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Results of Noise Monitoring

Blakebrook Quarry
550 Nimbin Road
Blakebrook NSW 2480

Prepared for

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1 INTRODUCTION

Ambience Audio Services have been engaged by Ecoteam to conduct noise monitoring at Blakebrook Quarry, 550 Nimbin Road, Blakebrook NSW.

The current Noise and Blast Management Plan (NBMP) for Blakebrook Quarry (Lismore City Council Oct 2022) includes an Out of Hours Work Protocol (OHWP) for the asphalt plant, which is anticipated to occur 5 nights per month on scheduled projects. Section 7 of the NBMP details the noise monitoring program. Section 7.3 requires noise monitoring to be conducted once every 6 months to represent winter and summer conditions. The noise monitoring and reporting is to be conducted for each assessment time period; Day - 7am to 6pm, Evening – 6pm to 10pm, Night – 10pm to 7am).

Noise monitoring was conducted on the 19th of December 2022 with the quarry and asphalt plant operating under normal load conditions and suitable weather conditions.

Quarry operations while noise monitoring was conducted for the day time period included: crushing, screening and stockpiling on the northern end of the quarry floor, asphalt production at the mobile plant in the southern section of the quarry, and trucks and loaders on the quarry floor and internal haul roads. A diagram of equipment operating on the quarry floor during noise monitoring at residential receivers is provided in Appendix C.

The asphalt plant was producing cold mix during the evening and night time noise monitoring periods. There were no truck movements during the evening and night time noise monitoring.

To assist with the interpretation of some of the terminology used in this report, Appendix A provides definitions of acoustic terms. Appendix B is a chart of everyday sound pressure levels.

2 NOISE MONITORING REQUIREMENTS

The noise monitoring requirements for the Blakebrook Quarry are outlined in Section 2.2, Sections 7.1, 7.2, 7.3, 7.4, 7.5 and 7.7 of the NBMP (LCC Oct 2022).

Extracts of the relevant parts are copied below.

Section 2.2

3. *The Proponent must ensure that the noise generated by the project does not exceed the criteria in Table 2 at any residence on privately owned land.*

Table 2: Noise Criteria dB(A)

Receiver	Day L_{Aeq} (15 minute)
Location 2 and 7	36
All other locations	35

Out of Hours Work Protocol – Asphalt Operations

The OHWP has provided management strategies for potential noise sources involving asphalt operations and truck movements. The evening and night project-specific noise level criterion is 35 dB(A) LAeq (15 minute).

L4.1 Noise from the licenced premises must not exceed an LAeq (15 minute) noise emission criteria of 36 dB(A) at Location 2 and 7, and 35 dB(A) at all other sensitive receivers, except as expressly provided by in this licence.

7.2 MONITORING LOCATIONS

The original Noise Assessment (ERM 2009) and updated NIA (Mitchel Hanlon, SEE 2019) included six (6) noise monitoring locations that were used throughout the assessment, based on proximity to nearby potentially sensitive receptors. Given the proximity between monitoring locations and the location of anticipated noise-generating plant and equipment, the monitoring locations have been revised and separated into primary and supplementary acoustic monitoring locations for the purposes of the NBMP.

Primary and supplementary acoustic locations are identified in *Figure 2*. Primary acoustic monitoring locations consist of locations **2**, **4** and **8** with the remainder of locations being supplementary acoustic monitoring locations.

An agreement was reached with the landowner located along Nimbin Road (previously identified as location 8, ERM 2009) in April 2016, wherein the landowner has agreed to the exceedances in noise levels from Quarry operations. As such the location has been removed as a primary acoustic monitoring location, and a new monitoring location selected being (current) location 8.

Primary monitoring locations will be utilised during noise compliance monitoring and are considered representative in determining compliance with the relevant Conditions of Approval.

In the event that additional monitoring is required then additional monitoring may be undertaken at the most practical supplementary acoustic monitoring locations, as well as at the primary acoustic monitoring locations.

7.4 METHODOLOGY

Noise

Operator attended noise measurements shall be conducted at all primary acoustic measurement locations (Locations 2, 4 and 8 – refer *Figure 2*) to quantify and characterise the maximum (L_{Amax}), the energy equivalent (L_{Aeq}), and the background (L_{A90}) noise levels from ambient noise sources and quarrying operations over a 15 minute measurement period.

The operator shall quantify noise emissions and estimate the L_{Aeq} (Period) noise contribution during Quarry activities, as well as the overall level of ambient noise. During attended monitoring, digital recordings will be conducted to allow for additional post analysis of the Quarry noise levels and source identification.

All acoustic instrumentation employed throughout the monitoring program shall meet with the requirements of AS/NZS IEC 61672.1 Sound level meters Specifications & AS/NZS IEC 61672.2 Sound level meters Pattern Evaluation.

Instrument calibration shall be checked before and after each measurement survey, with the variation in calibrated levels not exceeding $\pm$ 0.5 dBa.

7.5 METEOROLOGICAL PARAMETERS

Adverse meteorological conditions have the potential to increase noise levels, for example wind speeds up to 3 m/s or temperature inversions, however wind speeds above 5 m/s (and rainfall) have the potential to generate extraneous and erroneous noise events, which reduce the accuracy and confidence in measured data.

As such, meteorological parameters will be evaluated prior to undertaking works on site, to gain an understanding of the weather conditions and the potential for variations in noise levels.

All noise measurements shall be accompanied by both qualitative description (including cloud cover, approximate wind direction and speed) and quantitative measurements of prevailing local weather conditions throughout the survey period. Rainfall data and meteorological parameters will be collected from the weather station located on-site. as shown in *Table H*.

Table H: Meteorological Measurement Parameters

Measured Parameter	Unit	Sample Interval
Mean Wind Speed	m/s	15 minutes
Mean Wind Direction	Degrees	15 minutes
Aggregate Rainfall	mm	15 minutes
Mean Air Temperature	C°	15 minutes

Accounting For Annoying Noise Characteristics (Low Frequency Noise)

The *Noise Policy for Industry* (NPfI 2017) states that a noise source may exhibit a range of particular characteristics that increase annoyance, such as tones, impulses, low frequency noise and intermittent noise.

Where this is the case, an adjustment ('modifying factor corrections') is applied to the source noise level received at an assessment point before it is compared with criteria to account for the additional annoyance caused by the particular characteristic.

Application of these modifying factors is described in. *Fact Sheet C: Corrections for annoying noise characteristics* and outlines correction factors to be applied to the source noise level at the receiver before comparison with the project noise trigger levels to account for the additional annoyance caused by those modifying factors.

The modifying factor corrections should be applied having regard to:

- the contribution noise level from the premises when assessed/measured at a receiver location, and
- the nature of the noise source and its characteristics (as set out in this fact sheet).

The NPfI provides the following definitions to support the modifying factor corrections:

- Tonal Noise – Containing a prominent frequency and characterised by a definite pitch.
- Low Frequency Noise – Containing major components within the low frequency range (20 Hz to 250 Hz) of the frequency spectrum.
- Impulsive Noise – Having a high peak of short duration or a sequence of such peaks.
- Intermittent Noise – The level suddenly drops to that of the background noise several times during the assessment period, with a noticeable change in noise level of at least 5 dB.

The modifying factor corrections (and how they are applied) are present in *Table C1* of the NPfI and vary depending on the noise characteristic being assessed. All noise levels generated by the Quarry, which may generate tonal or low frequency content, will be assessed as part of the NBMP monitoring with due regard to these modifying factor penalties, and in accordance with the requirements presented in the NPfI.

Impulsive and intermittent noise, as defined by the NPfI, are not typical characteristics of the Quarry, hence tonal and low frequency noise (LFN) are most relevant to the Quarry and those modifying corrections are reproduced in *Table I*.

Table I: Meteorological Measurement Parameters

Tonal Noise	One-third octave band analysis using the objective method for assessing the audibility of tones in noise – simplified method (*ISO1996.2-2007 – Annex D*)	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is in the range 500–10,000 Hz • 8 dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz • 15 dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz.	5 dB [2,3]	Third octave measurements should be undertaken using unweighted or Z-weighted measurements. **Note:** Narrow-band analysis using the reference method in *ISO1996-2:2007, Annex C* may be required by the consent/regulatory authority where it appears that a tone is not being adequately identified, e.g. where it appears that the tonal energy is at or close to the third octave band limits of contiguous bands.
Low Frequency Noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements in the range 10–160 Hz	Measure/assess source contribution C- and A-weighted Leq,T levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and: • where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2-dB(A) positive adjustment applies for the daytime period.	2 or 5 dB [2]	A difference of 15 dB or more between C- and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.

Notes:
1. Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.
2. Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.
3. Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the *ISO1996-2:2007* standard.

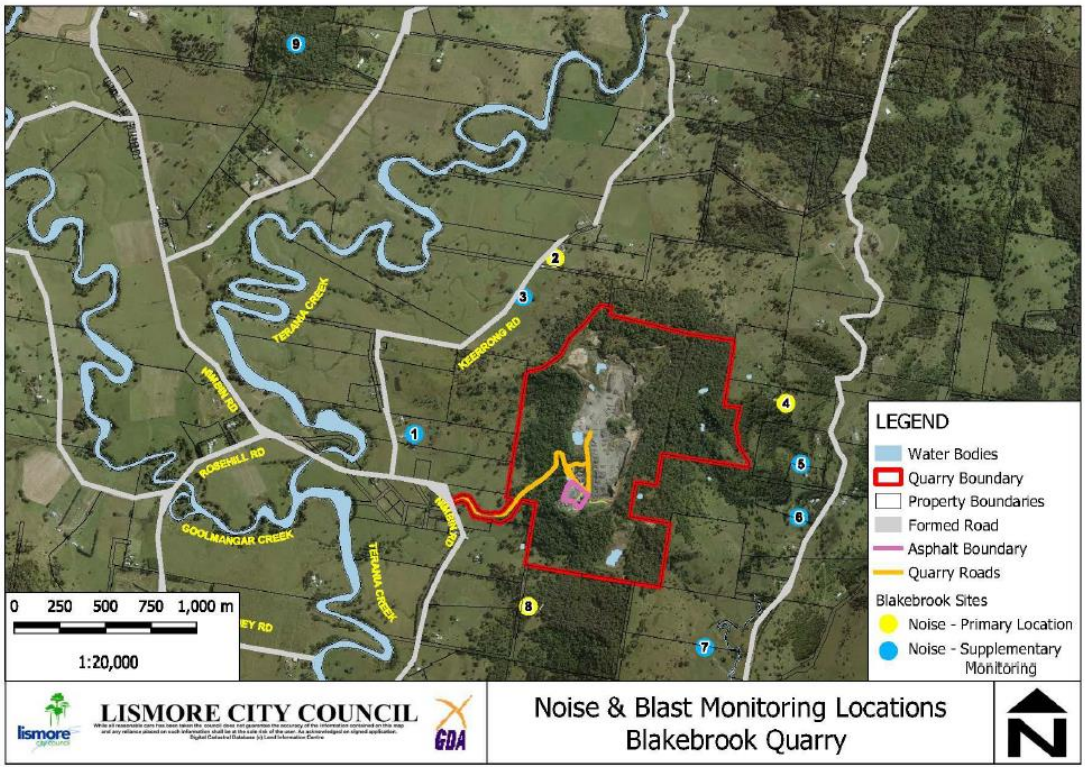
Noise monitoring at the receiver locations were conducted within 30m of the residential dwelling in the direction of the quarry.

