QUARRY OPERATION NOISE MONITORING

Albion Park Quarry Extension - Stages 5 & 6
August 2023

Prepared for:

Cleary Bros (Bombo) Pty Ltd
39 Five Islands Road
PORT KEMBLA NSW 2505

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Cleary Bros (Bombo) Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.04156.01100-R01-v1.1	6 October 2023	Jason Rasquinha	Aaron McKenzie	Aaron McKenzie
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CONTENTS

1 INTRODUCTION 4
2 SITE DESCRIPTION 4
3 QUARRY ENVIRONMENTAL MANAGEMENT PLAN 6
4 OPERATING HOURS 8
5 SITE EQUIPMENT 8
6 INSTRUMENTATION AND MEASUREMENT PARAMETERS 9
6.1 Noise Monitoring Equipment 9
6.2 Meteorological Station and Conditions during Noise Survey 10
7 NOISE MONITORING 10
7.1 Unattended Noise Monitoring 10
7.2 Attended Monitoring 11
8 NOISE IMPACT ASSESSMENT 13
9 CONCLUSION 14

DOCUMENT REFERENCES

TABLES

Table 1 Quarry Extension and Processing Plant Area (Stages 5 & 6 Extraction Area Operations) Equipment Fleet – July/August 2023 8
Table 2 Acoustic Instrumentation 9
Table 3 Unattended Statistical Ambient Noise Level Summary (July/August 2023) 10
Table 4 Operator Attended Noise Survey Results 11
Table 5 Calculated Daytime Noise Contribution of the Albion Park Quarry 13

APPENDICES

Appendix A: Acoustic Terminology
Appendix B: Noise Monitoring Graphs
Appendix C: Site Contributions at Receivers

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Cleary Bros (Bombo) Pty Ltd to conduct the 2023 annual noise compliance monitoring of its Albion Park Quarry Operations, Albion Park Rail, NSW.

Noise monitoring was undertaken during Winter 2023 including attended noise measurements and noise logging on the site and at the nearest receivers to assist in quantifying quarry noise levels. A noise model of the site was also utilised to assist in determining site contribution where the site was inaudible during noise monitoring. This report details the findings of the noise compliance assessment.

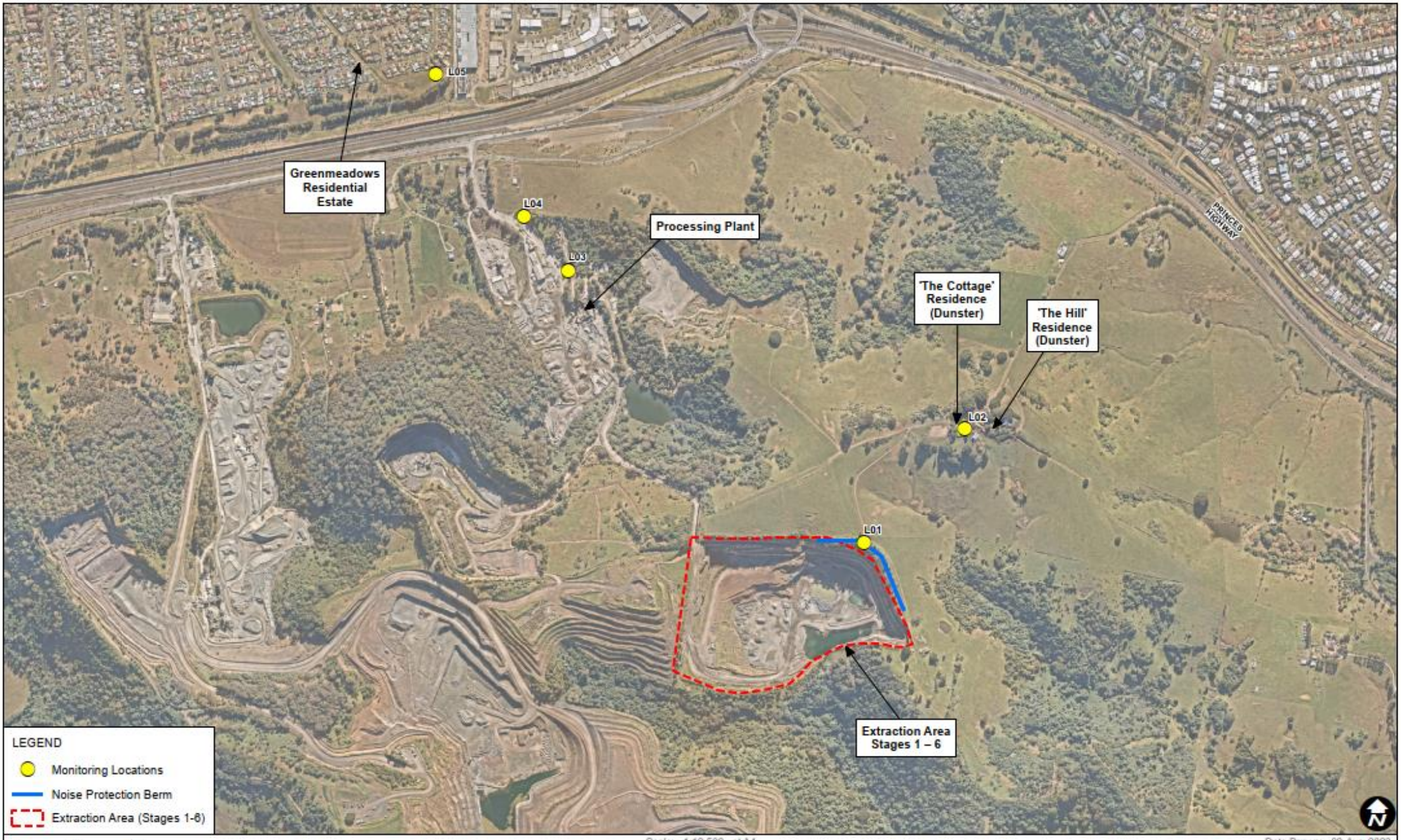
The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

2 Site Description

Albion Park Quarry is located at Albion Park around 1.2 km to the south of Princes Highway. A site map showing the location of the Albion Park Quarry Processing Plant and Quarry Extension Area (currently operating in the Stages 5/6 Extraction Area) and the nearest noise-sensitive receivers, is presented in **Figure 1**.

The Cottage residence is the nearest privately owned residence to the Quarry Extension Area and that the Greenmeadows Residential Estate is the nearest noise sensitive residential area affected by noise from the Processing Plant.

The 5 m high noise protection berm required under the original Development Consent to attenuate noise transmission from the Quarry Extension Area activities is shown in **Figure 1**.



Scale: 1:12,500 at A4
Coordinate System: GDA2020 MGA Zone 56

Date Drawn: 08-Aug-2023
Project Number: 610.04156

SLR

Data Source:
Nearmap Imagery June 2023

SITE LAYOUT

FIGURE 1

H:\Projects-SLR\610-SrvSYD\610-SYD\610.04156.11000 - Quarry Operation Noise Monitoring July 2022\04 GIS\SLR610041S6_Site_Layout_03.mxd

3 Quarry Environmental Management Plan

The criteria and procedures in the Quarry Environmental Management Plan (QEMP) for the Albion Park Quarry which relate to noise are as follows:

"4.5 NOISE LIMITS

4.5.1 Performance Objective

Source - Quarry development consent: schedule 4, conditions 4, 7 and 8; Access road consent: conditions 16, 17 and 18 (identical).

Requirement - Operational noise generated by the development must not exceed criteria specified in the Table below under conditions of wind speeds (10 metres above ground) of up to 0.5 metres per second and under temperature gradients of up to 0°C per 100 metres (Condition 4).

Receiver Locations	**Noise Limits $L_{Aeq15min}$**		
	Stages 1-2	**Stages 3-4**	**Stages 5-6**
"The Hill" residence (Dunster premises)	35	38	35
"The Cottage" residence (Dunster premises)	35	38	35
Approved rural worker's dwelling (Dunster premises)	35	38	35
Greenmeadows residential estate	41	41	41

Verification - Noise measurement to be undertaken at the most affected point on the receptor boundary or within 30 metres of the dwelling where the dwelling is more than 30 metres from the boundary. Measurements to be undertaken by a qualified person on an annual basis during the Winter months. Results are to be included in the Annual Review. Noise monitoring procedures are included in the Noise and Blast Management Plan and summarised in section 6.2 of this QEMP.

Notification - Within seven days of detecting an exceedance of a noise limit in the table above, the exceedance is to be reported to the EPA, the Secretary and the owner of the property."

"6.2 NOISE MONITORING

Source - Noise monitoring requirements are detailed in the Noise and Blast Management Plan and summarised below.

Location - Noise monitoring locations are as follows:

Location Type	**Monitoring**
Unattended monitor	Quarry Extension Area
Unattended monitor	Processing Plant
Residential Assessment Location (attended)	"The Cottage" (Fig Tree Hill Residence)
Residential Assessment Location (attended)	Greenmeadows Residential Estate

		Operator attended monitoring and unattended noise logging shall be carried at all of the above locations, except as detailed under "Frequency".
Frequency	-	*Unattended noise logging is to be carried out for a minimum period of seven days on an annual basis during the Winter months, and is to be accompanied by operator attended monitoring.*
Method	-	*Operator attended monitoring shall quantify and characterise the maximum (L_{Amax}) and the average ($L_{Aeq(15minute)}$) intrusive noise from quarrying over a 15 minute measuring period.* *Unattended continuous noise logging shall be conducted to quantify overall ambient noise amenity levels resulting from quarrying and processing emissions and other environmental noise sources.* *Measurements will be taken with acoustic instrumentation carrying current NATA or manufacturer calibration certificates. Instrument calibration will be checked before and after each measurement survey.* *All noise measurements will be accompanied by qualitative and quantitative measurements of prevailing local weather conditions. The operator shall record any significant quarry generated noise sources and obtain the operating logs for quarry plant and equipment during the measurement period.*
Performance Targets		*Performance targets are summarised in Section 4.5 of this QEMP.*
Assessment	-	*Operator attended residential measurements are designed to confirm that noise generated by the development does not exceed the noise limits specified in the development consent (see Section 4.5 of this QEMP).* *Unattended noise logger data shall be correlated with weather data and quarry operating conditions, with data from periods of unstable weather deleted. The results shall be presented graphically.*
Review and reporting		*The results of noise monitoring are to be included in the Annual Review.* *In the event of any exceedance of relevant criteria, the matter will immediately be brought to the attention of the Quarry Production Manager, who will report the exceedance as required in Section 6.7 of this QEMP."*

4 Operating Hours

Conditions 5 and 6, Schedule 4 of the 2017 Modified Quarry Extension DA Consent states that:

5. *"The Applicant must comply with the operating hours in Table 2.*

Activity	***Days of the Week***	***Time***
Drilling, rock breaking, loading and haulage of materials from quarry to processing plant, processing and stockpiling, overburden stripping and other stage preparatory works, all site construction activities, rehabilitation works, general plant and maintenance. Processing, crushing and screening and product transfer to stockpiles	*Monday - Friday* *Saturday*	*7.00 am - 5.30 pm* *7.00 am - 1.00 pm*

Table 2: Operating Hours of the Development

6. *The following activities may be carried out at the premises outside the hours specified in Table 2:*
   a) the delivery of materials as requested by police or other authorities for safety reasons;
   b) emergency work to avoid the loss of lives, property and/or to prevent environmental harm;
   c) workshop activities and other maintenance work inaudible at the nearest affected receiver."

5 Site Equipment

In order to assist in assessing the noise emissions from the Quarry Extension and Processing Plant Area activities, the equipment operating during the 2023 noise survey was recorded and is presented in **Table 1**. Not all equipment was operating on all days of the noise survey.

