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Results of Noise Monitoring

Blakebrook Quarry
550 Nimbin Road
Blakebrook NSW 2480

Prepared for

Ecoteam
13 Ewing Street
Lismore NSW 2480

Document Control				
Rev. No	**Date**	**Prepared By**		**Notes**
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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 7th and 14th of June 2023 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 hot mix during the day, evening and night time noise monitoring periods. There were truck movements on the internal haul roads, entry/exit haul road and Nimbin Road during the day, 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.

Appendix D are the logged noise levels for the asphalt plant, above crushing operations on the quarry floor, and at each receiver location.

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*.

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.

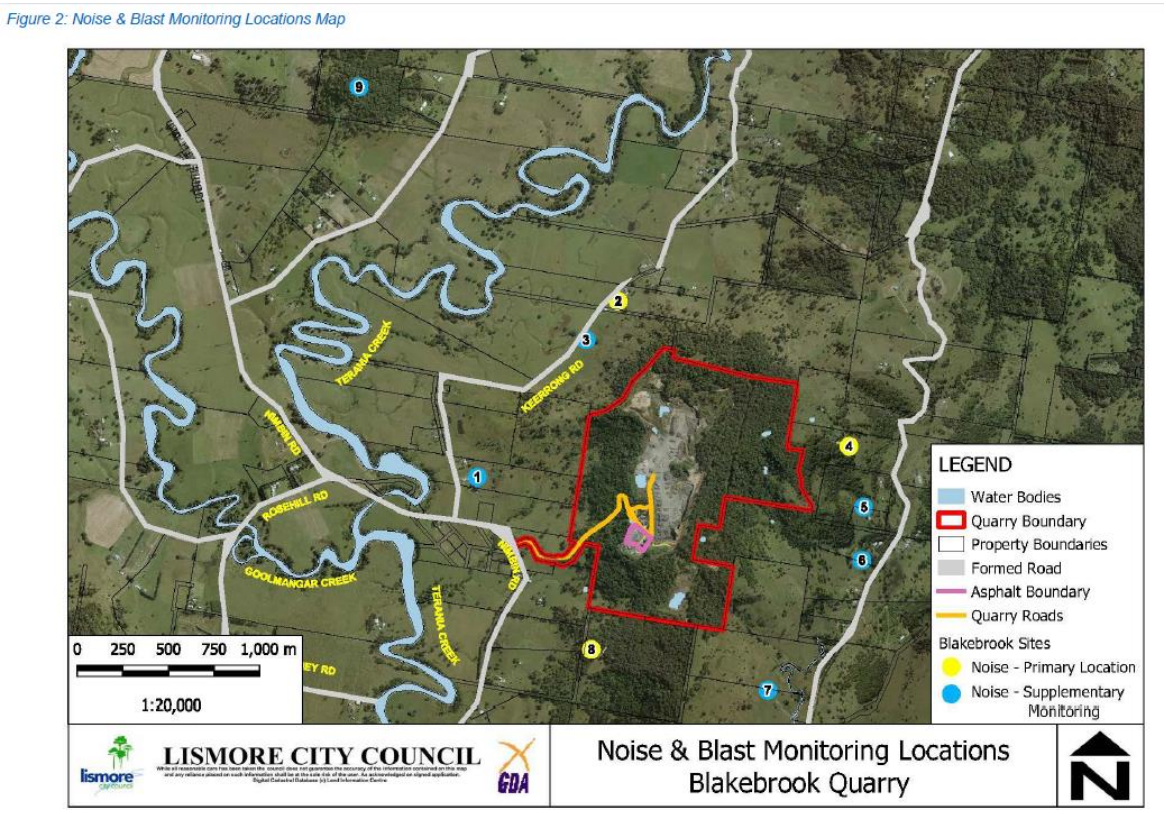
Notes:
1. Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.
2. Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that 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	190 Keerrong Rd Blakebrook
4	365 Booerie Creek Road Booerie Creek
8	484 Nimbin Rd Blakebrook

Figure 2.1 Noise Monitoring Locations



3 MEASUREMENT PROCEDURE AND RESULTS

3.1 Instrumentation

Table 3.1 Instrumentation		
Instrument	**Serial #**	**Calibration Date**
Brüel and Kjær 2250 G4 Sound Level Meter	3006868	July 2021
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 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. The sound recording feature was utilised on both SLMs.

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. Markers and sound recording were utilised on the sound level meter for post event analysis of acoustic events during each monitoring period.

A 15 minute period was recorded at each receiver location with A and C weighting, fast response, and 1 second samples. Spectrum data was recorded with a linear (Z) weighting in 1/3 octave bands.

The clocks on the 3 SLMs were synchronised to enable comparison of noise levels at the asphalt plant and top of quarry reference locations with noise levels at the receiver locations.

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 7th June 2023

Receiver	Time	Temp	Relative Humidity	Wind	Wind Dir	Cloud Cover
		˚C	%	Speed (m/s)		
2	8:59 PM	12	91	Calm		0/8
	12:08 AM	13	90	Calm		0/8
4	10:23 PM	14	94	Calm		0/8
	10:38 PM	14	94	Calm		0/8
8	9:37 PM	14	95	Calm		0/8
	11:27 PM	14	94	Calm		0/8

Table 3.3 Receiver Locations Weather Summary 14th June 2023

Receiver	Time	Temp	Relative Humidity	Wind	Wind Dir	Cloud Cover
		˚C	%	Speed (m/s)		
2	10:58 AM	23	48	1 - 2	W	0/8
4	9:16 AM	19	62	0.5 - 1.5	Calm	0/8
8	10:04 AM	18	70	0.5 - 1.5	NW	0/8

Weather data from the weather station at Blakebrook Quarry is presented in Table 3.4 below.

Table 3.4 Blakebrook Quarry Weather Station Observations June 2023								
Date	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
7/06/2023	8:10 PM	15.3	1.6	0.4	341.3	26.1	0.5	0
	8:20 PM	15.2	2.2	0.6	10.8	24.4	0.5	0
	8:30 PM	15	2.1	0.6	18.5	27.9	0.5	0
	8:40 PM	14.9	1.8	0.5	9.2	22.7	0.3	0
	8:50 PM	14.9	1.6	0.4	3.9	25.3	0.3	0
	9:00 PM	14.8	2	0.6	17.6	22.2	0.2	0
	9:10 PM	14.7	2.6	0.7	1.7	19.5	0.2	0
	9:20 PM	14.7	1.3	0.4	2.7	30	0.6	0
	9:30 PM	14.4	2.5	0.7	357.1	28.7	0.6	0
	9:40 PM	14.2	2.6	0.7	350.7	25.4	0.5	0
	9:50 PM	14.1	2.1	0.6	353.7	28	0.4	0
	10:00 PM	14.1	2.8	0.8	358.4	25.1	0.4	0
	10:10 PM	14	3.2	0.9	7	23.9	0.6	0
	10:20 PM	13.9	2	0.6	5.9	35.5	0.7	0
	10:30 PM	13.7	4.3	1.2	2.1	31.2	0.6	0
	10:40 PM	13.7	4	1.1	357.7	29.3	0.8	0
	10:50 PM	13.6	3	0.8	358.6	31.4	0.7	0
	11:00 PM	13.6	2.3	0.6	346.7	27.6	0.5	0
	11:10 PM	13.5	2.1	0.6	356	29.1	0.5	0
	11:20 PM	13.5	2.8	0.8	2.5	29.2	0.5	0
	11:30 PM	13.6	2.8	0.8	17	34.3	0.6	0
	11:40 PM	13.6	1.4	0.4	345	22	0.4	0
	11:50 PM	13.5	1.1	0.3	353.6	24.5	0.4	0
8/06/2023	12:10 AM	13.2	1.4	0.4	318.1	16.6	0.5	0
	12:20 AM	12.9	1.7	0.5	344.3	28.6	0.9	0
	12:30 AM	12.8	1.4	0.4	326.4	32.4	0.6	0
	12:40 AM	12.7	1.1	0.3	328.4	41.6	0.4	0
	12:50 AM	12.9	1	0.3	319.9	51.9	0.6	0
	1:00 AM	12.8	0.8	0.2	318.5	26	0.4	0
14/06/2023	8:10 AM	14.8	2.6	0.7	5.5	31.3	0.8	0
	8:20 AM	15.3	2.8	0.8	345.3	40.5	0.8	0
	8:30 AM	15.9	2.7	0.8	336.3	38.3	0.8	0
	8:40 AM	16.3	2.8	0.8	326.9	43.9	1.1	0
	8:50 AM	16.7	2.1	0.6	341.8	50.9	0.7	0
	9:00 AM	16.9	2.5	0.7	317.8	35.1	0.6	0
	9:10 AM	17	2.3	0.6	336.2	39.8	0.7	0
	9:20 AM	17.2	3.3	0.9	314.1	27.8	0.8	0
	9:30 AM	17.4	2	0.6	325.6	40.5	0.5	0
	9:40 AM	17.9	2.8	0.8	314.2	39.5	1	0
	9:50 AM	18.1	2.8	0.8	326.9	43.6	0.8	0
	10:00 AM	18.4	3.7	1.0	304.9	27.5	0.8	0
	10:10 AM	18.4	3.9	1.1	311.8	36.6	1.2	0
	10:20 AM	19	3.7	1.0	296.8	42.6	1	0
	10:30 AM	19.7	4.3	1.2	294.4	28.2	1.2	0
	10:40 AM	20.2	4.4	1.2	260.9	50.8	2	0
	10:50 AM	20.7	3.7	1.0	257.2	54.1	1.4	0
	11:00 AM	20.8	5.1	1.4	238.7	29.7	0.8	0
	11:10 AM	21	5.3	1.5	227.1	57.3	1.3	0
	11:20 AM	21.1	4.8	1.3	221.9	55.2	2.3	0
	11:30 AM	21.3	5.4	1.5	266.3	76.2	1	0
	11:40 AM	21.8	3.6	1.0	222.5	62.1	1.3	0
	11:50 AM	21.9	4.9	1.4	220.7	75.6	1.3	0
	12:00 PM	21.6	5.7	1.6	244.4	54.2	1.8	0

Wind Direction O and 360 degrees – North, 90 degrees – East,

180 degrees South, 270 degrees - West

3.4 Measurement Results

Table 3.5 Blakebrook Quarry Receiver Locations Measurement Summary - 7th/8th June 2023 (All measurements 15 mins)								
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]
2	8:59 PM	0:15:00	42.5	30.7	38.6	7.9	32.7	26.7
	12:08 AM	0:15:00	77.4	49.2	51.7	2.6	32.9	21.5
4	10:23 PM	0:15:00	46.0	26.0	42.2	16.3	27.5	23.2
	10:38 PM	0:15:00	41.8	24.4	40.0	15.6	25.8	21.7
8	9:37 PM	0:15:00	47.6	36.1	51.8	15.7	38.0	33.4
	11:27 PM	0:15:00	46.9	37.8	52.3	14.5	39.7	34.0

Table 3.6 Blakebrook Quarry Receiver Locations Measurement Summary - 14th June 2023 (All measurements 15 mins)								
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]
2	10:58 AM	0:15:00	65.8	45.8	56.7	10.9	42.0	32.8
4	9:16 AM	0:15:00	58.7	37.9	48.1	10.2	41.0	30.3
8	10:04 AM	0:15:00	50.8	42.1	52.8	10.7	44.1	39.3

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

Post processing was conducted in Bruel & Kjaer BZ 5505 sound processing software to exclude other noise sources for the receiver location measurements. The exclude function was enabled for the traffic, animal and other markers. The total – exclude data enables a more accurate assessment of the noise source under investigation, by eliminating the periods that other random noise sources occur during monitoring. The results for Receiver 4 and Receiver 8 are presented below.