Table 2.1 Primary Receiver Locations

Receiver	Street Address
2	[redacted]
4	[redacted]
8	[redacted]

Figure 2.1 Noise Monitoring Locations

Figure 2: Noise & Blast Monitoring Locations Map



3 MEASUREMENT PROCEDURE AND RESULTS

3.1 Instrumentation

Table 3.1 Instrumentation		
Instrument	**Serial #**	**Calibration Date**
Brüel and Kjær 2250 G4 Sound Level Meter	3031300	Oct 2022
Bruel & Kjaer 2250 G4 Sound Level Meter	3008548	Dec 2021
Brüel and Kjær 2250 G4 Sound Level Meter	3028735	Jan 2022
Bruel & Kjaer 4231 Calibrator	3029274	Oct 2022

The sound level meters (SLM) used during the noise survey conform to Australian Standard 1259 "Acoustics - Sound Level Meters", (1990) as type 1 precision sound level meters, and have an accuracy suitable for both field and laboratory use.
The meters' calibrations were checked before and after the measurement periods with a Bruel & Kjaer acoustic calibrator. No significant system drift occurred over the measurement periods.

The SLMs and calibrator have been checked, adjusted and aligned to conform to the factory specifications and issued with conformance certificates by a certified NATA facility.

3.2 Measurement Procedure

Measurements were made in general accordance with procedures laid down in:

1. Australian Standard AS 1055 : 2018 *Acoustics - Description and measurement of environmental noise*

2. The NSW Government *Noise Policy for Industry* (EPA Oct 2017)

The microphone of a B&K 2250 G4 SLM was mounted at a height of 1.2m above the ground and a Bruel and Kjær outdoor windscreen fitted to the microphone. The SLM was located above the cliff face where the crushing and screening equipment was operating to monitor noise levels while measurements were being conducted at the receiver locations.

The microphone of a B&K 2250 G4 was mounted on a 1.5m high tripod, a Bruel and Kjær outdoor windscreen fitted to the microphone, and located near the asphalt plant to monitor noise levels of the asphalt plant while measurements were being conducted at the receiver locations.

Both SLMs were set to record continuously for the duration of receiver monitoring with 1 second samples. A sound recording was conducted simultaneously.

A third SLM (B&K 2250 G4) was mounted on a 1.2m – 1.5m high tripod and a Bruel and Kjær outdoor windscreen fitted to the microphone. The SLM was used at the receiver locations to monitor noise levels while the quarry and asphalt plant were operating.

A 15 minute period was recorded at each receiver location with A and C weighting, fast response, and 1 second samples with a simultaneous sound recording. Spectrum data was recorded with a linear (Z) weighting.

3.3 Weather Conditions

Weather conditions were generally good for acoustic measurements. Observations were taken at each receiver location with a Kestrel 3000 pocket weather meter.

Table 3.2 Receiver Locations Weather Summary 19th December 2022

Receiver	Time	Temp	Relative Humidity	Wind	Wind Dir	Cloud Cover
		°C	%	Speed (m/s)		
2	8:20am	20	60	1.5 - 3	SW	3/8
	8:26pm	19	66	1.5 - 4	S	4/8
	11:21pm	16	70	1 - 2.5	S	1/8
8	9:17am	22	58	0.5 - 1.5	SW	5/8
	9:01pm	20	63	Calm		4/8
	10:48pm	17	73	0.5 - 1	S	3/8
4	10:05am	23	60	0.5 - 1.5	S	6/8
	9:41pm	19	66	0.5 - 1.5	S	5/8
	10:00pm	18	71	0.5 - 1	S	5/8

Weather data from the weather station at Blakebrook Quarry is presented in Table 3.3 below.

Table 3.3 Blakebrook Quarry Weather Station Observations 19th December 2022							
Time	AVERAGE Air Temperature 10m - DegC	AVERAGE Wind Speed 10m - km/h	AVERAGE Wind Speed 10m - m/s	AVGDIR Wind Direction 10m - Degs	S-THETA Wind Direction 10m - Degs	STDEV Wind Speed 10m - km/h	TOTAL Rain Gauge - mm
8:10 AM	17.7	2.5	0.7	205.6	57.9	1.1	0
8:20 AM	18.2	2.3	0.6	204.5	59.8	0.8	0
8:30 AM	18.6	2.7	0.7	200.3	66.2	1.1	0
8:40 AM	18.8	2.4	0.7	201	66.9	0.8	0
8:50 AM	18.8	2.2	0.6	184.6	68.3	0.7	0
9:00 AM	19.3	3	0.8	198.9	62.5	1.1	0
9:10 AM	19.9	3.5	1.0	163.9	73.6	1.8	0
9:20 AM	19.7	3.5	1.0	201.4	62.5	1.8	0
9:30 AM	19.7	4.1	1.1	202.3	47.6	1.9	0
9:40 AM	19.9	3.8	1.1	195.9	51.6	1.3	0
9:50 AM	20.5	3.8	1.1	187.2	53.3	1.8	0
10:00 AM	20.3	3.8	1.1	192.5	76.3	1.9	0.2
10:10 AM	20.8	4	1.1	223.1	89.9	1.4	0
10:20 AM	21.4	3.6	1.0	179.3	71	0.9	0
10:30 AM	21	5.8	1.6	187.3	54.6	2.6	0
8:10 PM	18.5	5.8	1.6	193.1	48.8	2.6	0
8:20 PM	18.4	6.8	1.9	179.6	36.7	1.7	0
8:30 PM	18.4	6.2	1.7	202.6	44.6	2.3	0
8:40 PM	18.3	4.6	1.3	190	57.2	1.9	0
8:50 PM	18.1	2.9	0.8	231.6	50.1	1.5	0
9:00 PM	17.8	1.7	0.5	212.5	44.7	0.8	0
9:10 PM	17.6	1	0.3	231.9	71.5	0.5	0
9:20 PM	17.5	1	0.3	206.2	61.9	0.6	0
9:30 PM	17.3	1	0.3	198.2	58.4	0.6	0
9:40 PM	17.1	1.8	0.5	200	43.7	1.6	0
9:50 PM	17	1.6	0.4	206.2	44.7	0.9	0
10:00 PM	17	1.8	0.5	199.3	57	1	0
10:10 PM	16.8	1.2	0.3	202.8	53.3	0.8	0
10:20 PM	16.6	1.4	0.4	158.4	65.9	0.4	0
10:30 PM	16.4	1.1	0.3	197.2	54.9	0.4	0
10:40 PM	16.2	1	0.3	192.3	42.2	0.3	0
10:50 PM	16.2	0.8	0.2	189.2	48.2	0.2	0
11:00 PM	16.2	1.2	0.3	191.8	41.5	0.4	0
11:10 PM	16.2	1.2	0.3	191.5	57.5	0.4	0
11:20 PM	16.1	1.3	0.4	189.1	51.5	0.3	0
11:30 PM	16.1	1.4	0.4	202.8	53.3	0.1	0
11:40 PM	16.1	1.4	0.4	211.1	49.5	0.2	0
11:50 PM	16.1	1.2	0.3	205.1	61.7	0.4	0

3.3 Measurement Results

Table 3.4 Blakebrook Quarry Receiver Locations Measurement Summary - 19th Dec 2022								
Receiver	**Start Time**	**Elapsed Time h:mm:ss**	**L_{AFmax} [dB]**	**L_{Aeq} [dB]**	**L_{Ceq} [dB]**	**$L_{Ceq-LAeq}$ [dB]**	**$L_{AF10.0}$ [dB]**	**$L_{AF90.0}$ [dB]**
R2	8:20 AM	0:15:00	65.8	42.5	60.0	17.5	43.3	35.1
	8:26 PM	0:15:00	73.8	52.1	60.4	8.3	54.7	44.9
	11:21 PM	0:15:00	61.7	35.6	49.7	14.1	36.7	32.7
R4	10:05 AM	0:15:00	61.5	47.8	50.6	2.8	51.0	39.3
	9:41 PM	0:15:00	49.5	40.6	44.3	3.7	41.9	39.1
	10:00 PM	0:15:00	53.8	42.1	44.4	2.4	43.0	41.0
R8	9:17 AM	0:15:00	67.6	42.7	49.7	7.1	41.0	36.6
	9:01 PM	0:15:00	50.3	40.8	46.9	6.1	42.9	38.1
	10:48 PM	0:15:00	50.4	36.9	44.1	7.1	38.6	34.6

