Golder Associates

TECHNICAL MEMORANDUM

DATE November 2, 2012 **PROJECT No.** 11-1422-0046

TO Derek Holmes
BURNCO Rock Products Ltd

CC

FROM Zhaohui Yu, Virgini Senden **EMAIL** zhaohui_yu@golder.com, virgini_senden@golder.com

RE: BURNCO AGGREGATE PROJECT AT MCNAB CREEK/HOWE SOUND, BC – SOURCE MEASUREMENT PROGRAM FOR TREAT CREEK AGGREGATE PIT WITH MARINE BARGE LOADING FACILITY IN BRITISH COLUMBIA

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by BURNCO Rock Products Ltd. (BURNCO) to conduct an Environmental Impact Assessment (EIA) for the BURNCO Aggregate Project in Howe Sound, BC (the Project). The focus of this technical memorandum is potential project-related noise effects and computer generated noise model that will include representations of source acoustics of proposed Project equipment. Sound sources of comparable or similar scale aggregate operation equipment to that proposed for the Project were measured at BURNCO and third-party aggregate and processing facilities in Alberta, British Columbia (BC), and Manitoba during the summer of 2012. These source acoustic data will be used as inputs into the modelled conditions for the proposed Project. This technical memorandum presents results from sound source measurements conducted at the Treat Creek Operation Site of Jack Cewe Ltd. (Treat Creek) located in Jervis Inlet, BC.

As described in the Environmental Assessment Project Description (Golder 2011), the Project will make use of a marine barge loading facility to transport product off-site. During Project operation, tug boats will deliver empty barges and pick up aggregate filled barges from the site. The other main equipment elements of the Project will consist of aggregate crushing and screening equipment and an aggregate processing area comprised of sorting, storage and conveyor facilities. These source sound measurements, scaled appropriately for actual Project operations, will serve as inputs to the computer noise model used to assess noise impacts in the Project Noise Impact Assessment (NIA).

2.0 SOUND SOURCES AT TREAT CREEK

Operation at Treat Creek was divided among four areas including:

- Crushing and screening area,
- Sorting and storage area,
- Barge loading area, and
- Generator building.

The aggregate operation at Treat Creek comprised the following general process and facility components.

- Aggregate extracted from the areas surrounding Treat Creek was transported by truck to the crushing and screening area;
- Crushed and screened material was conveyed to the sorting and storage area;
- Barges were loaded by filled dump trucks; and
- Electric generator(s) provided power for Treat Creek operations.

Major sound sources located within the crushing and screening area included:

- Two electric motor powered crushers (Terex Canica 2350);
- One electric motor powered primary screen;
- Two electric motor powered fine screens; and
- A conveyor system to transport aggregate, connecting crushers, screens and the sorting and storage area.

Major sound sources associated within sorting and storage area included:

- Backhoe (Cat 980G) and excavator (Hitachi ZX270) for moving aggregate material between different sorting and storage stockpiles;
- Front end loaders (Cat 930G) for loading aggregate material into dump trucks;
- Dump trucks (Cat 735) for transporting aggregate material from the sorting and storage area to the barge loading area; and
- A conveyor system to move aggregate including sound sources associated with the conveyor electric motors and aggregate dropping into stock piles.

Major sound sources associated within barge loading area included:

- Dump trucks loading aggregate material into a hopper to the conveyor system; and
- A conveyor system to move aggregate including sound sources associated electric motors and aggregate dropping into barges.

Major sound sources associated with the Generator Building included:

- Two cooling units, manufactured by Young Radiator Company (only one of which was operating at the time of the Treat Creek source measurements), that cool the electric generating equipment inside the building.

Photos from the site identify the location and spacing of equipment measured as sound sources.

- Photo 1 shows equipment located in the crushing and screening area; one crusher, two screens, and several conveyor belts are visible in this photo.
- Photo 2 shows equipment located in the sorting and storage area; one front end loader, one excavator, one conveyor belt, and several aggregate stockpiles are visible in this photo.
- Photo 3 shows equipment located in barge loading area; a dump truck loading the hopper and one conveyor belt are visible in this photo.

