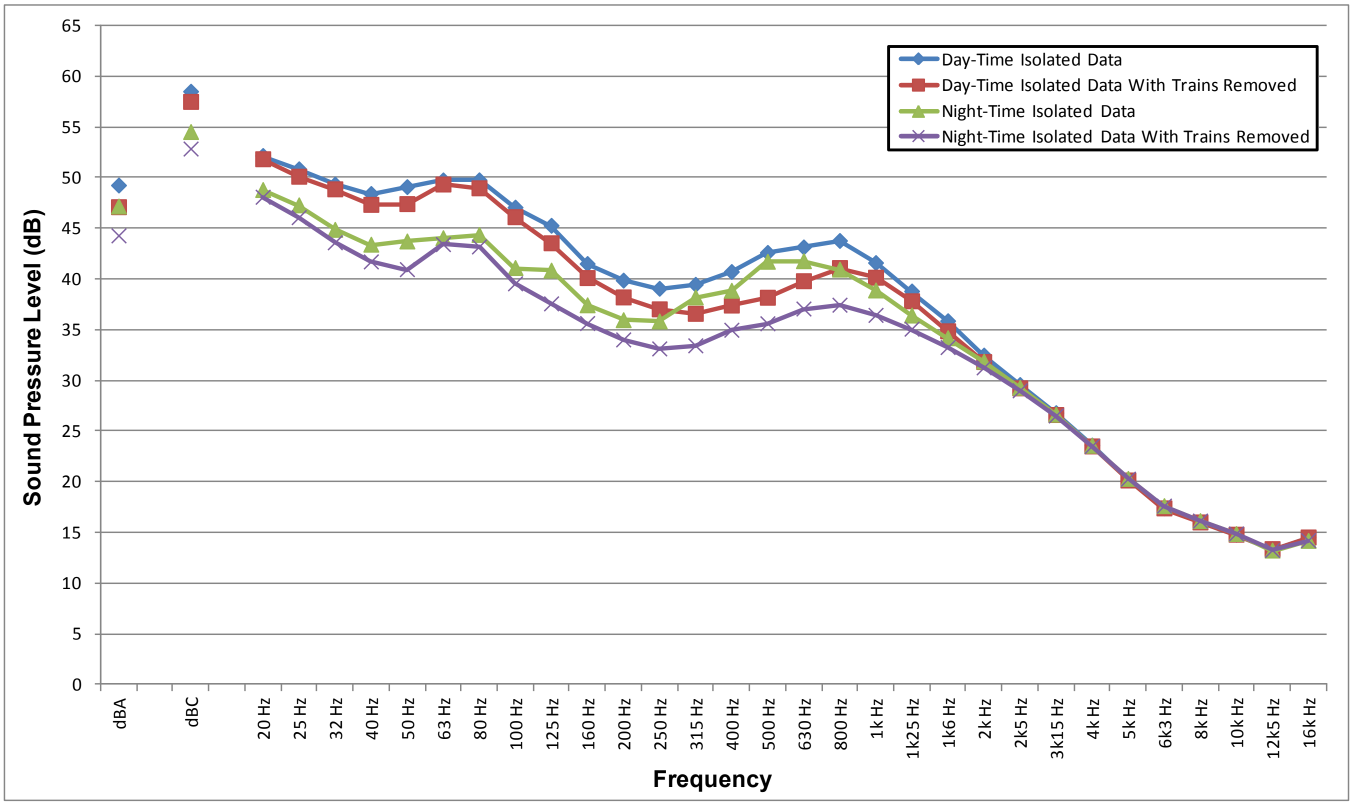


Figure 17. *East* Noise Monitor 1/3 Octave Band Results

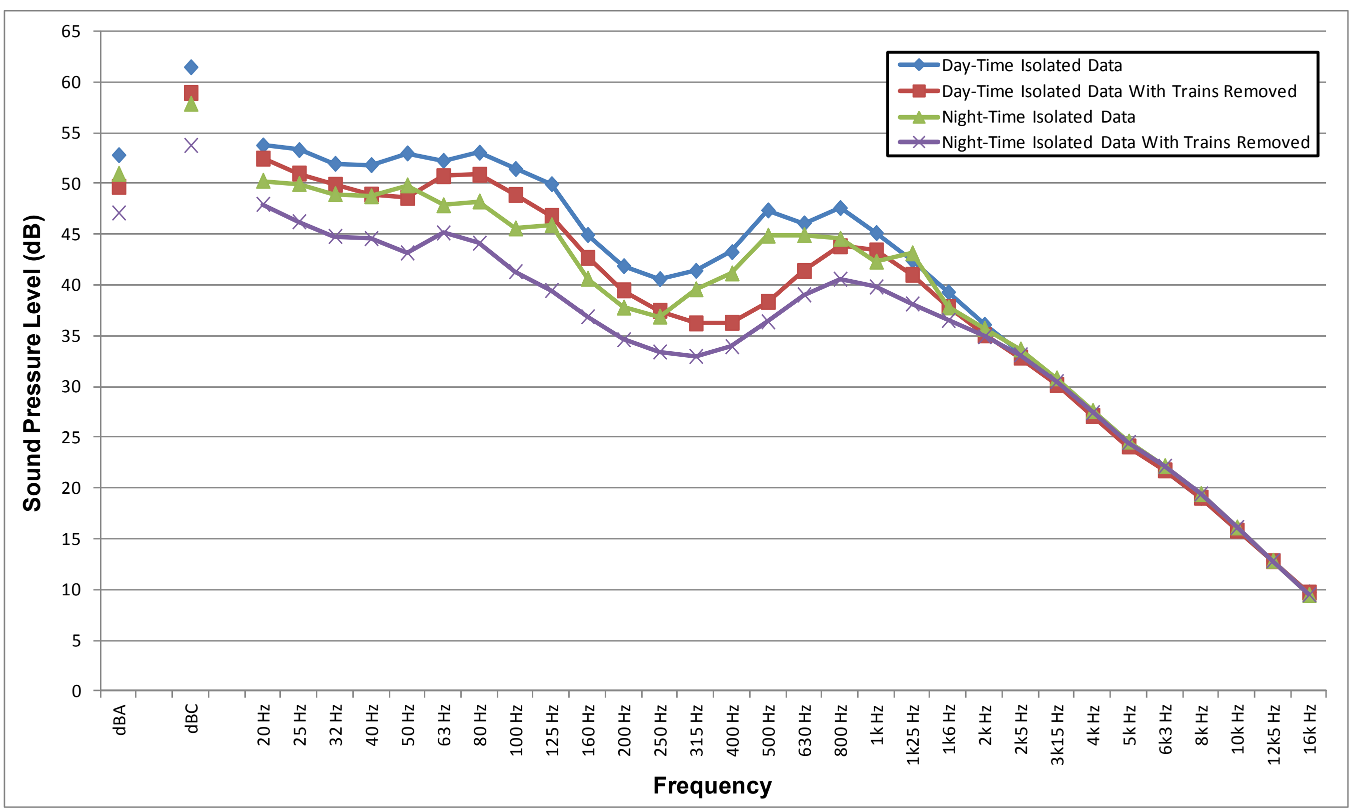


Figure 18. *West* Noise Monitor 1/3 Octave Band Results

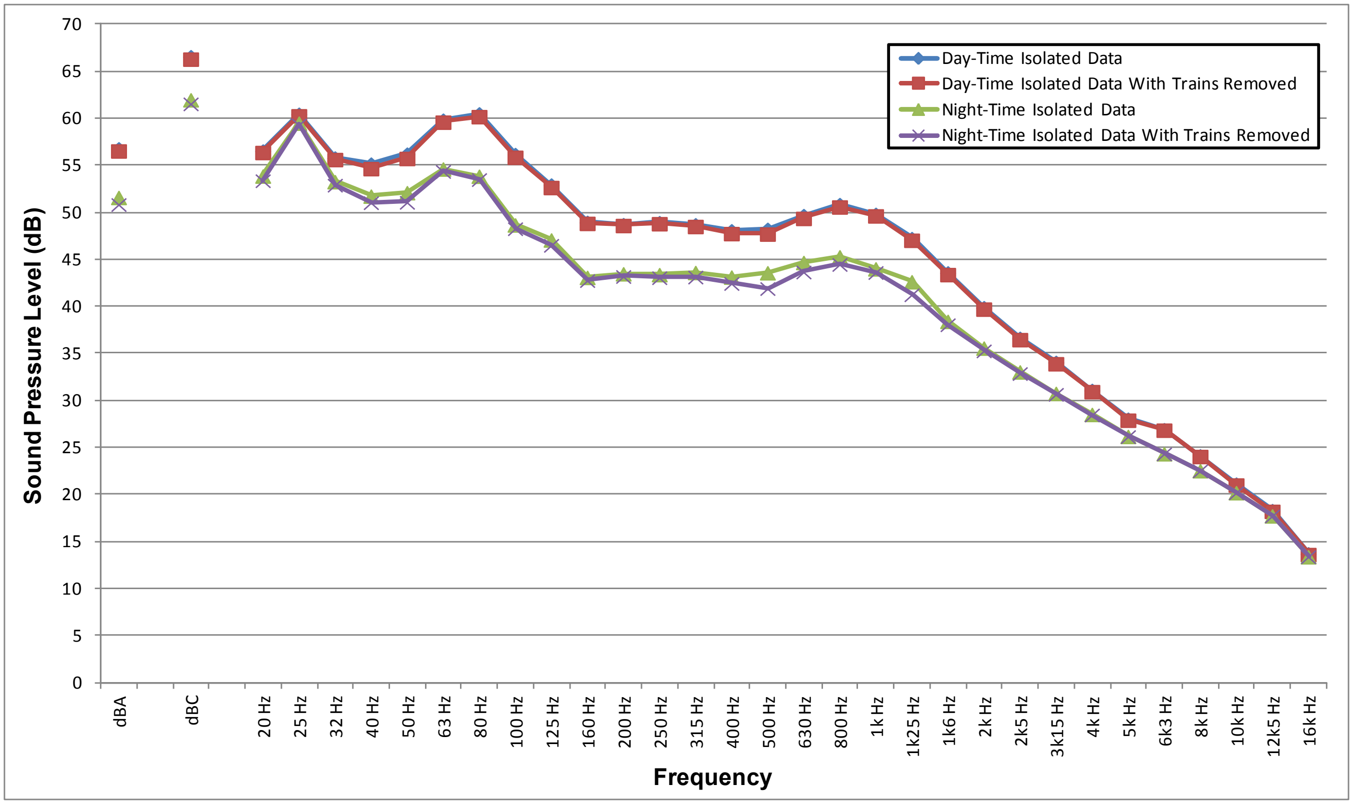


Figure 19. *Hospital* Noise Monitor 1/3 Octave Band Results

Appendix I MEASUREMENT EQUIPMENT USED

Noise Monitors

The environmental noise monitoring equipment used consisted of Brüel and Kjær Type 2250 Precision Integrating Sound Level Meters enclosed in environmental cases with tripods, weather protective microphone hoods, external batteries and solar panels. The systems acquired data in 15-second L_{eq} samples using 1/3 octave band frequency analysis and overall A-weighted and C-weighted sound levels. The sound level meter conforms to Type 1, ANSI S1.4, ANSI S1.43, IEC 61672-1, IEC 60651, IEC 60804 and DIN 45657. The 1/3 octave filters conform to S1.11 – Type 0-C, and IEC 61260 – Class 0. The calibrator conforms to IEC 942 and ANSI S1.40. The sound level meter, pre-amplifier and microphone were certified on April 30, 2014 / April 30, 2014 / April 30, 2015 and the calibrator (type B&K 4231) was certified on November 23 2015 by a NIST NVLAP Accredited Calibration Laboratory for all requirements of ISO 17025: 1999 and relevant requirements of ISO 9002:1994, ISO 9001:2000 and ANSI/NCSL Z540: 1994 Part 1. All measurement methods and instrumentation conform to the requirements of the AER Directive 038. Simultaneous digital audio was recorded directly on the sound level meter using a 8 kHz sample rate for more detailed post-processing analysis. Refer to the next section in the Appendix for a detailed description of the various acoustical descriptive terms used.

Weather Monitor

The weather monitoring equipment used for the study consisted of an Orion Weather Station 9510-A-1 with a WXT520 Self-Aspirating Radiation Shield Sensor Unit, a Weather MicroServer 9590 Data-logger, and a Lightning Arrestor. The Data-logger and batteries were located in a grounded, weather protective case. The Sensor Unit was mounted on a sturdy survey tripod (with supporting guy-wires) at approximately 5.0 m above ground. The system was set up to record data in 1-minute samples obtaining the wind-speed, peak wind-speed, and wind-direction in a rolling 2-minute average as well as the 1-minute temperature, relative humidity, barometric pressure, rain rate and total rain accumulation.

Record of Calibration Results

Description	Date	Time	Pre / Post	Calibration Level	Calibrator Model	Serial Number
East Noise Monitor	March 02 2016	14:00	Pre	93.9 dBA	B&K 4231	2594693
East Noise Monitor	March 17 2016	13:20	Post	93.8 dBA	B&K 4231	2594693
West Noise Monitor	March 02 2016	12:45	Pre	93.9 dBA	B&K 4231	2594693
West Noise Monitor	March 17 2016	12:30	Post	93.8 dBA	B&K 4231	2594693
Hospital Noise Monitor	March 02 2016	10:30	Pre	93.9 dBA	B&K 4231	2594693
Hospital Noise Monitor	March 17 2016	14:00	Post	93.8 dBA	B&K 4231	2594693

B&K 4231 Calibrator Calibration Certificate

Scantek, Inc.
CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.35026

Instrument: **Acoustical Calibrator**
Model: **4231**
Manufacturer: **Brüel and Kjær**
Serial number: **2594693**
Class (IEC 60942): **1**
Barometer type:
Barometer s/n:

Date Calibrated: **11/23/2015** *Cal Due:*

Status:	**Received**	**Sent**
In tolerance:	**X**	**X**
Out of tolerance:		
See comments:		

Contains non-accredited tests: __ **Yes** _X_ **No**

Customer: **ACI Acoustical Consultants Inc.**
Tel/Fax: **780-414-6373 / -6376**
Address: **5031 - 210 Street**
Edmonton, Alberta
CANADA T6M 0A8

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., Rev. 1/16/2015

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 2, 2015	Scantek, Inc./ NVLAP	Jul 2, 2016
DS-360-SRS	Function Generator	61646	Aug 12, 2015	ACR Env./ A2LA	Aug 12, 2017
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Aug 13, 2015	ACR Env. / A2LA	Aug 13, 2016
DPI 141-Druck	Pressure Indicator	790/00-04	Nov 18, 2014	ACR Env./ A2LA	Nov 18, 2016
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Oct 1, 2015	ACR Env./ A2LA	Apr 1, 2017
8903A-HP	Audio Analyzer	2514A05691	Dec 12, 2013	ACR Env./ A2LA	Dec 12, 2016
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	950698	Nov 11, 2015	Scantek, Inc. / NVLAP	Nov 11, 2016
1203-Norsonic	Preamplifier	14059	Jan 5, 2015	Scantek, Inc./ NVLAP	Jan 5, 2016

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by:	Valentin Buzduga	**Authorized signatory:**	Mariana Buzduga
Signature	<Original signed by>	Signature	<Original signed by>
Date	11/23/2015	Date	11/23/2015

Document stored as: Z:\Calibration Lab\Cal 2015\BNK4231_2594693_M1.doc

Page 1 of 2

B&K 2250 Unit #8 SLM Calibration Certificate

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2250--D00-** Serial No. **3005978** has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 30-apr-2014

<Original signed by>

Torben Bjørn
Vice President, Operations

Please note that this document is not a calibration certificate.
For information on our calibration services please contact your nearest Brüel & Kjær office.