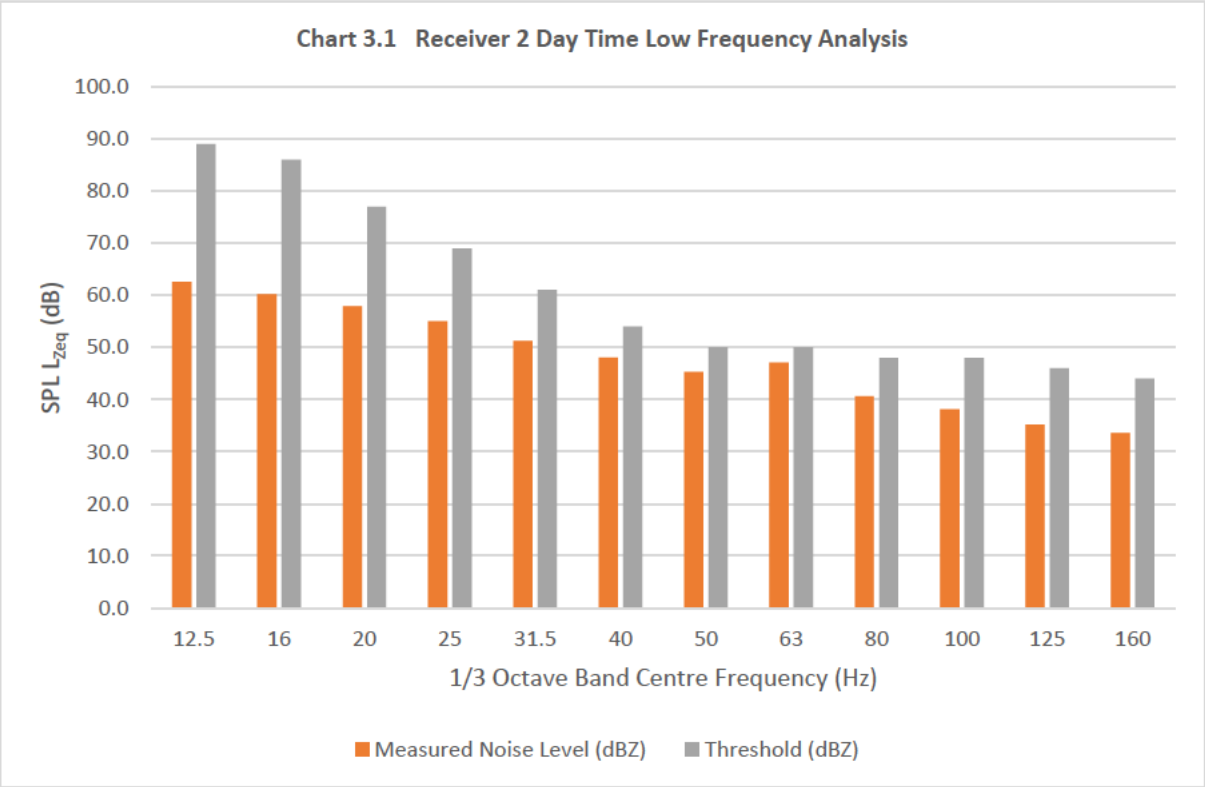
Note:
The above results are the ambient noise levels and includes noise from the rural surroundings and quarry noise if audible.

Table 3.5 Noise Observations at Receiver Locations 19th December 2022 (All measurements 15 mins)			
Receiver	**Start Time**	**Observed Noise Sources**	**Quarry Noise**
2	8:20 AM	Wind in trees, occasional traffic on Keerrong Road, birds, dog barking when vehicle passing	Quarry low frequency barely audible at times
	8:26 PM	Insects consistent (8kHz - 12kHz), nearby windmill, occasional vehicle on Keerrong Road	Machinery just audible at times - wind dependent
	11:21 PM	Insects consistent (3.15kHz - 6.3kHz), distant dog barking, occasional distant traffic on Nimbin Road, occasional distant cattle	Machinery low frequency barely audible at times
4	10:05 AM	Insects dominant (2kHz - 8kHz), wind in trees, very distant traffic, distant dog barking	Occasional low frequency of machinery, barely audible
	9:41 PM	Insects consistent, (3.15kHz - 5kHz), distant traffic at times, occasional low level wind noise in trees	Machinery low frequency barely audible
	10:00 PM	Insects consistent, (3.15kHz - 5kHz), distant traffic at times, occasional low level wind noise in trees	Machinery low frequency barely audible
8	9:17 AM	Birds, distant traffic on Nimbin Road, insects consistent (4kHz), wind in trees for last minute	Machinery low frequency just audible
	9:01 PM	Insects consistent (4kHz), distant traffic Nimbin Road, distant aircraft	Machinery low frequency barely audible
	10:48 PM	Insects consistent (4kHz), occasional vehicle on Nimbin Road, occasional wind in trees	Machinery low frequency barely audible, occasionally low frequency noise level increased

3.4 Low Frequency Analysis

The difference between the C and A L_{eq} levels at Receiver 2 was greater than 15 decibels during the day time measurement period. Insect noise increased the A weighting at other measurement times at all locations.

Table 3.6 Low Frequency Analysis (R2 day time)			
1/3 Octave band Centre Frequency (Hz)	**Measured Noise Level (dBZ)**	**Threshold (dBZ)**	**Difference (dB)**
12.5	62.6	89	-26.42
16	60.2	86	-25.78
20	57.9	77	-19.1
25	55.0	69	-13.98
31.5	51.3	61	-9.74
40	48.1	54	-5.93
50	45.3	50	-4.74
63	47.0	50	-2.96
80	40.6	48	-7.4
100	38.1	48	-9.9
125	35.1	46	-10.87
160	33.6	44	-10.42



4 DISCUSSION OF RESULTS

The noise loggers above the quarry and near the asphalt plant indicated that there was consistent quarry and asphalt plant noise during the measurement periods at receiver locations.

Receiver 2 – Quarry low frequency noise was barely or just audible. The location of the crushing was in the northern section of the quarry and closer than previous monitoring events. The $L_{A90,15min}$ ranged from 32.7 to 44.9 dB(A). The higher background noise can be attributed to seasonal insects. Evening insect noise was observed to be higher in noise level and frequency.

Analysis of the low frequencies (below 250Hz) indicate a combined level of approximately 30 dB(A), which also includes other ambient non-quarry noise sources.

The low frequency analysis (Table 3.6 and Chart 3.1) Z weighted 1/3 octave band noise levels are below the threshold specified in Table C2 in Fact Sheet C of the NSW NPfI.

The $L_{Aeq,15\ min}$ of the quarry operations is estimated to be below 30 dB(A).

Receiver 4 - Quarry low frequency noise was barely audible. Insect noise was consistent. The $L_{A90,15min}$ ranged from 39.3 to 41.0 and is due to consistent seasonal insects.

Analysis of the low frequencies (below 250Hz) indicate a combined level below 27 dB(A) for the quarry and asphalt plant, and below 24 dB(A) for the asphalt plant only. There was a southerly breeze, which would have reduced noise levels of the quarry operations and asphalt production at this location.

The $L_{Aeq,15\ min}$ of the quarry operations is estimated to be below 35 dB(A) for calm meteorological conditions.

Receiver 8 - Quarry noise was barely or just audible. The $L_{A90,15min}$ ranged from 34.6 to 38.1 dB(A) and mainly due to seasonal insects for the evening and night time, and distant non-quarry noises such as distant traffic on Nimbin Road during the day .

During the night time noise monitoring period, it was noted there was an increase in the low frequency noise level for approximately 4 minutes, and is attributed to the start-up procedure of the asphalt plant (the equipment was temporarily shut down during the relocation of noise monitoring equipment from Receiver 4, as there was a limited supply of resources available to complete the noise monitoring).

The $L_{Aeq,15\ min}$ of the quarry operations is estimated to be below 35 dB(A).

The resident noted that there was a hum from quarry operations most of the time, but did not feel it was excessively intrusive. The resident also noted sometimes on start-up of the asphalt plant, noise levels increased for a short period of time.

Analysis of the low frequencies (below 400Hz – low mid frequencies audible at this location) indicate a combined level below 30 dB(A) for the quarry and asphalt plant, and below 25 dB(A) for the asphalt plant only. There was a southerly breeze, which would have created an upwind condition at Receiver 8 and reduced noise levels of the quarry operations and asphalt production at this location.

The $L_{Aeq,15\ min}$ of the quarry operations is estimated to be below 35 dB(A) for calm meteorological conditions.

5 SUMMARY AND CONCLUSION

A noise monitoring survey was conducted to assess compliance of the quarry and asphalt plant operational noise levels at Blakebrook Quarry, Blakebrook, via Lismore NSW. Measurements were undertaken with calibrated noise monitoring equipment on the 19th of December 2022 and conducted in general accordance with procedures in Australian Standard AS 1055:2018 and the NSW Noise Policy for Industry.

The Blakebrook Quarry operates under the New South Wales Government Environment Protection Authority, Environmental Protection Licence, EPL No. 3384. Noise emissions from quarry and asphalt plant operations at nearby residential receivers, is managed by the Noise and Blast Management Plan (NBMP) for Blakebrook Quarry (Lismore City Council Oct 2022), and includes an Out of Hours Work Protocol (OHWP) for the asphalt plant, which is anticipated to occur 5 nights per month on scheduled projects.

Day time (7am – 6pm) noise limits at residential receivers without a written agreement with the quarry are 36 dB(A) $L_{Aeq,15min}$ for receivers 2 and 7, and 35 dB(A) $L_{Aeq,15min}$ for all other receivers. The evening (6pm – 10pm) and night time (10pm – 7am) noise limit is 35dB(A) $L_{Aeq,15min}$ at all receiver locations without a written agreement with the quarry.

Measurements were conducted at the 3 primary receiver locations (Receivers 2, 4, 8) while the quarry and asphalt plant were operating during the day, and during the evening and night time periods, with only the asphalt plant producing cold mix.

Low frequency noise from the quarry and asphalt plant operations was barely audible or just audible at the primary receiver locations for the day, evening and night time periods.

The quarry operational noise levels ($L_{Aeq,15min}$) were not able to be accurately assessed at residential receiver monitoring locations, as the quarry noise was barely audible against other noise sources such as distant traffic, insects and birds.

It is estimated from the recorded $L_{A90,15\ min}$ levels, listening to the sound recordings, analysing the spectrum data, and observations during the attended noise monitoring, that the combined quarry and asphalt plant noise levels are below the NBMP day time noise criteria of 35 dB(A) $L_{eq,15min}$ at receiver locations 4 and 8, and below 36 dB(A) $L_{eq,15min}$ at receiver location 2. It is estimated that evening and night time noise levels of the asphalt plant are below the NBMP criteria of 35 dB(A) $L_{eq,15min}$.