- Photo 4 shows barge loading area from a different angle; the loaded conveyor belt, the loading deck, and the barge itself are visible in this photo.
- Photo 5 shows the Generator Building; both cooling units are visible in this photo.

Photo 1: Crushing and screening Area

Photo 2: Sorting and storage area

Photo 3: Barge loading area (looking parallel to the shoreline)

Photo 4: Barge loading area (looking out from the shoreline toward Jervis Inlet)

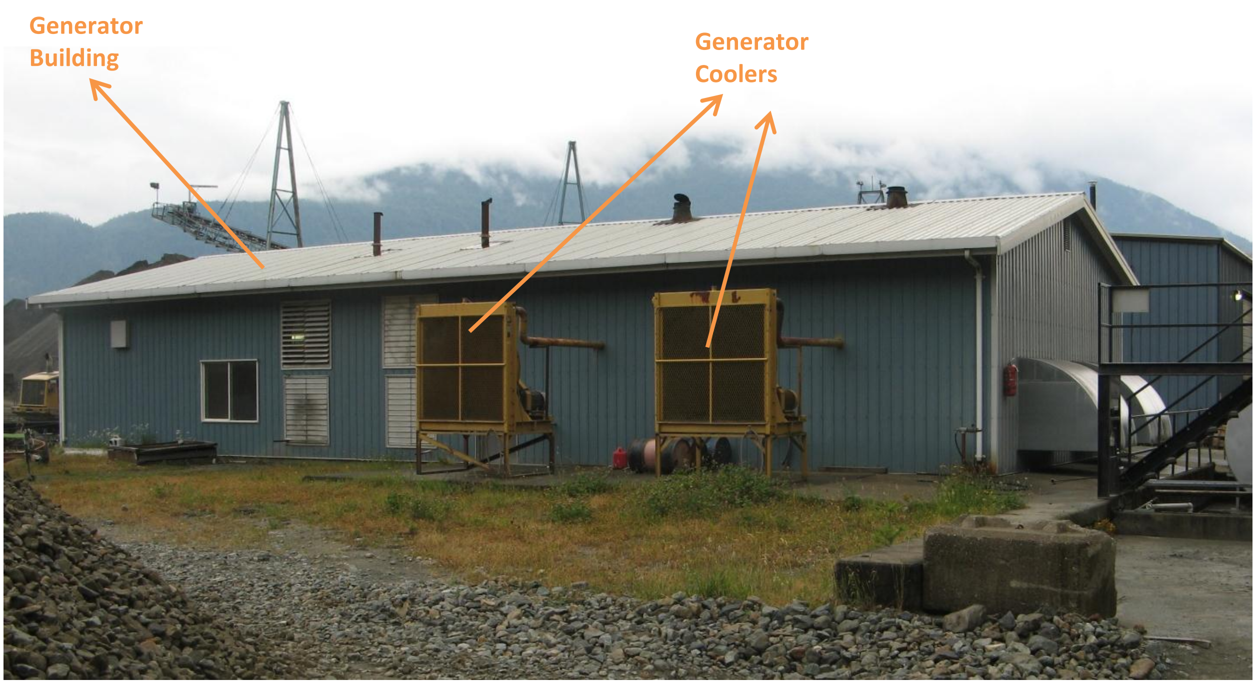

Photo 5: Generator building

3.0 SOUND SOURCE MEASUREMENT METHODS AND RESULTS

The envelope and concentrated source methods were used to measure sound pressure levels and calculate sound power levels (PWLs) for individual pieces of equipment and across the Treat Creek operation area as a whole. The specific measurement and calculation techniques associated with both the envelope and concentrated source methods are described in detail in the document *BURNCO Aggregate Project at McNab Creek / Howe Sound, BC – Source Measurement Program for Pine Ridges Inland Clamshell Operation* (Golder 2012). The results of the Treat Creek source measurements are presented in the following sub-sections.

3.1 Envelope Method

The envelope method was used to measure sound pressure for:

- screens and electric motors,
- falling sand and gravel ,
- crushers and electric motors,
- conveyor belts and motors, and
- generator building cooler and motor.