Table 1 Quarry Extension and Processing Plant Area (Stages 5 & 6 Extraction Area Operations) Equipment Fleet – July/August 2023

Equipment Type	Fleet
Excavator - CAT 345	1
Excavator – Komatsu PC800	1
Excavator – Hitachi 1200	1
Excavator (26t)	1
Dump trucks – CAT 773 (50t)	1
Dump trucks – CAT 777 (100t)	3
Water truck	1
Loader – CAT 980	4
Loader - CAT 992	1
Blasthole Drill Rig	1

Equipment Type	Fleet
Grader	1
Dewatering Pump	1
Primary Crusher	1
Secondary Crusher	1
Level 1 Crusher	1
Quarry Pit Mobile Crusher & Screen	1
Jaw and Bone Crusher & Screen	1
Pugmill	1
Dozer – CAT D10	1

6 Instrumentation And Measurement Parameters

6.1 Noise Monitoring Equipment

All acoustic instrumentation employed throughout the monitoring programme was designed to comply with the requirements of AS IEC 61672.1-2004 "*Electroacoustics - Sound Level Meters*" and carried current NATA or manufacturer calibration certificates.

All instrumentation was programmed to continuously record statistical noise level indices in 15-minute intervals, which included the L_{A1}, L_{A10}, L_{A90} and the L_{Aeq}.

Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding the acceptable variation of ±0.5 dBA (in accordance with AS 1055).

Table 2 Acoustic Instrumentation

Location	Description	Type or Class	Serial Number
L01 – Near Extraction Area	Svan 977 Noise Logger	Type 1	99025
L02 – The Cottage Residence	Svan 977 Noise Logger	Type 1	98492
L03 – Near Processing Plant	Svan 977 Noise Logger	Type 1	99023
L04 – Weighbridge	Svan 977 Noise Logger	Type 1	98464
-	Brüel & Kjær 2250L Precision Sound Level Meter	Type 1	3005904
-	G.R.A.S 42 AG Sound Level Calibrator	Type 1	280550

6.2 Meteorological Station and Conditions during Noise Survey

Cleary Bros operate an on-site meteorological monitoring station. The collected weather data was used for the identification of periods when wind speeds of up to 0.5 m/s at 10 m above ground level were experienced (refer to **Section 3**).

Wind has the potential to increase noise at a receiver when it is light and stable and blows from the direction of the noise source. As the strength of the wind rises the noise produced by the wind will obscure noise from most industrial and transportation sources.

Wind effects must be considered when wind is a feature of the area under consideration. Where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30% of the time in any season, wind is considered a feature of the area, and noise level predictions must be made under these conditions.

It was established in 2002 that noise enhancing downwind conditions are not a feature of this site, as defined in the Environment Protection Authority's (EPA's) *Industrial Noise Policy (INP)*.

7 Noise Monitoring

7.1 Unattended Noise Monitoring

Four unattended continuous noise loggers were installed at strategic positions within the site to capture the contributions from Albion Park Quarry. The on-site loggers were installed near the Extraction Area as well as in the Processing Plant Area near the crusher on 28 July 2023 for a period of 7 days.

The weather conditions would have had a minimal effect on the measured noise level at the two unattended monitoring locations (Processing Plant and Quarry Extension Areas) because of the proximity of the noise loggers to the Albion Park Quarry operations.

In order to derive the statistical noise levels for various daily time periods, the data was processed for the periods 0700 hours to 1800 hours (daytime), 1800 hours to 2200 hours (evening) and 2200 hours to 0700 hours (night-time). The calculated statistical ambient noise levels at each monitoring location are presented in **Table 3**.

The results from the noise loggers situated at the Extraction Area (L01), the Cottage Residence (L02), the Processing Plant (L03) and the Weighbridge (L04) are presented in **Table 3**. The noise monitoring graphs together with the wind speed, wind direction and rainfall measured at the on-site meteorological monitoring station are presented in **Appendix A**.

Table 3 Unattended Statistical Ambient Noise Level Summary (July/August 2023)

Logger Location	Daytime (dBA)				Evening (dBA)				Night-time (dBA)			
	L_{Aeq}	L_{A1}	L_{A10}	RBL	L_{Aeq}	L_{A1}	L_{A10}	RBL	L_{Aeq}	L_{A1}	L_{A10}	RBL
L01 – Extraction Area	62	64	61	40	51	42	40	33	52	39	35	29
L02 – Cottage Residence	52	61	50	37	45	47	43	38	42	42	39	29
L03 – Processing Plant	65	73	68	53	61	65	61	57	61	62	54	32
L04 – Weighbridge	65	65	58	48	57	55	52	47	60	51	48	33

Note 1: RBL = Rating Background Level.

The monitoring results and graphs indicate that the measured ambient noise levels at L01, L03 and L04 are predominantly from the Albion Park Quarry operations alone. The graphs clearly indicate the periods when the Albion Park Quarry was operating. The noise monitoring results from "The Cottage" indicate that the ambient environment is influenced by local noise sources and transport (local fauna, road and aircraft) noise.

During the deployment of the unattended noise monitor at the quarry extension area, it was observed that a front-end loader, two excavators, a mobile crusher, a dozer and dump trucks were operating in the extraction area.

7.2 Attended Monitoring

Operator attended noise monitoring was conducted at five locations including Greenmeadows residential estate to confirm the noise contributions from the site. Results of the operator attended noise surveys are provided in **Table 4**.

Table 4 Operator Attended Noise Survey Results

Location	Date/Start Time/ Weather	Primary Noise Descriptor dBA (15 minute)					Modifying Factors Applicable	Description of Noise Emissions and Typical Maximum Noise Levels (dBA)
		L_{Amax}	L_{A1}	L_{A10}	L_{A90}	L_{Aeq}		
L01 – Near Extraction Area	4/8/2023 11:14 21°C 2.1 m/s NNE	80	75	72	61	68	N/A	*Site related noise events:* **APQ: Clearly audible** Front end loader: 70 – 80 Dozer: 62 – 65 Loading truck: 60 - 65 **$L_{Aeq(15minute)}$ contribution: 68 dBA** *Other noise events:* Birds : 50 – 60
L02 – "The Cottage" Residence	4/8/2023 11:40 21°C 1.7 m/s NE	59	49	43	39	42	N/A	*Site related noise events:* **APQ: Inaudible** **$L_{Aeq(15minute)}$ contribution: <29 dBA** *Other noise events:* Traffic: 38 – 48 Birds: 43 – 58 Aircraft: 36 – 48 Impact: 59

Location	Date/Start Time/ Weather	Primary Noise Descriptor dBA (15 minute)					Modifying Factors Applicable	Description of Noise Emissions and Typical Maximum Noise Levels (dBA)
		L_{Amax}	L_{A1}	L_{A10}	L_{A90}	L_{Aeq}		
L03 – Near Processing Area	4/8/2023 10:36 20°C 2.5 m/s NNE	84	74	62	48	61	N/A	*Site related noise events:* **APQ: Clearly audible** Heavy vehicles: 56 – 77 Light vehicles: 46 – 62 Impacts: 52 – 55 Vehicle cleaning: 58 Horn: 84 **$L_{Aeq(15minute)}$ contribution: 61 dBA** *Other noise events:* Aircraft: 60 – 70
L04 - Near Weighbridge	4/8/2023 12:17 21°C 1.2 m/s NE	83	76	65	53	63	N/A	*Site related noise events:* **APQ: Clearly audible** Heavy vehicle movements: 55 – 83 Idling trucks: 57 Airbrake: 66 **$L_{Aeq(15minute)}$ contribution: 63 dBA** *Other noise events:* Aircraft: 50-55
L05 - Greenmeadows Residential Area	4/8/2023 12:51 20°C 2.1 m/s WNW	67	61	54	46	52	N/A	*Site related noise events:* **APQ: Inaudible** **$L_{Aeq(15minute)}$ contribution: <36 dBA** *Other noise events:* Highway traffic:45-56 Construction: 49-54 Aircraft: 53 – 67

It was observed that operations within the Extraction Area were inaudible at The Cottage residence. $L_{Aeq(15minute)}$ and noise contributions from the site, at this location, was estimated to be below 29 dBA. The existing noise environment at this location is dominated by distant traffic, aircraft and local fauna. Attended measurements conducted at the Greenmeadows residential estate, indicated that the processing plant is inaudible and noise contributions from the site, at this location, was estimated to be below 36 dBA. The existing noise environment at this location is dominated by traffic on the Princes Highway, aircraft, and construction activities at a site located to the east of the receivers. It is noted that the winds between 1.2 to 2.5 m/s, were recorded at the APQ weather station during the attended measurements.

8 Noise Impact Assessment

In order to give an indication of the quarry noise level contributions at the nominated receiver locations, the noise level contributions were calculated based on analysis of the noise logger results in conjunction with noise modelling.

Operational noise levels from the Site have been predicted at the various assessment locations using the CONCAWE industrial noise algorithm in SoundPLAN. The model includes buildings and site noise sources, ground topography and ground type (ground absorption modelled as 0.9 for the surrounding grassland areas and 0.5 for the quarry processing and storage areas).

The noise model, developed to assess the proposed stage 7 quarry extension, was updated to include the unattended monitoring locations at the Processing Plant and the quarry Extraction Area as well as general plant and equipment locations over the monitoring period. The 10 m wind speeds measured at the APQ weather station during the monitoring period were greater than 0.5 m/s during the periods when the site was identified to be operational. Minimum wind speeds of 1 m/s to 2 m/s were measured when the site was operational between 12:00 pm and 1:30 pm on 31 July 2023. This period is considered representative of typical quarry operations during the monitoring period and has been used to model the noise impact at the assessment locations. A propagation difference between the two monitoring locations and the assessment locations has been calculated using the noise modelling results. The measured noise levels at the Processing Plant and Quarry Extension Area have been corrected based on this propagation difference, to determine the noise levels measured at the nearest receivers.

The 2017 Modified Consent Condition noise limits apply under calm conditions only (wind speeds up to 0.5 m/s at 10 m height). Accordingly, neutral (i.e. no wind) conditions have been taken into account for the assessment.

The calculated calm scenario quarry noise levels are summarised in **Table 5**.

Table 5 Calculated Daytime Noise Contribution of the Albion Park Quarry

Residences	Noise Limits $L_{Aeq\ (15\ minute)}$ (dBA)	Noise Contribution at Receivers $L_{Aeq\ (15\ minute)}$ (dBA)[1]
"The Hill" Residence (Dunster)	35	32
"The Cottage" Residence	35	34
Greenmeadows Residential Estate	41	38

Note 1: Calculated site noise contributions from the site during neutral conditions.

A review of the results in **Table 5** indicates that the Albion Park Quarry complies with the noise limits at all three assessment locations during calm conditions.

Appendix B presents the $L_{Aeq(15minute)}$ noise level monitored at the Albion Park Quarry together with the calculated contribution from the site at all receivers. It should be noted that the noise charts in **Appendix B** only give an indication of the quarry noise contribution between 12:00 pm and 1:30 pm on 31 July 2023.

9 Conclusion

SLR has been engaged to conduct an operational noise compliance assessment of the Albion Park Quarry Processing Plant and Quarry Extension Area (currently operating in the Stages 5/6 Extraction Area).

Unattended noise monitoring was conducted at strategic locations within the site in order to measure the noise from the site operations. Additional unattended and attended monitoring was conducted at the assessment locations to determine the noise contributions from site activities.

In addition to noise monitoring, noise modelling was conducted to determine the noise contribution from the site at the nearest receivers under neutral weather conditions. A comparison of the noise levels predicted by the noise model and the observations from the attended measurements indicate that the site is predicted to comply with the noise limits at all assessment locations.

Appendix A:

Acoustic Terminology

1. Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that 'noise' often refers to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range with the loudest sound pressure to which the human ear can respond being ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2. 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB(lin) or dB.

3. Sound Power Level

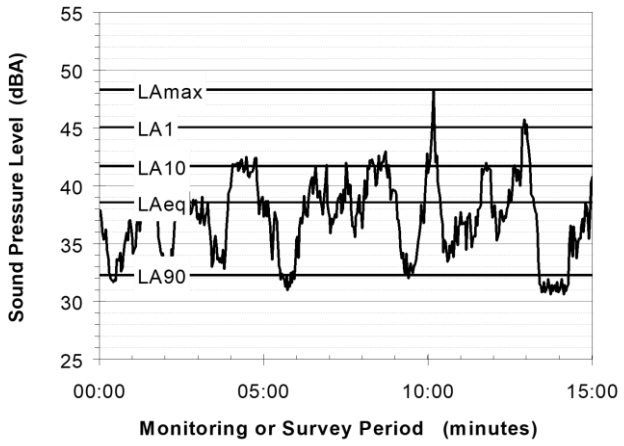
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure is similar to the effect of an electric radiator, which is characterised by a power rating but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4. Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

LA1 The noise level exceeded for 1% of the 15 minute interval.

LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

LAeq The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

5. Frequency Analysis

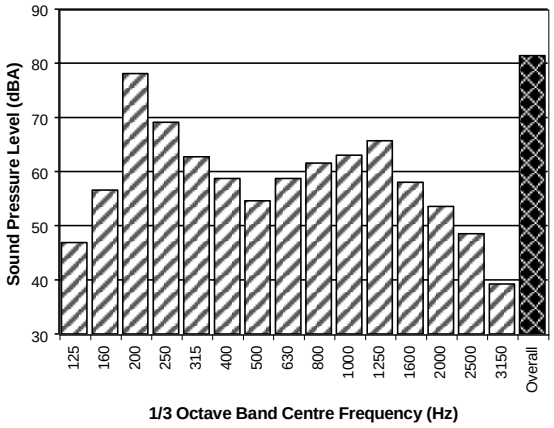
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (three bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



6. Annoying Noise (Special Audible Characteristics)

A louder noise will generally be more annoying to nearby receivers than a quieter one. However, noise is often also found to be more annoying and result in larger impacts where the following characteristics are apparent:

- **Tonality** - tonal noise contains one or more prominent tones (ie differences in distinct frequency components between adjoining octave or 1/3 octave bands), and is normally regarded as more annoying than 'broad band' noise.
- **Impulsiveness** - an impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.
- **Intermittency** - intermittent noise varies in level with the change in level being clearly audible. An example would include mechanical plant cycling on and off.
- **Low Frequency Noise** - low frequency noise contains significant energy in the lower frequency bands, which are typically taken to be in the 10 to 160 Hz region.

7. Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements (ie vertical, longitudinal and transverse).

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used.

8. Human Perception of Vibration

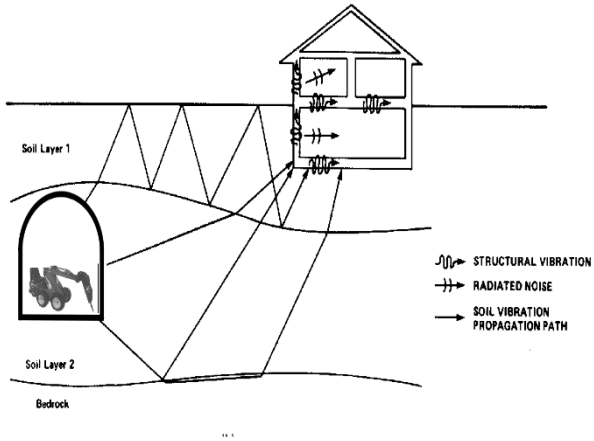
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

9. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.

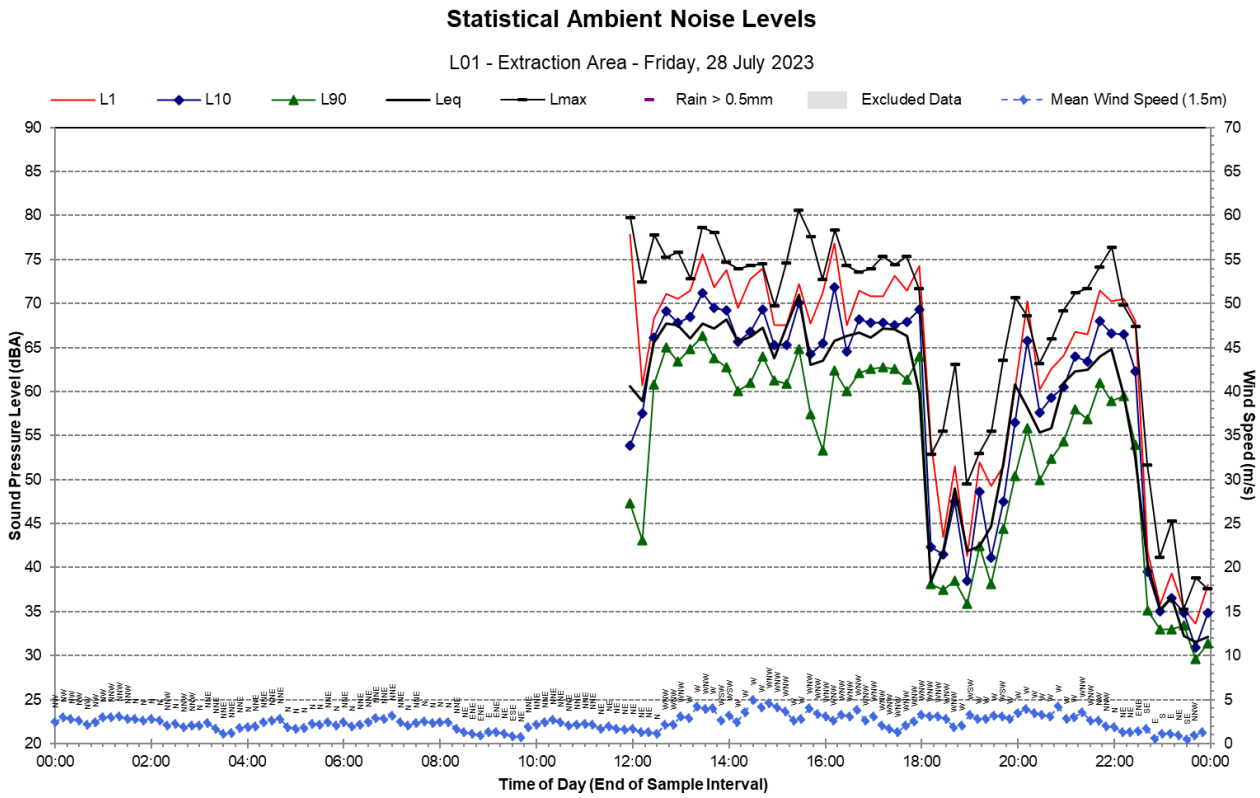


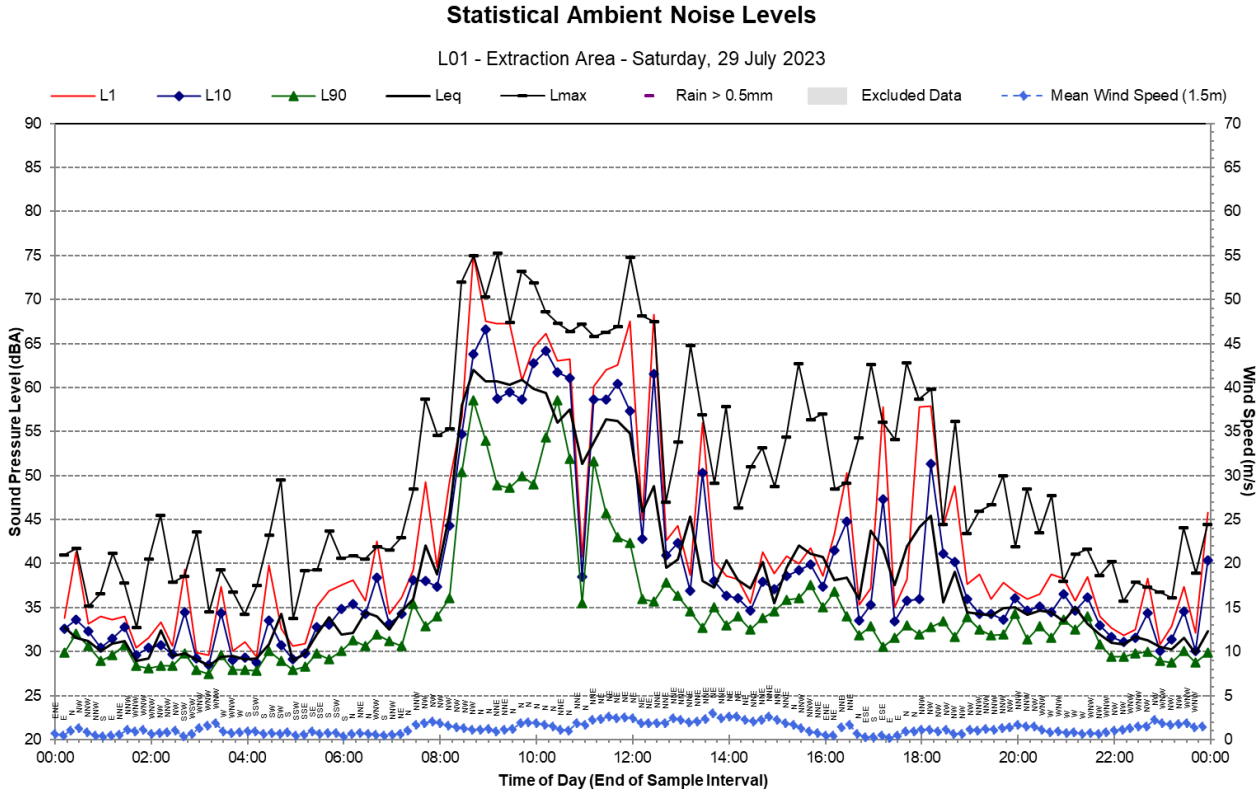
The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise.

Appendix B:

Noise Monitoring Graphs

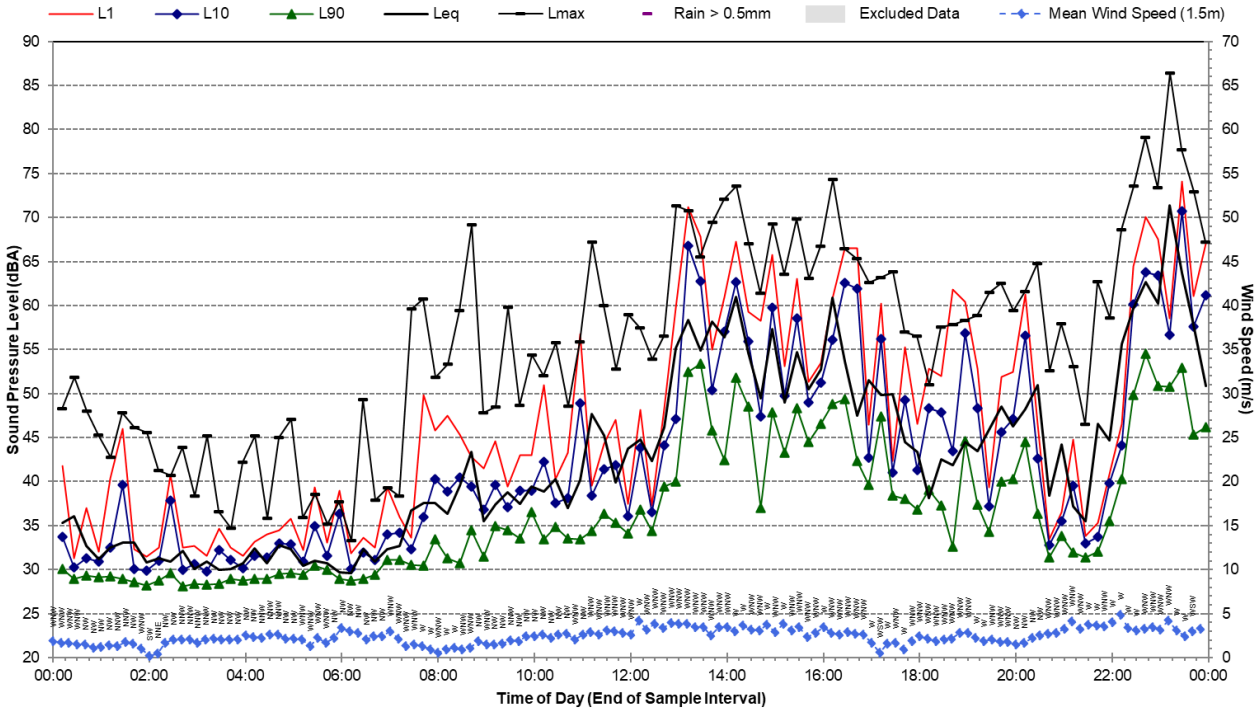
L01 – Near Extraction Area





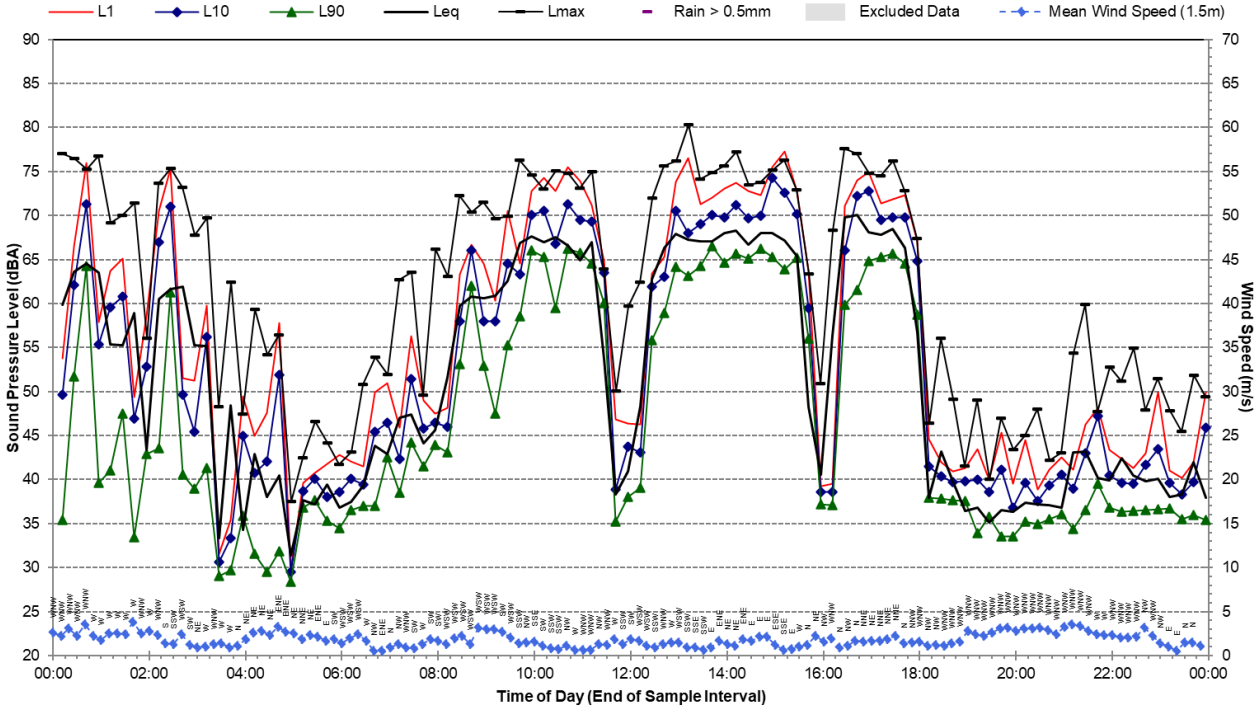
Statistical Ambient Noise Levels

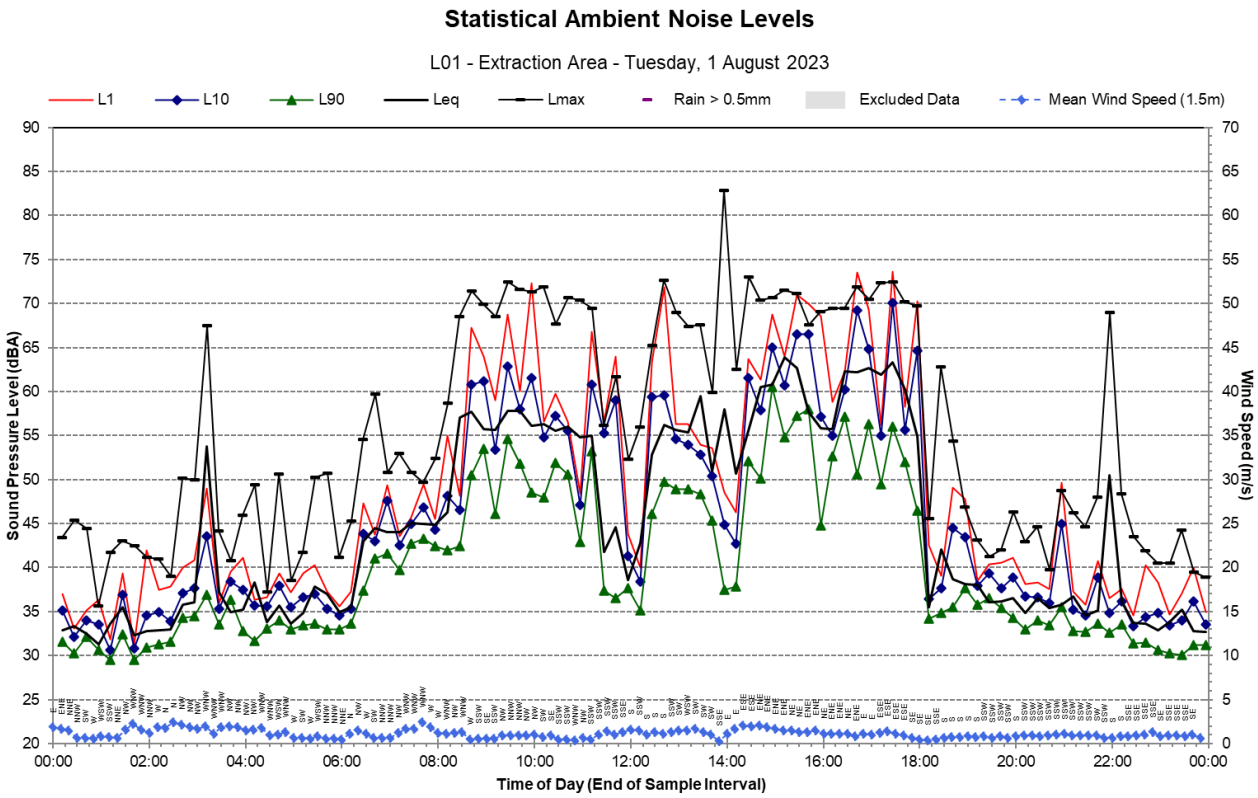
L01 - Extraction Area - Sunday, 30 July 2023