Table 3.7 Receiver 4 Measurement Summary Total - Exclude June 2023 (All measurements 15 mins)							
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]
7/06/2023 22:23	0:14:49	42.4	25.8	42.2	16.4	27.4	23.2
7/06/2023 22:38	0:14:16	36.0	23.7	39.8	16.1	25.5	21.6
14/06/2023 9:16	0:07:55	39.9	31.8	46.1	14.3	33.4	30.0

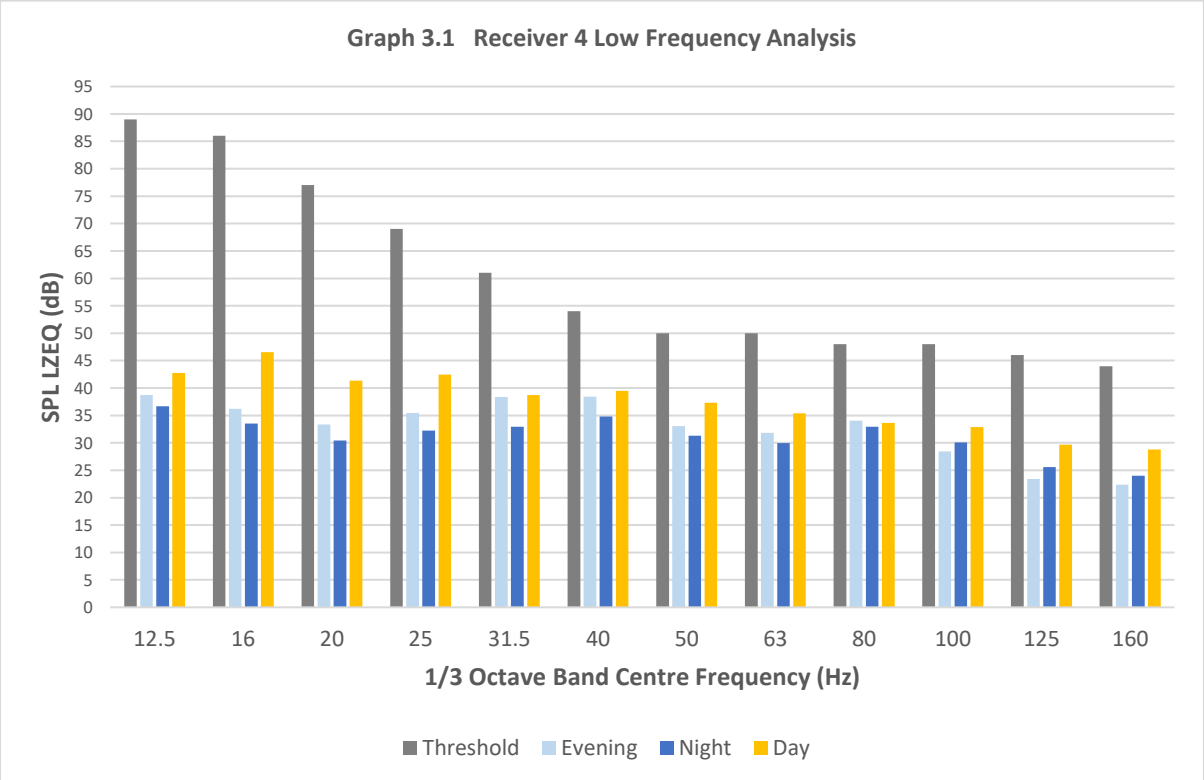
Table 3.8 Receiver 8 Measurement Summary Total - Exclude June 2023 (All measurements 15 mins)							
Start Time	**Elapsed Time h:mm:ss**	L_{AFmax} [dB]	L_{Aeq} [dB]	L_{Ceq} [dB]	$L_{Ceq-LAeq}$ [dB]	$L_{AF10.0}$ [dB]	$L_{AF90.0}$ [dB]
7/06/2023 21:37	0:11:58	46.9	35.2	51.7	16.5	36.7	33.3
7/06/2023 23:27	0:12:09	42.7	37.3	52.2	14.9	39.1	33.8
14/06/2023 10:04	0:03:25	45.8	40.6	52.1	11.5	42.4	38.2

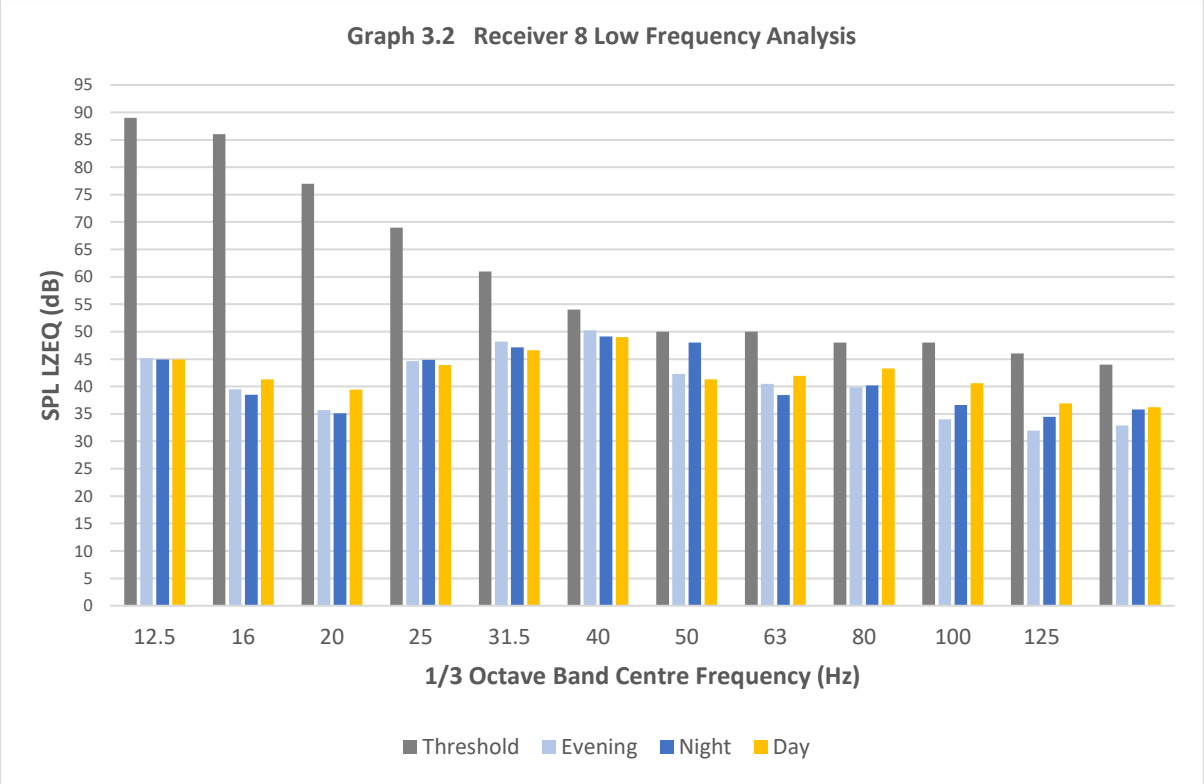
Table 3.9 Noise Observations at Receiver Locations 7th/8th June 2023 (All measurements 15 mins)			
Receiver	**Start Time**	**Observed Noise Sources**	**Quarry Noise**
2	8:59 PM	Distant cattle, distant traffic Nimbin Road, intermittent insects (3.15kHz - 4kHz) , distant birds, distant dogs barking	Asphalt plant not audible
	12:08 AM	Distant cattle quite consistent, distant traffic Nimbin Road, 1 vehicle passby, intermittent insects, distant birds, distant dogs barking	Asphalt plant not audible
4	10:23 PM	Very distant traffic, very distant dog, distant cattle	Asphalt plant low frequency just audible
	10:38 PM	Very distant traffic, very distant dog	Asphalt plant low frequency barely audible
8	9:37 PM	Distant traffic Nimbin Road, distant dog low level,	Asphalt plant audible
	11:27 PM	Distant traffic Nimbin Road, distant dog low level, vehicle on haul road	Asphalt plant audible - consistent

Table 3.10 Noise Observations at Receiver Locations 14th June 2023 (All measurements 15 mins)			
Receiver	**Start Time**	**Observed Noise Sources**	**Quarry Noise**
2	10:58 AM	Occasional wind in trees, occasional traffic on Keerrong Road, birds, dog barking, distant traffic Nimbin Road, people talking occasionally, distant aircraft	Quarry not audible
4	9:16 AM	Distant traffic, birds, light aircraft, distant dog barking,	Crushing just audible, very low frequency of quarry just audible
8	10:04 AM	Road traffic noise from Nimbin Road, insects 16kHz - 20kHz, birds	Quarry audible

3.5 Low Frequency Analysis

The difference between the A and C L_{eq} levels at Receivers 4 and 8 was greater than 15 decibels during some measurements.





4 DISCUSSION OF RESULTS

There was a delay in the asphalt plant starting on the night of the 7th. The evening measurement at Receiver 4 was not completed until 10:38pm.

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 (graphs D1, D2, D3).

Receiver 2

Quarry noise was not audible for any monitoring period. The background noise level (21.5 dB $L_{A90,15min}$) after midnight was very low.

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

Receiver 4

Night time background noise levels are quite low. Crushing from the quarry floor was just audible during the day time period. During all monitoring periods, low frequency noise was just, or barely audible. The low frequency is from the asphalt plant.

Table 3.7 indicates the results of the total measurement without the other identified noises (graphs D7, D8 and D9). Graph 3.1 is the low frequency analysis for Receiver 4. The measured 1/3 octave data between 12.5Hz and 160Hz indicate all measured data is below the threshold criteria.

Based on the measured data and analysis, it is estimated quarry operations at Receiver 4 are below 32 dB(A) $L_{eq,15min}$ for calm meteorological conditions.

Receiver 8

Quarry noise was audible at Receiver 8 for the day, evening and night time periods. The measured noise levels were higher than previous noise surveys. The crushing operations only occur during the day and was operating at the northern end of the quarry. The asphalt plant was operating during all measurement period and has been identified as the contributing factor to the higher noise levels.

Table 3.8 indicates the total noise level less the other identified noises. The L_{Aeq} is 40.6 for the day time, 35.3 for the evening and 37.3 for the night time, and exceeds the assessment criteria of 35 dB(A) $L_{Aeq,15min}$ for this receiver location for each measurement period.

Graphs D1 and D2 (Appendix D) are the logged noise levels of the noise monitor near the asphalt plant. The graphs indicate the asphalt plant noise levels were consistent during the monitoring periods at Receiver 8.

Data from previous noise surveys indicates the asphalt plant was operating below 35 dB(A) during calm meteorological conditions with similar noise levels at the asphalt plant noise monitoring reference location. Insect noise was noticeable in some of the previous noise surveys.

The wind conditions at Receiver 8 were observed as calm on the night of the 7th, and a 0.5 – 1.5 m/s NW wind during the day time. Data from the meteorological station at the quarry indicated the following average 10m wind speeds (m/s) and direction during the monitoring periods at Receiver 8.

Day	1.0 - 1.1	NWW – NW
Evening	0.6 – 0.8	N
Night	0.3 – 0.8	N – NNW

Receiver 8 is approximately 600m south of the asphalt plant.

The noise levels at the asphalt plant are very consistent 65 – 66 L_{AFmax} during the evening and night time measurement periods. Graph D10 indicates the noise level from 34 dB(A) to 38 dB(A) when no other noise sources are present. The increase is due to the downwind location of Receiver 8 during breezes from the north. The wind was calm at the noise monitoring location as it was in a sheltered location. The strength of the breeze was not strong enough to cause noticeable foliage noise at the Receiver 8 measurement location.