Measurement contamination from nearby equipment can be neglected based on what was audible in the field at the measurement location and the distance of less than 0.5m between the measurement points and the surface of the equipment, and a spacing distance of at least 2 m between other equipment sound sources.

The results of sound measurements for the above equipment using the envelope method are presented in Sections 3.1.1 to 3.1.7.

3.1.1 Screens and Electric Motors

The crushing and screening area comprised a total of three vibrating screens: one primary screen and two fine screens. Each screen is powered by an electric motor. The primary screen (Screen 1) and two fines screens (Screen 2 and Screen 3) are shown in Photos 6, 7, and 8, respectively.

Photo 6: Screen 1 – Primary Screen

Photo 7: Screen 2 – Fine Screen

Photo 8: Screen 3 – Fine Screen

The envelope method involves measuring energy equivalent sound pressure level (L_{eq}) on the surface of an assumed envelope surrounding the source equipment (c.f. Golder 2012). In the case of Screen 1, Screen 2, and Screen 3, the envelope was selected to surround both the screen itself and its electric motor. The measurement of the equipment surface area was 115.2 m^2 for Screen 1, 52.8 m^2 for Screen 2, and 31.0 m^2 for Screen 3.

Table 1 presents the measured L_{eq} and calculated PWLs in octave bands (31.5 Hz - 8000 Hz) for each of the three screens along with their associated electric motors.

Table 1: Measured L_{eq} and Calculated PWLs for Vibrating Screens

Equipment	Measured L_{eq} / Calculated PWL	Octave Band Centre Frequency [Hz]									Overall
		31.5	63	125	250	500	1000	2000	4000	8000	
Screen 1	L_{eq} [dBA]	53.1	67.6	74.0	84.4	89.4	92.7	94.2	91.9	88.2	99.0
	PWL [dBA]	73.7	88.2	94.7	105	110	113.3	114.8	112.5	108.8	119.6
Screen 2	L_{eq} [dBA]	59.2	64.4	77.9	81.5	87.8	92.4	95.5	95.3	93.3	100.7
	PWL [dBA]	76.5	81.6	95.1	98.8	105.1	109.6	112.8	112.5	110.5	117.9
Screen 3	L_{eq} [dBA]	56.6	64.8	75.2	81.2	88.7	94.7	98	98.5	97.2	103.5
	PWL [dBA]	71.5	79.7	90.1	96.1	103.6	109.6	113	113.5	112.1	118.5

3.1.2 Sand and Gravel Falling from Screens

Falling sand and gravel from screens was considered major sound source. Three measurements from each screen were made for sand and gravel falling from the screens. The maximum range in dimension of aggregate material observed at each screen included: screen 1 – 7 to 10 cm in diameter, screen 2 – 5 to 7 cm, and screen 3 – 5 to 7 cm. Photo 9 shows sand and gravel falling from screen 3.

Photo 9: Aggregate Material Falling from Screen 3

For each screen, the L_{eq} was measured on the surface of an assumed envelope surrounding the falling aggregate material. These measured L_{eq}s were then used to calculate the PWLs for the falling aggregate material. The measurement surface areas were 5.2 m^2, 4.2 m^2, and 3.4 m^2 for aggregate material falling from screen 1, screen 2, and screen 3, respectively.

Table 2 presents the measured L_{eq} and calculated PWLs in octave bands (31.5 Hz - 8000 Hz) for aggregate material falling from each of the three screens.

Table 2: Measured L_{eq} and Calculated PWLs for Aggregate Material Falling from Screens

Sound Source	Measured L_{eq} / Calculated PWL	Octave Band Centre Frequency [Hz]									Overall
		31.5	63	125	250	500	1000	2000	4000	8000	
Falling Gravel from Screen 1	L_{eq} [dBA]	51.4	66.3	78.8	92	100.6	104.4	109.1	107.3	101.4	112.8
	PWL [dBA]	58.6	73.5	86.0	99.2	107.8	111.5	116.3	114.5	108.6	120.0
Falling Gravel from Screen 2	L_{eq} [dBA]	53.1	70.0	81.4	86.9	92	96.4	100.5	102.8	102.8	107.5
	PWL [dBA]	59.4	76.2	87.7	93.2	98.2	102.6	106.7	109.1	109	113.7
Falling Gravel from Screen 3	L_{eq} [dBA]	39.8	60.2	73.8	82.8	92.7	103.2	105.6	103.9	98.8	109.6
	PWL [dBA]	45.1	65.5	79.1	88.1	98.1	108.5	110.9	109.2	104.1	114.9