BA 0238 – 18

HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark
Telephone: +45 7741 2000 · Fax: +45 4580 1405 · www.bksv.com · info@bksv.com
Local representatives and service organisations worldwide

Brüel & Kjær

Bruel & Kjær

Prepolarized Free-field 1/2" Microphone Type 4189

Calibration Chart

Serial No: 2851039

Open-circuit Sensitivity*, S_0:	-25.8	dB re 1V/Pa
Equivalent to:	51.6	mV/Pa
Uncertainty, 95 % confidence level	0.2	dB
Capacitance:	13.7	pF
Valid At:		
Temperature:	23	°C
Ambient Static Pressure:	101.3	kPa
Relative Humidity:	50	%
Frequency:	251.2	Hz
Polarization Voltage, external:	0	V

Sensitivity Traceable To:
DPLA: Danish Primary Laboratory of Acoustics
NIST: National Institute of Standards and Technology, USA

IEC 61094-4: Type WS 2 F

Environmental Calibration Conditions:
102.5 kPa 23 °C 46 % RH

Procedure: 704215 **Date:** 10. Dec. 2013 **Signature:**

$^{*}K_0 = -26 - S_0$ Example: $K_0 = -26 - (-26.2) = +0.2$ dB

B&K 2250 Unit #9 SLM Calibration Certificate

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2250--D00-** Serial No. **3006198**
has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to National or International Standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 30-apr-2014

<Original signed by>

Torben Bjørn
Vice President, Operations

Please note that this document is not a calibration certificate.
For information on our calibration services please contact your nearest Brüel & Kjær office.

BA 0238-18

HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark
Telephone: +45 77412000 · Fax: +45 4580 1405 · www.bksv.com · info@bksv.com
Local representatives and service organisations worldwide

Brüel & Kjær

Bruel & Kjær

Prepolarized Free-field 1/2" Microphone Type 4189

Calibration Chart

Serial No:	**2906926**	
Open-circuit Sensitivity*, S_0:	***-25.7***	dB re 1V/Pa
Equivalent to:	***52.0***	mV/Pa
Uncertainty, 95 % confidence level	0.2	dB
Capacitance:	*12.7*	pF
Valid At:		
Temperature:	23	°C
Ambient Static Pressure:	101.3	kPa
Relative Humidity:	50	%
Frequency:	251.2	Hz
Polarization Voltage, external:	0	V

Sensitivity Traceable To:
DPLA: Danish Primary Laboratory of Acoustics
NIST: National Institute of Standards and Technology, USA

IEC 61094-4: Type WS 2 F

Environmental Calibration Conditions:
99.2 kPa 23 °C 50 % RH

Procedure: 704215 **Date:** 10. Feb. 2014 **Signature:**

*$K_0 = -26 - S_0$ Example: $K_0 = -26 - (-26.2) = +0.2$ dB

B&K 2250 Unit #10 SLM Calibration Certificate

Brüel & Kjær

MANUFACTURER'S CERTIFICATE OF CONFORMANCE

We certify that Brüel & Kjær **-2250--D00-** Serial No. **3007542**
has been tested and passed all production tests, confirming compliance with the manufacturer's published specification at the date of the test.

The final test has been performed using calibrated equipment, traceable to national or international standards or by ratio measurements.

Brüel & Kjær is certified under ISO 9001:2008 assuring that all test data is retained on file and is available for inspection upon request.

Nærum 30-apr-2015

<Original signed by>

Torben Bjørn
Vice President, Operations

Please note that this document is not a calibration certificate.
For information on our calibration services please go to www.bksv.com/service.

BA 0238 - 19

Bruel & Kjær

Prepolarized Free-field 1/2" Microphone Type 4189

Calibration Chart

Serial No: 2978664

Open-circuit Sensitivity*, S_0:	*-27.1*	dB re 1V/Pa
Equivalent to:	*44.2*	mV/Pa
Uncertainty, 95 % confidence level	0.2	dB
Capacitance:	*13.3*	pF
Valid At:		
Temperature:	23	°C
Ambient Static Pressure:	101.3	kPa
Relative Humidity:	50	%
Frequency:	251.2	Hz
Polarization Voltage, external:	0	V

Sensitivity Traceable To:
DPLA: Danish Primary Laboratory of Acoustics
NIST: National Institute of Standards and Technology, USA

IEC 61094-4: Type WS 2 F

Environmental Calibration Conditions:
100.7 kPa 22 °C 52 % RH

Procedure: 704215 **Date:** 27. Feb. 2015 **Signature:** [signature]

*$K_0 = -26 - S_0$ Example: $K_0 = -26 - (-26.2) = +0.2$ dB

Appendix II THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

Sound Pressure Level

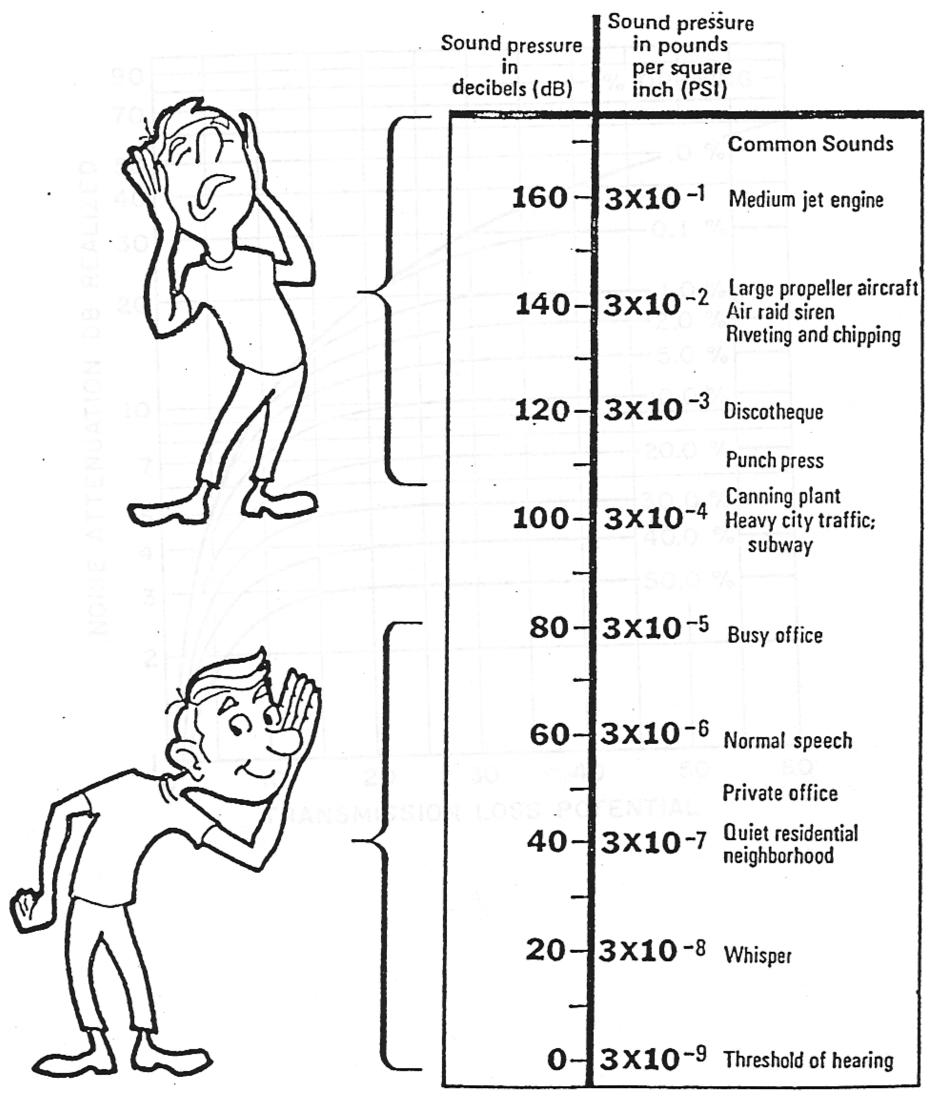
Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we 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
Canning plant
100
3X10 -4
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

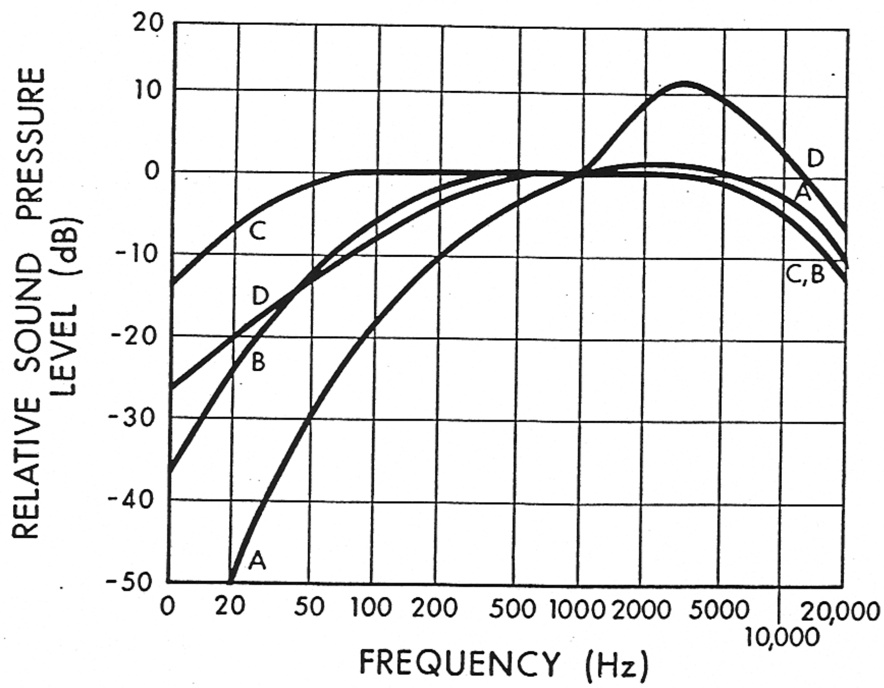
Frequency

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

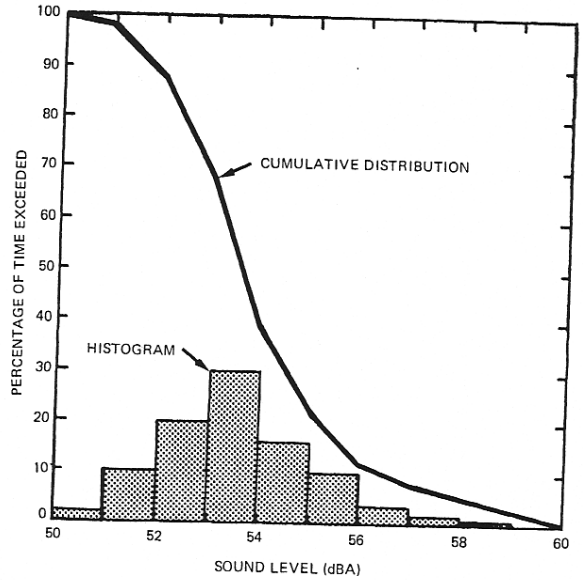


Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

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 44 dB at 400m.
- A line source measuring 50 dB at 100m will be 40 dB at 1000m.

Atmospheric Absorption

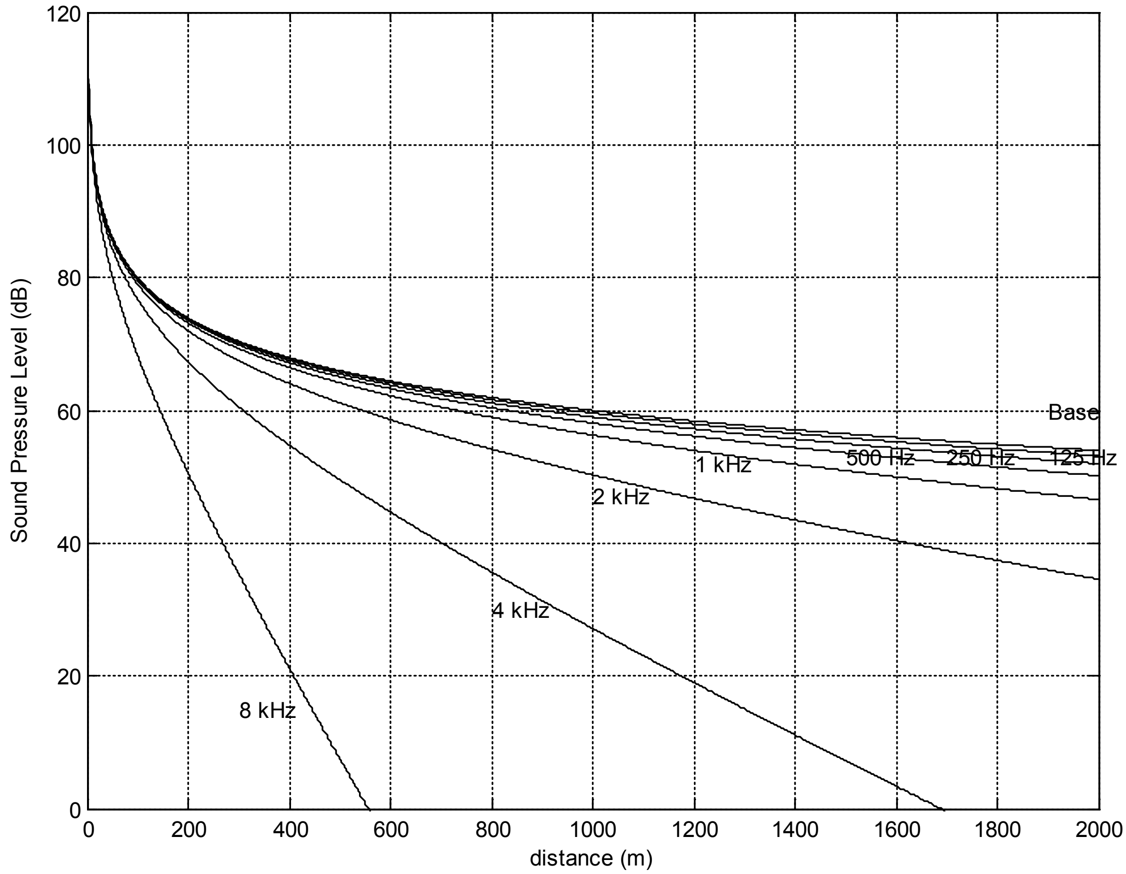
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

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 °C	Relative Humidity (%)	Frequency (Hz) 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 tends to increase
- As Relative Humidity increases, absorption tends to decrease
- 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^{o}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.