The current crushing, screening, rock hammering and stock piling operations are on the main pit floor, which provides a substantial noise barrier to receivers. If crushing, screening, rock hammering and stock piling operations change to a higher ground level, then there is potential for increased noise impact at receivers and it is recommended that noise monitoring be conducted at residential receivers.

Receiver 8 is close to the southern cell. It is recommended that noise monitoring be conducted at Receiver 8 when work in the southern cell is undertaken, to assess the noise impact at Receiver 8.

It is recommended for future evening and night time noise monitoring of the asphalt plant, that the noise monitoring be coordinated with truck movements to assess the combined noise levels of asphalt production and truck movements on the internal haul roads.

[redacted]

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APPENDIX A
Definitions of Terms

Sound pressure level (L_p): A measurable quantity of the size or amplitude of the pressure fluctuations (sound waves) above and below normal atmospheric pressure compared to a reference pressure. Sound pressure levels are measured in decibels whereas sound pressure is measured in pascals (N/m^2).

Decibels (dB): a ratio of energy flows. When used for sound measurement, it is the ratio between a measured quantity of sound pressure and an agreed reference sound pressure. The dB scale is logarithmic and uses the threshold of hearing of 20 μPa (micro pascals) as the reference pressure. This reference level is defined as 0 dB.

Frequency (Hz): The number of pressure variations per second (cycles per second) is called the **frequency** of sound and is measured in **Hertz (Hz)**. The rumble of distant thunder has a low frequency, while a whistle has a high frequency. The normal range of hearing for a healthy young person extends from approximately 20Hz up to 20 000 Hz (20 kHz) while the range from the lowest to highest note on a piano is approximately 27.5 Hz to 4.2 kHz.

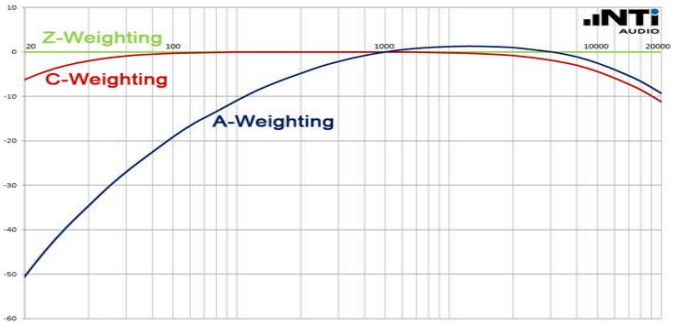
Spectral characteristics: The frequency content of noise.

Octave: a logarithmic unit for ratios between frequencies, with one octave corresponding to a doubling of frequency. For example, the frequency one octave above 40 Hz is 80 Hz.

1/3 Octave: a logarithmic unit of frequency ratio equal to one third of an octave.

"A" frequency weighting: The method of frequency weighting the electrical signal within a noise-measuring instrument to give a very approximate simulate to the human perception of loudness. The symbols for the noise parameters often include the letter "A" (e.g., L_{Aeq}, dBA) to indicate that frequency weighting has been included in the measurement. "A" weighting is most commonly used with regard to noise control issues, regulations and environmental standards.

"C" frequency weighting: The filters used in C weighting captures lower frequencies than A weighting as indicated in the chart below.



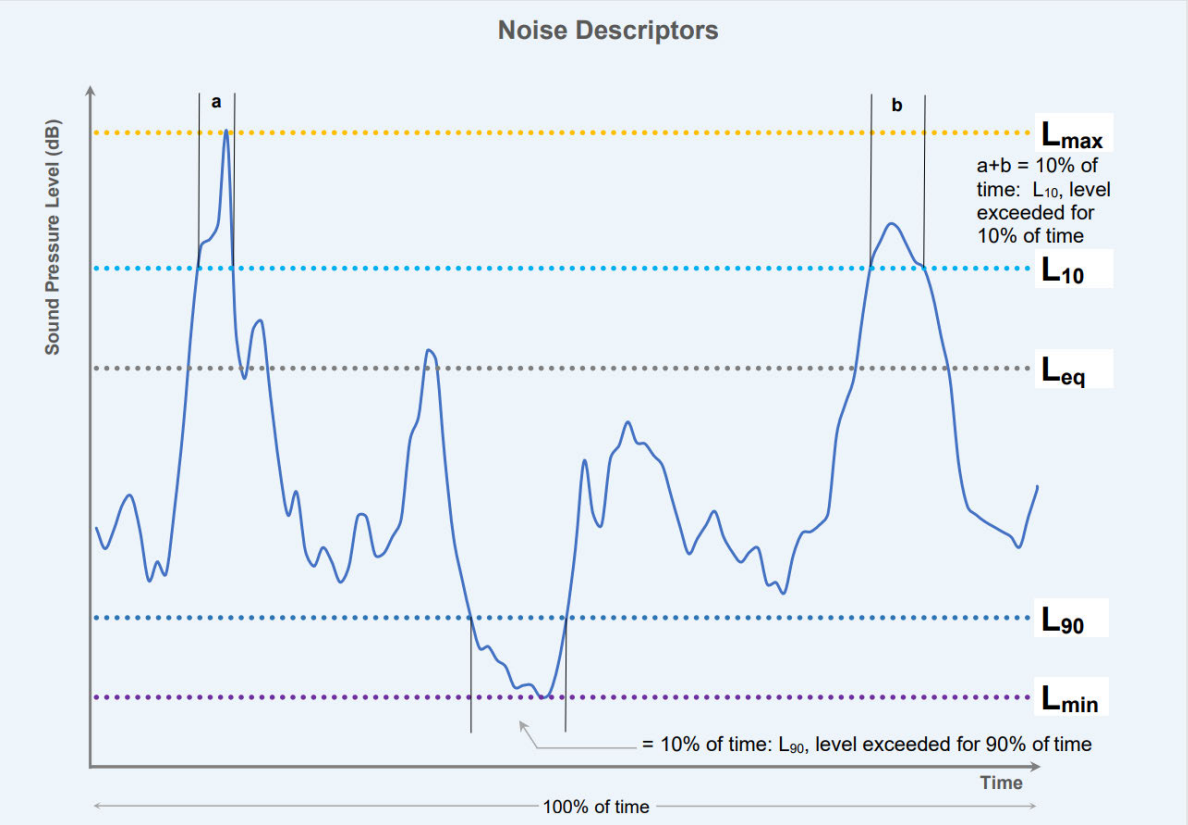
The A-weighting curve is used extensively for general purpose noise measurements but the C-weighting correlates better with the human response to high noise levels.

Fast, Slow and Impulse time weightings: Standardised root-mean-square (rms) averaging times to help define fluctuating noise levels. Impulsive noises have high peak levels with a very short duration (e.g., gun shot), or a sequence of such peaks. The 'Slow' time weighting averages the fluctuations over a one second time base whilst the 'Fast' time weighting averages the fluctuations over a one-eighth of a second time base. Environmental assessment standards usually specify the time weighting (**F**, **S**, or **I**) to be used.

L_{Aeq}: The A-weighted equivalent continuous noise level. A widely used noise descriptor which provides an average of the energy of a constant level of noise which is the same as the varying noise signal being measured. The time in which the measurement was sampled, is indicated with a subscripted number e.g. $L_{Aeq,15\ minute}$ is a 15-minute sample.

Percentile Levels L_N: The sound pressure level that is exceeded for N per cent of the time over which a given sound is measured. e.g. **L_{A90}** is the A-weighted sound pressure level that is exceeded for 90% of the time over which a given sound is measured.

L_{A90} is commonly used to describe the **background noise level** for community noise assessments.



Ambient noise: The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.

Extraneous noise: Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by events such as concerts or sporting events. Normal daily traffic is not to be considered extraneous.

Background noise: The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the $\mathbf{L_{A90}}$ descriptor, fast time weighting.

Intrusive Noise: Refers to noise that intrudes above the background level by more than 5 decibels.

Noise limits: Enforceable noise levels that appear in consents and licences. The noise limits are based on achievable noise levels, which the proponent has predicted can be met during the environmental assessment. Exceedance of the noise limits can result in the requirement for either the development of noise management plans or legal action.

References:

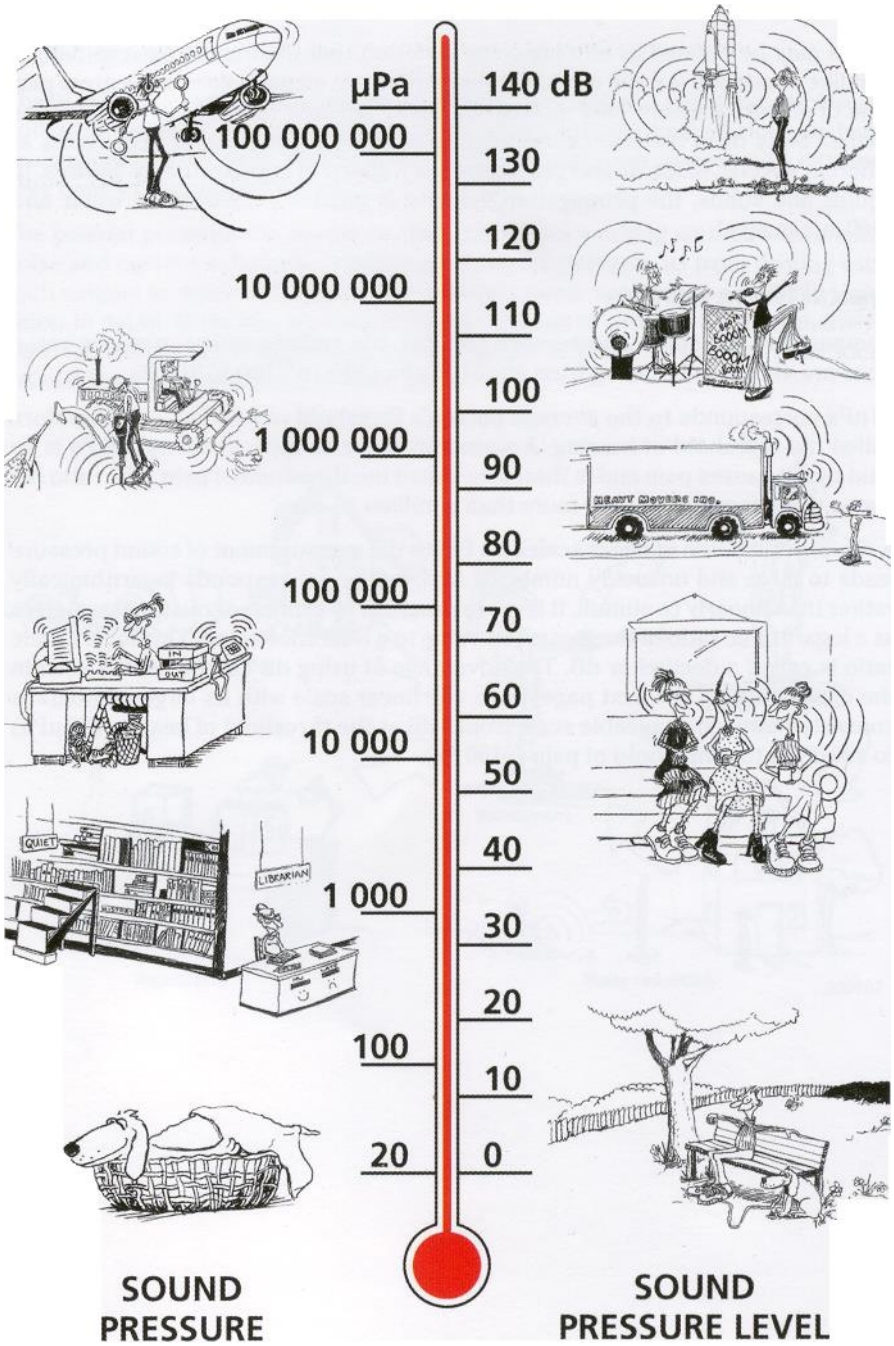
Measuring Sound Brüel and Kjær Sound & Vibration Measurements A/S September 1984