3.1.3 Crushers

Two crushers with identical dimension were observed in the crushing and screening area (Crusher 1 – Photo 10). As required by the envelope method, L_{eq} values for Crusher 1 and Crusher 2 were measured on the surface of assumed envelopes surrounding each crusher (not including the associated electric motors). Measured L_{eq} values were then used to calculate PWL values for each crusher. The measurement surface area was calculated as 46.4 m^2 for Crusher 1 and 2.

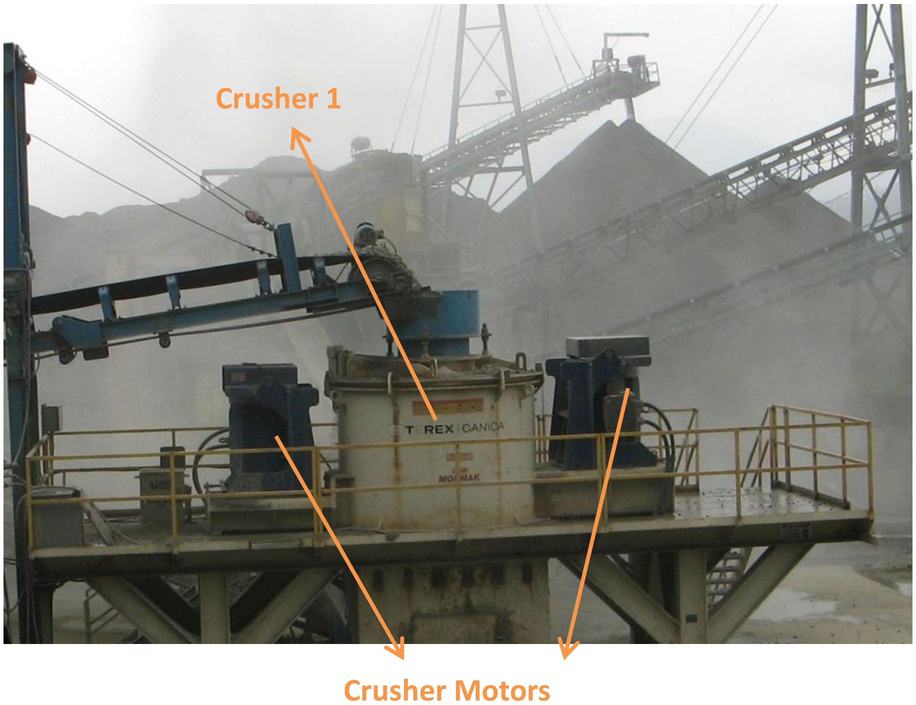

Photo 10: Crusher 1 with Motors

Table 3 presents the measured L_{eq} and calculated PWLs in octave bands (31.5 Hz - 8000 Hz) for Crusher 1 and Crusher 2. Although Crusher 1 and Crusher 2 appeared to be basically identical from the outside, the PWLs for the two crushers were found to be slightly different. The difference in PWL is believed to be the result of operating conditions and differences– e.g., it may be that Crusher 1 was being used on finer aggregate material than Crusher 2, or Crusher 1 may have had a different configuration of crushing teeth than Crusher 2.