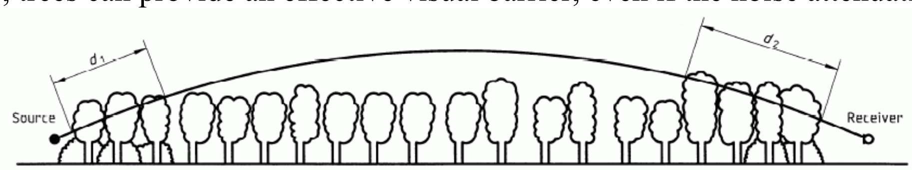
Topography
- One of the most important factors in sound propagation.
- Can provide a natural barrier between source and receiver (i.e. if berm or hill in between).
- Can provide a natural amplifier between source and receiver (i.e. large valley in between or hard reflective surface in between).
- Must 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 m	**Nominal midband frequency** Hz 63	125	250	500	1 000	2 000	4 000	8 000
$10 \leq d_f \leq 20$	Attenuation, dB: 0	0	1	1	1	1	2	3
$20 \leq d_f \leq 200$	Attenuation, dB/m: 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 approximately 1/2 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 the Alberta Energy Regulator Directive 038 (February, 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 the Alberta Energy Regulator Directive 038 (February, 2007)

Source[2]	**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

[2] 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 NOISE MODELING PARAMETERS

CHPP Equipment Broadband Sound Power Levels (Re 10^{-12} Watts)

Tag	Description	Location	Height (m)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
PP-111	ROM Bin Sump Pump 1	BN-101	2	Pump	37.0	1	102.5	0.0	**102.5**
PP-112	ROM Bin Sump Pump 2	BN-101	2	Pump	37.0	1	102.5	0.0	**102.5**
FB-101-a	Feeder Breaker - Breaker drive	BN-101	2	Motor	150.0	1	108.3	0.0	**108.3**
FB-101-b	Feeder Breaker - Chain drive	BN-101	2	Motor	220.0	1	110.0	0.0	**110.0**
FB-101-c	Feeder Breaker - cooling fan	BN-101	2	Fan	5.0	1	96.8	0.0	**96.8**
CV-101	Raw Coal Conveyor	CV-101	17	Motor	185.0	1	109.2	0.0	**109.2**
MG-101-b	Tramp Iron Magnet Heat exchanger fan motor	CV-101	17	Fan	0.8	1	90.2	0.0	**90.2**
SC-101	Raw Coal Screen	ST-101	12	Screen	90	1	114.9	0	**114.9**
CR-101-a	Secondary Sizer Drive 1	ST-101	7	Motor	150.0	1	108.3	0.0	**108.3**
CR-101-b	Secondary Sizer Drive 2	ST-101	7	Motor	150.0	1	108.3	0.0	**108.3**
CV-102	Sized Coal Conveyor	CV-102	17	Motor	185.0	1	109.2	0.0	**109.2**
FE-201-a	Plant Feed Feeder Drive 1	BN-102	3	Motor	5.5	1	93.9	0.0	**93.9**
FE-201-b	Plant Feed Feeder Drive 2	BN-102	3	Motor	5.5	1	93.9	0.0	**93.9**
CV-201	Plant Feed Conveyor	CV-201	17	Motor	110.0	1	106.9	0.0	**106.9**
FE-401-a	Deslime Screen Feeder - Vibrating Motor 1	CPP Building	5	Motor	4.5	1	93.1	19.3	**73.8**
FE-401-b	Deslime Screen Feeder - Vibrating Motor 2	CPP Building	5	Motor	4.5	1	93.1	19.3	**73.8**
SC-401	Desliming Screen	CPP Building	5	Screen	45	1	114.9	18.7	**96.2**
PP-401	DMC Feed Pump	CPP Building	5	Pump	355.0	1	105.5	18.8	**86.7**
SC-402	Product Drain & Rinse Screen	CPP Building	5	Screen	45	1	114.9	18.7	**96.2**
CF-401-a	Coarse Coal Centrifuge - Rotation Drive	CPP Building	5	Motor	45.0	1	103.1	19.3	**83.8**
CF-401-b	Coarse Coal Centrifuge - Vibration Drive	CPP Building	5	Motor	5.5	1	93.9	19.3	**74.6**
CF-401-c	Coarse Coal Centrifuge - Vibration Drive	CPP Building	5	Motor	5.5	1	93.9	19.3	**74.6**
SC-403	Reject Drain & Rinse Screen	CPP Building	5	Screen	30	1	114.9	18.7	**96.2**
PP-402	Correct Medium Pump	CPP Building	5	Pump	55.0	1	103.0	18.8	**84.2**
FE-421-a	Deslime Screen Feeder - Vibrating Motor 1	CPP Building	5	Motor	4.5	1	93.1	19.3	**73.8**
FE-421-b	Deslime Screen Feeder - Vibrating Motor 2	CPP Building	5	Motor	4.5	1	93.1	19.3	**73.8**
SC-421	Desliming Screen	CPP Building	5	Screen	45	1	114.9	18.7	**96.2**
PP-421	DMC Feed Pump	CPP Building	5	Pump	355.0	1	105.5	18.8	**86.7**
SC-422	Product Drain & Rinse Screen	CPP Building	5	Screen	45	1	114.9	18.7	**96.2**
CF-421-a	Coarse Coal Centrifuge - Rotation Drive	CPP Building	5	Motor	45.0	1	103.1	19.3	**83.8**
CF-421-b	Coarse Coal Centrifuge - Vibration Drive	CPP Building	5	Motor	5.5	1	93.9	19.3	**74.6**
CF-421-c	Coarse Coal Centrifuge - Vibration Drive	CPP Building	5	Motor	5.5	1	93.9	19.3	**74.6**
SC-423	Reject Drain & Rinse Screen	CPP Building	5	Screen	30	1	114.9	18.7	**96.2**
PP-422	Correct Medium Pump	CPP Building	5	Pump	55.0	1	103.0	18.8	**84.2**
PP-403	Dilute Medium Pump	CPP Building	5	Pump	150.0	1	104.3	18.8	**85.5**
PP-405	Desliming Cyclone Feed Pump	CPP Building	5	Pump	500.0	1	105.9	18.8	**87.1**
PP-410	DMC Area Floor Sump Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-501	Fines Feed Pump	CPP Building	5	Pump	110.0	1	103.9	18.8	**85.1**
PP-502	Fines Product Pump	CPP Building	5	Pump	315.0	1	105.3	18.8	**86.5**
CF-501-a	Fine Coal Centrifuge - Rotation Drive	CPP Building	5	Motor	75.0	1	105.3	19.3	**86.0**
CF-502-a	Fine Coal Centrifuge - Rotation Drive	CPP Building	5	Motor	75.0	1	105.3	19.3	**86.0**
CF-503-a	Fine Coal Centrifuge - Rotation Drive	CPP Building	5	Motor	75.0	1	105.3	19.3	**86.0**
CF-504-a	Fine Coal Centrifuge - Rotation Drive	CPP Building	5	Motor	75.0	1	105.3	19.3	**86.0**
SC-501-a	Fines Reject Dewatering Screen Drive A	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**
SC-501-b	Fines Reject Dewatering Screen Drive B	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**

CHPP Equipment Broadband Sound Power Levels (Re 10^{-12} Watts) Cont.

Tag	Description	Location	Height (m)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
SC-502-a	Fines Reject Dewatering Screen Drive A	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**
SC-502-b	Fines Reject Dewatering Screen Drive B	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**
SC-503-a	Fines Reject Dewatering Screen Drive A	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**
SC-503-b	Fines Reject Dewatering Screen Drive B	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**
SC-504-a	Fines Reject Dewatering Screen Drive A	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**
SC-504-b	Fines Reject Dewatering Screen Drive B	CPP Building	5	Screen	7	1	114.9	18.7	**96.2**
PP-503	Fines Effluent Pump	CPP Building	5	Pump	185.0	1	104.6	18.8	**85.8**
PP-601	Flotation Feed Pump	CPP Building	5	Pump	500.0	1	105.9	18.8	**87.1**
PP-621	Sec Flotation Feed Pump	CPP Building	5	Pump	500.0	1	105.9	18.8	**87.1**
PP-610	Flotation Area Floor Sump Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-605	Coal Clarified Water Pump	CPP Building	5	Pump	337.5	1	105.4	18.8	**86.6**
PP-602	Coal Thickener Underflow Pump	CPP Building	5	Pump	265.0	1	105.1	18.8	**86.3**
PF-601-b	HDF Rotation Drive	CPP Building	5	Motor	18.5	1	99.2	19.3	**79.9**
PF-601-c	Discharge Conveyor	CPP Building	5	Motor	18.5	1	99.2	19.3	**79.9**
PF-601-i	HDF Hydraulic Pack Motor 1	CPP Building	5	Hydraulic Pump	22.0	1	101.8	18.8	**83.0**
PP-603	HDF High Pressure Water Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-604	HDF High Pressure Water Pump	CPP Building	5	Pump	45.0	1	102.8	18.8	**84.0**
AC-601	HDF Compressor (Duty)	CPP Building	5	Compressor	1118.6	1	121.4	22.6	**98.8**
AD-601	HDF Compressed Air Dryer	CPP Building	5	Fan	28.0	1	102.8	15.0	**87.8**
AC-602	HDF Compressor (Duty)	CPP Building	5	Compressor	1118.6	1	121.4	22.6	**98.8**
AD-602	HDF Compressed Air Dryer	CPP Building	5	Fan	28.0	1	102.8	15.0	**87.8**
CV-601-a	HDF Screw Conveyor Screw 1	CPP Building	5	Motor	7.5	1	95.3	19.3	**76.0**
CV-601-b	HDF Screw Conveyor Screw 2	CPP Building	5	Motor	7.5	1	95.3	19.3	**76.0**
CV-601-c	HDF Screw Conveyor Screw 3	CPP Building	5	Motor	7.5	1	95.3	19.3	**76.0**
PF-621-b	HDF Rotation Drive	CPP Building	5	Motor	18.5	1	99.2	19.3	**79.9**
PF-621-c	Discharge Conveyor	CPP Building	5	Motor	18.5	1	99.2	19.3	**79.9**
PF-621-i	HDF Hydraulic Pack Motor 1	CPP Building	5	Hydraulic Pump	22.0	1	101.8	18.8	**83.0**
PP-623	HDF High Pressure Water Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-624	HDF High Pressure Water Pump	CPP Building	5	Pump	45.0	1	102.8	18.8	**84.0**
AC-621	HDF Compressor (Duty)	CPP Building	5	Compressor	1118.6	1	121.4	22.6	**98.8**
AD-621	HDF Compressed Air Dryer	CPP Building	5	Fan	28.0	1	102.8	15.0	**87.8**
AC-622	HDF Compressor (Duty)	CPP Building	5	Compressor	1118.6	1	121.4	22.6	**98.8**
AD-622	HDF Compressed Air Dryer	CPP Building	5	Fan	28.0	1	102.8	15.0	**87.8**
CV-621-a	HDF Screw Conveyor Screw 1	CPP Building	5	Motor	7.5	1	95.3	19.3	**76.0**
CV-621-b	HDF Screw Conveyor Screw 2	CPP Building	5	Motor	7.5	1	95.3	19.3	**76.0**
CV-621-c	HDF Screw Conveyor Screw 3	CPP Building	5	Motor	7.5	1	95.3	19.3	**76.0**
PP-611	Coal Thickener Floor Sump Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-700	Tailings Thickener Underflow Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-710	Tailings Thickener Floor Sump Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-701	BPF 1 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-702	BPF 2 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-703	BPF 3 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-704	BPF 4 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-705	BPF 5 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-706	BPF 6 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**

CHPP Equipment Broadband Sound Power Levels (Re 10^{-12} Watts) Cont.

Tag	Description	Location	Height (m)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
PP-707	BPF 7 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-708	BPF 8 Feed Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-709	Filtrate Pump	CPP Building	5	Pump	75.0	1	103.4	18.8	**84.6**
PP-711	BPF Wash Water Pump	CPP Building	5	Pump	110.0	1	103.9	18.8	**85.1**
PP-712	Gland Water Pump	CPP Building	5	Pump	56.3	1	103.1	18.8	**84.3**
PP-713	BPF Area Floor Sump Pump	CPP Building	5	Pump	37.0	1	102.5	18.8	**83.7**
PP-901	Clarified Water Pump	CPP Building	5	Pump	500.0	1	105.9	18.8	**87.1**
PP-903	Reflux Classifier Fluidising Water Pump	CPP Building	5	Pump	30.0	1	102.2	18.8	**83.4**
AC-901	Compressed Air System	CPP Building	5	Compressor	37.8	1	106.7	22.6	**84.1**
PP-980	Magnetite Addition Pump	CPP Building	5	Pump	45.0	1	102.8	18.8	**84.0**
CV-701	Ultrafine Rejects Collection Conveyor	CPP Building	5	Motor	22.0	1	100.0	19.3	**80.7**
PP-9190	Raw Water Pump	Raw Water Pump Shed	2	Pump	110.0	1	103.9	18.8	**85.1**
PP-9191	Raw Water Pump	Raw Water Pump Shed	2	Pump	110.0	1	103.9	18.8	**85.1**
CV-702	Reject Collection Conveyor	CV-702	10	Motor	45.0	1	103.1	0.0	**103.1**
HY-701	Rejects Bin Hydraulic System	BN-701	10	Hydraulic Pump	36.0	1	102.5	0.0	**102.5**
CV-801	Product Conveyor	CV-801	12	Motor	185.0	1	109.2	0.0	**109.2**
PK-820	Bifurcated chute Diverter Gate Hydraulic Power Pack	ST-801	12	Hydraulic Pump	7.5	1	100.4	0.0	**100.4**
SK-801	Product Radial Stacker 1	SK-801	10	Motor	100.0	1	106.5	0.0	**106.5**
CV-802	Product Stackout Conveyor	CV-802	12	Motor	75.0	1	105.3	0.0	**105.3**
SK-802	Product Radial Stacker 2	SK-802	10	Motor	100.0	1	106.5	0.0	**106.5**
CV-805	Product Stockpile Reclaim Conveyor	CV-805	18	Motor	355.0	1	112.0	0.0	**112.0**
RC-801-a	Feeder Breaker - Breaker drive	RC-801	2	Motor	150.0	1	108.3	0.0	**108.3**
RC-801-b	Feeder Breaker - Chain drive	RC-801	2	Motor	220.0	1	110.0	0.0	**110.0**
RC-801-c	Feeder Breaker - cooling fan	RC-801	2	Fan	5.0	1	96.8	0.0	**96.8**
RC-802-a	Feeder Breaker - Breaker drive	RC-802	2	Motor	150.0	1	108.3	0.0	**108.3**
RC-802-b	Feeder Breaker - Chain drive	RC-802	2	Motor	220.0	1	110.0	0.0	**110.0**
RC-802-c	Feeder Breaker - cooling fan	RC-802	2	Fan	5.0	1	96.8	0.0	**96.8**
RC-803-a	Feeder Breaker - Breaker drive	RC-803	2	Motor	150.0	1	108.3	0.0	**108.3**
RC-803-b	Feeder Breaker - Chain drive	RC-803	2	Motor	220.0	1	110.0	0.0	**110.0**
RC-803-c	Feeder Breaker - cooling fan	RC-803	2	Fan	5.0	1	96.8	0.0	**96.8**
RC-804-a	Feeder Breaker - Breaker drive	RC-804	2	Motor	150.0	1	108.3	0.0	**108.3**
RC-804-b	Feeder Breaker - Chain drive	RC-804	2	Motor	220.0	1	110.0	0.0	**110.0**
RC-804-c	Feeder Breaker - cooling fan	RC-804	2	Fan	5.0	1	96.8	0.0	**96.8**
FE-801-a	OLC Vibrating Feeder Drive 1	BN-801	18	Motor	5.5	1	93.9	0.0	**93.9**
FE-801-b	OLC Vibrating Feeder Drive 2	BN-801	18	Motor	5.5	1	93.9	0.0	**93.9**
CV-807-a	Product overland conveyor Motor A	BN-801	2	Motor	380.0	1	112.3	19.3	**93.0**
CV-807-b	Product overland conveyor Motor B	BN-801	2	Motor	380.0	1	112.3	19.3	**93.0**
CV-807-c	Product overland conveyor Motor C	North of BN-851	5	Motor	380.0	1	112.3	0.0	**112.3**
CV-807-d	Product overland conveyor Motor D	North of BN-851	5	Motor	380.0	1	112.3	0.0	**112.3**
CV-807-e	Product overland conveyor Motor E	North of BN-851	5	Motor	380.0	1	112.3	0.0	**112.3**
FE-851-a	OLC Surge Bin Discharge Feeder Drive 1	BN-851	5	Motor	5.5	1	93.9	0.0	**93.9**
FE-851-b	OLC Surge Bin Discharge Feeder Drive 2	BN-851	15	Motor	5.5	1	93.9	0.0	**93.9**
CV-851	TLO bin feed conveyor	CV-851	25	Motor	315.0	1	111.5	19.3	**92.2**
HY-804	Train Loadout Conveyor Hydraulic System	BN-852	5	Hydraulic Pump	36.0	1	102.5	18.8	**83.7**
	Conveyor Belt (Per Meter of Length)	Various	Various	Conveyor	Varies	Each	88.6 per meter	0	**88.6 per meter**

CHPP Equipment Octave Band Sound Power Levels (Re 10^{-12} Watts)