Graph D11 shows a similar effect for the night time measurement. The levels range from 33 to 40 dB(A) when no other noise sources are present.

It was noted that road traffic noise from Nimbin Road was underlying most of the time during the day time monitoring period due to the prevailing NW wind, which increased background noise levels and L_{Aeq} noise levels.

The downwind conditions at Receiver 8 has resulted in increased noise levels from the asphalt plant at Receiver 8.

Discussions were held with the asphalt plant manager regarding noise levels from the asphalt plant.

The fans for the asphalt mix will vary depending on the temperature and load conditions. Cold mix will be quieter than hot mix.

The asphalt plant manager also indicated the fans are due to be replaced within 3 to 4 months.

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 7th and 14th of June 2023, 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 hot mix and trucks on the haul road.

The quarry operations were not audible at Receiver 2 during the day, evening and night time periods. It is estimated quarry operations are below 30 dB(A) $L_{Aeq,15min,}$ which is below the day, evening and night time noise limits.

Low frequency noise from asphalt plant operations was barely audible or just audible at Receiver 4 for the day, evening and night time periods. The low frequency analysis indicates the measured low frequency is below the low frequency criteria. It is estimated quarry operations at Receiver 4 are below 32 dB(A) $L_{eq,15min}$ for calm meteorological conditions.

The measured noise levels at Receiver 8 exceeded the day, evening and night time noise limit criteria of 35dB(A) $L_{Aeq,15min.}$ The asphalt plant was identified as the contributor to the exceedances. The exceedances were 5.6 decibels for the day time, 0.3 decibels for the evening, and 2.3 decibels for the night time. It was noted that Receiver 8 was downwind of the asphalt plant for each of the monitoring periods and the main reason for the exceedances. Consistent underlying traffic noise from Nimbin Road due to the NW wind contributed to an increase in background and L_{Aeq} noise levels at Receiver 8 .

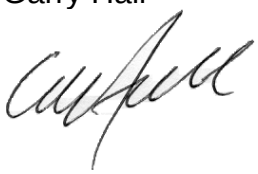
It is recommended that the fans at the asphalt plant be operated at the minimum safe fan speed when there is a northerly breeze.

It is recommended to investigate if quieter fans are available when the asphalt fans are due to be replaced in the next 3 to 4 months.

It is recommended a noise assessment be conducted after the installation of fans to ensure the asphalt plant operations comply with the noise criteria.

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.

Garry Hall



Acoustic Consultant
Ambience Audio Services

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.

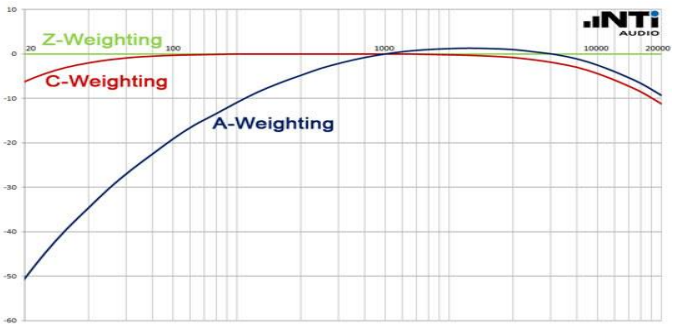
Spectral characteristics: The frequency content of noise.

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.



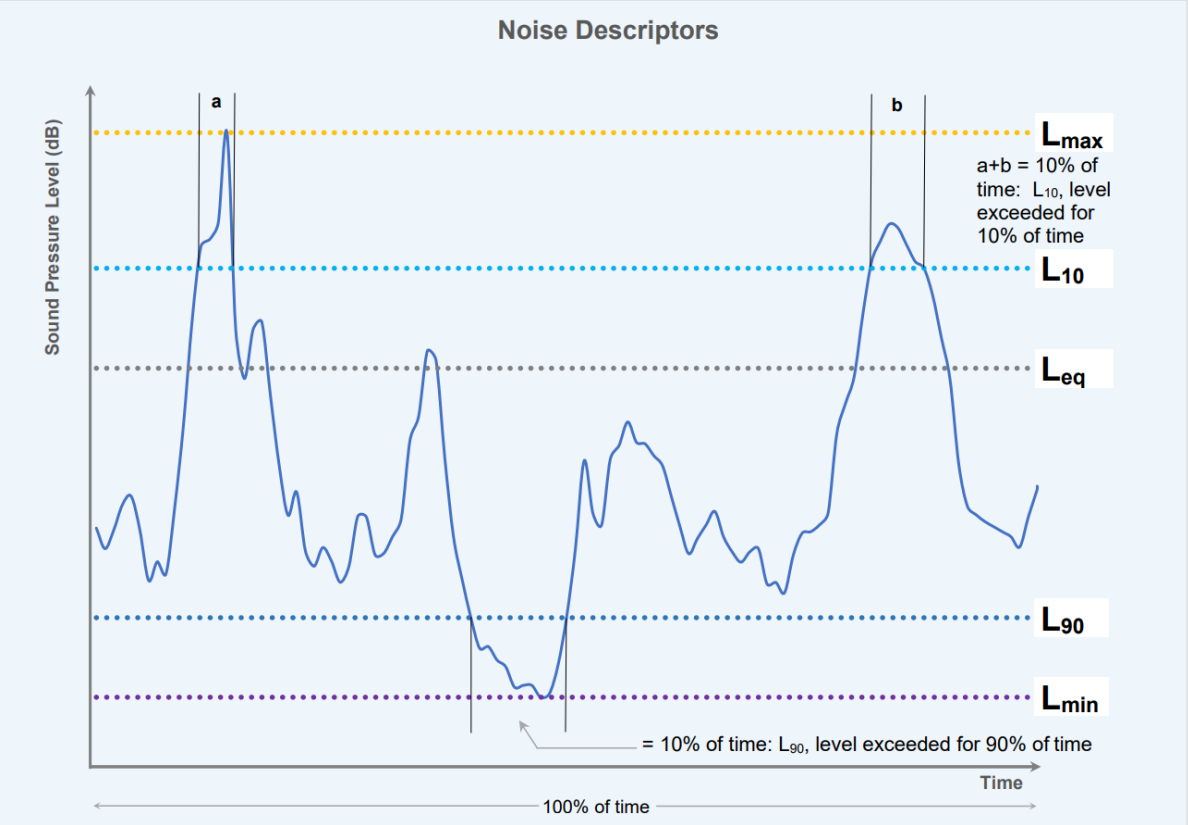
The A-weighting curve is used extensively for general purpose noise measurements but the C-weighting correlates better with the human response to high noise levels.

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:

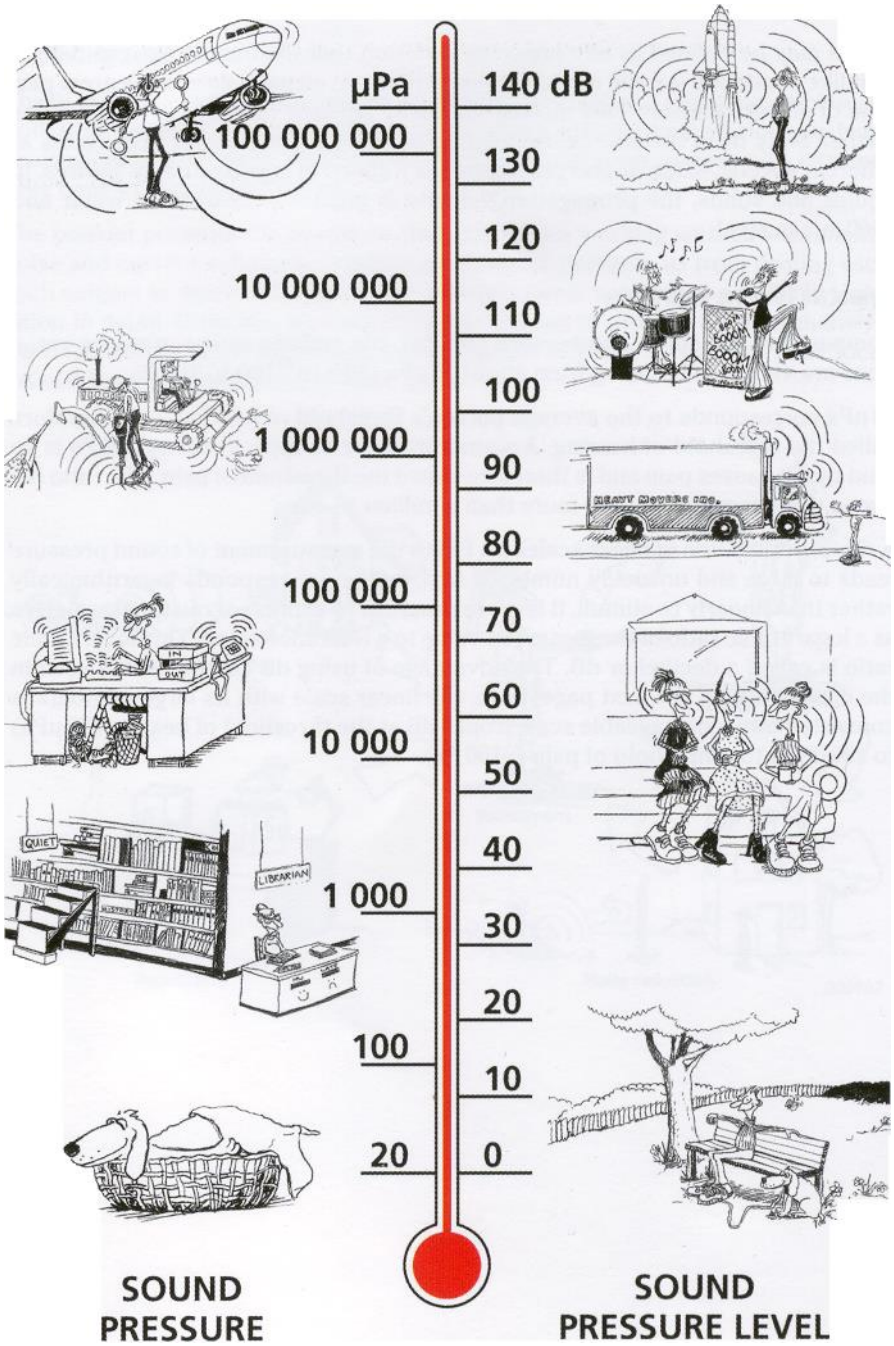
Measuring Sound Brüel and Kjær Sound & Vibration Measurements A/S September 1984

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 7th and 14th June 2023

Image Source – Lismore City Council Online Mapping
Note : Aerial photo not of June 2023 operations

Quarry Pit Floor Operations 14th June 2023

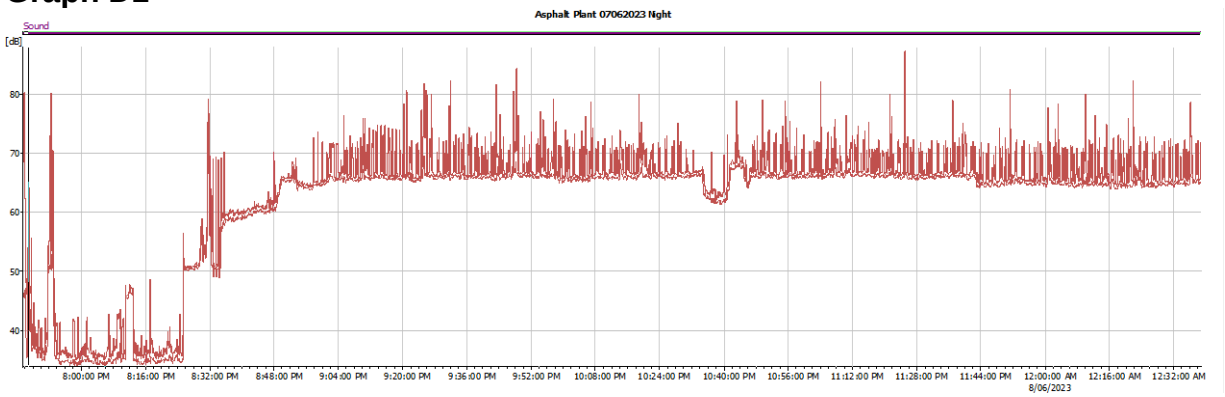
Quarry equipment in use during noise monitoring