Table 3: Measured L_{eq} and Calculated PWLs for Crushers

Equipment	Measured L_{eq} / Calculated PWL	Octave Band Centre Frequency [Hz]									Overall
		31.5	63	125	250	500	1000	2000	4000	8000	
Crusher 1	L_{eq} [dBA]	44.6	62.1	70.9	77.9	84.7	88.8	90.7	90.8	87.6	96.1
	PWL [dBA]	61.2	78.7	87.6	94.6	101.3	105.4	107.4	107.4	104.3	112.8
Crusher 2	L_{eq} [dBA]	45.3	63.4	71.5	79.9	88	91.7	92.8	92.7	89.4	98.4
	PWL [dBA]	62	80.1	88.2	96.6	104.6	108.4	109.5	109.3	106.1	115.0

3.1.4 Crusher Motors

There are two electric motors for each crusher (see Photo 10). L_{eq} values for one motor associated with Crusher 1 and one motor associated with Crusher 2 were measured on the surface of an assumed envelope around the motor. The L_{eq} values were then used to obtain separate PWL estimates for each crusher motor. For both measurements, the surface area was 8.6 m^2.

Table 4 presents the measured L_{eq} and calculated PWLs in octave bands (31.5 Hz - 8000 Hz) for one of the motors associated with Crusher 1 and one of the motors associated with Crusher 2.

Table 4: Measured L_{eq} and Calculated PWLs for Crusher Motors

Equipment	Measured L_{eq} / Calculated PWL	Octave Band Centre Frequency [Hz]									Overall
		31.5	63	125	250	500	1000	2000	4000	8000	
Crusher 1 Motor	L_{eq} [dBA]	44.6	61.5	70.6	78.3	84.5	88.6	91.1	91.4	88.8	96.5
	PWL [dBA]	54.0	70.9	80.0	87.6	93.8	97.9	100.5	100.7	98.2	105.9
Crusher 2 Motor	L_{eq} [dBA]	45.2	62.8	71.3	79.7	87.0	90.8	92.4	92.1	88.8	97.7
	PWL [dBA]	54.5	72.1	80.6	89.1	96.4	100.2	101.7	101.5	98.2	107.1

3.1.5 Conveyors

The conveyor system at Treat Creek included:

- One 95 m long belt, and four 40 m to 60 m long belts in the crushing and screening area;
- Three 50 m to 60 m long belts in sorting and storage area, and
- One 35 long belt, and two 20 m to 30 m long belts in barge loading area.

The PWLs for individual conveyors were determined in part by the size of the aggregate material being transported: smaller, more refined aggregate material tended to result in a lower PWL than coarser, less refined aggregate material. For example, the conveyor presented in Photo 3 and Photo 4 was used to transport refined aggregate material to the barge and have a lower PWL than the conveyor used to transport for larger size material from screen 3, shown in Photo 8

L_{eq} values for these two conveyors, which are believed to be representative of the other conveyors in use at Treat Creek, were measured on the surface of assumed envelopes around each conveyor. The measured L_{eq} values were then used to calculate corresponding PWLs. The measurement surface area was 35.2 m^2 for the conveyor connected to the barge system, and 33.0 m^2 for the conveyor connected to Screen 3.

Table 5 presents the measured L_{eq} and calculated PWLs per meter in octave bands (31.5 Hz - 8000 Hz) for each of the conveyor belts.

Table 5: Measured L_{eq} and Calculated PWLs for Conveyor Belts

Equipment	Measured L_{eq} / Calculated PWL	Octave Bands Centre Frequency [Hz]									Overall
		31.5	63	125	250	500	1000	2000	4000	8000	
Conveyor Belt to Barge System [(a)]	L_{eq} [dBA]	30.4	51.3	64.3	69	75.7	77.5	72.2	68.2	63.2	81.1
	PWL/m [dBA]	30.6	51.5	64.5	69.3	75.9	77.8	72.4	68.5	63.4	81.4
Conveyor Belt to Screen 3 [(b)]	L_{eq} [dBA]	37.6	51.8	67.6	75	80.7	81.2	83.8	83.2	79.4	89.2
	PWL/m [dBA]	37.9	52.2	68.0	75.4	81.1	81.5	84.2	83.6	79.8	89.6

(a) Finer aggregate on conveyor system

(b) Coarser aggregate on conveyor system

3.1.6 Conveyor Motors

Each conveyor had one electric motor to power the conveyor belt. The motors were observed to be similar for each conveyor belt and located at one end. L_{eq} for one conveyor motor was measured on the surface of an assumed envelope surrounding the motor. The measured L_{eq} was then used to calculate the corresponding PWL. The measurement surface area was 2.8 m^2.