Description	31.5 Hz	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
ROM Bin Sump Pump 1	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
ROM Bin Sump Pump 2	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Feeder Breaker - Breaker drive	95.6	95.6	98.6	100.6	103.6	103.6	102.6	97.6	89.6
Feeder Breaker - Chain drive	97.3	97.3	100.3	102.3	105.3	105.3	104.3	99.3	91.3
Feeder Breaker - cooling fan	97.6	100.6	100.6	97.6	94.6	90.6	87.6	84.6	76.6
Raw Coal Conveyor	96.5	96.5	99.5	101.5	104.5	104.5	103.5	98.5	90.5
Tramp Iron Magnet Heat exchanger fan motor	91.0	94.0	94.0	91.0	88.0	84.0	81.0	78.0	70.0
Raw Coal Screen	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Secondary Sizer Drive 1	95.6	95.6	98.6	100.6	103.6	103.6	102.6	97.6	89.6
Secondary Sizer Drive 2	95.6	95.6	98.6	100.6	103.6	103.6	102.6	97.6	89.6
Sized Coal Conveyor	96.5	96.5	99.5	101.5	104.5	104.5	103.5	98.5	90.5
Plant Feed Feeder Drive 1	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
Plant Feed Feeder Drive 2	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
Plant Feed Conveyor	94.2	94.2	97.2	99.2	102.2	102.2	101.2	96.2	88.2
Deslime Screen Feeder - Vibrating Motor 1	80.4	80.4	83.4	85.4	88.4	88.4	87.4	82.4	74.4
Deslime Screen Feeder - Vibrating Motor 2	80.4	80.4	83.4	85.4	88.4	88.4	87.4	82.4	74.4
Desliming Screen	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
DMC Feed Pump	97.7	98.7	99.7	100.7	99.7	101.7	98.7	94.7	88.7
Product Drain & Rinse Screen	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Coarse Coal Centrifuge - Rotation Drive	90.4	90.4	93.4	95.4	98.4	98.4	97.4	92.4	84.4
Coarse Coal Centrifuge - Vibration Drive	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
Coarse Coal Centrifuge - Vibration Drive	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
Reject Drain & Rinse Screen	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Correct Medium Pump	95.2	96.2	97.2	98.2	97.2	99.2	96.2	92.2	86.2
Deslime Screen Feeder - Vibrating Motor 1	80.4	80.4	83.4	85.4	88.4	88.4	87.4	82.4	74.4
Deslime Screen Feeder - Vibrating Motor 2	80.4	80.4	83.4	85.4	88.4	88.4	87.4	82.4	74.4
Desliming Screen	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
DMC Feed Pump	97.7	98.7	99.7	100.7	99.7	101.7	98.7	94.7	88.7
Product Drain & Rinse Screen	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Coarse Coal Centrifuge - Rotation Drive	90.4	90.4	93.4	95.4	98.4	98.4	97.4	92.4	84.4
Coarse Coal Centrifuge - Vibration Drive	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
Coarse Coal Centrifuge - Vibration Drive	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
Reject Drain & Rinse Screen	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Correct Medium Pump	95.2	96.2	97.2	98.2	97.2	99.2	96.2	92.2	86.2
Dilute Medium Pump	96.5	97.5	98.5	99.5	98.5	100.5	97.5	93.5	87.5
Desliming Cyclone Feed Pump	98.1	99.1	100.1	101.1	100.1	102.1	99.1	95.1	89.1
DMC Area Floor Sump Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Fines Feed Pump	96.1	97.1	98.1	99.1	98.1	100.1	97.1	93.1	87.1
Fines Product Pump	97.5	98.5	99.5	100.5	99.5	101.5	98.5	94.5	88.5
Fine Coal Centrifuge - Rotation Drive	92.6	92.6	95.6	97.6	100.6	100.6	99.6	94.6	86.6
Fine Coal Centrifuge - Rotation Drive	92.6	92.6	95.6	97.6	100.6	100.6	99.6	94.6	86.6
Fine Coal Centrifuge - Rotation Drive	92.6	92.6	95.6	97.6	100.6	100.6	99.6	94.6	86.6
Fine Coal Centrifuge - Rotation Drive	92.6	92.6	95.6	97.6	100.6	100.6	99.6	94.6	86.6
Fines Reject Dewatering Screen Drive A	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Fines Reject Dewatering Screen Drive B	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0

CHPP Equipment Octave Band Sound Power Levels (Re 10^{-12} Watts) Cont.

Description	31.5 Hz	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Fines Reject Dewatering Screen Drive A	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Fines Reject Dewatering Screen Drive B	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Fines Reject Dewatering Screen Drive A	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Fines Reject Dewatering Screen Drive B	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Fines Reject Dewatering Screen Drive A	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Fines Reject Dewatering Screen Drive B	108.0	113.0	113.0	109.0	110.0	109.0	109.0	106.0	100.0
Fines Effluent Pump	96.8	97.8	98.8	99.8	98.8	100.8	97.8	93.8	87.8
Flotation Feed Pump	98.1	99.1	100.1	101.1	100.1	102.1	99.1	95.1	89.1
Sec Flotation Feed Pump	98.1	99.1	100.1	101.1	100.1	102.1	99.1	95.1	89.1
Flotation Area Floor Sump Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Coal Clarified Water Pump	97.6	98.6	99.6	100.6	99.6	101.6	98.6	94.6	88.6
Coal Thickener Underflow Pump	97.3	98.3	99.3	100.3	99.3	101.3	98.3	94.3	88.3
HDF Rotation Drive	86.5	86.5	89.5	91.5	94.5	94.5	93.5	88.5	80.5
Discharge Conveyor	86.5	86.5	89.5	91.5	94.5	94.5	93.5	88.5	80.5
HDF Hydraulic Pack Motor 1	94.0	95.0	96.0	97.0	96.0	98.0	95.0	91.0	85.0
HDF High Pressure Water Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
HDF High Pressure Water Pump	95.0	96.0	97.0	98.0	97.0	99.0	96.0	92.0	86.0
HDF Compressor (Duty)	111.5	107.5	112.5	111.5	109.5	112.5	117.5	114.5	107.5
HDF Compressed Air Dryer	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
HDF Compressor (Duty)	111.5	107.5	112.5	111.5	109.5	112.5	117.5	114.5	107.5
HDF Compressed Air Dryer	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
HDF Screw Conveyor Screw 1	82.6	82.6	85.6	87.6	90.6	90.6	89.6	84.6	76.6
HDF Screw Conveyor Screw 2	82.6	82.6	85.6	87.6	90.6	90.6	89.6	84.6	76.6
HDF Screw Conveyor Screw 3	82.6	82.6	85.6	87.6	90.6	90.6	89.6	84.6	76.6
HDF Rotation Drive	86.5	86.5	89.5	91.5	94.5	94.5	93.5	88.5	80.5
Discharge Conveyor	86.5	86.5	89.5	91.5	94.5	94.5	93.5	88.5	80.5
HDF Hydraulic Pack Motor 1	94.0	95.0	96.0	97.0	96.0	98.0	95.0	91.0	85.0
HDF High Pressure Water Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
HDF High Pressure Water Pump	95.0	96.0	97.0	98.0	97.0	99.0	96.0	92.0	86.0
HDF Compressor (Duty)	111.5	107.5	112.5	111.5	109.5	112.5	117.5	114.5	107.5
HDF Compressed Air Dryer	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
HDF Compressor (Duty)	111.5	107.5	112.5	111.5	109.5	112.5	117.5	114.5	107.5
HDF Compressed Air Dryer	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
HDF Screw Conveyor Screw 1	82.6	82.6	85.6	87.6	90.6	90.6	89.6	84.6	76.6
HDF Screw Conveyor Screw 2	82.6	82.6	85.6	87.6	90.6	90.6	89.6	84.6	76.6
HDF Screw Conveyor Screw 3	82.6	82.6	85.6	87.6	90.6	90.6	89.6	84.6	76.6
Coal Thickener Floor Sump Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Tailings Thickener Underflow Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Tailings Thickener Floor Sump Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
BPF 1 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
BPF 2 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
BPF 3 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
BPF 4 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
BPF 5 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
BPF 6 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7

CHPP Equipment Octave Band Sound Power Levels (Re 10^{-12} Watts) Cont.

Description	31.5 Hz	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
BPF 7 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
BPF 8 Feed Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Filtrate Pump	95.6	96.6	97.6	98.6	97.6	99.6	96.6	92.6	86.6
BPF Wash Water Pump	96.1	97.1	98.1	99.1	98.1	100.1	97.1	93.1	87.1
Gland Water Pump	95.3	96.3	97.3	98.3	97.3	99.3	96.3	92.3	86.3
BPF Area Floor Sump Pump	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Clarified Water Pump	98.1	99.1	100.1	101.1	100.1	102.1	99.1	95.1	89.1
Reflux Classifier Fluidising Water Pump	94.4	95.4	96.4	97.4	96.4	98.4	95.4	91.4	85.4
Compressed Air System	96.8	92.8	97.8	96.8	94.8	97.8	102.8	99.8	92.8
Magnetite Addition Pump	95.0	96.0	97.0	98.0	97.0	99.0	96.0	92.0	86.0
Ultrafine Rejects Collection Conveyor	87.3	87.3	90.3	92.3	95.3	95.3	94.3	89.3	81.3
Raw Water Pump	96.1	97.1	98.1	99.1	98.1	100.1	97.1	93.1	87.1
Raw Water Pump	96.1	97.1	98.1	99.1	98.1	100.1	97.1	93.1	87.1
Reject Collection Conveyor	90.4	90.4	93.4	95.4	98.4	98.4	97.4	92.4	84.4
Rejects Bin Hydraulic System	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Product Conveyor	96.5	96.5	99.5	101.5	104.5	104.5	103.5	98.5	90.5
Bifurcated chute Diverter Gate Hydraulic Power Pack	92.6	93.6	94.6	95.6	94.6	96.6	93.6	89.6	83.6
Product Radial Stacker 1	93.8	93.8	96.8	98.8	101.8	101.8	100.8	95.8	87.8
Product Stackout Conveyor	92.6	92.6	95.6	97.6	100.6	100.6	99.6	94.6	86.6
Product Radial Stacker 2	93.8	93.8	96.8	98.8	101.8	101.8	100.8	95.8	87.8
Product Stockpile Reclaim Conveyor	99.3	99.3	102.3	104.3	107.3	107.3	106.3	101.3	93.3
Feeder Breaker - Breaker drive	95.6	95.6	98.6	100.6	103.6	103.6	102.6	97.6	89.6
Feeder Breaker - Chain drive	97.3	97.3	100.3	102.3	105.3	105.3	104.3	99.3	91.3
Feeder Breaker - cooling fan	97.6	100.6	100.6	97.6	94.6	90.6	87.6	84.6	76.6
Feeder Breaker - Breaker drive	95.6	95.6	98.6	100.6	103.6	103.6	102.6	97.6	89.6
Feeder Breaker - Chain drive	97.3	97.3	100.3	102.3	105.3	105.3	104.3	99.3	91.3
Feeder Breaker - cooling fan	97.6	100.6	100.6	97.6	94.6	90.6	87.6	84.6	76.6
Feeder Breaker - Breaker drive	95.6	95.6	98.6	100.6	103.6	103.6	102.6	97.6	89.6
Feeder Breaker - Chain drive	97.3	97.3	100.3	102.3	105.3	105.3	104.3	99.3	91.3
Feeder Breaker - cooling fan	97.6	100.6	100.6	97.6	94.6	90.6	87.6	84.6	76.6
Feeder Breaker - Breaker drive	95.6	95.6	98.6	100.6	103.6	103.6	102.6	97.6	89.6
Feeder Breaker - Chain drive	97.3	97.3	100.3	102.3	105.3	105.3	104.3	99.3	91.3
Feeder Breaker - cooling fan	97.6	100.6	100.6	97.6	94.6	90.6	87.6	84.6	76.6
OLC Vibrating Feeder Drive 1	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
OLC Vibrating Feeder Drive 2	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
Product overland conveyor Motor A	99.6	99.6	102.6	104.6	107.6	107.6	106.6	101.6	93.6
Product overland conveyor Motor B	99.6	99.6	102.6	104.6	107.6	107.6	106.6	101.6	93.6
Product overland conveyor Motor C	99.6	99.6	102.6	104.6	107.6	107.6	106.6	101.6	93.6
Product overland conveyor Motor D	99.6	99.6	102.6	104.6	107.6	107.6	106.6	101.6	93.6
Product overland conveyor Motor E	99.6	99.6	102.6	104.6	107.6	107.6	106.6	101.6	93.6
OLC Surge Bin Discharge Feeder Drive 1	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
OLC Surge Bin Discharge Feeder Drive 2	81.2	81.2	84.2	86.2	89.2	89.2	88.2	83.2	75.2
TLO bin feed conveyor	98.8	98.8	101.8	103.8	106.8	106.8	105.8	100.8	92.8
Train Loadout Conveyor Hydraulic System	94.7	95.7	96.7	97.7	96.7	98.7	95.7	91.7	85.7
Conveyor Belt (Per Meter of Length)	74.9	82.7	85.2	87.6	85.9	85.7	76.4	69.8	61.1

CPP Building Dimensions

Tag	Building Name	Length (m)	Width (m)	Height (m)
CPP	CPP Process Building	75.0	22.0	26.0

Building Sound Level Attenuation

	31.5 Hz	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Building Attenuation (dB)	3	6	9	12	15	20	25	30	30

Mine Equipment Sound Power Levels (Re 10^{-12} Watts)

Equipment	dBA		32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz		Height (m)
Waste Shovel (Komatsu PC5500)	123.9		121.4	129.7	131.1	123.4	121.3	117.8	115.3	108.6	100.5		7
Waste Backhoe (Komatsu PC4000)	120.9		118.4	126.7	128.1	120.4	118.3	114.8	112.3	105.6	97.5		7
Backhoe, 122 ton (Komatsu PC1250)	117.9		115.4	123.7	125.1	117.4	115.3	111.8	109.3	102.6	94.5		4
Backhoe, 71 ton (Komatsu PC650)	116.9		114.4	122.7	124.1	116.4	114.3	110.8	108.3	101.6	93.5		4
Backhoe, 34 ton (Komatsu)	116.9		114.4	122.7	124.1	116.4	114.3	110.8	108.3	101.6	93.5		4
Haul Truck (Komatsu)	123.3		113.4	125.1	124.8	120.6	119.2	115.7	116.0	115.2	114.0		4
Wheel Loader (Komatsu WA1200-6)	125.0		118.4	121.2	127.4	120.4	118.6	119.7	119.6	114.6	106.9		4
Bulldozer (CAT D11)	121.4		111.4	126.3	128.4	114.9	118.8	115.8	114.0	108.0	100.3		3
Bulldozer (CAT D10)	118.0		112.0	123.7	133.0	110.1	107.6	106.7	104.3	95.8	94.2		3
Bulldozer (CAT D9)	118.0		112.0	123.7	133.0	110.1	107.6	106.7	104.3	95.8	94.2		3
Blast Hole Drill (P&H 250XPC)	114.3		112.2	110.6	123.4	114.5	107.6	107.9	106.3	103.5	97.8		3
Wheel dozer (CAT 834K)	118.0		112.0	123.7	133.0	110.1	107.6	106.7	104.3	95.8	94.2		3
Articulated Trucks	118.3		108.8	110.1	118.7	122.3	113.6	112.2	108.9	104.6	97.5		3
Diesel Driven Pump	110.8		104.5	104.5	109.5	112.5	107.5	105.5	102.5	96.5	90.5		1.5
Light Plant	103.1		96.8	96.8	101.8	104.8	99.8	97.8	94.8	88.8	82.8		1
Motor Grader (Cat 20M) + other service vehicles on haul roads	118.2		108.0	111.4	122.1	121.6	115.2	111.6	108.7	102.2	93.4		3
Locomotives at Train Loadout (each)	107.9		108.1	126.4	111.6	104.0	103.1	99.9	99.5	99.3	95.6		5

Notes:

- The mining equipment sound power levels indicated above are the maximum levels measured.
- For equipment such as Dozers, Loaders, Shovels, Rock Haul Trucks, etc. the maximum noise levels are not achieved 100% of the time. To take into account the fact that the noise levels are lower during low-idle operations and that there is minimal noise during coffee and lunch breaks, re-fueling, etc., each of these noise sources have been reduced by 6 dB.
- The Haul Trucks (Waste and Coal) have been modeled as traveling point sources. The traveling speed and distance has been used along with loading/unloading and other usage time to determine the round-trip time for each of the haul routes. This has been used to calculate the quantity of Haul Trucks per hour and then multiplied by the number of Haul Trucks on each route to determine the number of Haul Truck passages per hour for each route.
- Noise levels for the Diesel Driven Pumps and Light Plants have been left at the maximum values.
- Noise levels for the Diesel Locomotives have been left at the maximum values.
- The Articulated Trucks and Reclamation Loader only operate during the day-time hours.
- The Light Plants only operate during the night-time hours

Vehicle Traffic Data

Road	Day (Vehicles Per Hour)	Day % Heavy Vehicles	Night (Vehicles Per Hour)	Night % Heavy Vehicles	Speed (km/hr)	Total Volume (vehicles per day)
Highway 3 West of 20 Avenue WEST	521	14	165	14	80	9300
Highway 3 West of 107 Street	381	14	121	14	80	6800
Highway 3 Between 20 Ave and 107 Street EAST	442	14	140	14	80	7900
Highway 3 East of 20 Avenue EAST	543	12	172	12	80	9700
20 Avenue	110	4	39	5	50	2000

Rail Traffic Data

Rail Line	Trains per Day	Trains per Night	Track Speed (km/hr)	Average Train Length (m)
Existing Rail Line Traffic	7	3	64	2140

General Noise Modelling Parameters

Parameter	Value
Modelling Software	CADNA/A (Version 4.6.153)
Standard Followed	ISO 9613-2
Ground Sound Absorption Coefficient	0.7
Wind Speed	1 - 5 m/s (3.6 - 18 km/hr)
Wind Direction	Downwind from all sources to all receptors
Temperature	10 °C
Humidity	70%
Topography	Used Digital Terrain Model Contours Provided by Client

Appendix V ISOLATED NOISE MONITORING DATA

East Noise Monitor

Start Time	End Time	Duration (min)	Reason
3/8/2016 9:45	3/8/2016 9:49	4.25	Train Passby
3/8/2016 10:54	3/8/2016 11:00	6	Train Passby
3/8/2016 13:06	3/8/2016 13:08	1.25	Loud Truck
3/8/2016 13:29	3/8/2016 13:35	6	Train Passby
3/8/2016 13:40	3/8/2016 13:45	5.5	Train Passby
3/8/2016 15:19	3/8/2016 15:21	2.25	Aircraft Flyover
3/8/2016 16:48	3/8/2016 16:53	5	Train Passby
3/8/2016 19:42	3/8/2016 19:43	1.5	Loud Vehicle Passby
3/8/2016 20:55	3/8/2016 21:03	8.25	Train Passby
3/9/2016 0:38	3/9/2016 0:45	6.25	Train Passby
3/10/2016 0:13	3/10/2016 0:21	8.25	Train Passby
3/10/2016 2:07	3/10/2016 2:13	6.5	Train Passby
3/11/2016 14:31	3/11/2016 14:32	1.25	Loud Vehicle Passby
3/11/2016 15:34	3/11/2016 15:39	4.25	Train Passby
3/11/2016 16:37	3/11/2016 16:42	5.5	Train Passby
3/11/2016 16:49	3/11/2016 16:54	5	Train Passby
3/11/2016 17:33	3/11/2016 17:34	1	Siren
3/11/2016 17:57	3/11/2016 18:02	4.75	Train Passby
3/11/2016 23:32	3/11/2016 23:39	6.25	Train Passby
3/12/2016 5:47	3/12/2016 5:53	5.75	Train Passby
3/12/2016 6:35	3/12/2016 6:46	10.5	Train Passby
3/12/2016 9:30	3/12/2016 9:35	4.75	Train Passby
3/14/2016 5:20	3/14/2016 5:28	8.5	Train Passby
3/14/2016 5:32	3/14/2016 5:41	9.25	Train Passby
3/15/2016 23:04	3/15/2016 23:11	7	Train Passby
3/16/2016 2:30	3/16/2016 2:37	6.25	Train Passby
3/16/2016 6:42	3/16/2016 6:49	7.25	Train Passby
3/17/2016 2:05	3/17/2016 2:16	11.5	Train Passby
3/17/2016 7:53	3/17/2016 8:05	12.25	Train Passby
3/17/2016 8:23	3/17/2016 8:29	5.75	Train Passby
3/17/2016 8:50	3/17/2016 8:51	0.75	Loud Vehicle Passby

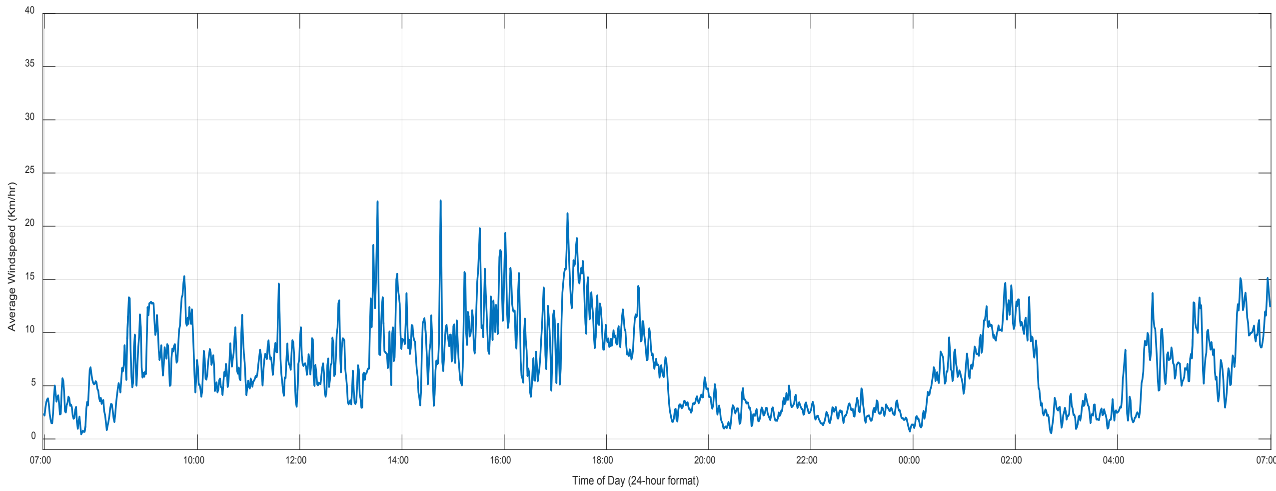
West Noise Monitor

Start Time	End Time	Duration (min)	Reason
3/8/2016 8:11	3/8/2016 8:12	1.5	Loud Vehicle Passby
3/8/2016 9:45	3/8/2016 9:50	5.5	Train Passby
3/8/2016 10:19	3/8/2016 10:20	1.25	Loud Vehicle Passby
3/8/2016 10:27	3/8/2016 10:29	1.25	Loud Vehicle Passby
3/8/2016 10:53	3/8/2016 11:01	8	Train Passby
3/8/2016 11:45	3/8/2016 11:46	1.25	Loud Vehicle Passby
3/8/2016 13:29	3/8/2016 13:37	7.75	Train Passby
3/8/2016 13:38	3/8/2016 13:45	7	Train Passby
3/8/2016 14:26	3/8/2016 14:27	1	Loud Vehicle Passby
3/8/2016 15:18	3/8/2016 15:21	2.5	Aircraft Flyover
3/8/2016 16:47	3/8/2016 16:53	5.5	Train Passby
3/8/2016 20:55	3/8/2016 21:05	10.5	Train Passby
3/8/2016 23:57	3/8/2016 23:58	1.25	Loud Vehicle Passby
3/9/2016 0:38	3/9/2016 0:44	6	Train Passby
3/10/2016 0:13	3/10/2016 0:22	9	Train Passby
3/10/2016 2:07	3/10/2016 2:12	4.5	Train Passby
3/11/2016 14:15	3/11/2016 14:16	1.75	Loud Vehicle Passby
3/11/2016 15:35	3/11/2016 15:39	3.75	Train Passby
3/11/2016 16:36	3/11/2016 16:45	9	Train Passby
3/11/2016 16:47	3/11/2016 16:53	6	Train Passby
3/11/2016 17:56	3/11/2016 18:02	6	Train Passby
3/11/2016 21:17	3/11/2016 21:18	1.25	Loud Vehicle Passby
3/11/2016 23:32	3/11/2016 23:37	5	Train Passby
3/12/2016 5:48	3/12/2016 5:53	5.5	Train Passby
3/12/2016 6:36	3/12/2016 6:47	10.75	Train Passby
3/12/2016 9:30	3/12/2016 9:36	6	Train Passby
3/12/2016 9:36	3/12/2016 9:40	4	Train Passby
3/14/2016 5:21	3/14/2016 5:29	8	Train Passby
3/14/2016 5:32	3/14/2016 5:41	9.25	Train Passby
3/15/2016 23:04	3/15/2016 23:12	8	Train Passby
3/16/2016 1:34	3/16/2016 1:36	1.5	Loud Vehicle Passby
3/16/2016 2:30	3/16/2016 2:35	4.5	Train Passby
3/16/2016 6:42	3/16/2016 6:47	5	Train Passby
3/17/2016 2:06	3/17/2016 2:17	10.75	Train Passby
3/17/2016 7:52	3/17/2016 7:59	6.75	Train Passby
3/17/2016 8:23	3/17/2016 8:30	7.25	Train Passby

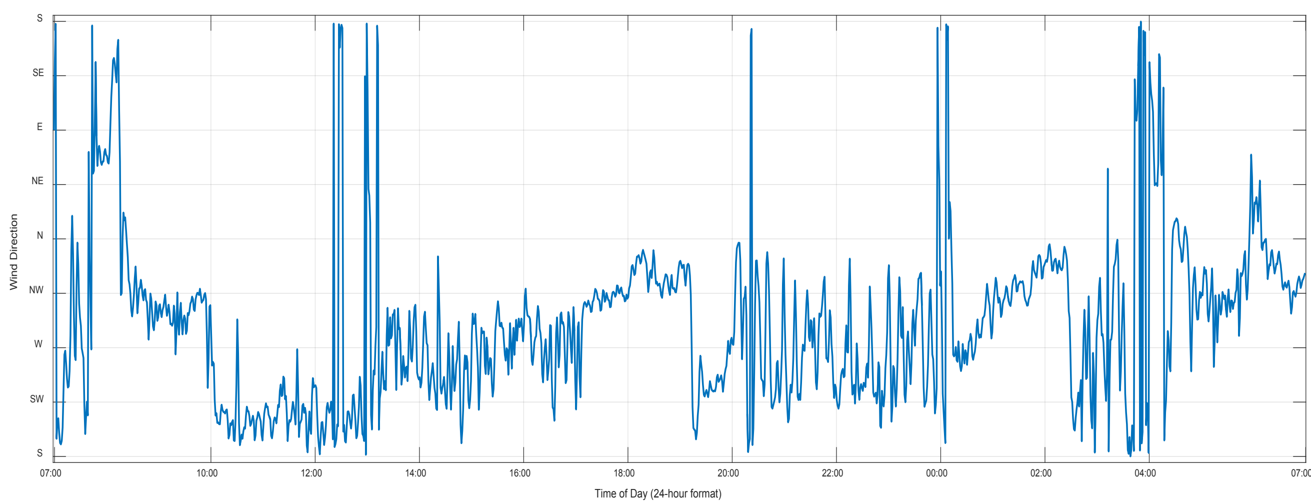
Hospital Noise Monitor

Start Time	End Time	Duration (min)	Reason
3/8/2016 9:44	3/8/2016 9:48	3.5	Train Passby
3/8/2016 10:53	3/8/2016 10:57	3.5	Train Passby
3/8/2016 10:58	3/8/2016 11:00	1.25	Sirens
3/8/2016 13:31	3/8/2016 13:34	3	Train Passby
3/8/2016 13:38	3/8/2016 13:41	3.25	Train Passby
3/8/2016 16:52	3/8/2016 16:57	5	Train Passby
3/8/2016 18:35	3/8/2016 18:36	1	Loud Vehicle Passby
3/8/2016 19:44	3/8/2016 19:45	1	Loud Vehicle Passby
3/8/2016 20:56	3/8/2016 21:01	5	Train Passby
3/8/2016 23:19	3/8/2016 23:19	0.75	Loud Vehicle Passby
3/9/2016 0:38	3/9/2016 0:42	4	Train Passby
3/10/2016 0:15	3/10/2016 0:22	6.5	Train Passby
3/10/2016 2:07	3/10/2016 2:12	4.5	Train Passby
3/11/2016 15:36	3/11/2016 15:40	4.5	Train Passby
3/11/2016 16:35	3/11/2016 16:39	4	Train Passby
3/11/2016 16:49	3/11/2016 16:53	4.25	Train Passby
3/11/2016 17:33	3/11/2016 17:34	0.5	Siren
3/11/2016 17:55	3/11/2016 18:02	6.75	Train Passby
3/11/2016 23:25	3/11/2016 23:26	0.75	Aircraft Flyover
3/11/2016 23:32	3/11/2016 23:38	5.75	Train Passby
3/12/2016 5:46	3/12/2016 5:52	6.25	Train Passby
3/12/2016 6:36	3/12/2016 6:41	5	Train Passby
3/12/2016 9:31	3/12/2016 9:35	4	Train Passby
3/14/2016 3:49	3/14/2016 3:52	2.25	Loud Vehicle Passby
3/14/2016 4:47	3/14/2016 6:09	81.5	Engine Nearby (Possibly Genset at Hospital)
3/15/2016 23:06	3/15/2016 23:10	4.5	Train Passby
3/16/2016 2:30	3/16/2016 2:34	4.75	Train Passby
3/16/2016 6:40	3/16/2016 6:46	6	Train Passby
3/17/2016 0:11	3/17/2016 0:11	0.75	Loud Vehicle Passby
3/17/2016 2:08	3/17/2016 2:17	8.5	Train Passby
3/17/2016 7:52	3/17/2016 7:56	4.25	Train Passby
3/17/2016 8:23	3/17/2016 8:27	4	Train Passby