1 x Kleeman MC110z jaw crusher
1 x Kleeman MC09S cone crusher
1 X Komatsu WA470 Loader
1 x Cat 329 excavator

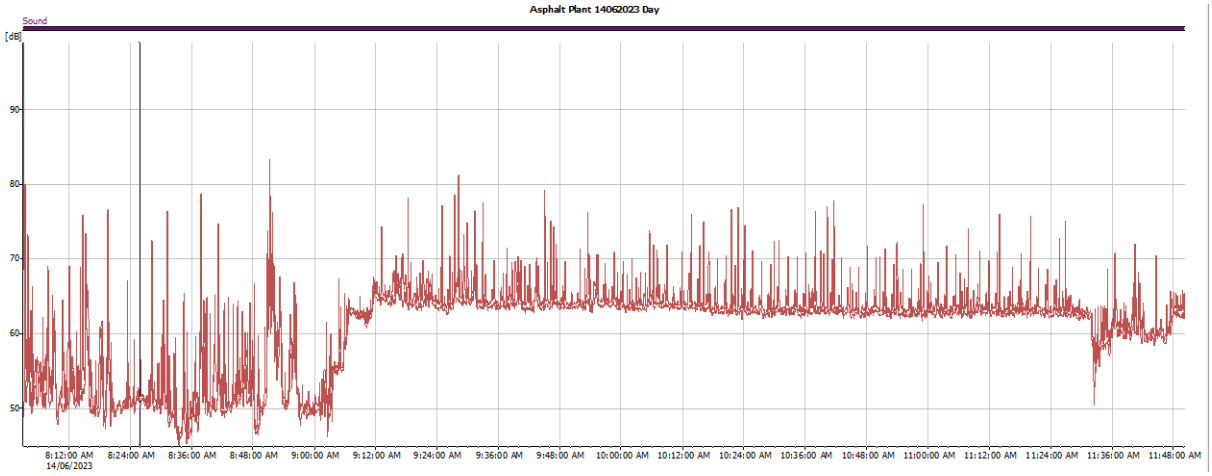
1 x water truck
various haul trucks
various service vehicles