Environmental Noise Brüel and Kjær Sound & Vibration Measurements A/S 2000, 2001

New South Wales Industrial Noise Policy NSW Environment Protection Authority January 2000

https://www.nti-audio.com/en/support/know-how/frequency-weightings-for-sound-level-measurements

APPENDIX B
Comparison of Sound Pressure Levels



Our hearing covers a wide range of sound pressures – a ratio of over a million to one. The dB scale makes the numbers manageable.
Reproduced from
Environmental Noise Brüel and Kjær Sound & Vibration Measurements A/S 2000, 2001

Appendix C
Quarry Operations 19th December 2022

Image Source – Lismore City Council Online Mapping
Note : Aerial photo not of 19th of December 2022 operations

Quarry Pit Floor Operations 19th December 2022

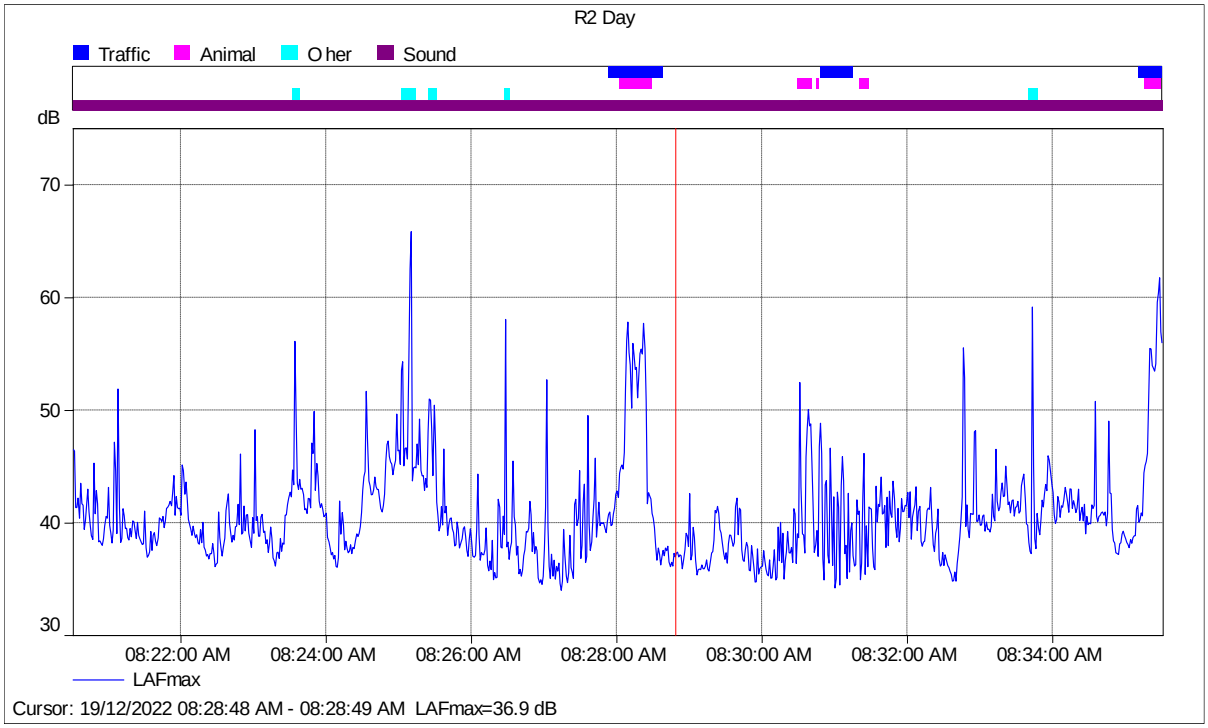
Quarry equipment in use during noise monitoring

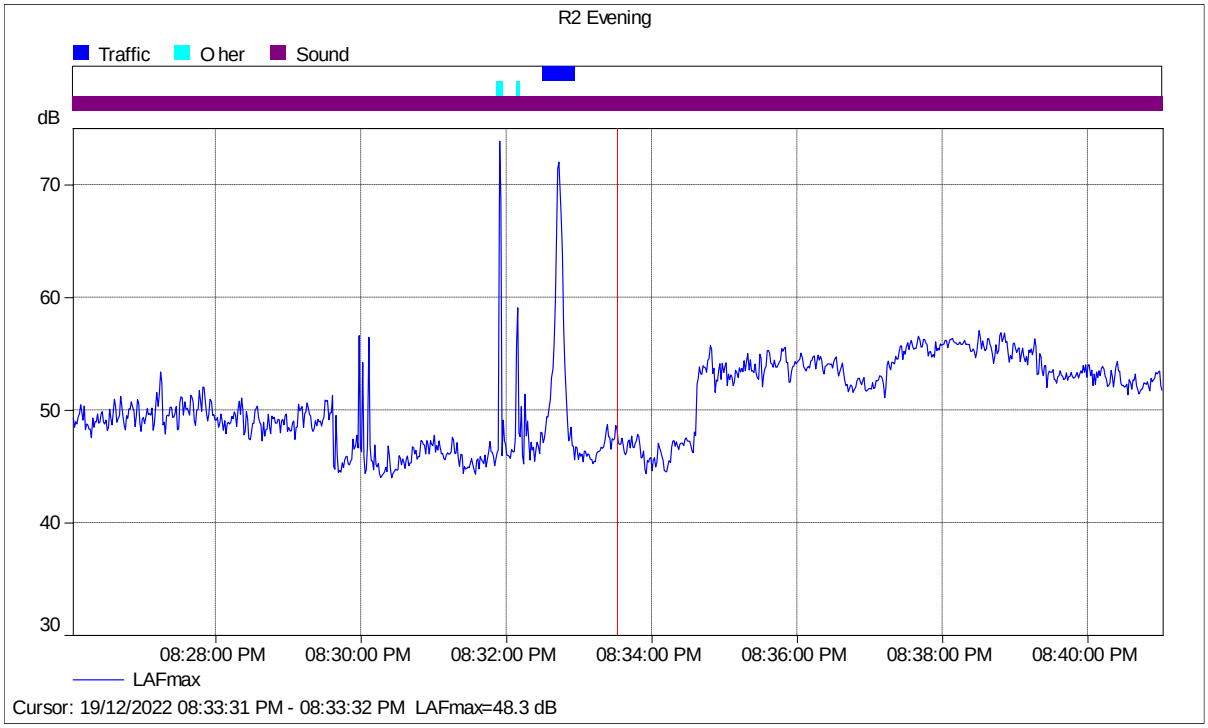
1 x Kleeman MC110z jaw crusher
1 x McCloskey R155 reclaimer
1 x Lp 12/75 stacker
1 x Lp 14/75 stacker
1 x 1300 Maxtrax cone crusher
1 x WA 500 loader
1 x Cat 329 excavator

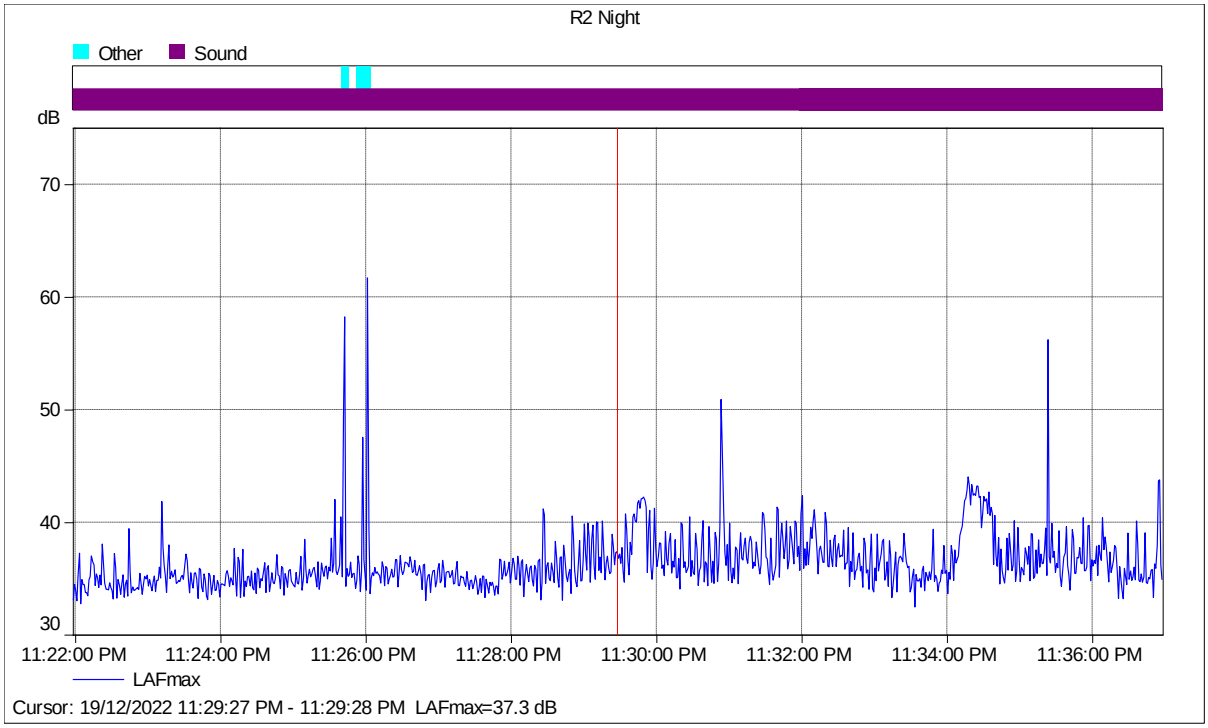
Opertating but not in photo
1 x Hyundai 520 excavator (out of view – working in hole left hand side of photo)
1 x water truck
various haul trucks
various service vehicles