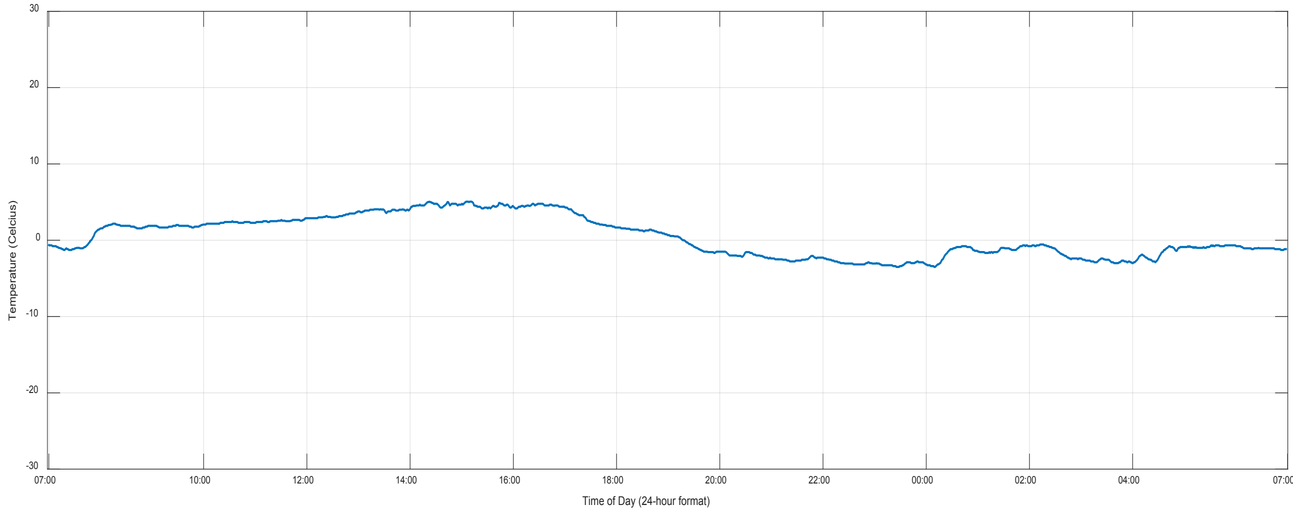
Appendix VI WEATHER DATA



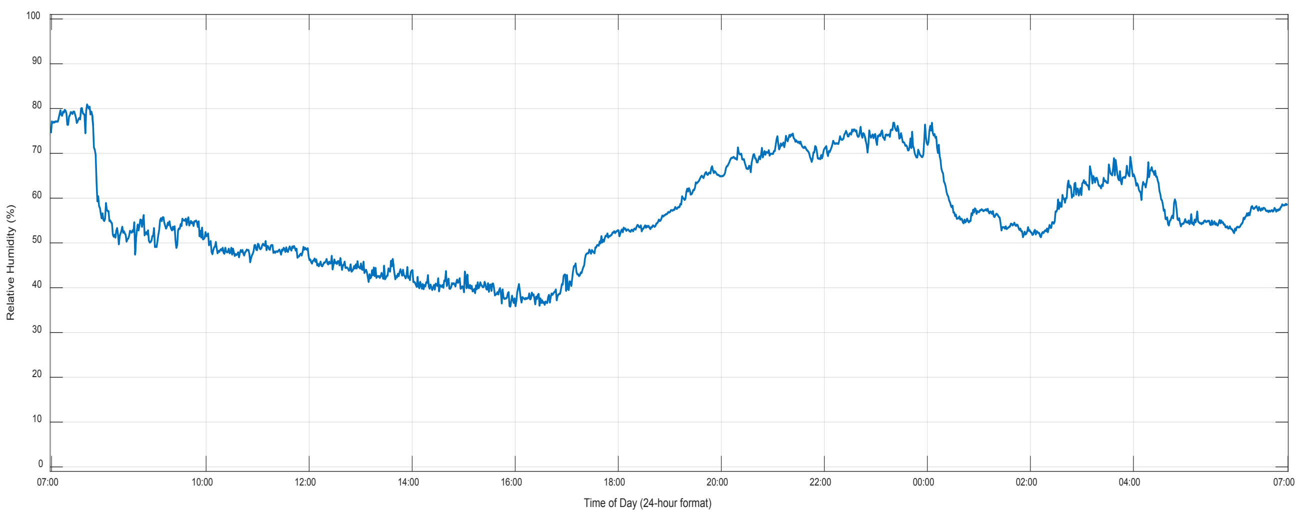
Monitored Wind Speed (March 08 – 09, 2016)



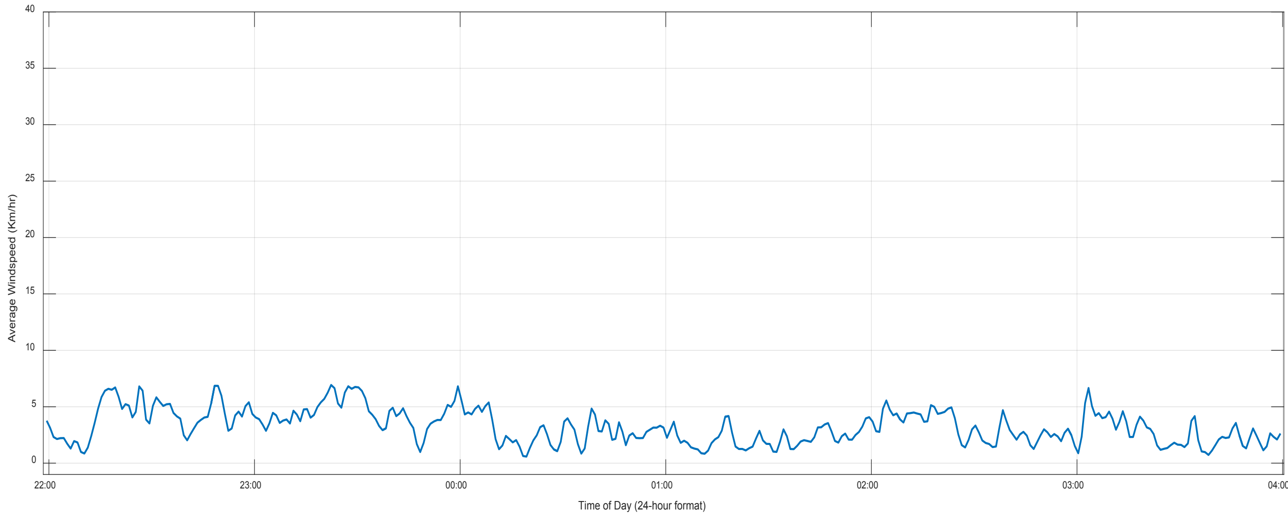
Monitored Wind Direction (March 08 – 09, 2016)



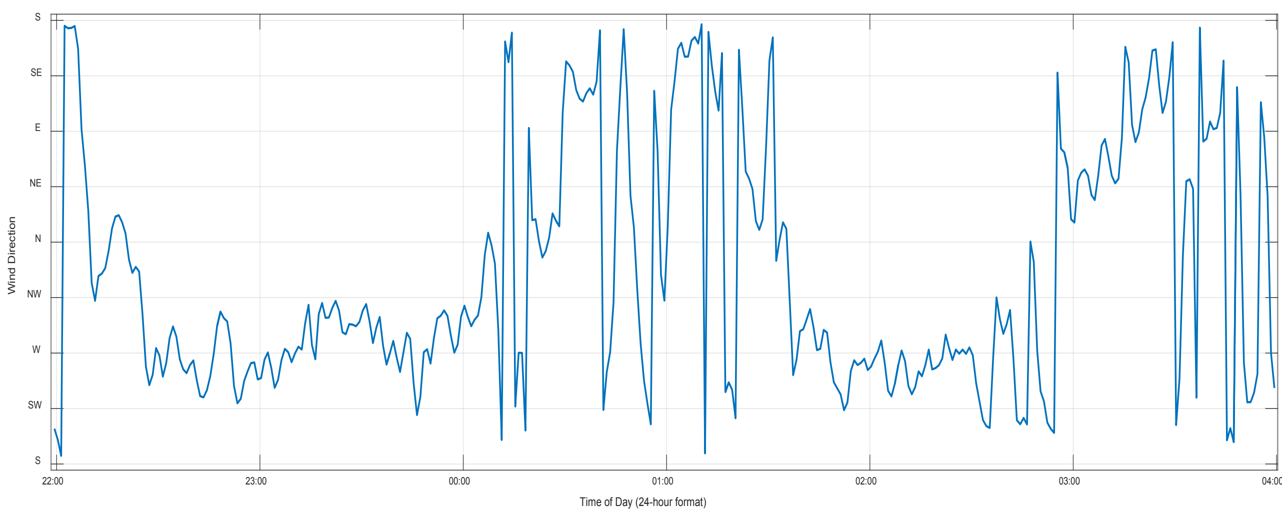
Monitored Temperature (March 08 – 09, 2016)



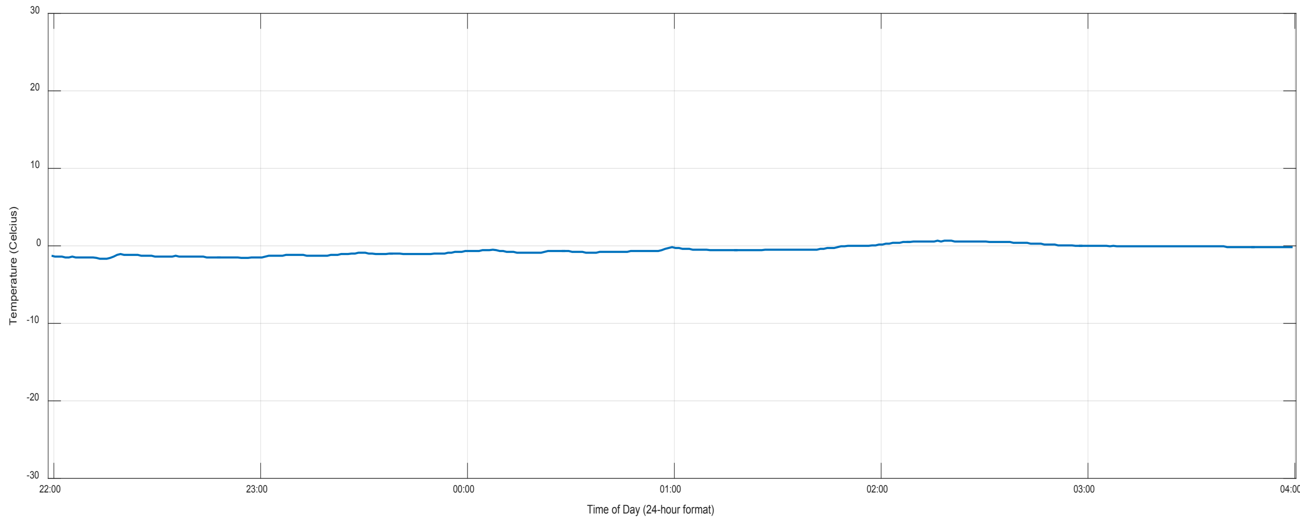
Monitored Relative Humidity (March 08 – 09, 2016)



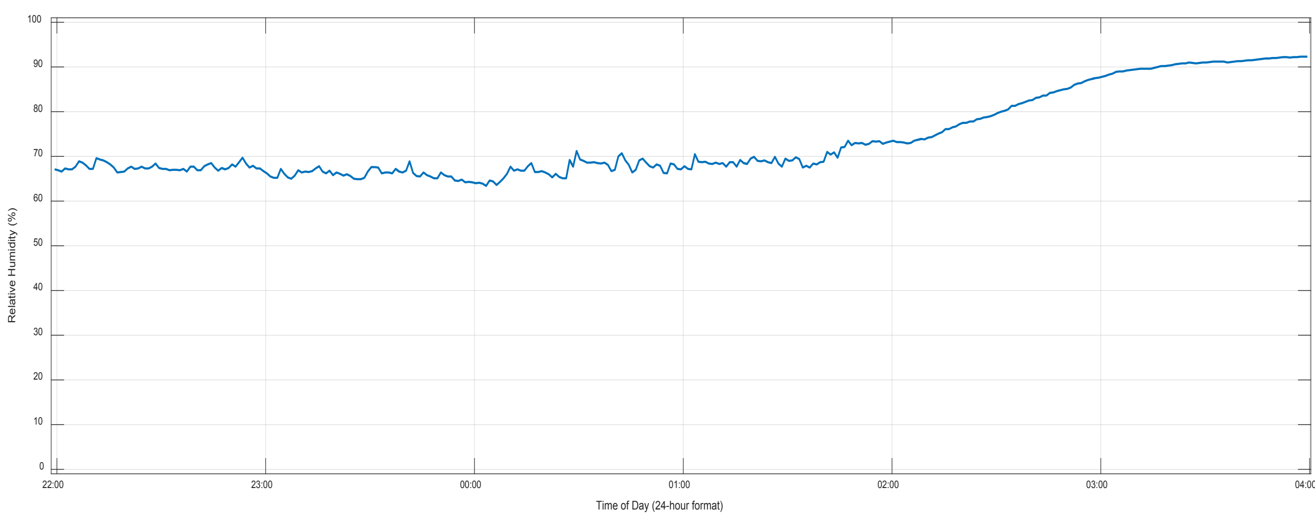
Monitored Wind Speed (March 09 – 10, 2016)



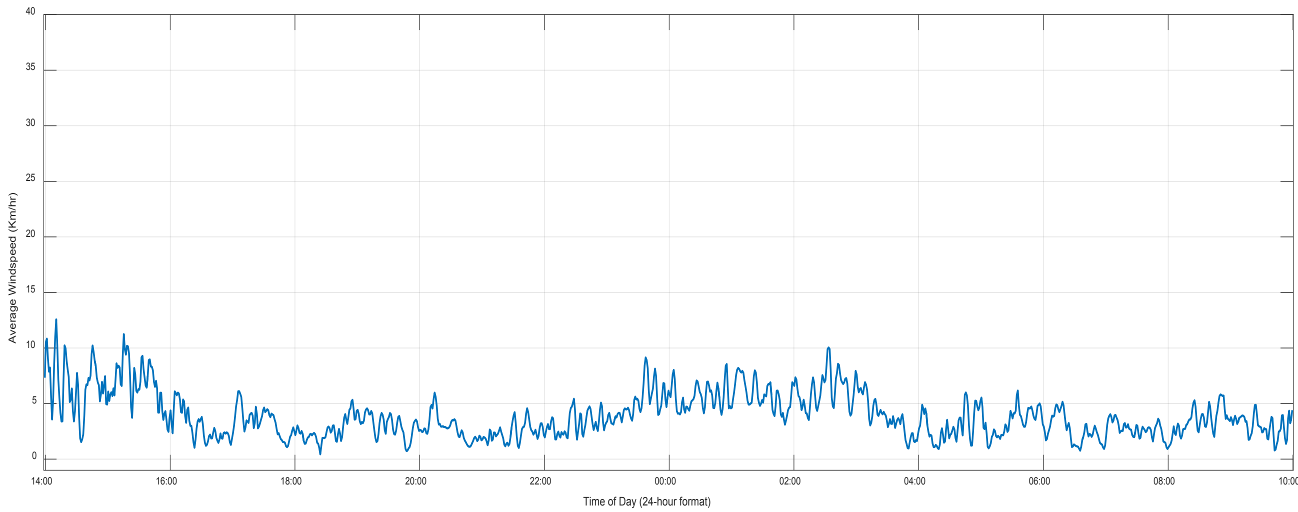
Monitored Wind Direction (March 09 – 10, 2016)



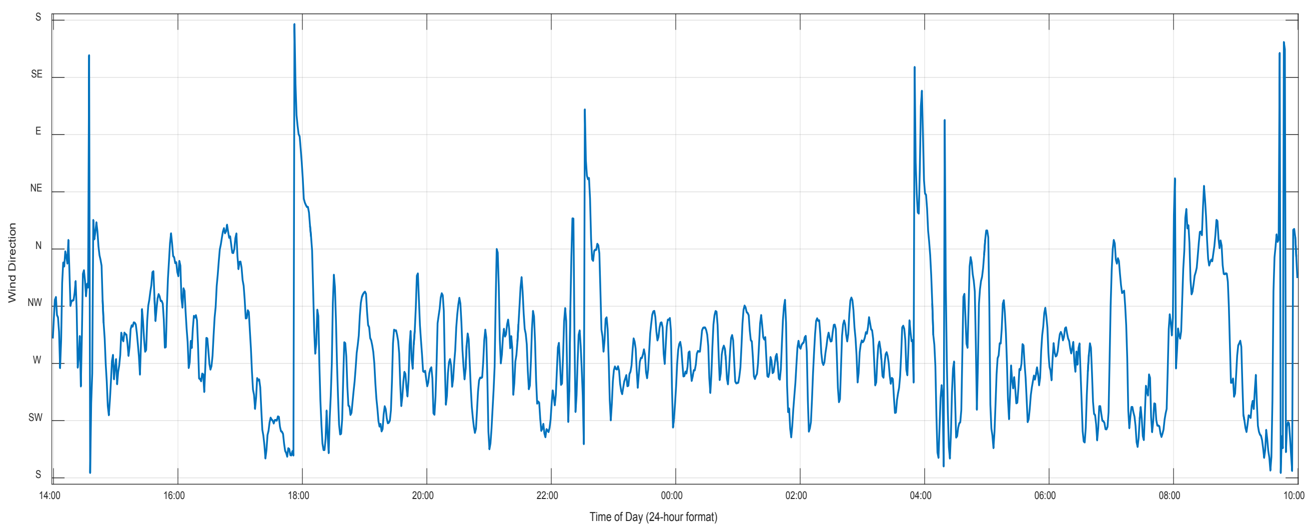
Monitored Temperature (March 09 – 10, 2016)