APPENDIX D
L_{AFmax} Logged Noise Level Graphs 7th and 14th June 2023

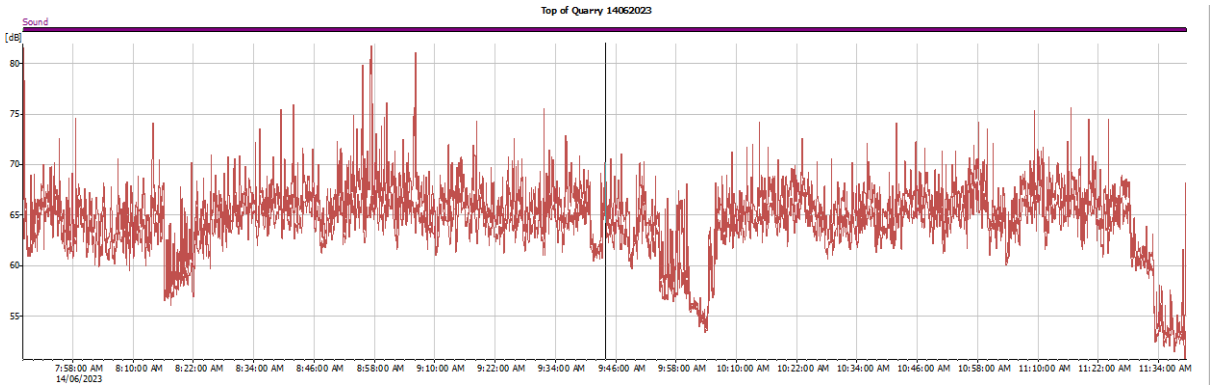
Graph D1



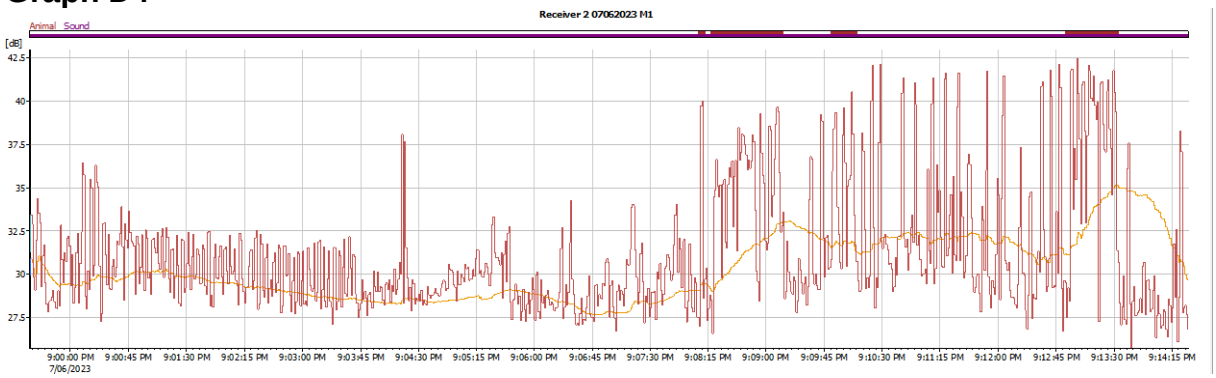
Graph D2



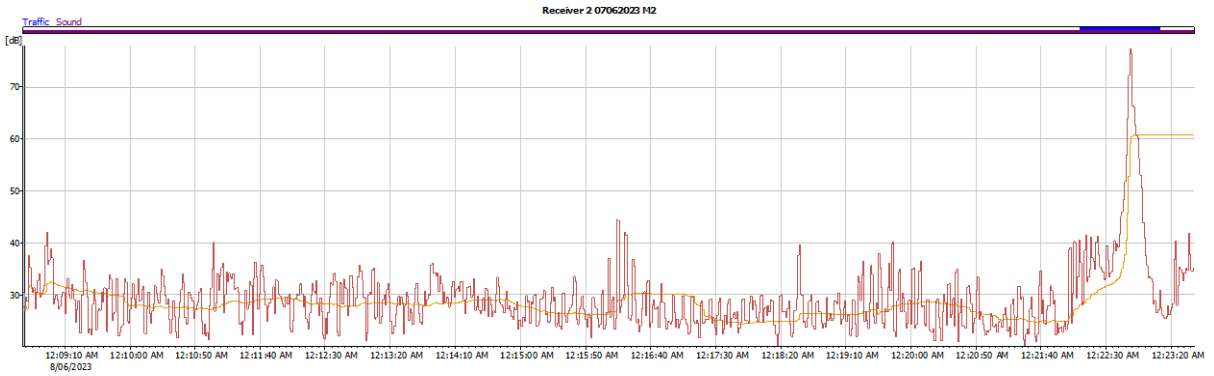
Graph D3



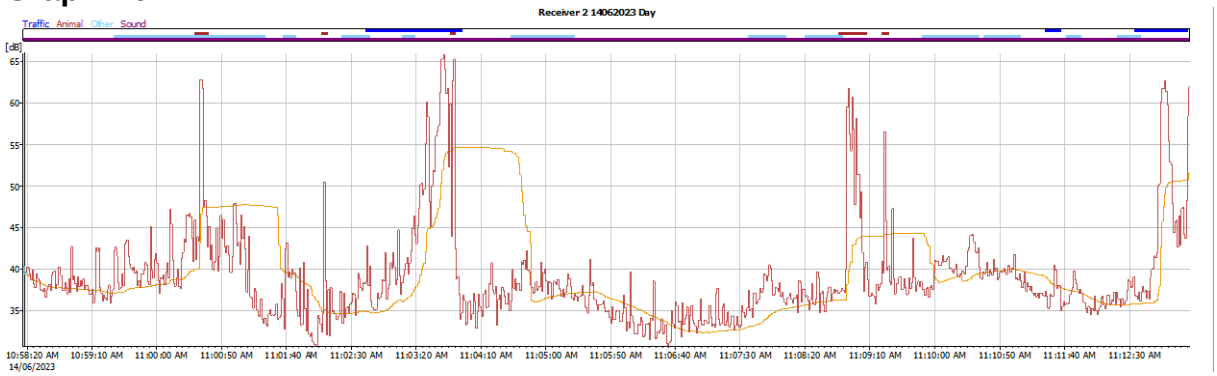
Graph D4



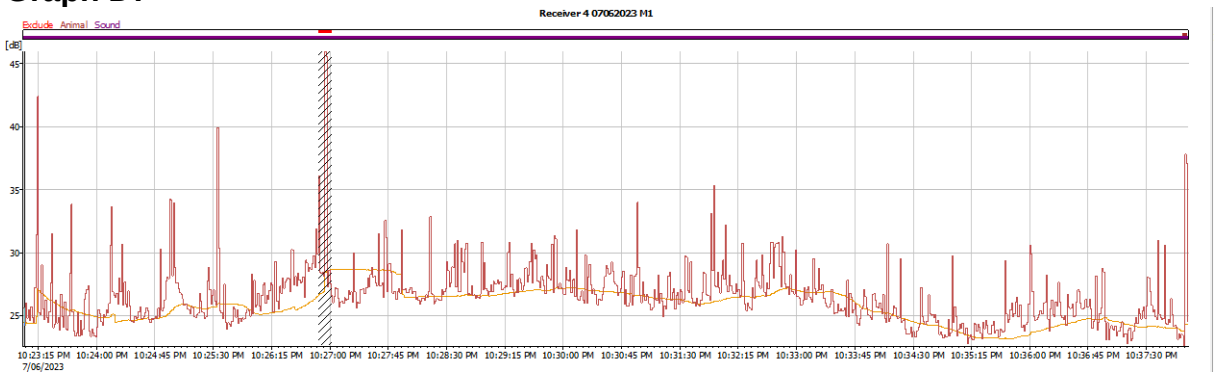
Graph D5



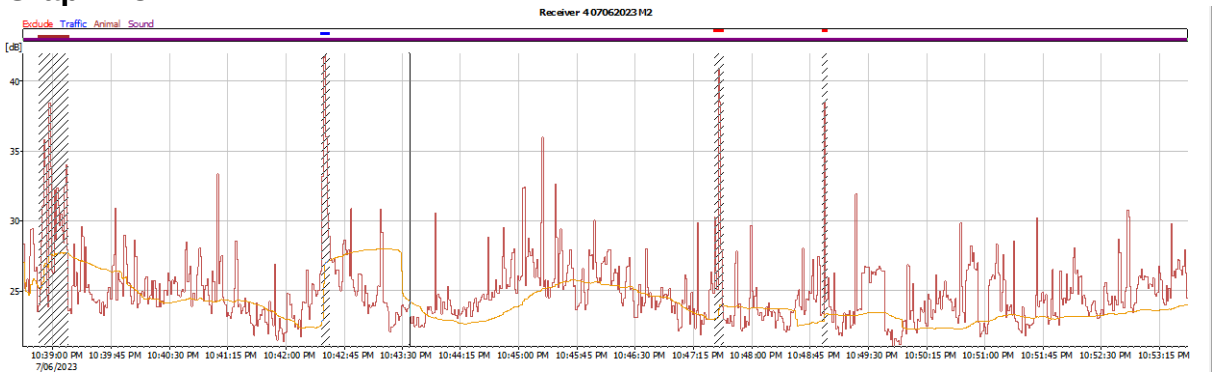
Graph D6



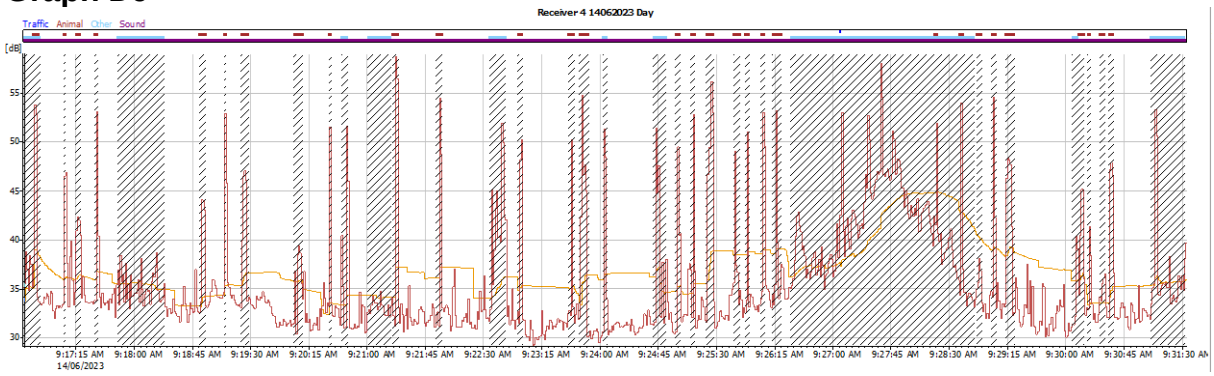
Graph D7



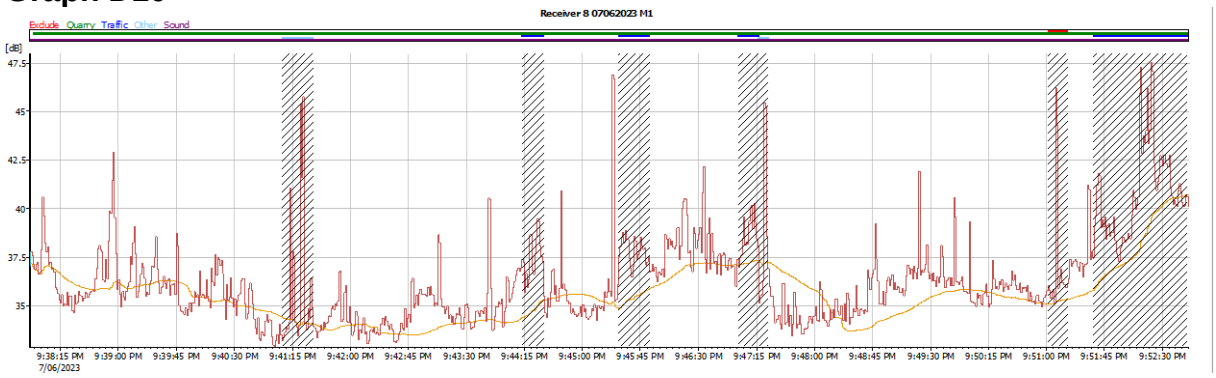
Graph D8



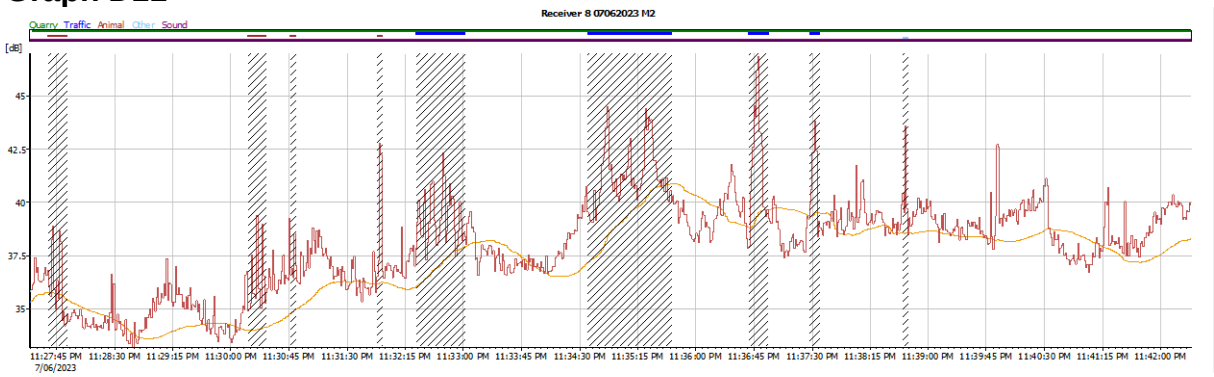
Graph D9



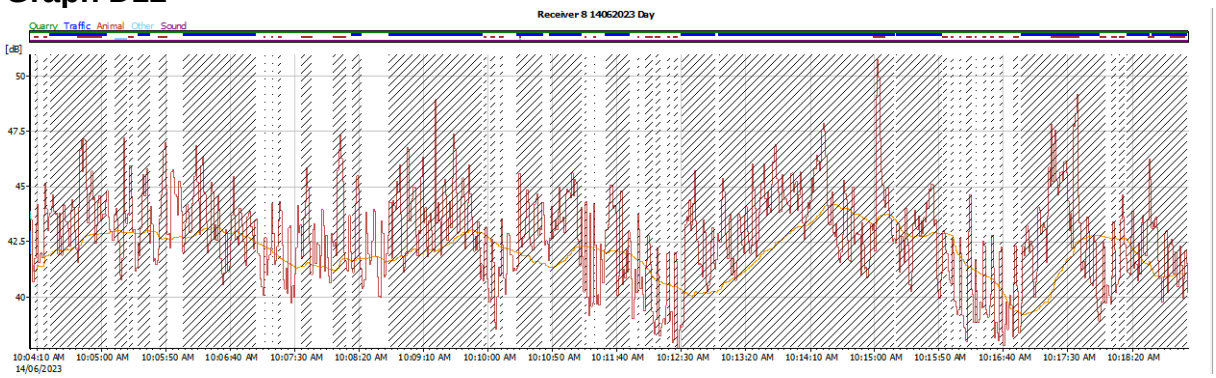
Graph D10



Graph D11



Graph D12


Receiver 8 14062023 Day
Quarry Traffic Animal Other Sound
[dB]
50
47.5
45
42.5
40
10:04:10 AM
14/06/2023
10:05:00 AM
10:05:50 AM
10:06:40 AM
10:07:30 AM
10:08:20 AM
10:09:10 AM
10:10:00 AM
10:10:50 AM
10:11:40 AM
10:12:30 AM
10:13:20 AM
10:14:10 AM
10:15:00 AM
10:15:50 AM
10:16:40 AM
10:17:30 AM
10:18:20 AM

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Results of Noise Monitoring
Winter 2023 Supplementary Assessment

Blakebrook Quarry
550 Nimbin Road
Blakebrook NSW 2480

Prepared for

Ecoteam
13 Ewing Street
Lismore NSW 2480

Document Control				
Rev. No	**Date**	**Prepared By**		**Notes**
Final	24/09/2023	Garry Hall		

Table of Contents

1 INTRODUCTION

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.

Ambience Audio Services were engaged by Ecoteam of Lismore to conduct a noise compliance assessment for Blakebrook Quarry in June 2023 at the three nominated receiver locations. The results indicated noise emissions from operations within the quarry were below the noise limits at two of the three nominated receiver locations as specified in the NBMP and OHWP. The results also indicated exceedances at Receiver 8. It was noted that the exceedances occurred during downwind conditions. It was also noted that the noise levels from the fans vary depending on the temperature and load conditions. The asphalt plant has recently upgraded some of the fans.

Noise compliance monitoring was conducted at all three receiver locations on the evening and night of the 22nd and the morning of the 23rd, of August with the quarry and asphalt plant operating under normal load conditions and suitable weather conditions, to check noise levels after the fans were upgraded.

Quarry operations while noise monitoring was conducted for the day time period included: crushing, screening and stockpiling on the central area 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.

There were truck movements on the internal haul roads, entry/exit haul road and Nimbin Road during the day 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.

Appendix D are the logged noise levels for the asphalt plant, above crushing operations on the quarry floor, and at each receiver location.

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*.

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.

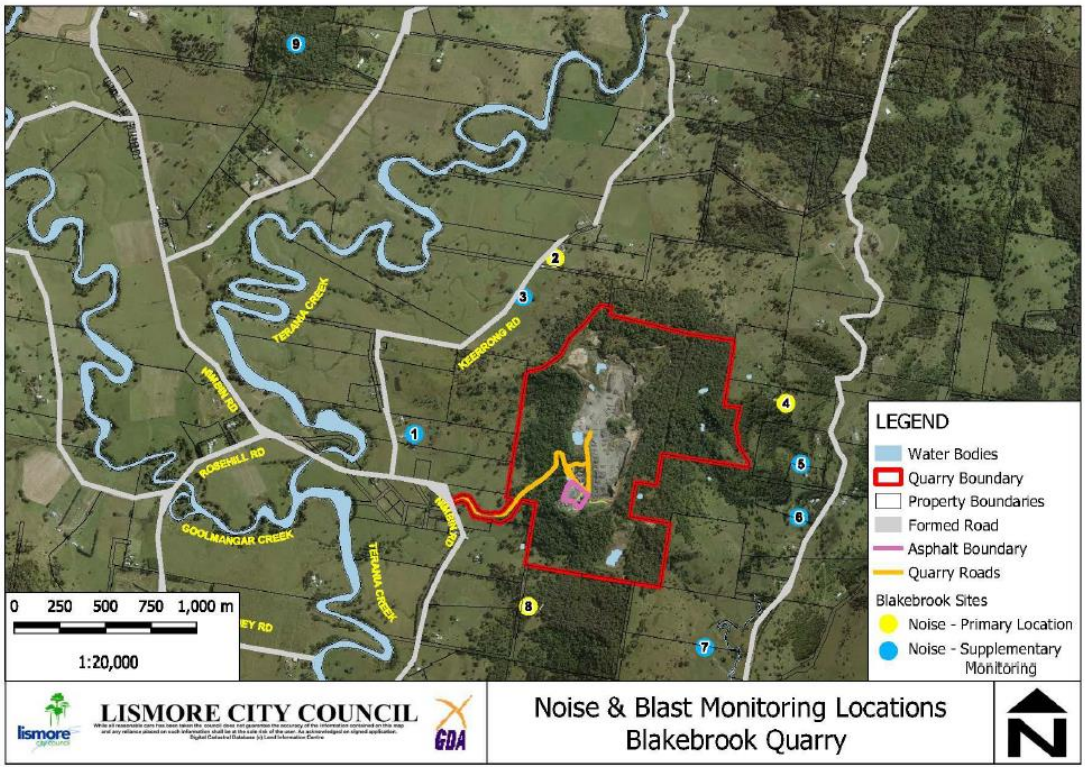
Noise monitoring at the receiver locations were conducted within 30m of the residential dwelling in the direction of the quarry.