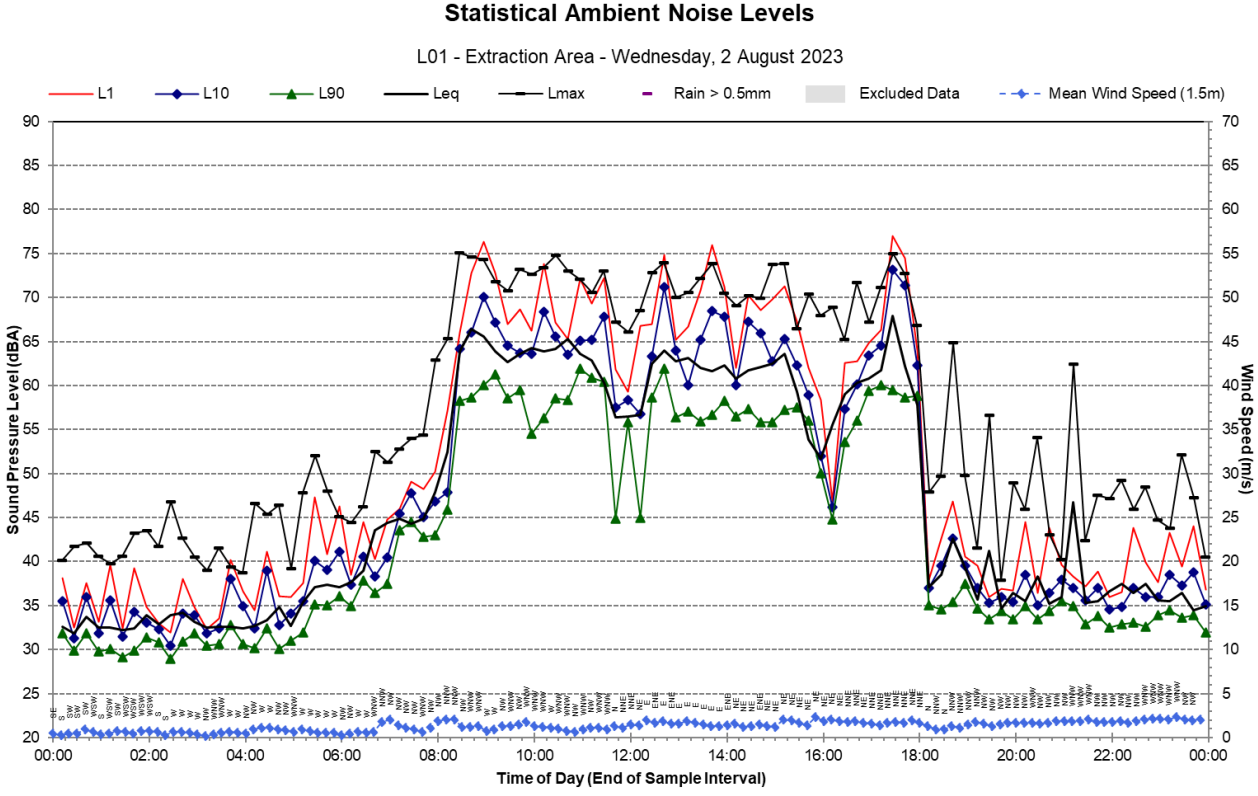


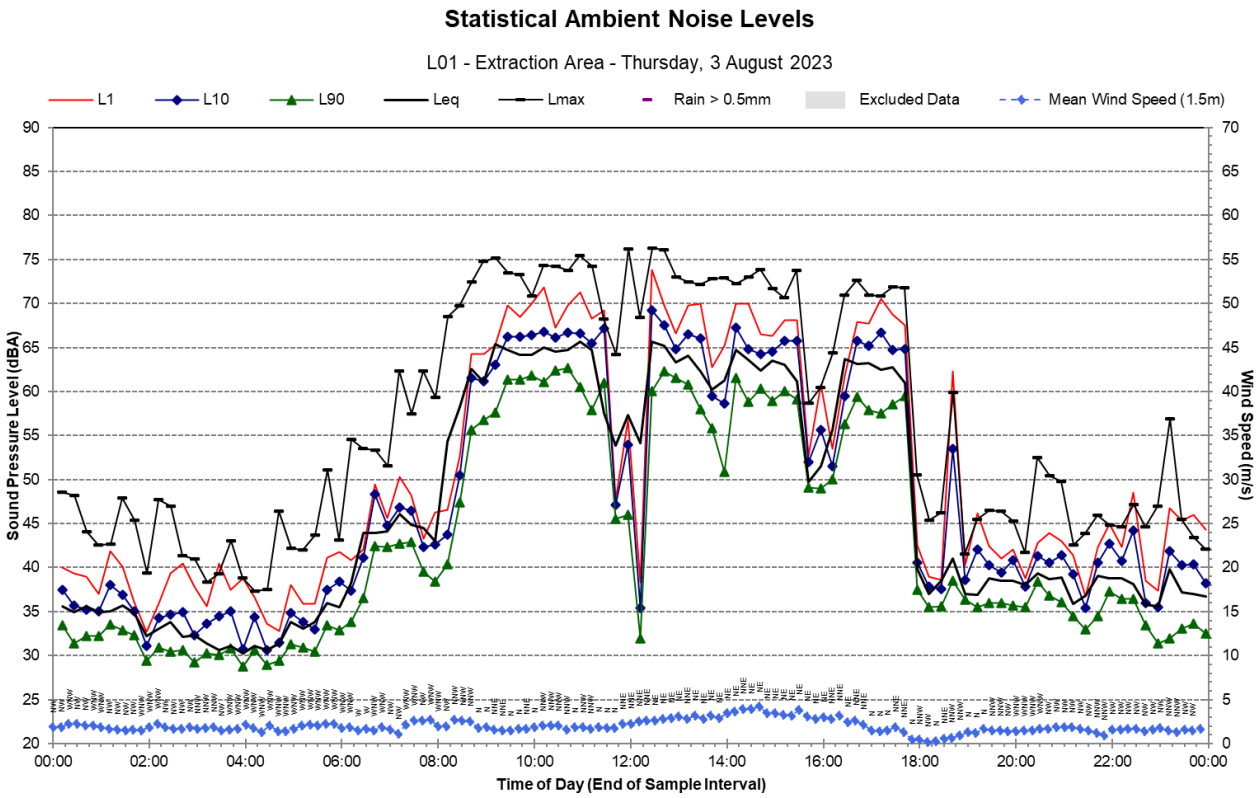
Statistical Ambient Noise Levels

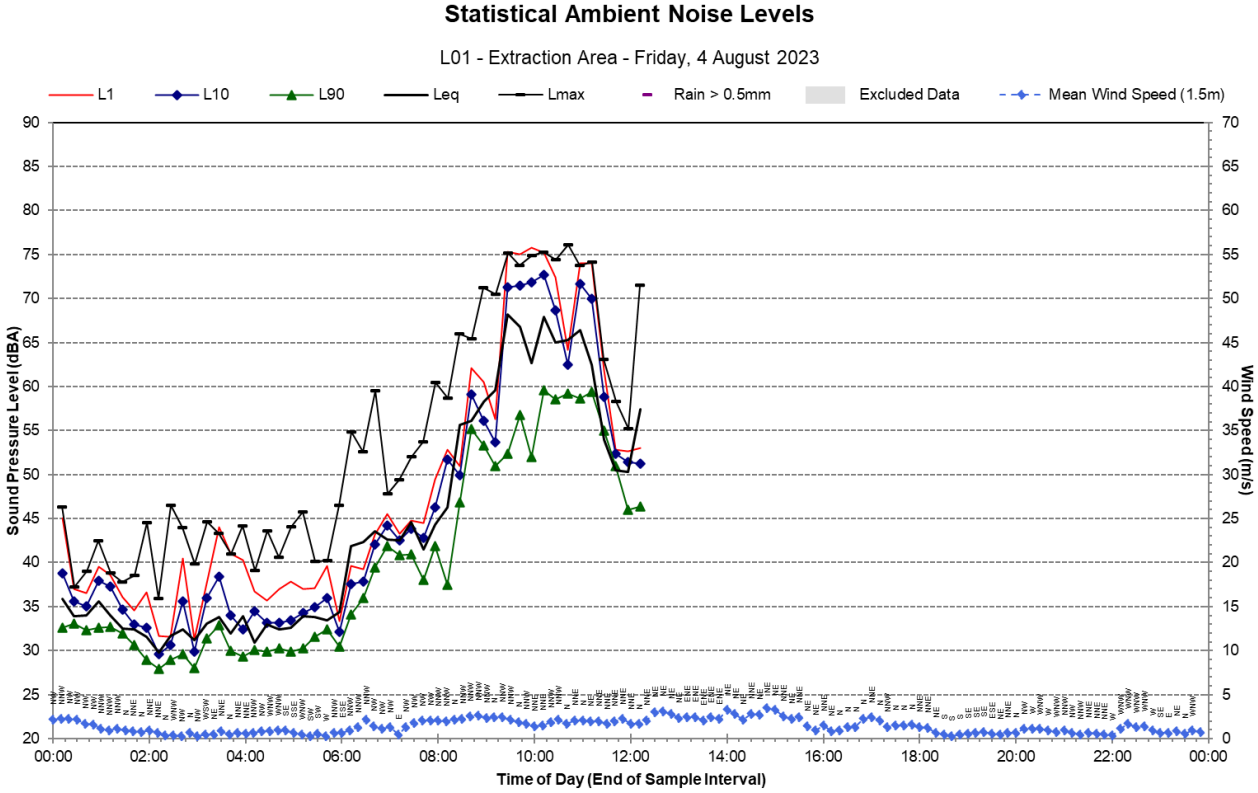
L01 - Extraction Area - Monday, 31 July 2023



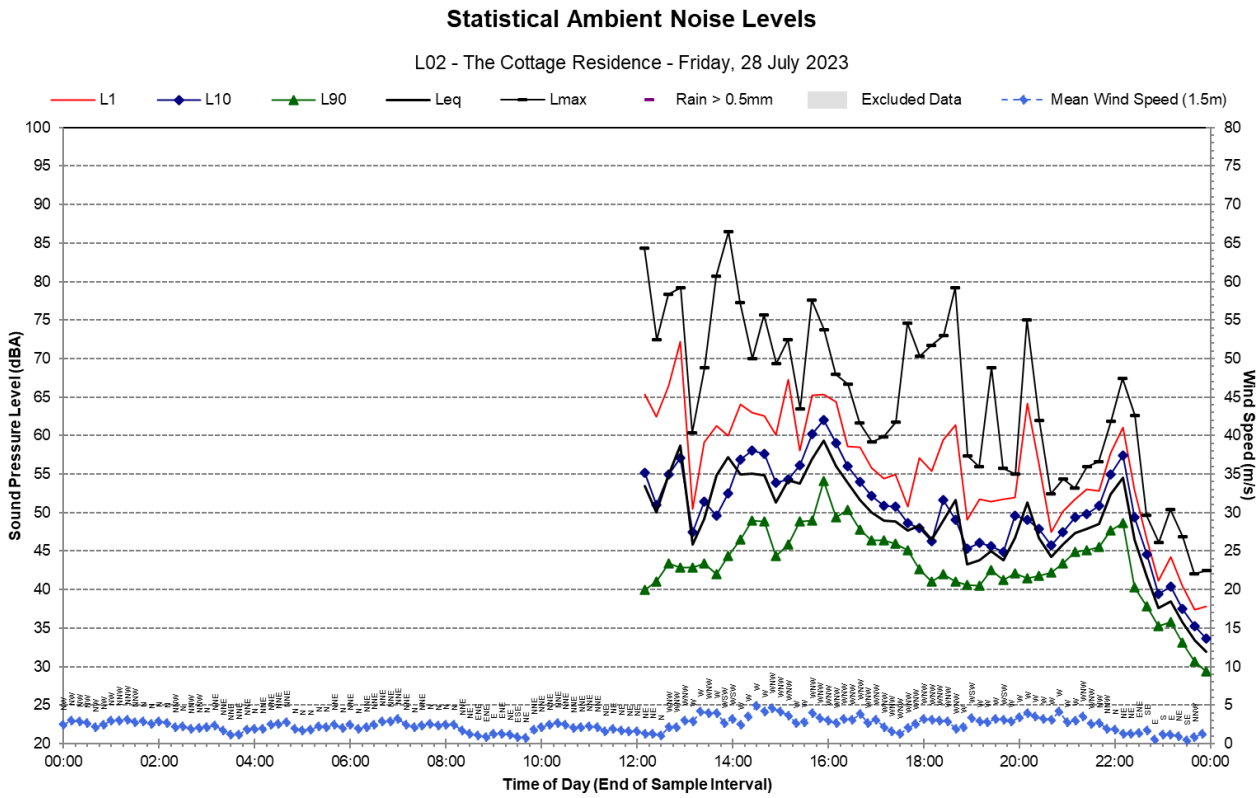

Statistical Ambient Noise Levels
L01 - Extraction Area - Tuesday, 1 August 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

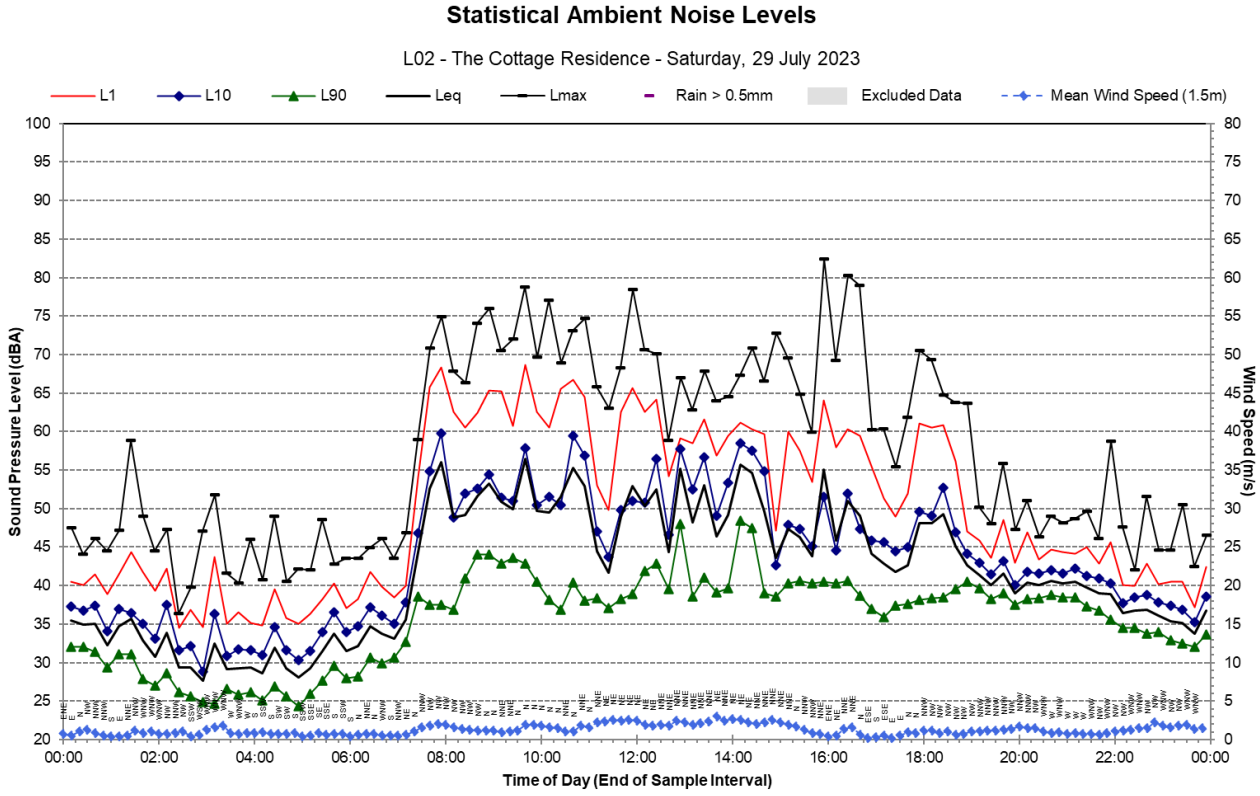

Statistical Ambient Noise Levels
L01 - Extraction Area - Wednesday, 2 August 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L01 - Extraction Area - Thursday, 3 August 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L01 - Extraction Area - Friday, 4 August 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