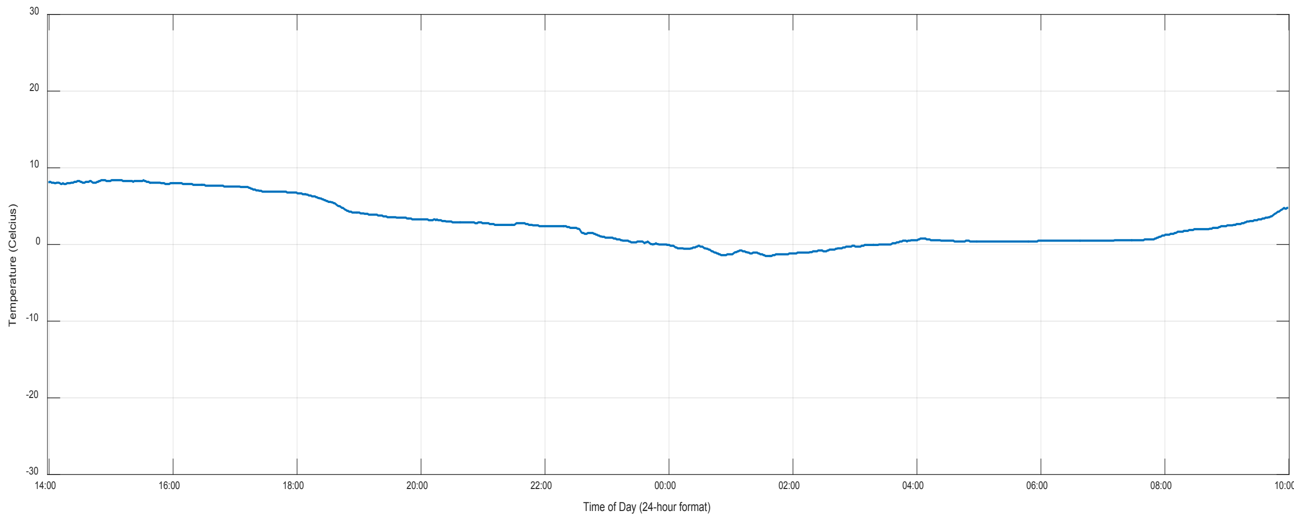
Monitored Relative Humidity (March 09 – 10, 2016)



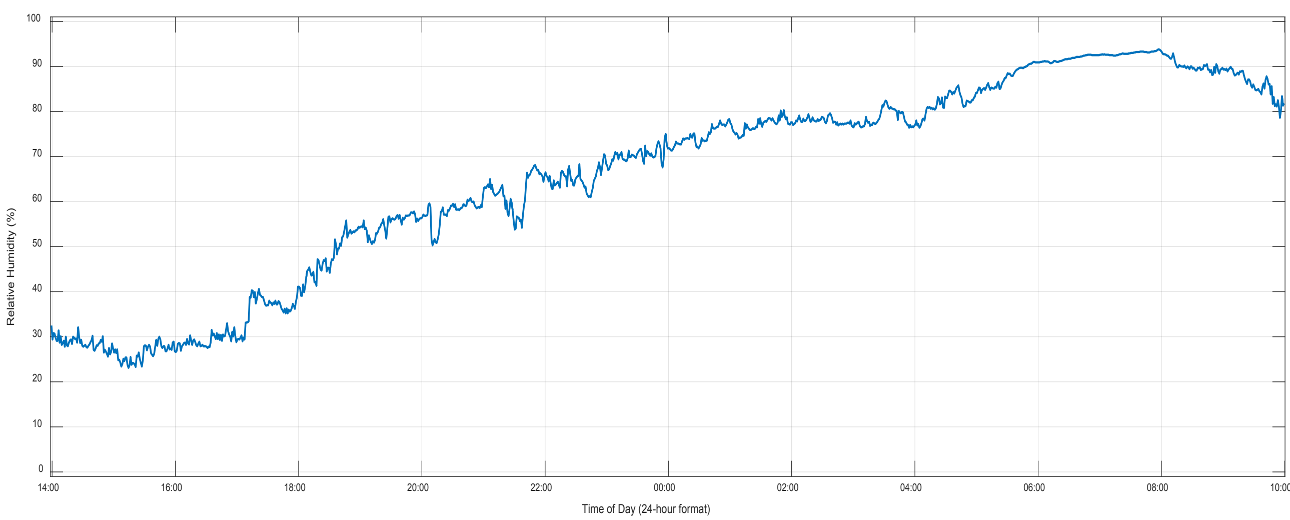
Monitored Wind Speed (March 11 – 12, 2016)



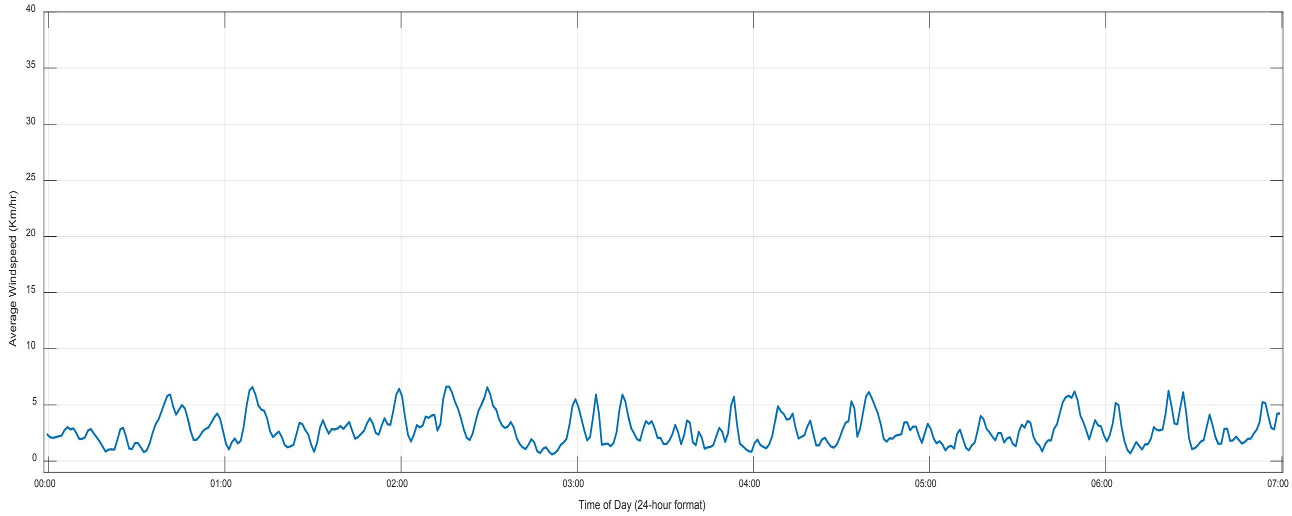
Monitored Wind Direction (March 11 – 12, 2016)



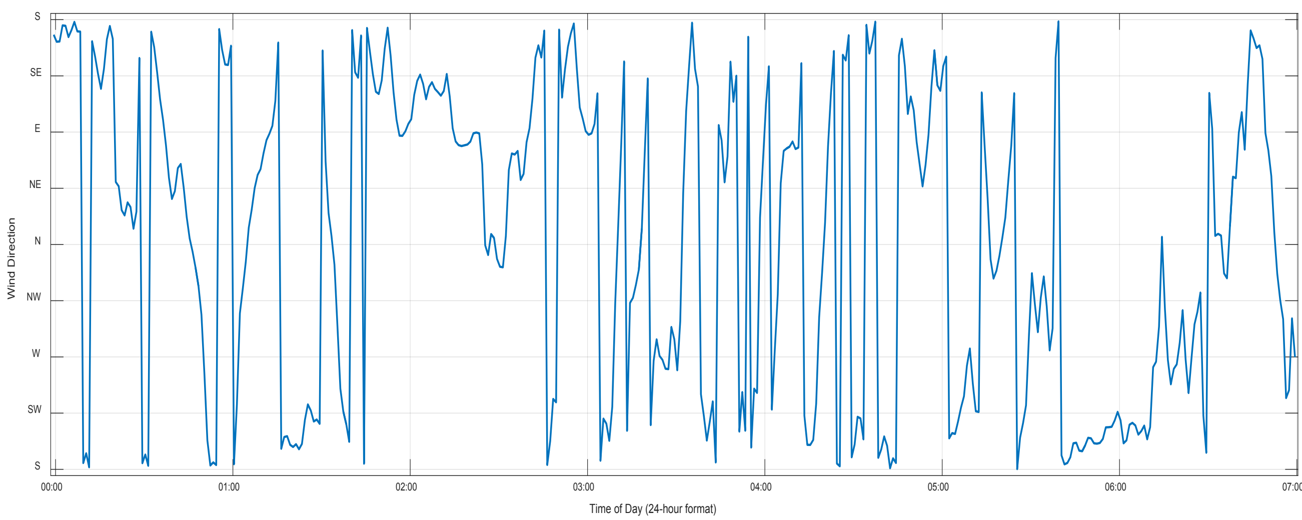
Monitored Temperature (March 11 – 12, 2016)



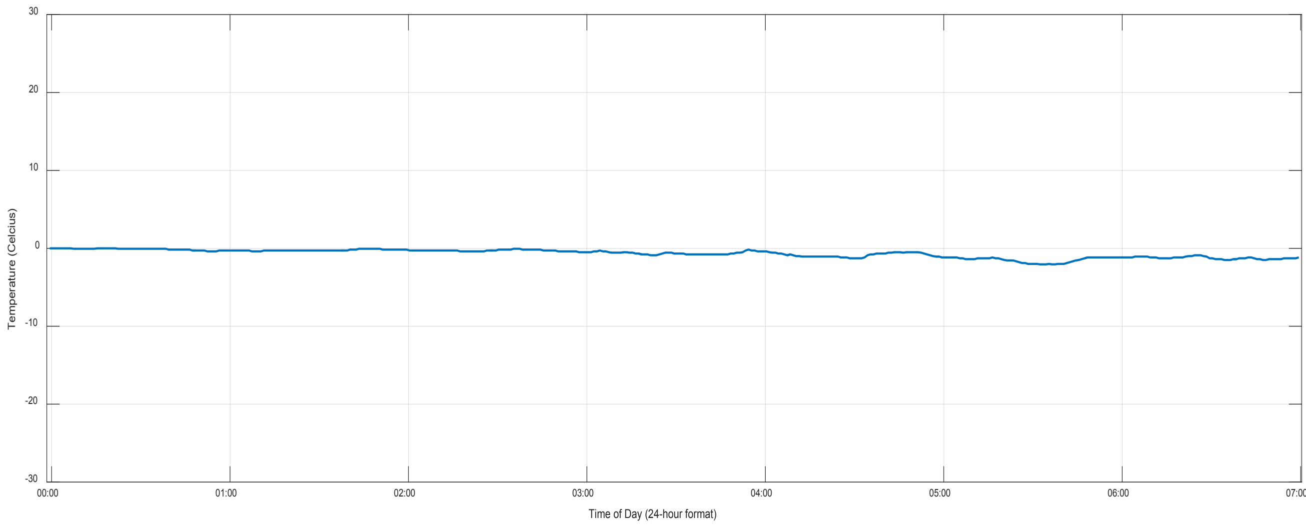
Monitored Relative Humidity (March 11 – 12, 2016)



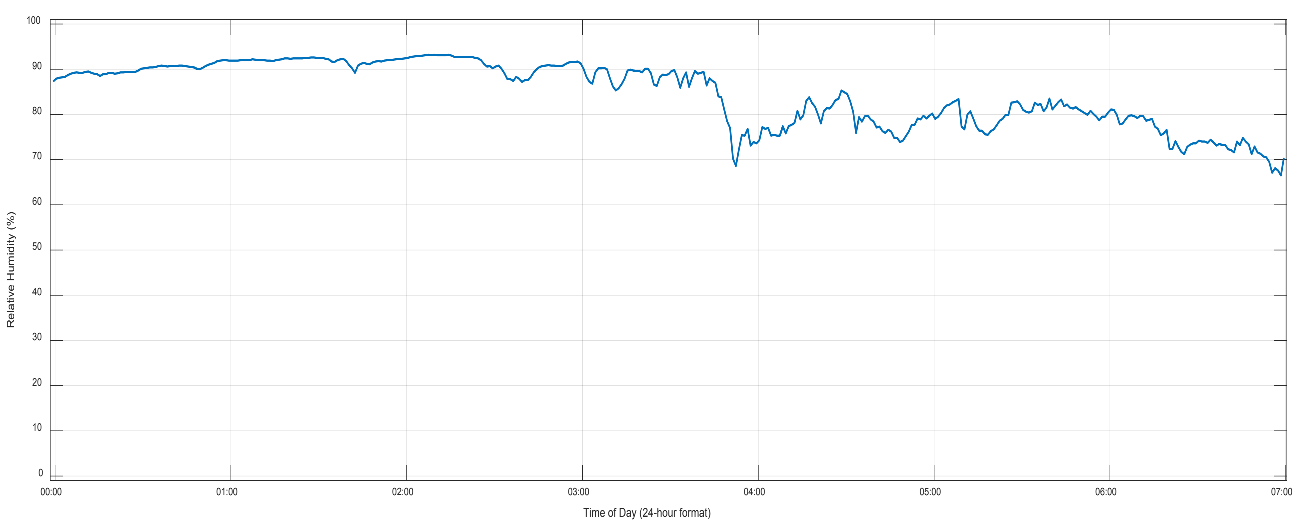
Monitored Wind Speed (March 14, 2016)



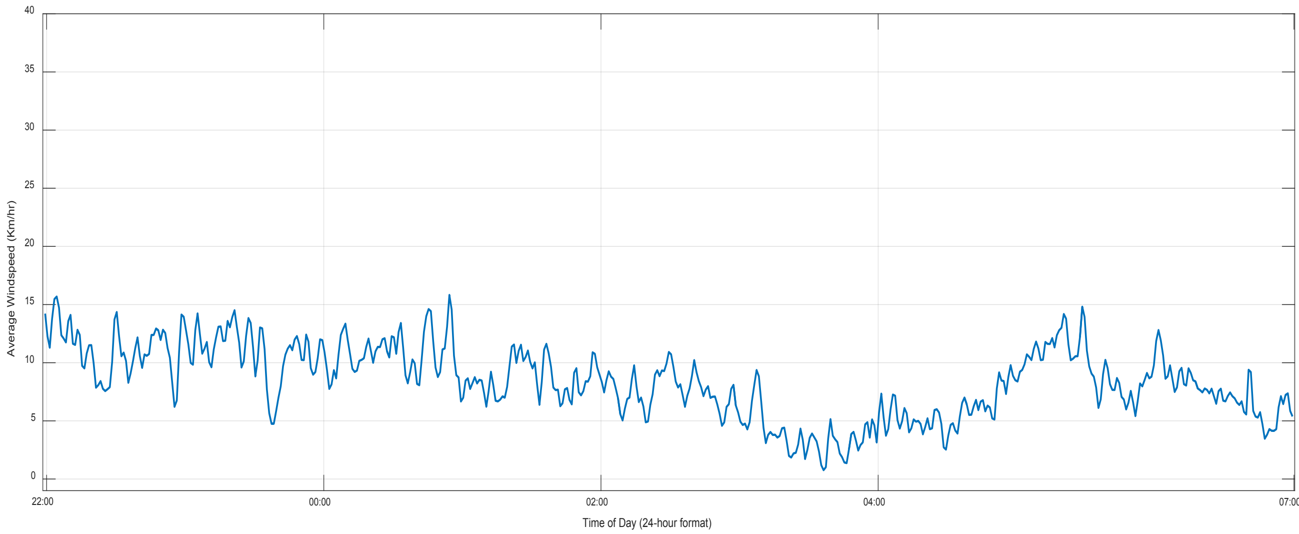
Monitored Wind Direction (March 14, 2016)