Table 6 presents the measured L_{eq} and calculated PWL in octave bands (31.5 Hz - 8000 Hz) for the conveyor motor.

Table 6: Measured L_{eq} and Calculated PWL for Conveyor Motor

Equipment	Measured L_{eq} / Calculated PWL	Octave Band Centre Frequency [Hz]									Overall
		31.5	63	125	250	500	1000	2000	4000	8000	
Conveyor Motor	L_{eq} [dBA]	37.1	52.5	69.9	74.3	78.6	84.2	86.4	86.6	83.7	91.8
	PWL [dBA]	41.5	57	74.3	78.8	83	88.7	90.8	91	88.2	96.2

3.1.7 Generator Building Cooler with Motor

The generator building structure did not produce sound, but two coolers attached to the building were major sound sources (see Photo 5). During field measurements, only a single cooler was operating. L_{eq} for the operating cooler, including its electric motor, was measured on the surface of an assumed envelope surrounding the cooler. The measured L_{eq} value was then used to calculate the corresponding PWL. The measurement surface area was 31.1 m^2.

Table 7 presents the measured L_{eq} and calculated PWL in octave bands (31.5 Hz - 8000 Hz) for cooler and its associated motor attached to the generator building.

Table 7: Measured L_{eq} and Calculated PWLs for Generator Building Cooler

Equipment	Measured L_{eq} / Calculated PWL	Octave Band Centre Frequency [Hz]									Overall
		31.5	63	125	250	500	1000	2000	4000	8000	
Generator Building Cooler	L_{eq} [dBA]	58.1	72.9	94.8	92.6	95.7	95.9	94.3	91.5	88	102.4
	PWL [dBA]	73.0	87.8	109.7	107.5	110.6	110.8	109.2	106.4	102.9	117.3

3.2 Concentrated Source Measurement Method

A dump truck loading sand and gravel into the hopper in the barge loading area, and equipment in sorting and storage area, including a front end loader, excavator, backhoe, and dump truck handling aggregate material were measured and their PWLs were determined using the concentrated sound source method. In addition, for the purposes of calibration and confirmation:

- One measurement using the concentrated source method was made for the generator building cooler with its motor; and
- Two measurements were made from Jervis Inlet northwest of the barge in the far field away from the Treat Creek site, and the PWL for the entire operation site was calculated by the concentrated source method.

The propagation distance between source and measurement point modelled using the concentrated source method is greater than when compared using the envelope method. The use of the concentrated source method to measure sound may tend to have greater potential for sound contamination from other sources near the sound source that gets measured. However, because the concentrated source method does not rely on an estimate of a sound envelope, the concentrated source method does not therefore require detailed or accurate estimation of the equipment's specific dimensions. The concentrated source method relies on larger distance from equipment for measuring sound and is therefore not dependent on where within the assumed envelope that sound is measured and potential inaccurate measures of sound propagated in the near field (close distance) influences are absent. The results of sound measurements for the above equipment using the concentrated source method are presented in Sections 3.2.1 to 3.2.4.

3.2.1 Dump Truck Loading Hopper

The concentrated source method was used to determine the PWL of a dump truck loading aggregate material into the vibrating hopper that fed the main barge loading conveyor. The average measurement distance was 59 m and there was an unobstructed line of sight between the measurement location and the dump truck and loading activities. Because the source and measurement heights were small compared to the distance between source and measurement point, geometric spreading of sound was assumed to be consistent with a half sphere. Measurement contamination from the screens and crushers located in the crushing and screening area (a minimum of 100 m from the measurement location) was estimated to be negligible.

Table 8 presents the measured L_{eq} and calculated PWL in octave bands (31.5 Hz - 8000 Hz) for the dump truck loading the hopper.