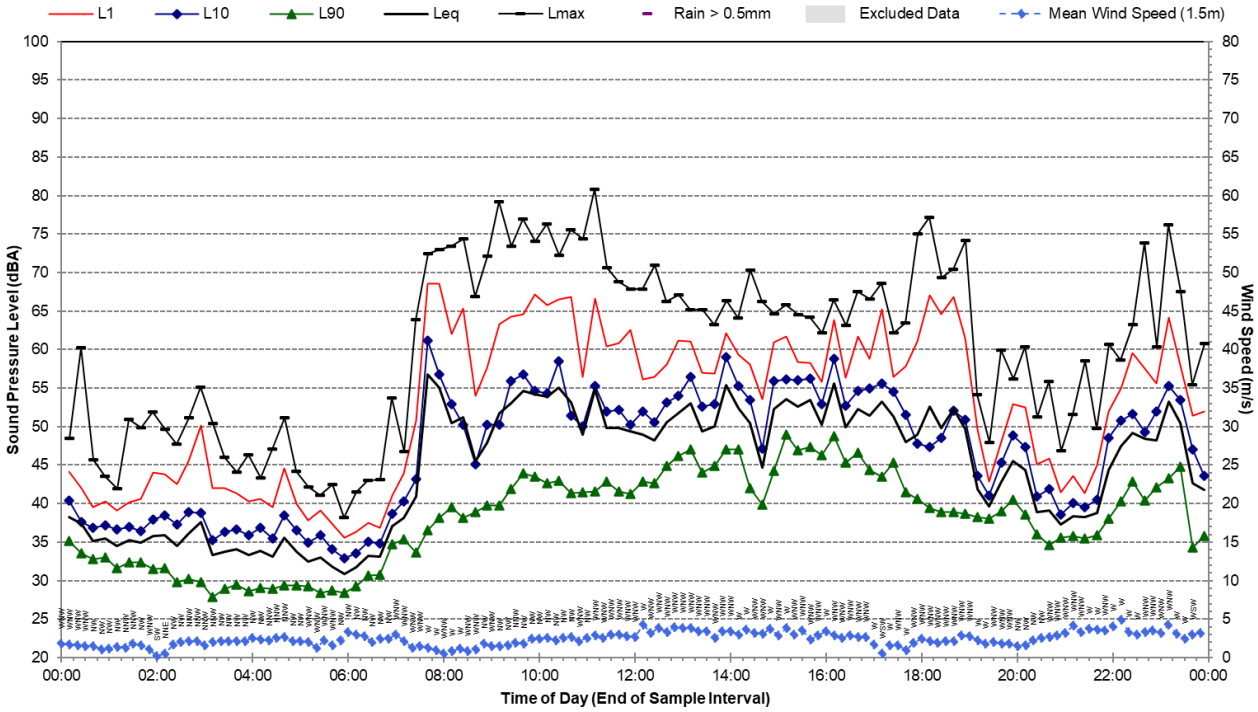
L02 – The Cottage Residence





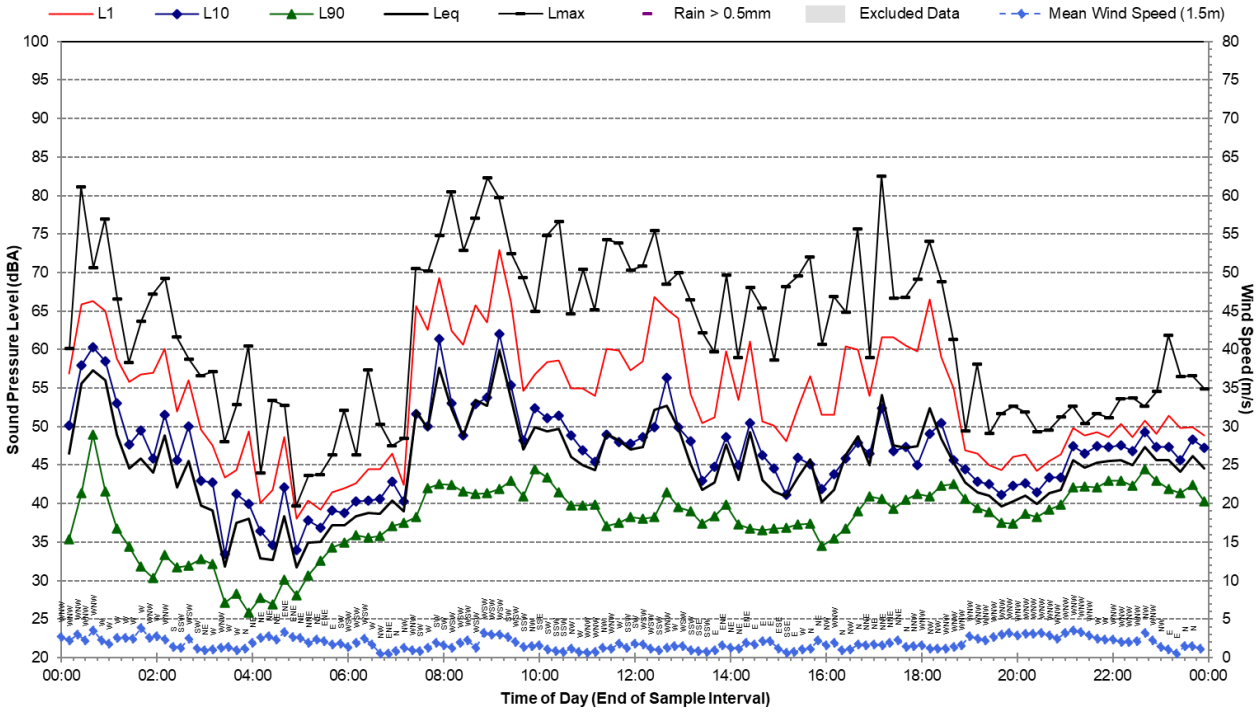
Statistical Ambient Noise Levels

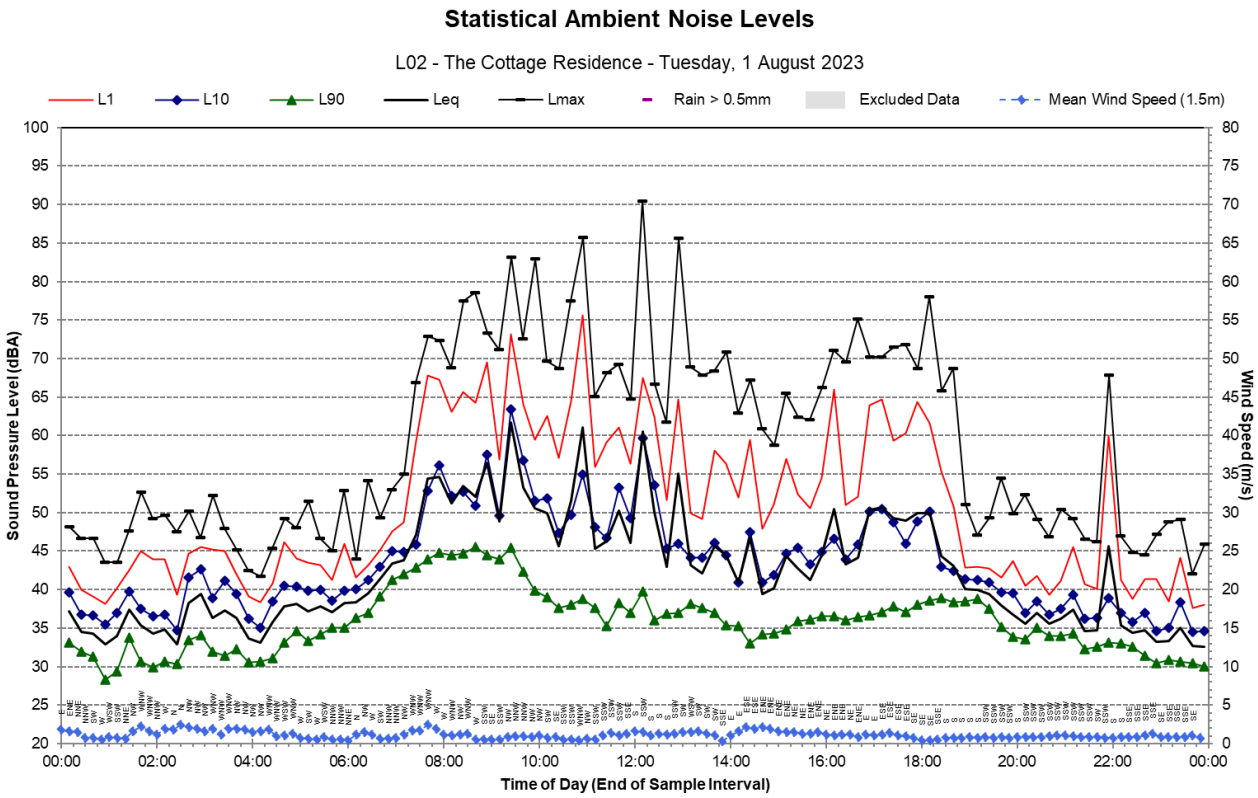
L02 - The Cottage Residence - Sunday, 30 July 2023