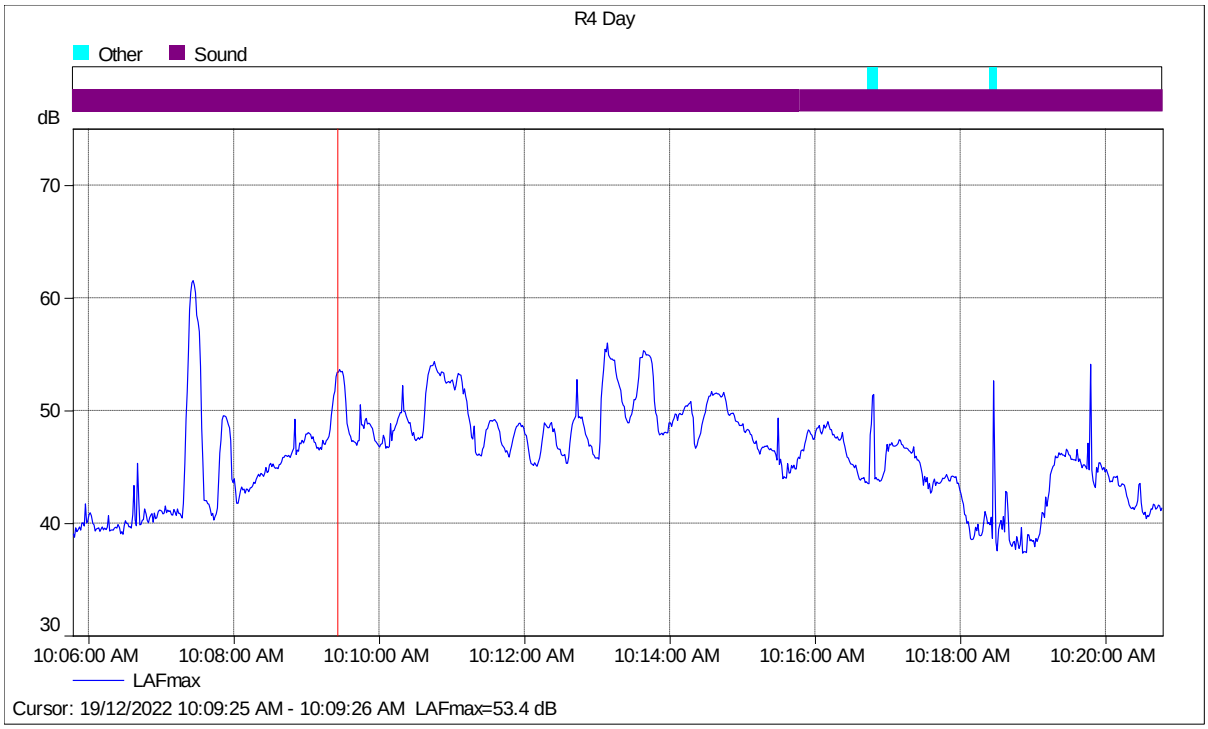
Mobile Asphalt Plant 19th December 2022

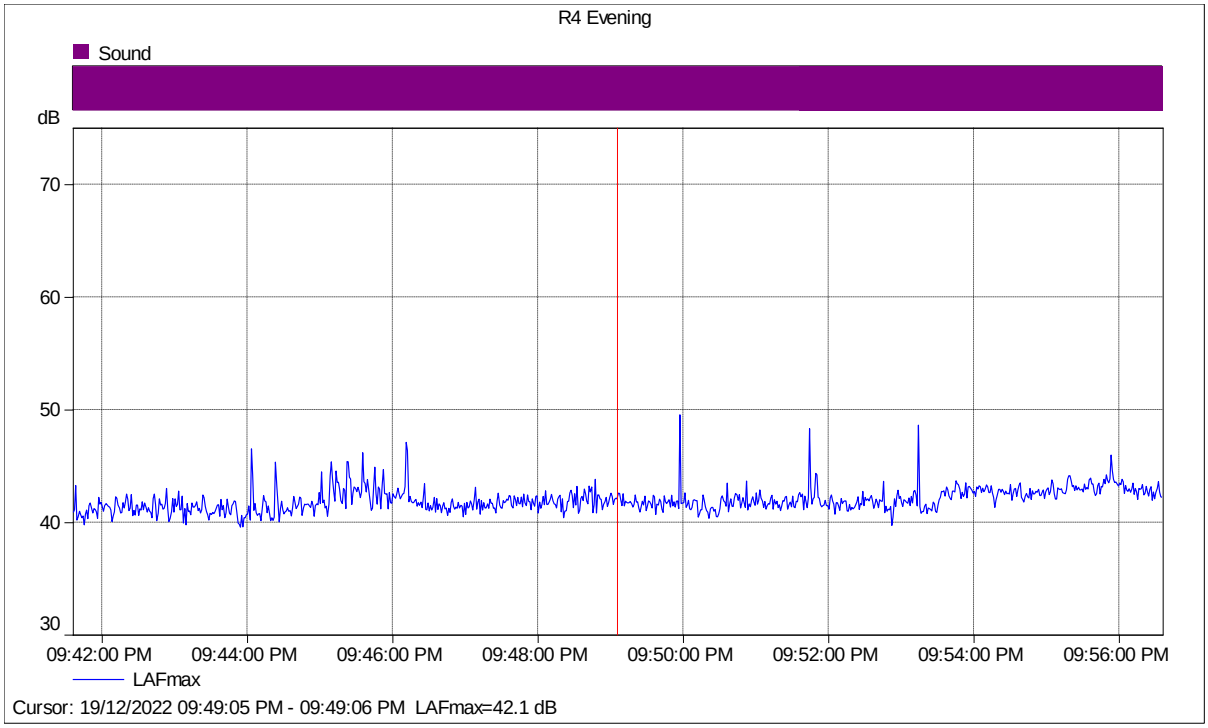
Appendix D
Logged Noise Profiles

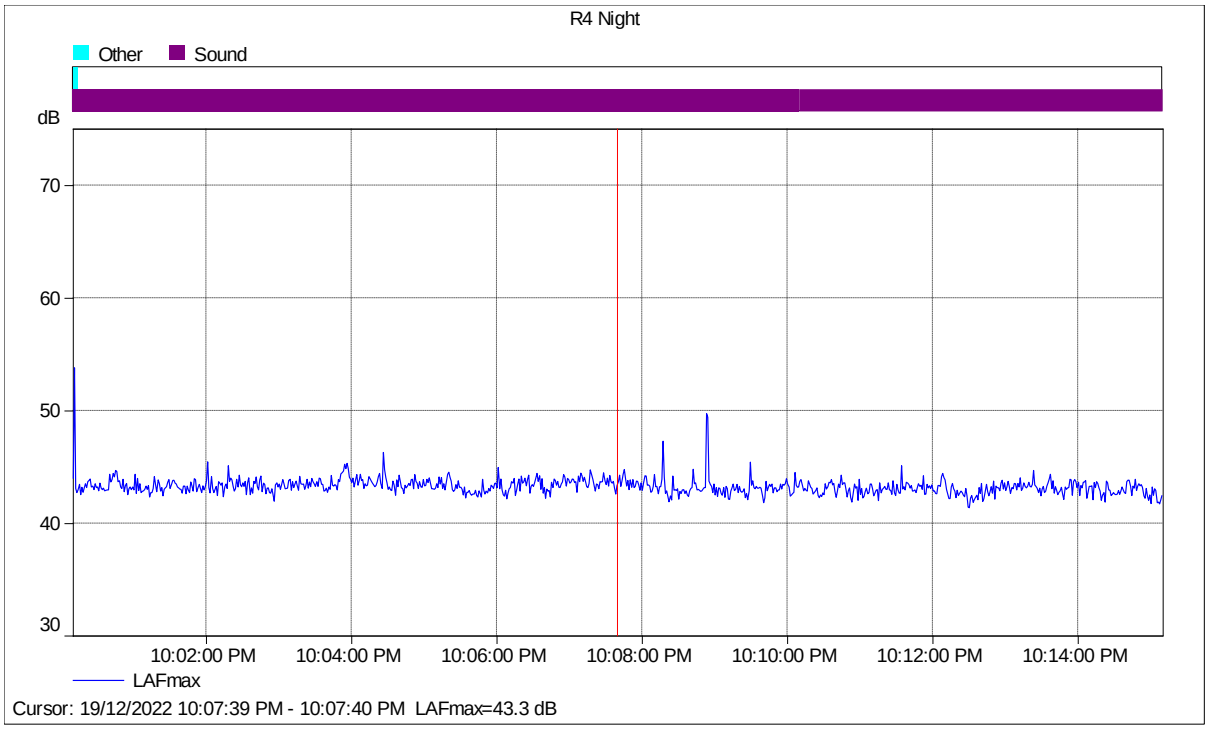


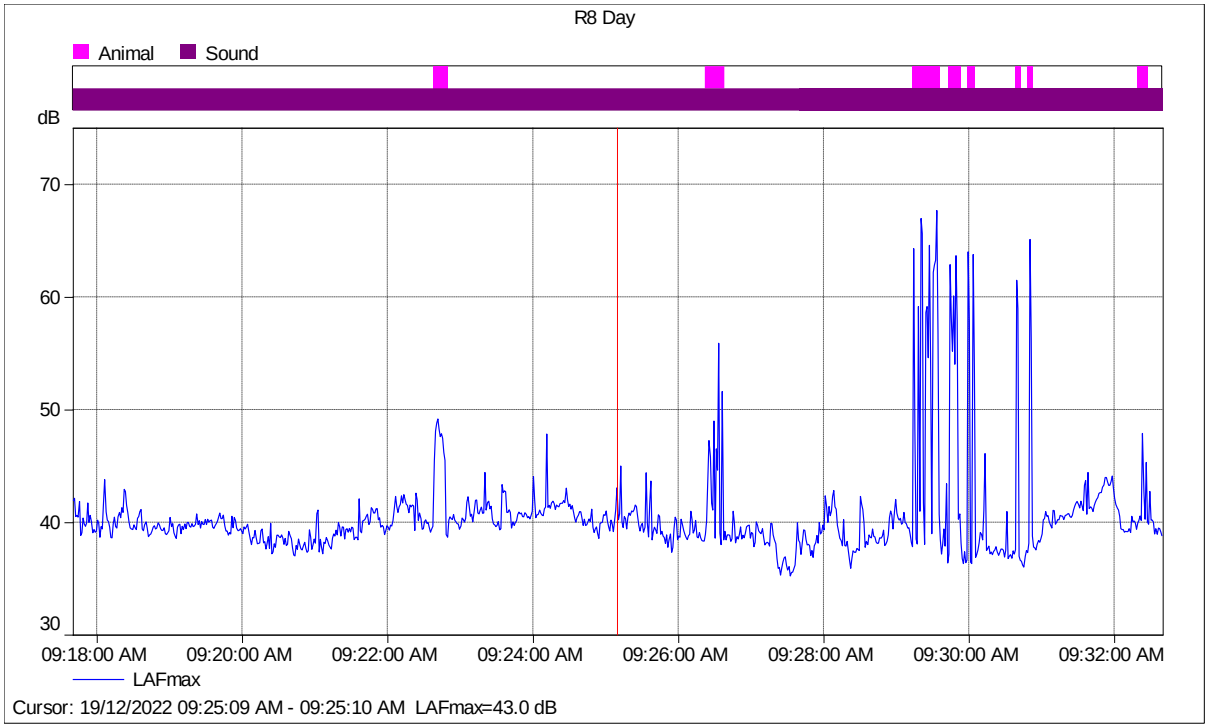


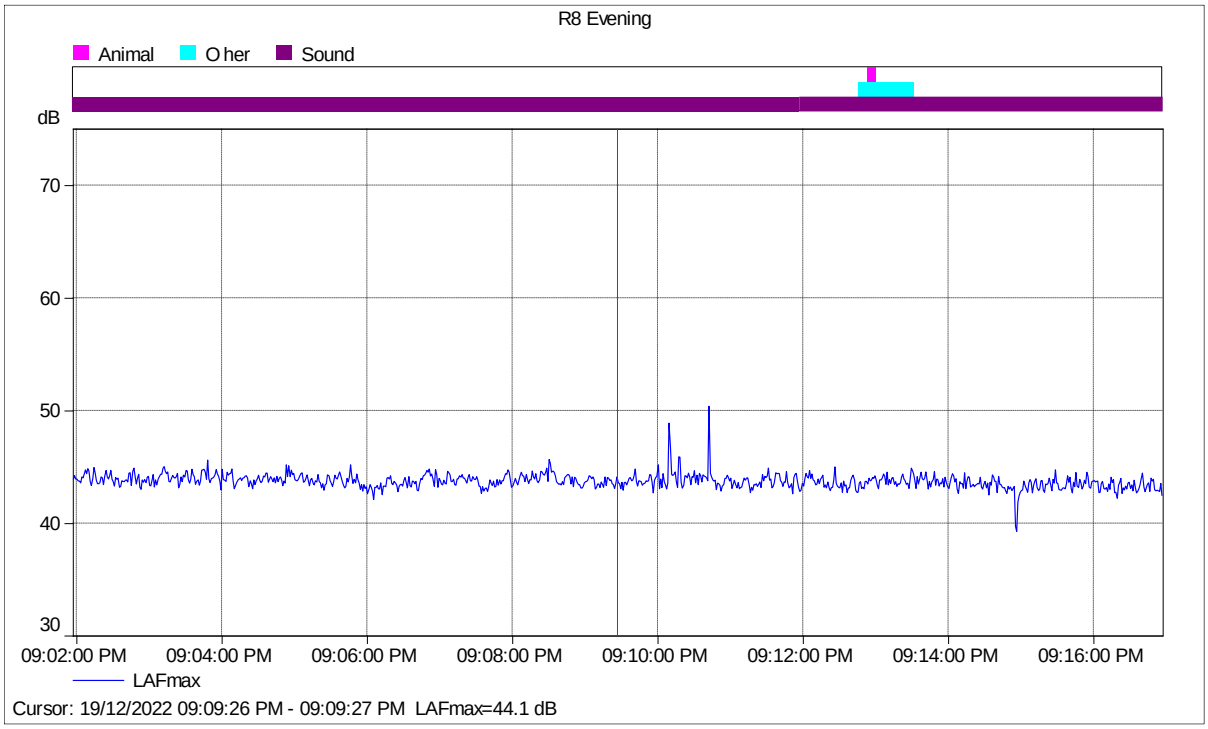

R2 Night
Other
Sound
dB
70
60
50
40
30
11:22:00 PM
11:24:00 PM
11:26:00 PM