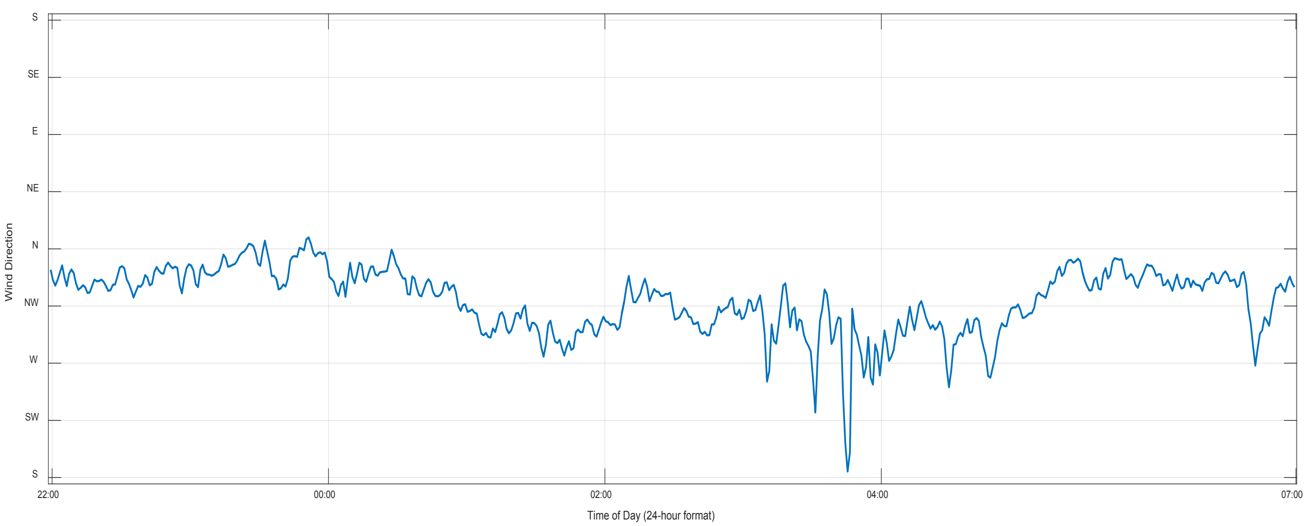
Monitored Temperature (March 14, 2016)



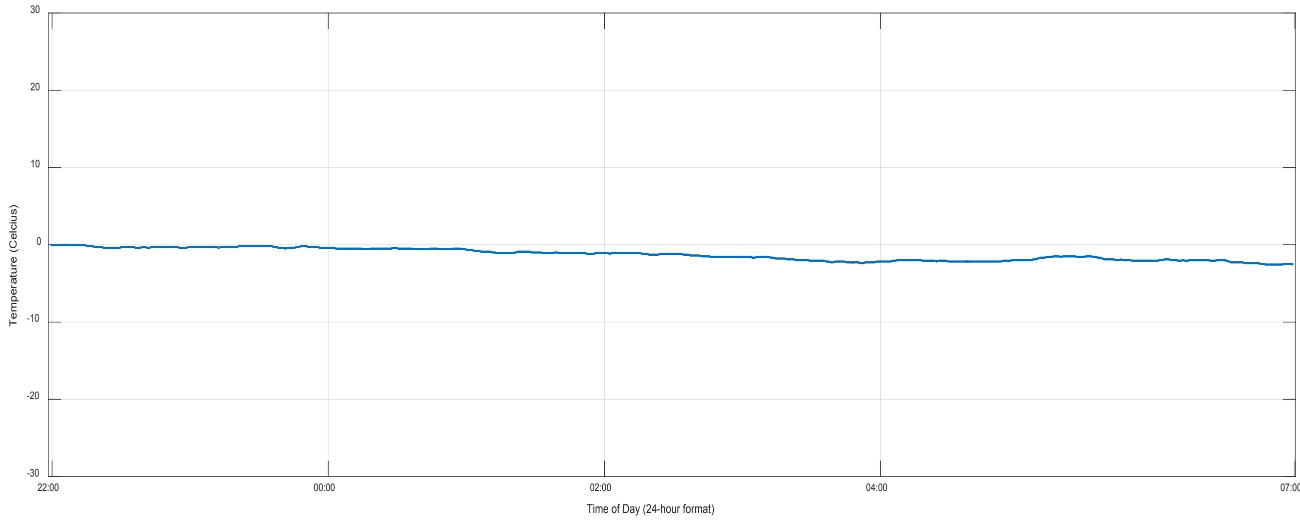
Monitored Relative Humidity (March 14, 2016)



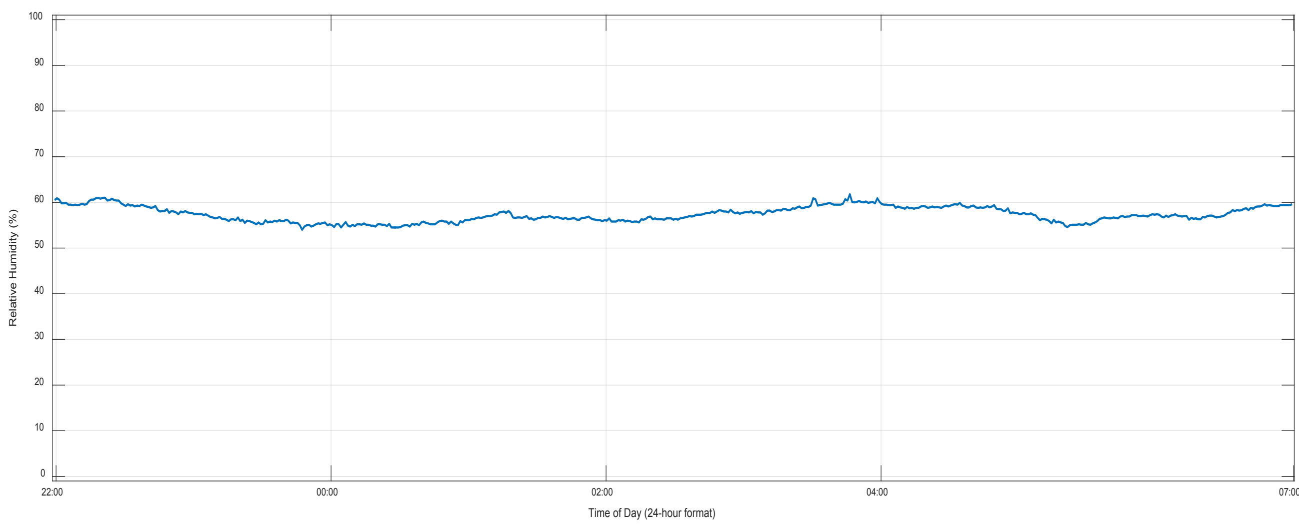
Monitored Wind Speed (March 15 – 16, 2016)



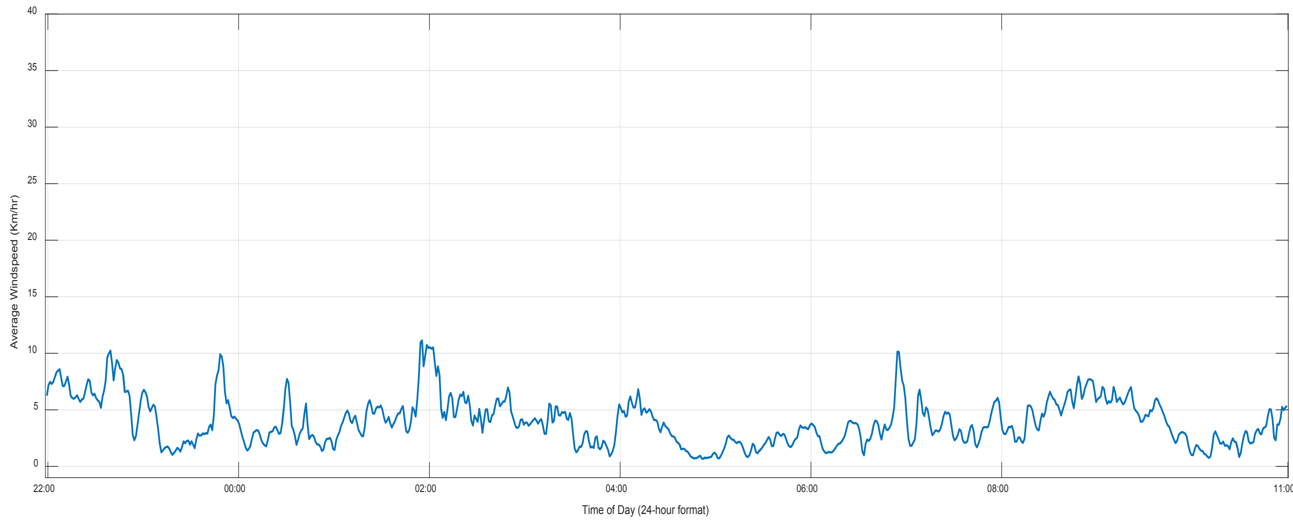
Monitored Wind Direction (March 15 – 16, 2016)



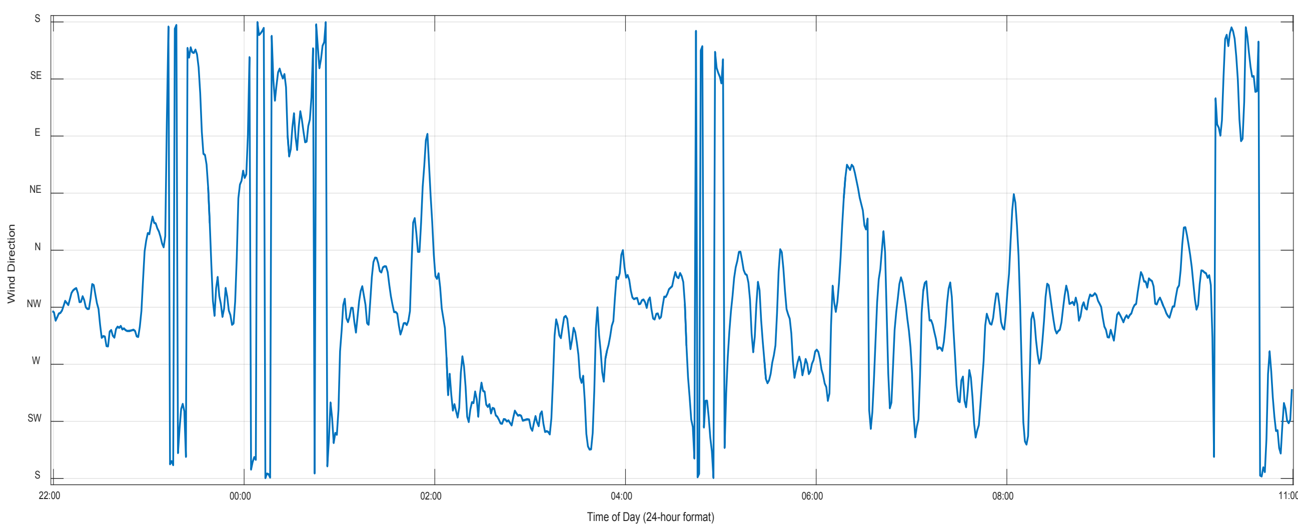
Monitored Temperature (March 15 – 16, 2016)



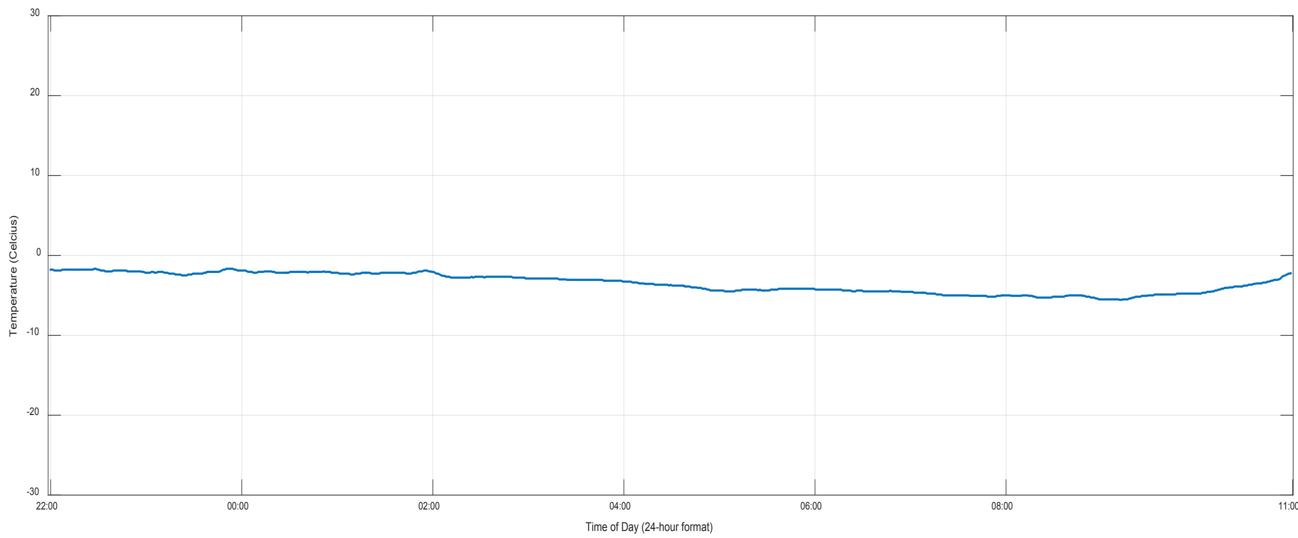
Monitored Relative Humidity (March 15 – 16, 2016)



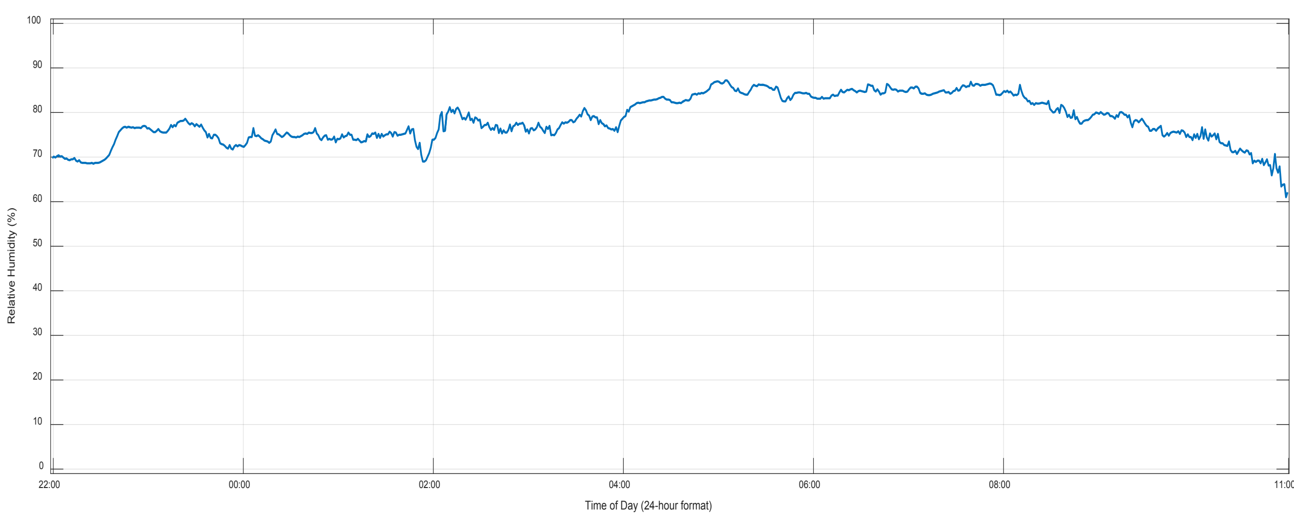
Monitored Wind Speed (March 16 – 17, 2016)



Monitored Wind Direction (March 16 – 17, 2016)



Monitored Temperature (March 16 – 17, 2016)



Monitored Relative Humidity (March 16 – 17, 2016)