Table 2.1 Primary Receiver Locations

Receiver	Street Address
2	190 Keerrong Rd Blakebrook
4	365 Booerie Creek Road Booerie Creek
8	484 Nimbin Rd Blakebrook

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**
Bruel & Kjaer 2250 G4 Sound Level Meter	3031300	Oct 2022
Bruel & Kjaer 2250 G4 Sound Level Meter	3008548	Dec 2021
Bruel & Kjaer 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 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. The sound recording feature was utilised on both SLMs.

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. Markers and sound recording were utilised on the sound level meter for post event analysis of acoustic events during each monitoring period.

A 15 minute period was recorded at each receiver location with A and C weighting, fast response, and 1 second samples. Spectrum data was recorded with a linear (Z) weighting in 1/3 octave bands.

The clocks on the 3 SLMs were synchronised to enable comparison of noise levels at the asphalt plant and top of quarry reference locations with noise levels at the receiver locations.

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 22nd August 2023

Receiver	Time	Temp	Relative Humidity	Wind	Wind Dir	Cloud Cover
		˚C	%	Speed (m/s)		
2	8:30PM	16	75	Calm		0/8
	11:20PM	15	80	Calm		0/8
4	9:44PM	18	73	Calm		0/8
	10:00PM	18	75	Calm		0/8
8	9:05PM	18	78	Calm		0/8
	10:43PM	17	77	Calm		0/8

Table 3.3 Receiver Locations Weather Summary 23rd August 2023

Receiver	Time	Temp	Relative Humidity	Wind	Wind Dir	Cloud Cover
		˚C	%	Speed (m/s)		
2	7:38AM	13	90	0.5 - 1	NW	0/8
4	9:15AM	22	75		Calm	0/8
8	8:18AM	18	70		Calm	0/8

Weather data from the weather station at Blakebrook Quarry is presented in Table 3.4 below.

Table 3.4 Blakebrook Quarry Weather Station Observations August 2023							
Date	**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**	**TOTAL Rain Gauge - mm**
22/08/2023	7:10 PM	20.4	9	2.5	21	26.9	0
	7:20 PM	20.3	7.9	2.2	19.3	21.2	0
	7:30 PM	20.1	8.3	2.3	15.7	20.9	0
	7:40 PM	19.9	7.1	2.0	16.3	25.2	0
	7:50 PM	19.6	8.1	2.3	12.9	20.8	0
	8:00 PM	19.4	7.2	2.0	13.9	19.5	0
	8:10 PM	19.2	6.9	1.9	9.9	22.8	0
	8:20 PM	19	6.3	1.8	5.5	22.3	0
	8:30 PM	18.8	5.3	1.5	8	20.8	0
	8:40 PM	18.7	4.5	1.3	5.9	25	0
	8:50 PM	18.6	4.7	1.3	4.5	23.9	0
	9:00 PM	18.6	4.9	1.4	7.8	19.2	0
	9:10 PM	18.5	4.3	1.2	6.3	22.1	0
	9:20 PM	18.6	4.5	1.3	16.5	19.6	0
	9:30 PM	18.7	4.6	1.3	5.3	26.2	0
	9:40 PM	18.6	4.7	1.3	0.5	23.6	0
	9:50 PM	18.4	4.8	1.3	0.3	22.4	0
	10:00 PM	18.3	3.4	0.9	353.3	26.1	0
	10:10 PM	18.2	4.2	1.2	2.1	24	0
	10:20 PM	18	3	0.8	10.7	25.8	0
	10:30 PM	17.8	2.2	0.6	21.6	33	0
	10:40 PM	17.6	1.4	0.4	355.4	68.4	0
	10:50 PM	17.8	2.4	0.7	3.8	26.5	0
	11:00 PM	17.7	3.5	1.0	11	24.5	0
	11:10 PM	17.5	3.2	0.9	20.6	25.9	0
	11:20 PM	17.6	4.1	1.1	3	27.7	0
	11:30 PM	17.7	4	1.1	357.6	27.9	0
	11:40 PM	17.8	4.7	1.3	353.6	26.5	0
	11:50 PM	17.8	5	1.4	354.8	25.4	0
23/08/2023	7:10 AM	14.6	3.4	0.9	24.1	18.1	0
	7:20 AM	15.1	3.5	1.0	10.3	28.4	0
	7:30 AM	15.6	1.4	0.4	274.3	78.4	0
	7:40 AM	15.8	3.3	0.9	349.1	37.5	0
	7:50 AM	16.3	2.5	0.7	354.1	59.9	0
	8:00 AM	17	1.6	0.4	202.9	87.9	0
	8:10 AM	17.5	2.2	0.6	306.8	56.5	0
	8:20 AM	18.3	3.3	0.9	304.5	38.3	0
	8:30 AM	18.7	3.3	0.9	305.7	25.7	0
	8:40 AM	18.9	2.8	0.8	310.2	36.8	0
	8:50 AM	19.2	3	0.8	317.9	32.3	0
	9:00 AM	19.6	2.6	0.7	325.9	34.3	0
	9:10 AM	20	3.7	1.0	329.5	30.2	0
	9:20 AM	20.3	3.3	0.9	317.3	33.9	0
	9:30 AM	21	3.3	0.9	311.8	36.9	0
	9:40 AM	21.5	4.5	1.3	314.5	29.5	0
	9:50 AM	22	5.1	1.4	295	28.8	0
	10:00 AM	22.7	4.5	1.3	274.6	44.6	0

Wind Direction O and 360 degrees – North, 90 degrees – East,

180 degrees South, 270 degrees - West

3.4 Measurement Results

Table 3.5 Blakebrook Quarry Receiver Locations Measurement Summary - 22nd August 2023								
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]
2	8:59 PM	0:15:00	49.6	28.4	32.6	4.2	29.1	27.2
	12:08 AM	0:15:00	49.0	26.1	33.9	7.9	29.1	20.4
4	10:23 PM	0:15:00	44.4	33.4	36.8	3.4	35.5	29.9
	10:38 PM	0:15:00	44.8	32.9	37.3	4.4	35.1	28.6
8	9:37 PM	0:15:00	53.7	35.6	48.2	12.6	38.4	31.6
	11:27 PM	0:15:00	44.2	31.8	45.8	14.0	33.0	30.0

Table 3.6 Blakebrook Quarry Receiver Locations Measurement Summary - 23rd August 2023								
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]
2	10:58 AM	0:15:00	65.2	46.5	56.2	9.7	50.5	37.6
4	9:16 AM	0:15:00	64.8	53.3	52.6	-0.8	56.3	47.0
8	10:04 AM	0:15:00	63.2	48.0	55.4	7.4	51.8	40.0

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

Post processing was conducted in Bruel & Kjaer BZ 5505 environmental noise analysis software to exclude other noise sources for the receiver location measurements. The exclude function was enabled for the traffic, animal and other markers. The total minus exclude data enables a more accurate assessment of the noise source under investigation, by eliminating data during the periods that other random noise sources occur during monitoring. The results are presented below.

Table 3.7 Receiver 2 Measurement Summary Total - Exclude August 22nd/23rd 2023							
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]
8:30PM	0:14:50	37.5	28.2	32.4	4.2	29.1	27.2
11:20PM	0:12:25	49.0	24.3	30.5	6.2	24.5	20.3
7:38AM	0:10:20	58.5	42.0	53.4	11.3	43.7	37.2

Table 3.8 Receiver 4 Measurement Summary Total - Exclude August 22nd/23rd 2023							
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]
9:44PM	0:13:50	43.2	33.3	36.6	3.3	35.4	29.8
10:00PM	0:13:58	44.8	32.9	37.2	4.3	35.1	28.8
9:15AM	0:12:58	64.8	53.3	52.2	-1.1	56.3	47.0

Table 3.9 Receiver 8 Measurement Summary Total - Exclude August 22nd/23rd 2023							
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]**
9:05PM	0:12:35	42.4	35.1	48.1	13.0	38.1	31.5
10:43PM	0:15:00	44.2	31.8	45.8	14.0	33.0	30.0
8:18AM	0:01:10	51.5	41.4	51.2	9.8	42.9	39.1

Table 3.10 Noise Observations at Receiver Locations 22nd August 2023 (All measurements 15 mins)			
Receiver	**Start Time**	**Observed Noise Sources**	**Quarry Noise**
2	8:30PM	Distant traffic Nimbin Road, insects, distant dogs barking, frogs, distant water fowl	Asphalt plant not audible
	11:20PM	Distant traffic Nimbin Road, distant cattle, insects, distant dogs barking, windmill, cattle nearby	Asphalt plant not audible
4	9:44PM	Very distant occasional traffic, distant aircraft, insects consistent (4kHz, 5kHz)	Asphalt plant not audible
	10:00PM	Very distant occasional traffic, distant traffic, distant aircraft, insects consistent (4kHz, 5kHz),	Asphalt plant not audible
8	9:05PM	Distant traffic Nimbin Road, distant aircraft	Asphalt plant audible
	10:43PM	Distant traffic Nimbin Road	Asphalt plant audible, loader audible at times

Table 3.11 Noise Observations at Receiver Locations 23rd August 2023 (All measurements 15 mins)			
Receiver	**Start Time**	**Observed Noise Sources**	**Quarry Noise**
2	7:38AM	Occasional traffic on Keerrong Road, birds, distant traffic Nimbin Road, distant aircraft,	Quarry not audible
4	9:15AM	Bird noise very dominant, light aircraft	Occasional low frequency from quarry
8	8:18AM	Consistent road traffic noise from Nimbin Road, consistent birds, nearby light aircraft	Quarry just audible when no traffic or birds, occasional loud bangs,

3.5 Low Frequency Analysis

The difference between the A and C L_{eq} levels at all three receiver was less than 15 decibels, so no low frequency analysis is required.

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 (graphs D1, D2, D3).

Receiver 2

Quarry noise was not audible for any monitoring period. The background noise level (20.3 dB $L_{A90,15min}$) during the late night was very low.

There was consistent bird noise, which contributed to the higher L_{Aeq} noise levels during the day, when compared to previous noise surveys.

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

Receiver 4

The asphalt plant was not audible during the evening and night time monitoring periods. Occasional low frequency from quarry operations were audible during the day period.

There was consistent bird noise during the day time monitoring period, which elevated overall L_{Aeq}, L_{A10} and L_{A90} noise levels compared to previous noise surveys.

Based on the measured data and analysis, it is estimated quarry operations at Receiver 4 are below 30 dB(A) $L_{eq,15min}$ for calm meteorological conditions.

Receiver 8

Quarry noise was audible at Receiver 8 for the day, evening and night time periods. The crushing operations only occur during the day and were operating at the central area of the quarry. The asphalt plant was operating during all measurement periods and has been identified as the contributing factor to the audible quarry noise at Receiver 8.

It was noted that there were down wind conditions during measurements at Receiver 8 and presents a worst-case scenario.

Table 3.9 indicates the total noise level, less the other identified noises. The L_{Aeq} was 31.8 for the night time, 35.1 for the evening and 41.4 for the day time. For the day time period, there was only 70 seconds of time where there were no other noise sources, other than the road traffic noise on Nimbin Road, which contributed to the higher L_{Aeq}, L_{A10} and L_{A90} noise levels compared to the evening and night time.

The asphalt plant noise levels were consistent during the evening and night time monitoring periods. There was a four minute period at the beginning of the day time monitoring period where the quarry equipment was not operating due to a breakdown. This was only notified after all the monitoring equipment had been packed up. The day time noise level at the reference monitoring location approximately 45m from the plant, indicated day time noise levels was approximately 3 decibels higher during the day time period compared to the night time period.

Based on the background noise levels of 31.5 for the evening and 30.0 for the night and an increase of 3 decibels for the day time, it is estimated the day time noise levels at Receiver 8 are approximately 35 dB(A) $L_{eq,15min}$, under down wind conditions.