11:28:00 PM
11:30:00 PM
11:32:00 PM
11:34:00 PM
11:36:00 PM
LAFmax
Cursor: 19/12/2022 11:29:27 PM - 11:29:28 PM LAFmax=37.3 dB

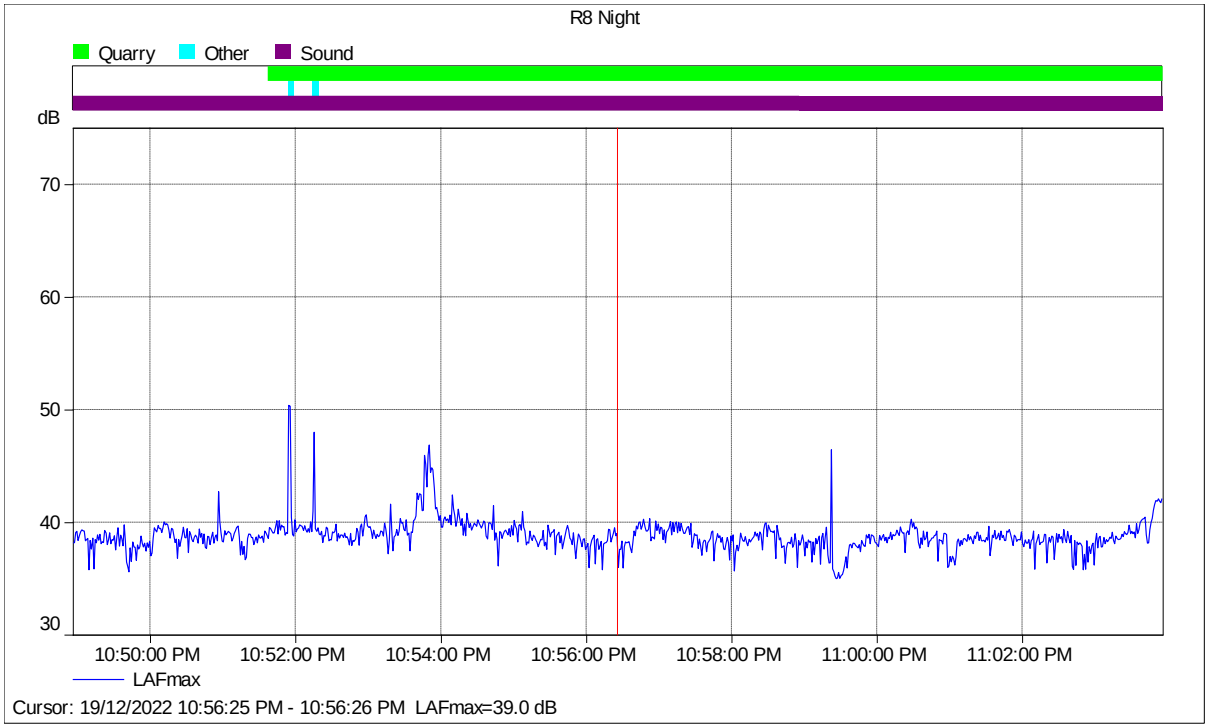

R4 Day
Other
Sound
dB
70
60
50
40
30
10:06:00 AM
10:08:00 AM
10:10:00 AM
10:12:00 AM
10:14:00 AM
10:16:00 AM
10:18:00 AM
10:20:00 AM
LAFmax
Cursor: 19/12/2022 10:09:25 AM - 10:09:26 AM LAFmax=53.4 dB