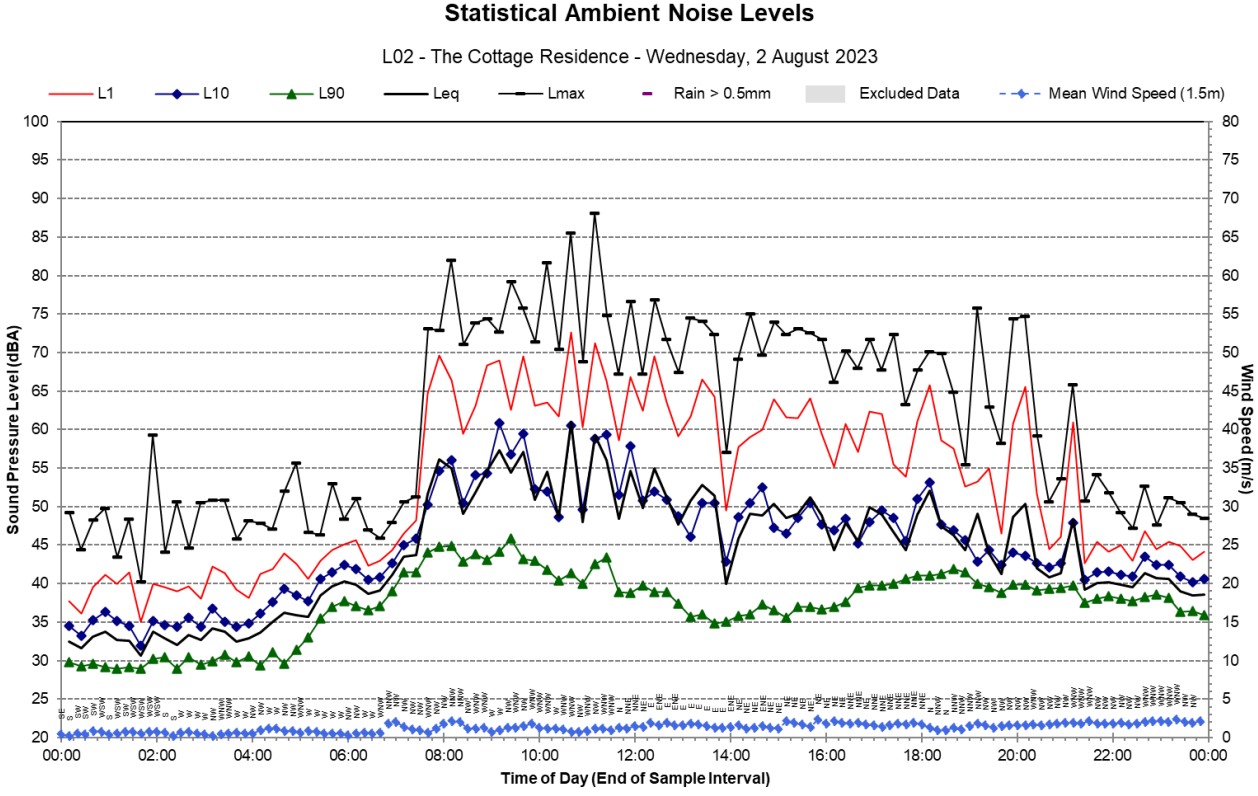


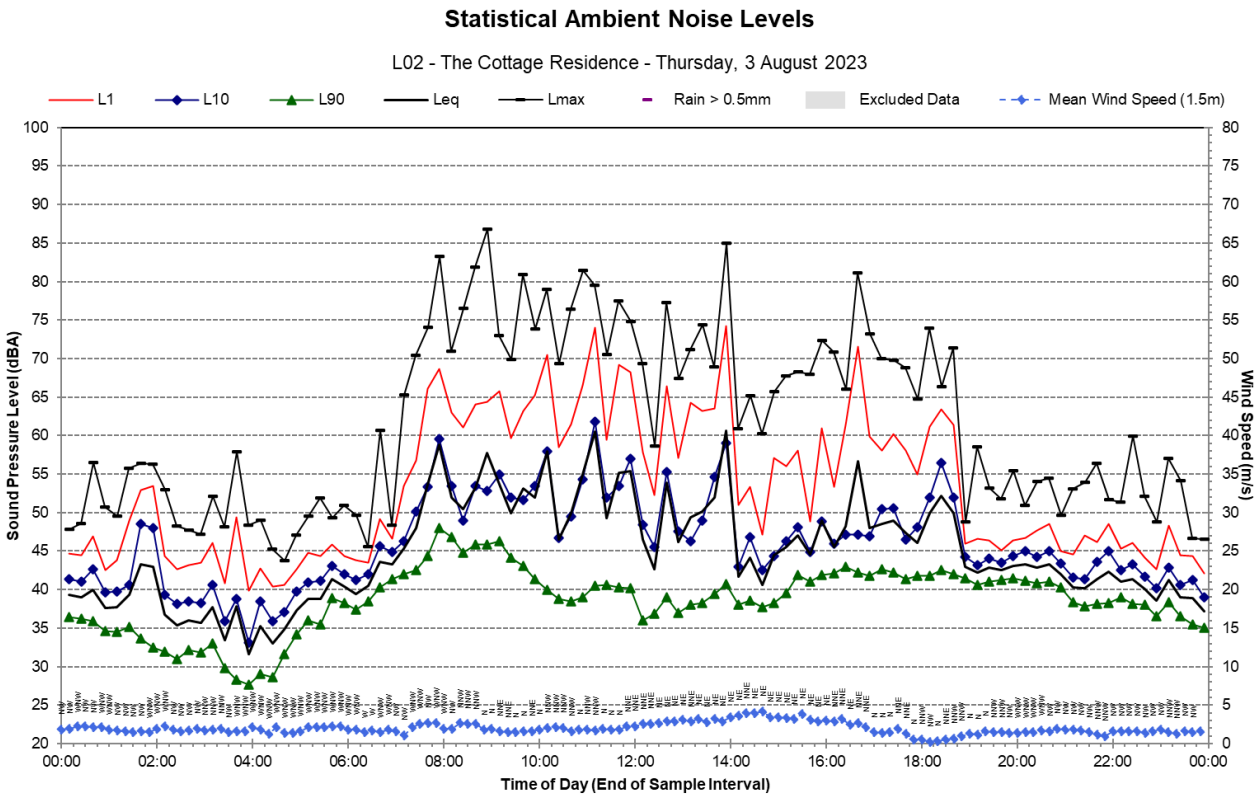
Statistical Ambient Noise Levels

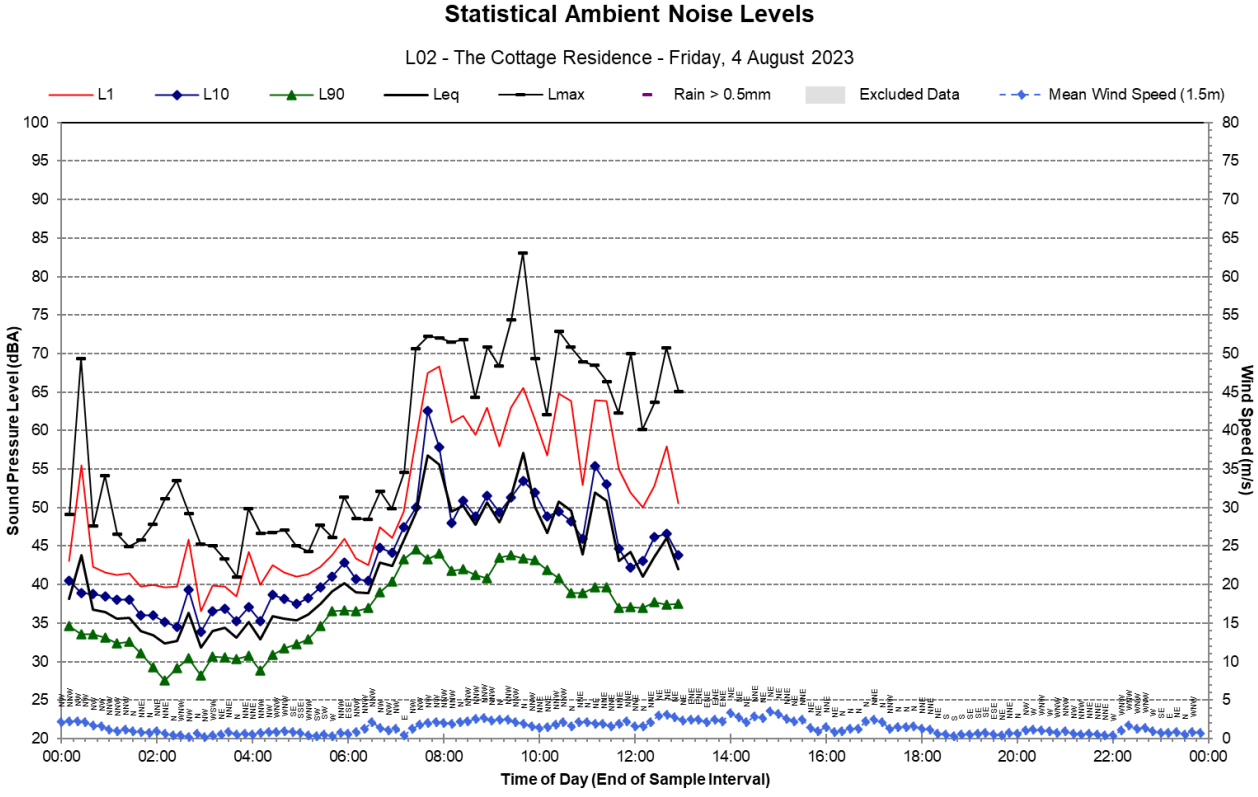
L02 - The Cottage Residence - Monday, 31 July 2023



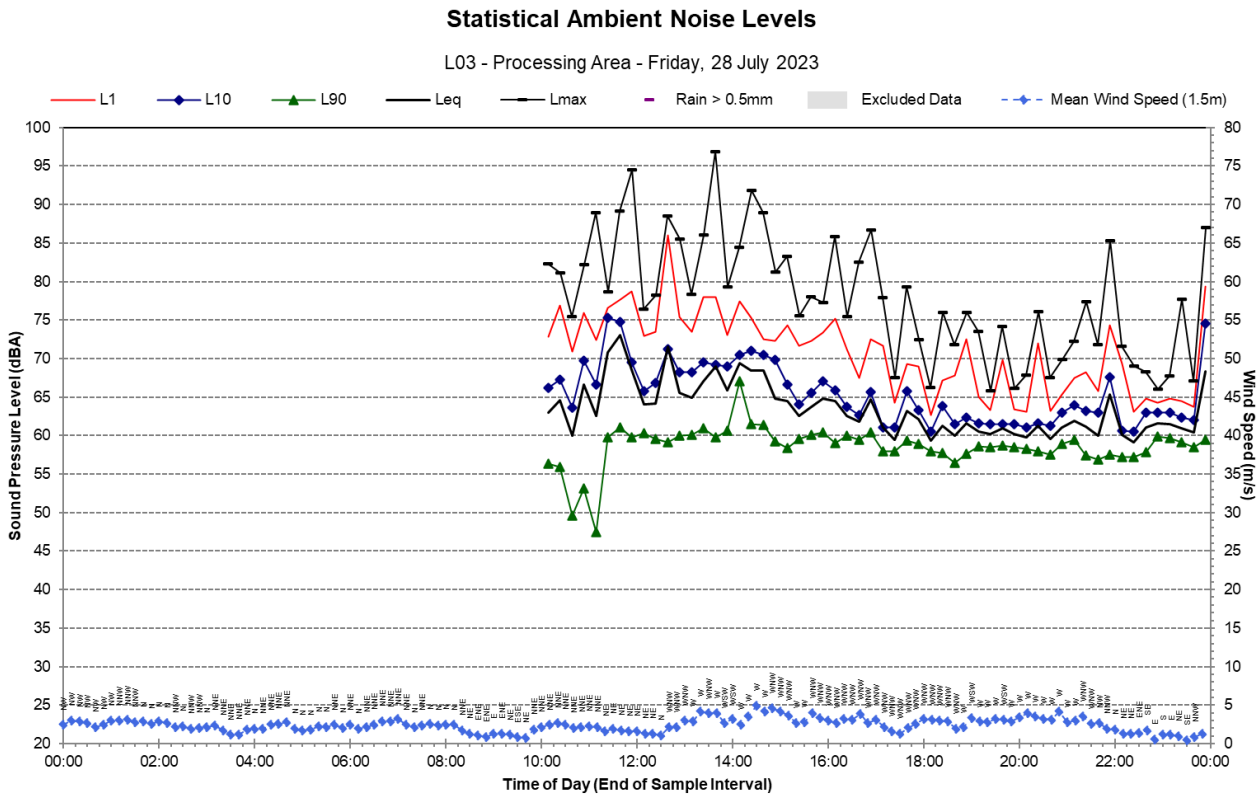

Statistical Ambient Noise Levels
L02 - The Cottage Residence - Tuesday, 1 August 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

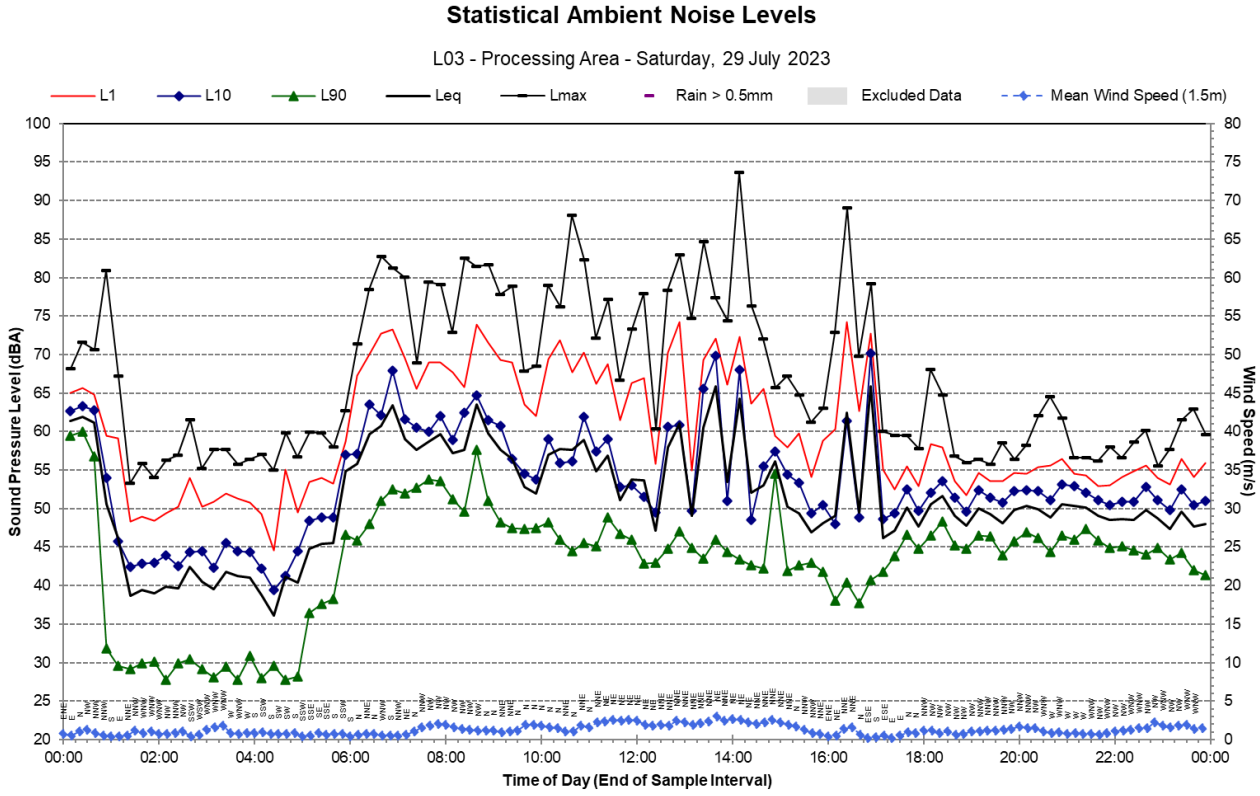

Statistical Ambient Noise Levels
L02 - The Cottage Residence - Wednesday, 2 August 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