Table 8: Measured L_{eq} and Calculated PWL for Dump Truck Loading Hopper

Sound Source	Measured L_{eq} / Calculated PWL	Octave Band Centre Frequency [Hz]									Overall
		31.5	63	125	250	500	1000	2000	4000	8000	
Dump Truck Loading Hopper	L_{eq} [dBA]	24.6	41.7	46.5	50.6	51.6	56.5	55.9	49.7	49.2	61.2
	PWL [dBA]	65.0	82.1	91	95.1	96.1	101	100.7	95.3	97.6	106.3

3.2.2 Equipment in Sorting and Storage area

At the time of the Treat Creek measurements, one front end loader, one backhoe, one excavator, and one dump truck were working in the sorting and storage area (Photo 2 - backhoe was not visible in the photo). These four pieces of equipment were treated as a single source and were measured using the concentrated source method. The following activities were observed during the period of field measurement including:

- the backhoe and excavator was digging product from one of the stockpiles,
- the front end loader was loading the dump truck, and
- the dump truck was transporting aggregate material out of the sorting and storage area.

The average measurement distance was 77 m with an unobstructed line of sight between the measurement location and the equipment. Because the source and measurement heights were small compared to the distance between source and measurement point, geometric sound spreading was assumed to be consistent with a half sphere. The crushing and screening area and barge loading area were located farther away from the measurement location than the sources being characterized - about 150 m and 210 m, respectively – and therefore contamination from the other sound sources was estimated to be negligible.

Table 9 presents the measured L_{eq} and calculated PWL in octave bands (31.5 Hz - 8000 Hz) of the front end loader, backhoe, and dump truck operating in the sorting and storage area.

Table 9: Measured L_{eq} and Calculated PWL for Equipment Operating in the Sorting and Storage Area

Sound Source	Measured L_{eq} / Calculated PWL	Octave Band Centre Frequency [Hz]									Overall
		31.5	63	125	250	500	1000	2000	4000	8000	
Equipment in Sorting and Storage area	L_{eq} [dBA]	25.6	43.5	49.0	49.5	57.1	61.6	58	52.6	48.1	64.8
	PWL [dBA]	68.4	86.2	95.7	96.3	104	108.6	105.2	100.8	100.0	112.1

3.2.3 Generator Building Cooler

As described in the Section 3.1.7, the envelope method was used to obtain PWL for the generator building cooler. For the purposes of calibration and confirmation (i.e., as a check on the validity of the PWL obtained via the envelope method), the concentrated source method was used to determine the PWL of the generator building cooler. The measurement distance was 23 m and there was an unobstructed line of sight between the measurement point and the generator building cooler. Because the source and measurement heights were small compared to the distance between source and measurement point, geometric spreading was assumed to be consistent with a half sphere. Measurement contamination from sources other than the generator cooler was estimated to be negligible because of the distance to the crushing and screening area (about 110 m), barge loading area (about 170 m) and sorting and storage area (about 120 m).

Table 10 presents the measured L_{eq} obtained via the concentrated source method along with PWLs in octave bands (31.5 Hz - 8000 Hz), calculated using both the concentrated source and envelope methods. The two PWL estimates are separated by only 0.6 dB; this is considered to be good agreement for a field measurement.

Table 10: Measured L_{eq} and Calculated PWLs for Generator Building Cooler

Sound Source	Measured L_{eq} / Calculated PWL	Octave Band Centre Frequency [Hz]									Overall
		31.5	63	125	250	500	1000	2000	4000	8000	
Generator Building Cooler	L_{eq} [dBA]	31.6	49.9	66.8	72.4	74.4	75.3	76.6	71.2	62.3	81.6
	Concentrated Source PWL [dBA]	63.8	82.1	103	108.6	110.6	111.6	112.9	107.9	100.1	117.9
Generator Building Cooler	Envelope PWL[a] [dBA]	73.0	87.8	109.7	107.5	110.6	110.8	109.2	106.4	102.9	117.3

[a] See Table 7

3.2.4 Treat Creek Operation as a Single Source

Two measurements that treated the entire Treat Creek operation as a single source were conducted using the concentrated source method. The purpose of these measurements was twofold:

i) Calibration and confirmation to provide a check on the validity of the individual source measurements; and

ii) Characterize the extent to which sound from the barge loading operation propagates across water as a component of the NIA for the Project.