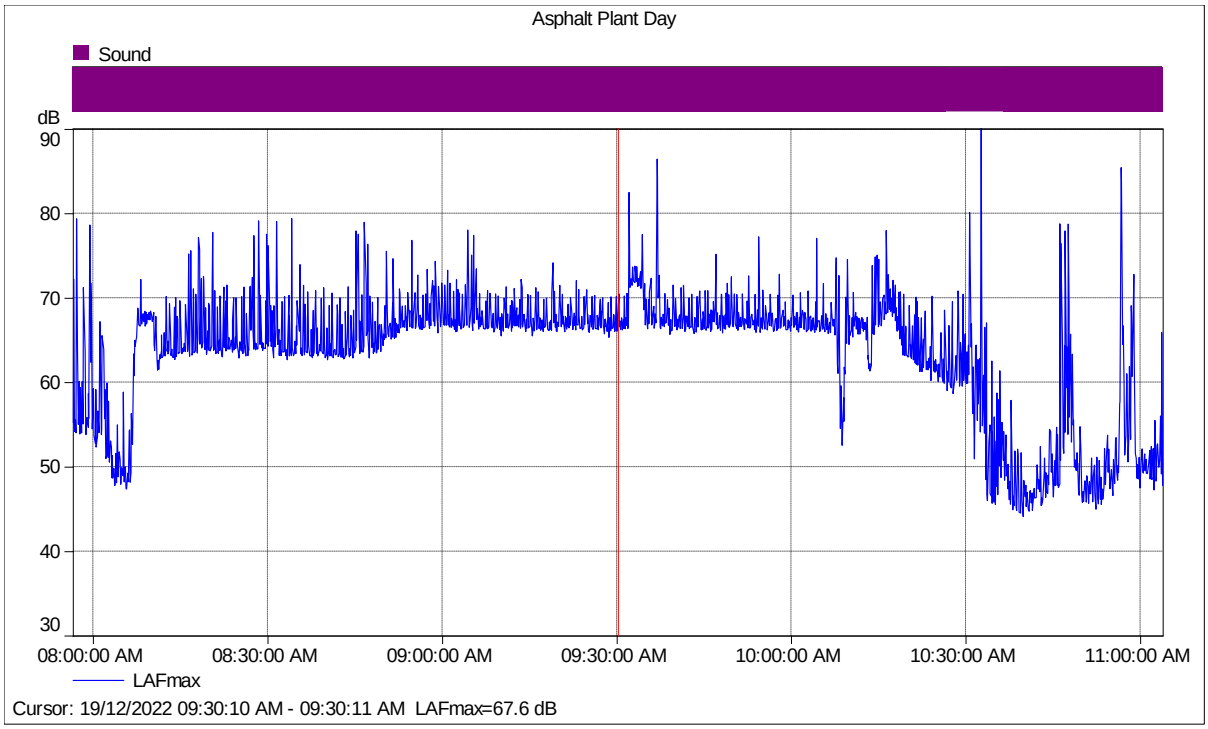

R4 Evening
Sound
dB
70
60
50
40
30
09:42:00 PM
09:44:00 PM
09:46:00 PM
09:48:00 PM
09:50:00 PM
09:52:00 PM
09:54:00 PM
09:56:00 PM
LAFmax
Cursor: 19/12/2022 09:49:05 PM - 09:49:06 PM LAFmax=42.1 dB

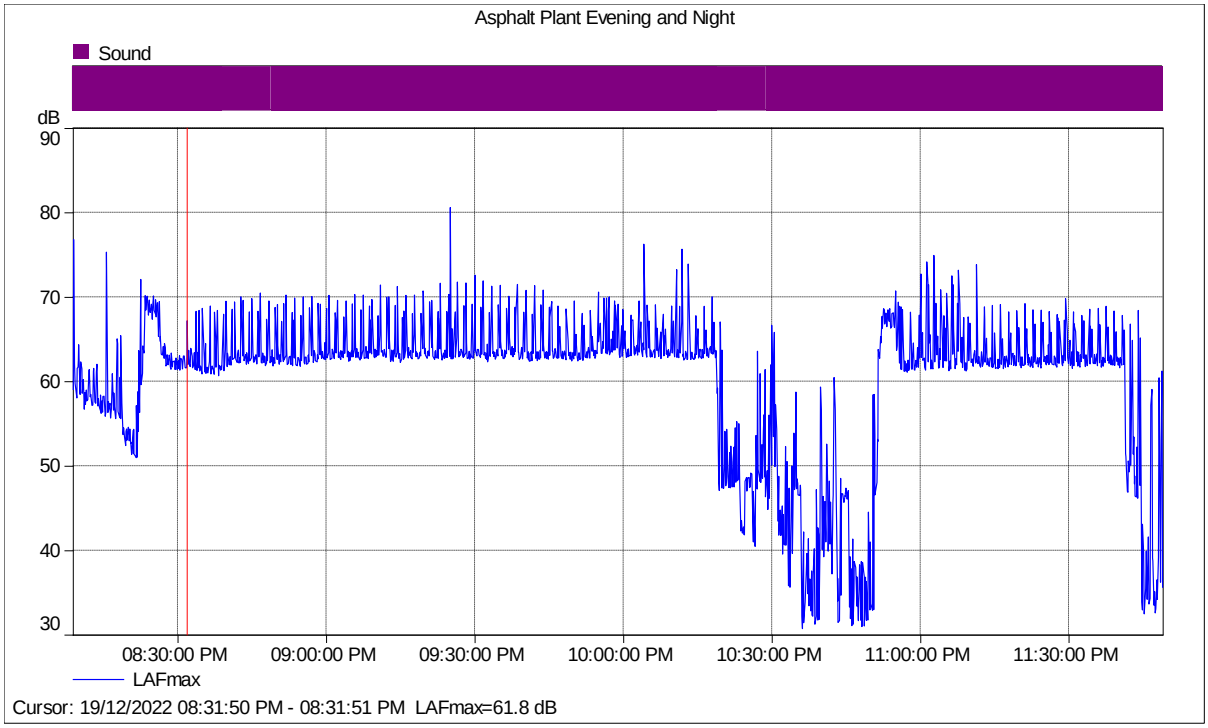

R4 Night
Other
Sound
dB
70
60
50
40
30
10:02:00 PM
10:04:00 PM
10:06:00 PM
10:08:00 PM
10:10:00 PM
10:12:00 PM
10:14:00 PM
LAFmax
Cursor: 19/12/2022 10:07:39 PM - 10:07:40 PM LAFmax=43.3 dB

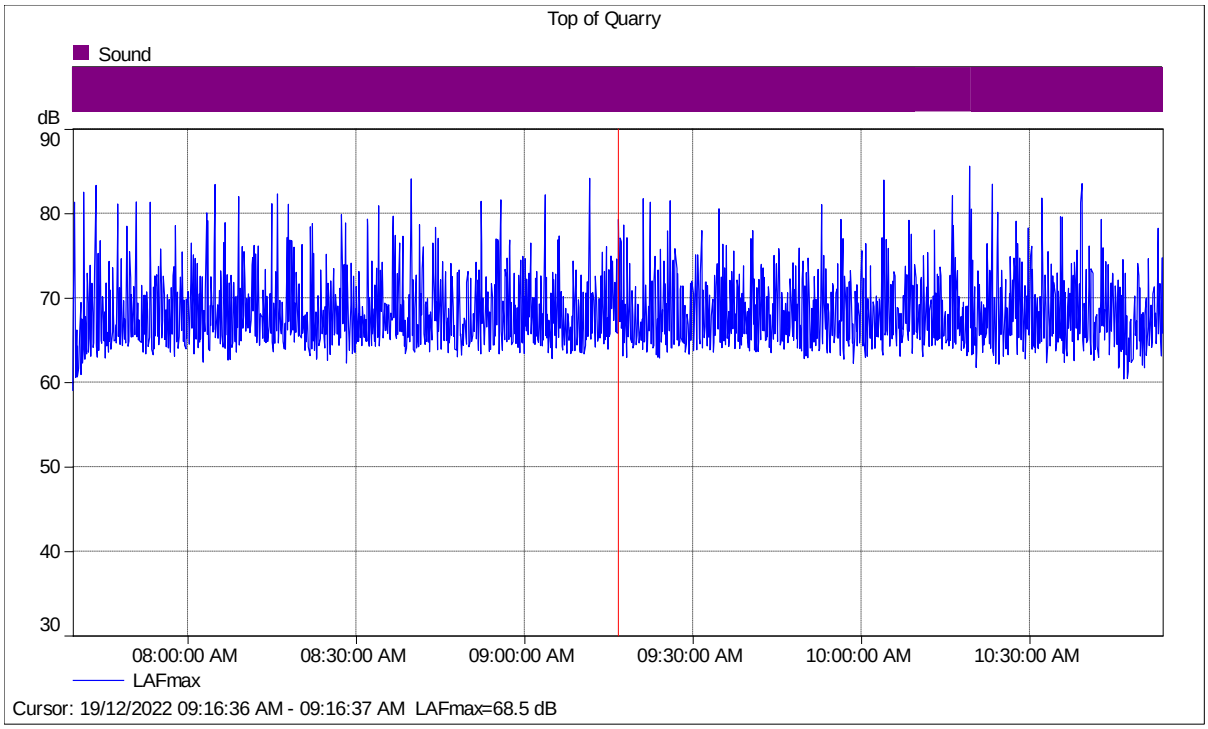

R8 Day
Animal
Sound
dB
70
60
50
40
30
09:18:00 AM
09:20:00 AM
09:22:00 AM
09:24:00 AM
09:26:00 AM
09:28:00 AM
09:30:00 AM
09:32:00 AM
LAFmax
Cursor: 19/12/2022 09:25:09 AM - 09:25:10 AM LAFmax=43.0 dB


R8 Evening
Animal
Other
Sound
dB
70
60
50
40
30
09:02:00 PM
09:04:00 PM
09:06:00 PM
09:08:00 PM
09:10:00 PM
09:12:00 PM
09:14:00 PM
09:16:00 PM
LAFmax
Cursor: 19/12/2022 09:09:26 PM - 09:09:27 PM LAFmax=44.1 dB


R8 Night
Quarry
Other
Sound
dB
70
60
50
40
30
10:50:00 PM
10:52:00 PM
10:54:00 PM
10:56:00 PM
10:58:00 PM
11:00:00 PM
11:02:00 PM
LAFmax
Cursor: 19/12/2022 10:56:25 PM - 10:56:26 PM LAFmax=39.0 dB


Asphalt Plant Day
Sound
dB
90
80
70
60
50
40
30
08:00:00 AM
08:30:00 AM
09:00:00 AM
09:30:00 AM
10:00:00 AM
10:30:00 AM
11:00:00 AM
LAFmax
Cursor: 19/12/2022 09:30:10 AM - 09:30:11 AM LAFmax=67.6 dB


Asphalt Plant Evening and Night
Sound
dB
90
80
70
60
50
40
30
08:30:00 PM
09:00:00 PM
09:30:00 PM
10:00:00 PM
10:30:00 PM
11:00:00 PM
11:30:00 PM
LAFmax
Cursor: 19/12/2022 08:31:50 PM - 08:31:51 PM LAFmax=61.8 dB


Top of Quarry
Sound
dB
90
80
70
60
50
40
30
08:00:00 AM
08:30:00 AM
09:00:00 AM
09:30:00 AM
10:00:00 AM
10:30:00 AM
LAFmax
Cursor: 19/12/2022 09:16:36 AM - 09:16:37 AM LAFmax=68.5 dB