Receiver 8 complies with the Noise and Blast Management Plan for Blakebrook Quarry (Lismore City Council Oct 2022).

The resident at Receiver 8 noted that they do hear the quarry, but generally does not bother them. The resident noted that occasionally reversing beepers were audible.

It is recommended that all operations are designed so that external vehicles operating near the asphalt plant and weighbridge areas are required to only travel in the forward direction.

5 SUMMARY AND CONCLUSION

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 for Blakebrook Quarry (Lismore City Council Oct 2022), and includes an Out of Hours Work Protocol for the asphalt plant.

A supplementary noise monitoring survey was conducted to assess the noise levels of quarry and asphalt plant operations at Blakebrook Quarry due to exceedances at a receiver location from a previous noise survey in June 2023.

It was noted that the exceedances occurred during downwind conditions with the asphalt plant operating. The operators of the asphalt plant have replaced some of the fan units.

Noise compliance monitoring was conducted at all three receiver locations on the evening and night of the 22nd and the morning of the 23rd of August with the quarry and asphalt plant operating under normal load conditions and suitable weather conditions, to check noise levels after the fans were upgraded.

The quarry operations were not audible at Receiver 2 during the day, evening and night time periods. It is estimated quarry operations are below 30 dB(A) $L_{Aeq,15min,}$ which is below the day, evening and night time noise limits.

At Receiver 4, the asphalt plant was not audible during the evening and night time monitoring periods. Occasional low frequency from quarry operations were audible during the day period. Based on the measured data and analysis, it is estimated quarry operations at Receiver 4 are below 30 dB(A) $L_{eq,15min}$ for calm meteorological conditions and complies with the day, evening and night time noise limits.

Quarry noise was audible at Receiver 8 for the day, evening and night time periods and mainly contributed to the asphalt plant. It is estimated the noise levels are approximately 30 – 32 dB(A) $L_{eq,15min}$ for the evening and night time periods and 35 dB(A) $L_{eq,15min}$ for the day time period at Receiver 8. The noise levels at Receiver 8 complies with the noise limits in the Noise and Blast Management Plan for Blakebrook Quarry.

The asphalt plant was consistent during all monitoring periods. The day time noise level at the reference monitoring location approximately 45m from the plant, indicated day time noise levels was approximately 3 decibels higher during the day time period compared to the night time period.

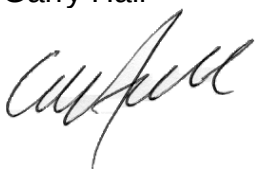
Based on the background noise levels of 31.5 for the evening and 30.0 for the night and an increase of 3 decibels for the day time, it is estimated the day time noise levels at Receiver 8 are approximately 35 dB(A) $L_{eq,15min}$, under down wind conditions for the day time.

The resident at Receiver 8 noted that they do hear the quarry, but generally does not bother them. The resident noted that occasionally reversing beepers were audible.

It is recommended that all operations are designed so that external vehicles operating near the asphalt plant and weighbridge areas are required to only travel in the forward direction.

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.

Garry Hall



Acoustic Consultant
Ambience Audio Services

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.

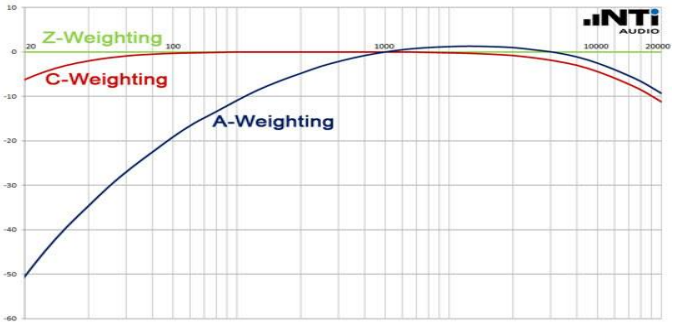
Spectral characteristics: The frequency content of noise.

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.



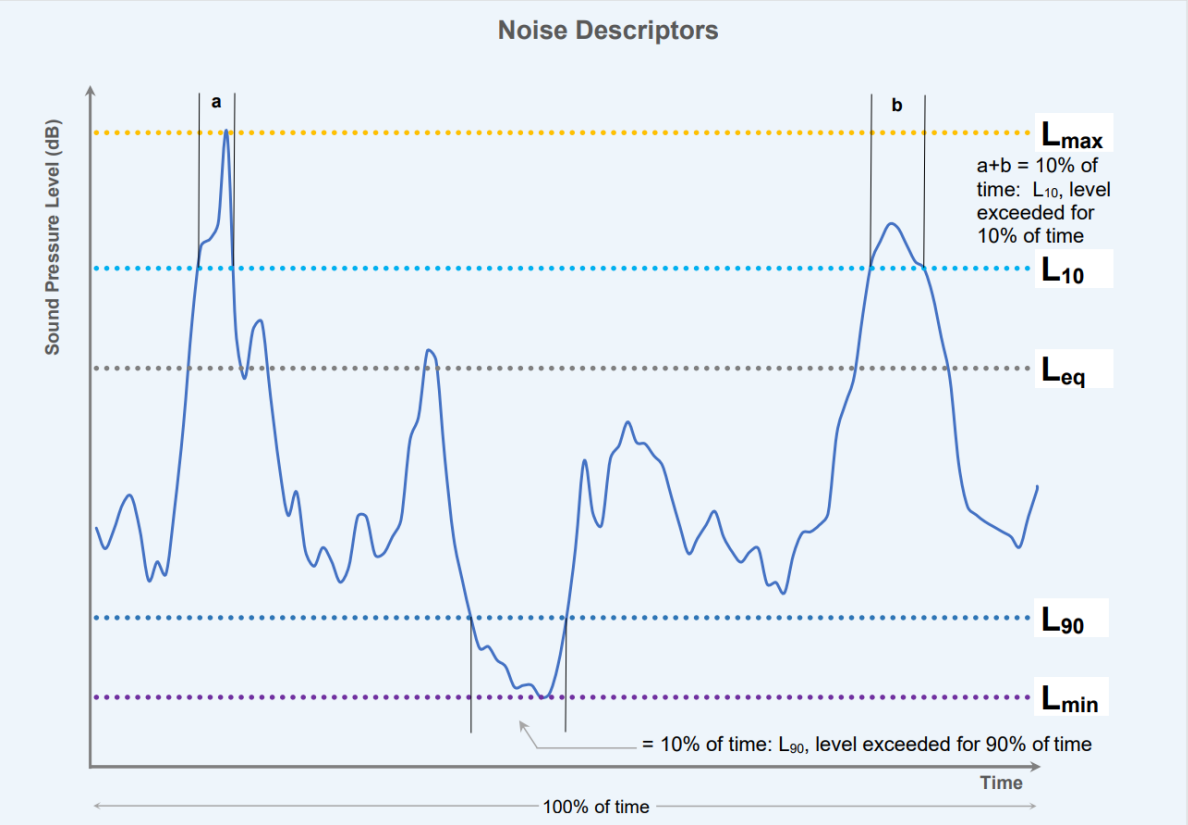
The A-weighting curve is used extensively for general purpose noise measurements but the C-weighting correlates better with the human response to high noise levels.

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:

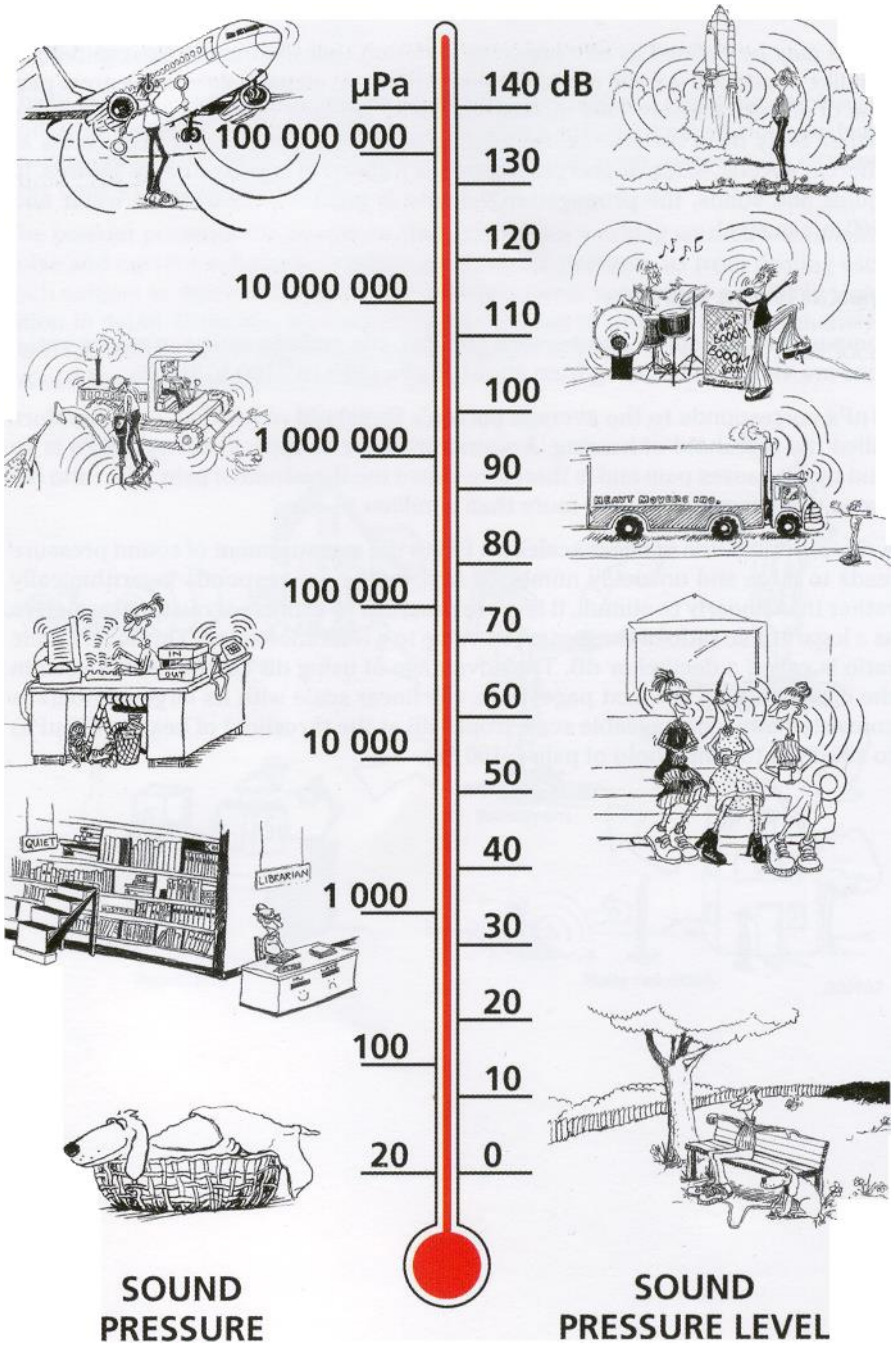
Measuring Sound Brüel and Kjær Sound & Vibration Measurements A/S September 1984

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 23rd August 2023

Image Source – Lismore City Council Online Mapping
Note : Aerial photo not of June 2023 operations