The measurements were conducted from a boat in Jervis Inlet. The boat motor was turned off and the sound level of the water was observed to be below 45 dBA. Contamination from other sound sources was estimated to be negligible (i.e., sound from the Treat Creek facility was the dominant source). The acoustic centre of the Treat Creek operation was assumed to coincide with the position of Screen 1. The first measurement was conducted from a distance of 207 m relative this acoustic centre and the second measurement was conducted from a distance of 290 m. Because the source and measurement heights were small compared to the distance between source and measurement point, geometric spreading was assumed to be consistent with a half sphere.

Table 11 presents the measured L_{eq} and calculated PWLs in octave bands (31.5 Hz - 8000 Hz) for the Treat Creek operation as a whole. Table 11 also presents the sum of the PWLs for the individual pieces of equipment operating at the time of these measurements (i.e., the sum of the relevant measurements of individual pieces of equipment). During the measurements to characterize the Treat Creek operation as a whole, Screen 3 and Crusher 1 were working but the other screens and crusher were turned off for inspection and repair; as such the contributions from Screen 1, Screen 2, and Crusher 2 are not included in the PWL sum presented in Table 11. Likewise, equipment operating in the sorting and storage area was not included in the PWL sum because this equipment was behind aggregate material stockpiles that obstructed the propagation of sound energy out to the measurement location in Jervis Inlet.

Table 11: Measured L_{eq} and Calculated PWLs of Treat Creek Operation as a Single Source and Comparison with Sum of Estimated PWLs of Operating Equipment

Whole Operation Area	Measured L_{eq} / Calculated PWL	Central Frequencies of Octave Bands [Hz]									Overall
		31.5	63	125	250	500	1000	2000	4000	8000	
Measurement 1	L_{eq} [dBA]	22.1	39.4	49.8	51.6	54.5	58.6	57.1	52.5	42.9	62.9
	PWL [dBA]	73.4	90.8	105.2	107	110.1	114.5	113.7	111.7	112.2	120.1
Measurement 2	L_{eq} [dBA]	17.2	32.6	45.8	51.3	50.1	54.5	53.5	47.2	34.5	59.2
	PWL [dBA]	71.5	86.8	104.1	109.8	108.9	113.6	113.6	110.9	112.3	119.8
Sum of PWLs of Operating Equipment Based on Individual Measurements	PWL [dBA]	75.6	89.0	109.8	108.2	112.2	115.2	116.9	116.4	113.9	122.6

The PWL values obtained via measurements from a boat in Jervis Inlet for Treat Creek operation as a single source were found to be 2-3 dB lower than the sum of estimated PWLs for the individual pieces of operating equipment. This is considered to be a good agreement in light of uncertainty associated with in-field measurements. One reason the measurements of the operation site as a whole is slightly lower than the sum of the individual pieces of equipment is likely due to physical screening – i.e., the physical presence of one piece of equipment partially blocks the sound energy from another piece of equipment from reaching the measurement location. A second is associated with the timing and operation and shut down of single pieces of equipment throughout the day. It was not feasible to monitor which pieces of equipment were online or offline at any given moment, and so it may be that although, for example, Crusher 1 was assumed to be operating for the entire duration of the measurements from a boat in Jervis Inlet, this piece of equipment was actually offline for parts of the measurement. Weather conditions might have had a small influence as well since there was a light cross wind observed during the measurements.

4.0 DISCUSSION AND SUMMARY

The equipment in the Treat Creek operation site was measured and their PWLs were determined by the envelope method and/or the concentrated source method. The whole operation area was measured and its PWL was determined by the concentrated source method. The sum of the individual measurements and the overall measurement were found to be consistent and in agreement with measurements conducted for individual pieces of equipment. These results suggest that the field measurements are accurately characterizing the acoustic properties of the Treat Creek equipment and operations as a whole.

As part of the NIA for the Project, the sound source measurement data obtained at Treat Creek (scaled appropriately for actual Project operations) will be used to develop a computer noise model.

5.0 CLOSURE

We trust that the above meets your present requirements. If you have any questions or require additional details, please contact the undersigned.

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6.0 REFERENCES

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