Quarry Pit Floor Operations 23rd August 2023

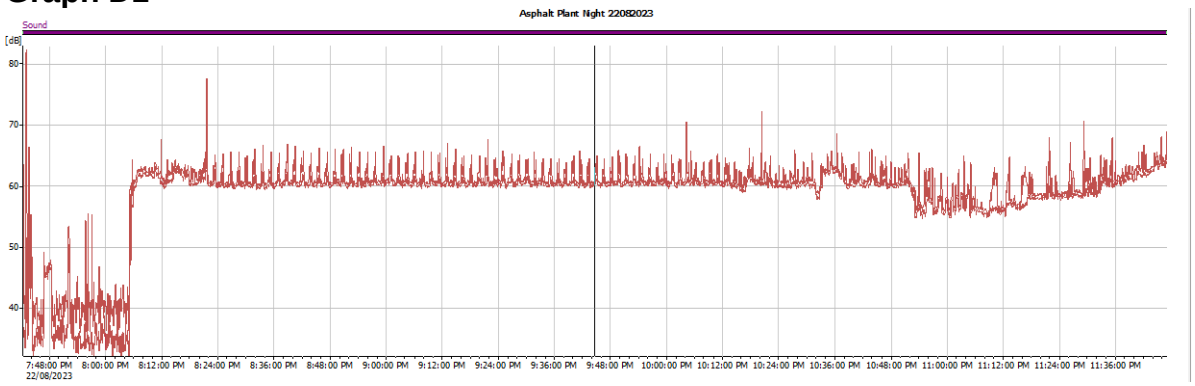
Quarry equipment in use during noise monitoring

1 x Kleeman MC110z jaw crusher
1 x Mcloskey R155 reclaimer
1 X Komatsu WA500 loader
1 x Cat 329 excavator

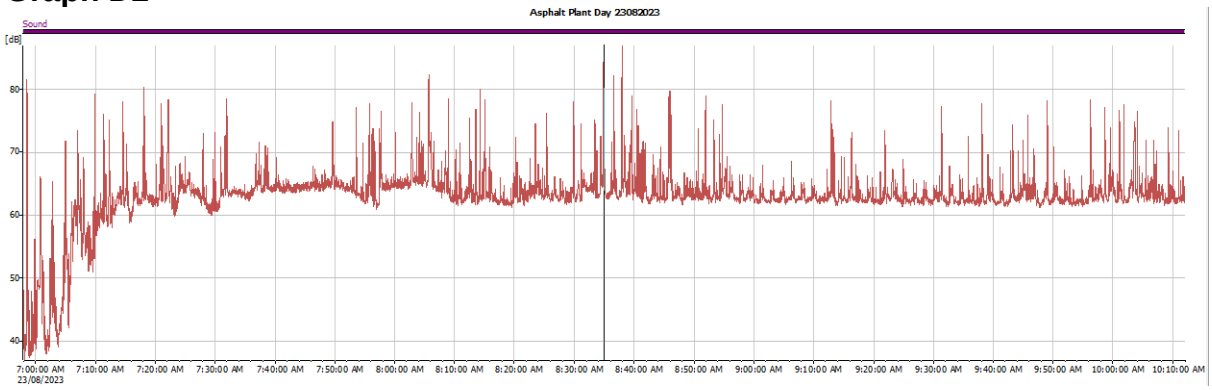
1 x water truck
various haul trucks
various service vehicles

APPENDIX D
L_{AFmax} Logged Noise Level Graphs 22nd & 23rd August 2023

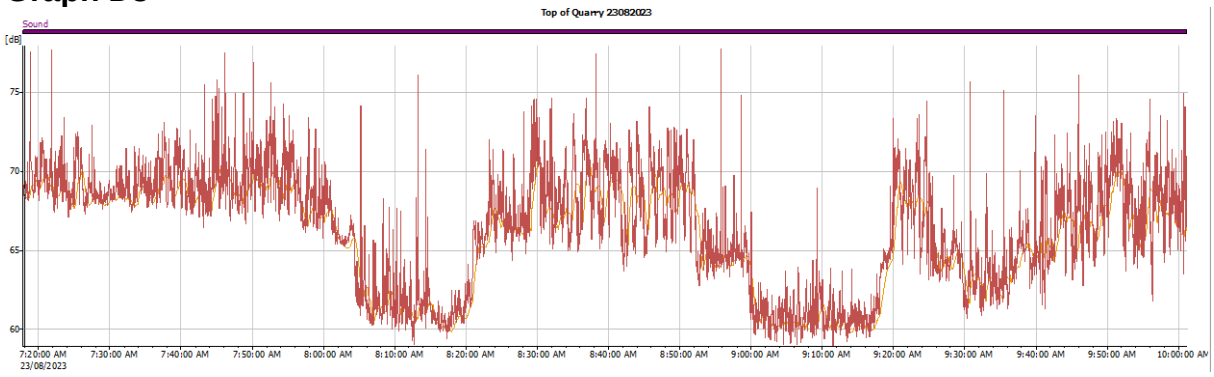
Graph D1



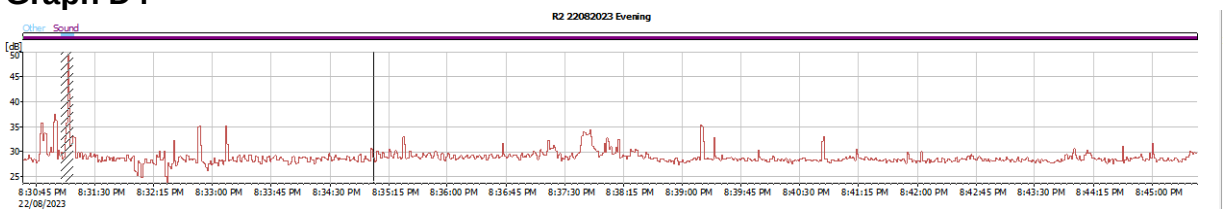
Graph D2



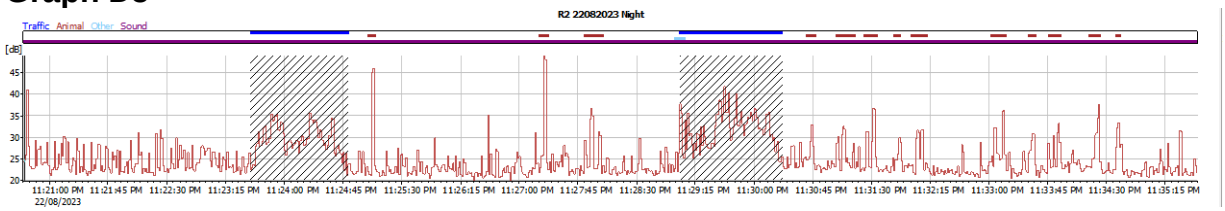
Graph D3



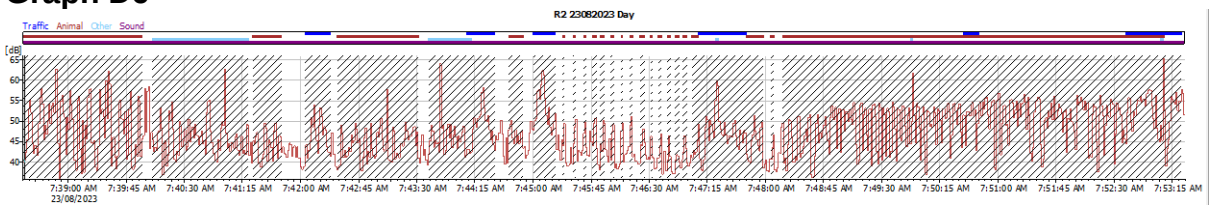
Graph D4



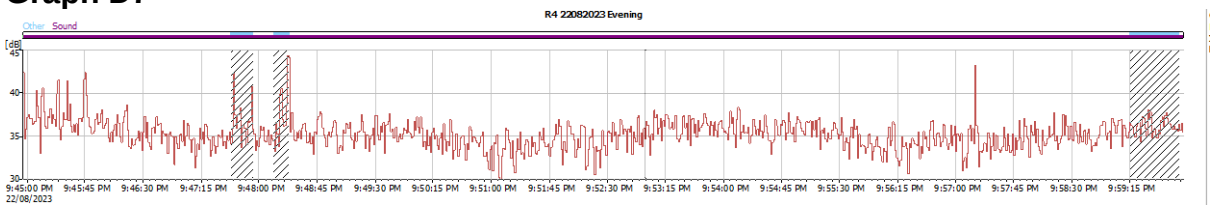
Graph D5



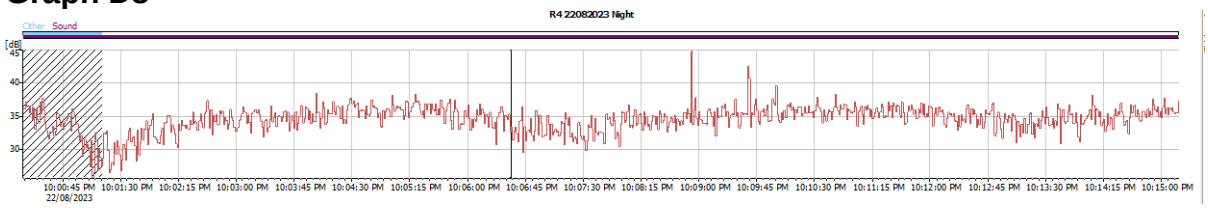
Graph D6



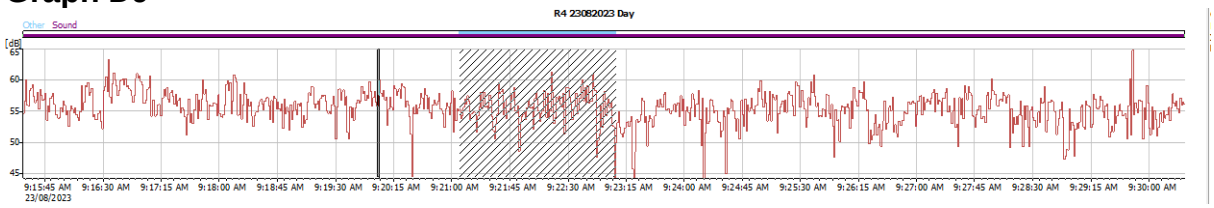
Graph D7



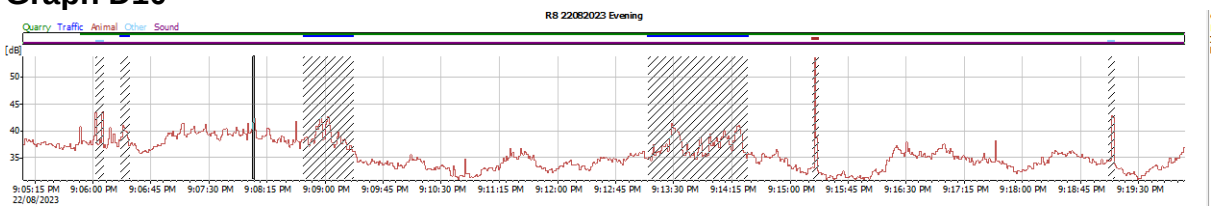
Graph D8



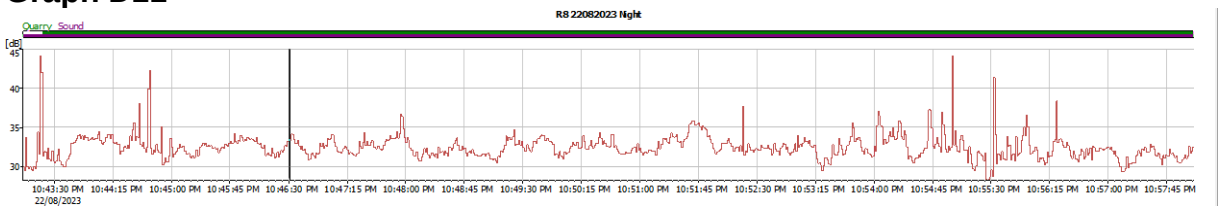
Graph D9



Graph D10



Graph D11



Graph D12