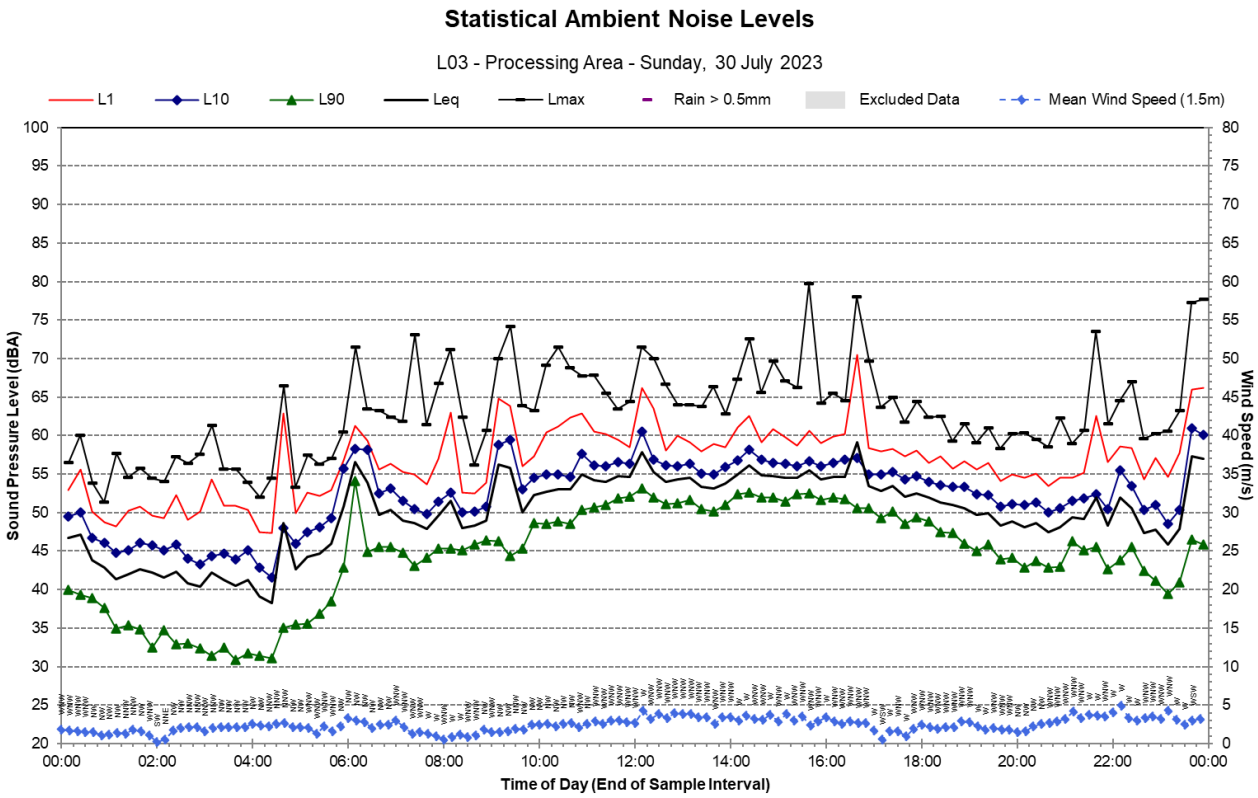

Statistical Ambient Noise Levels
L02 - The Cottage Residence - Thursday, 3 August 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

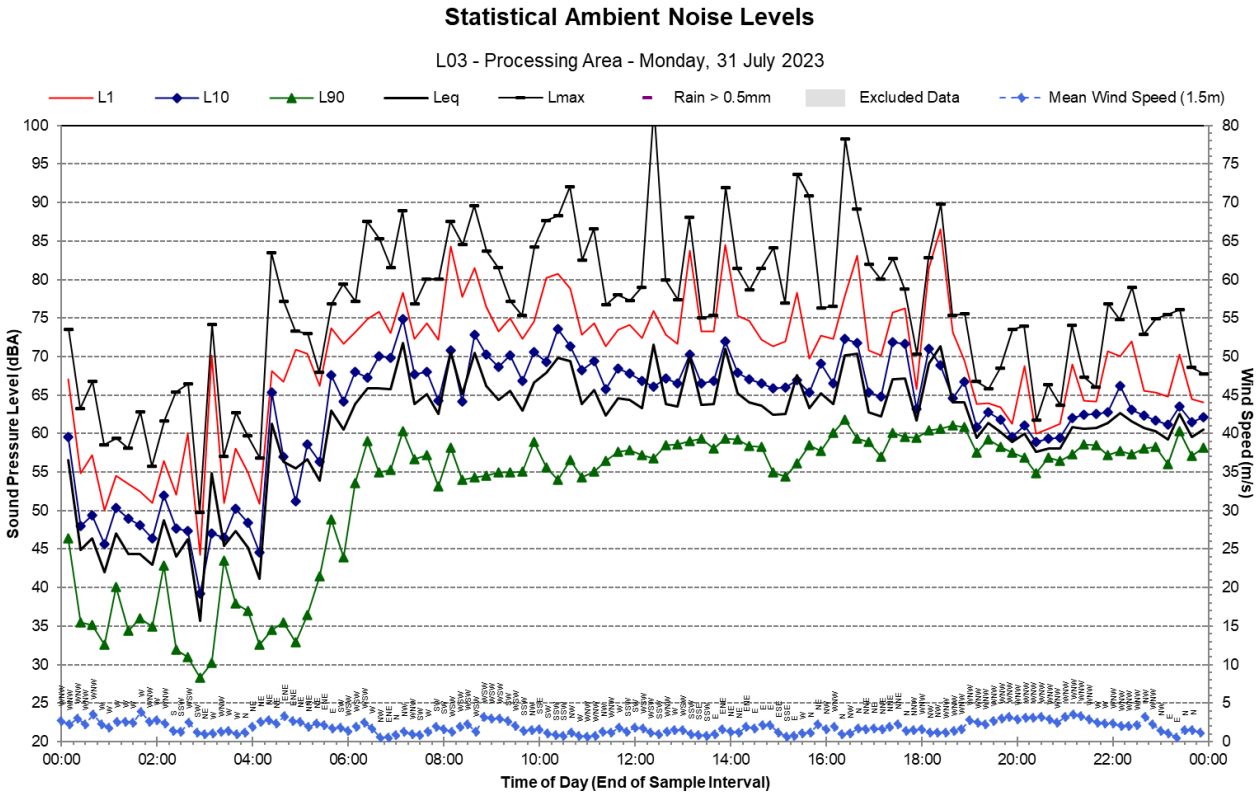

Statistical Ambient Noise Levels
L02 - The Cottage Residence - Friday, 4 August 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

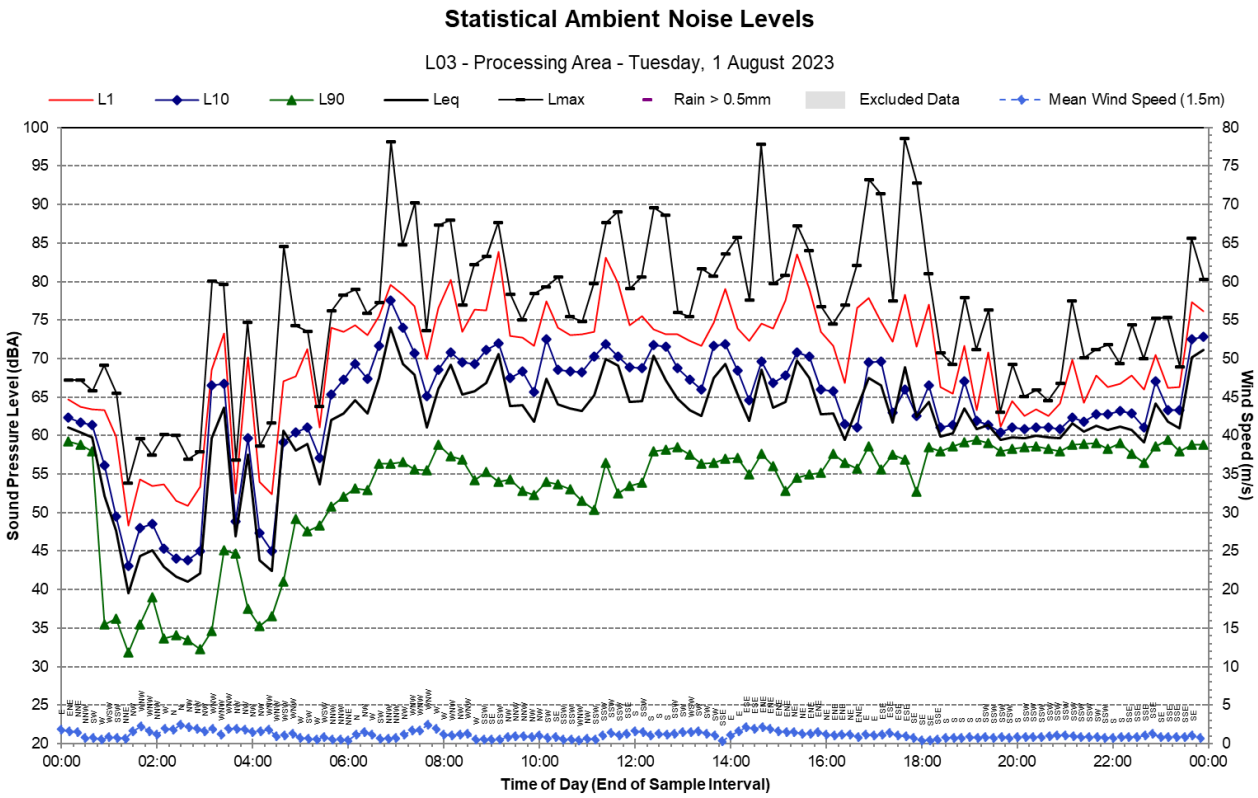
L03 - Processing Area

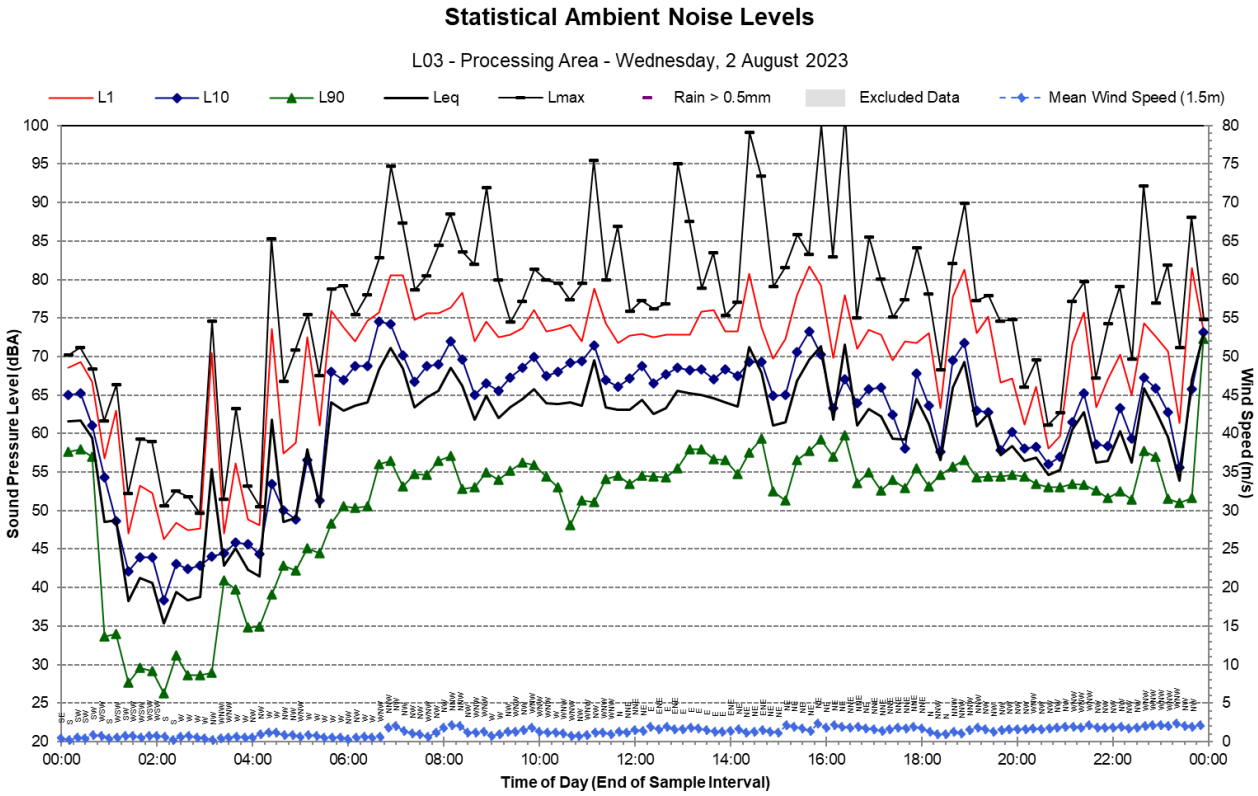





Statistical Ambient Noise Levels
L03 - Processing Area - Sunday, 30 July 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

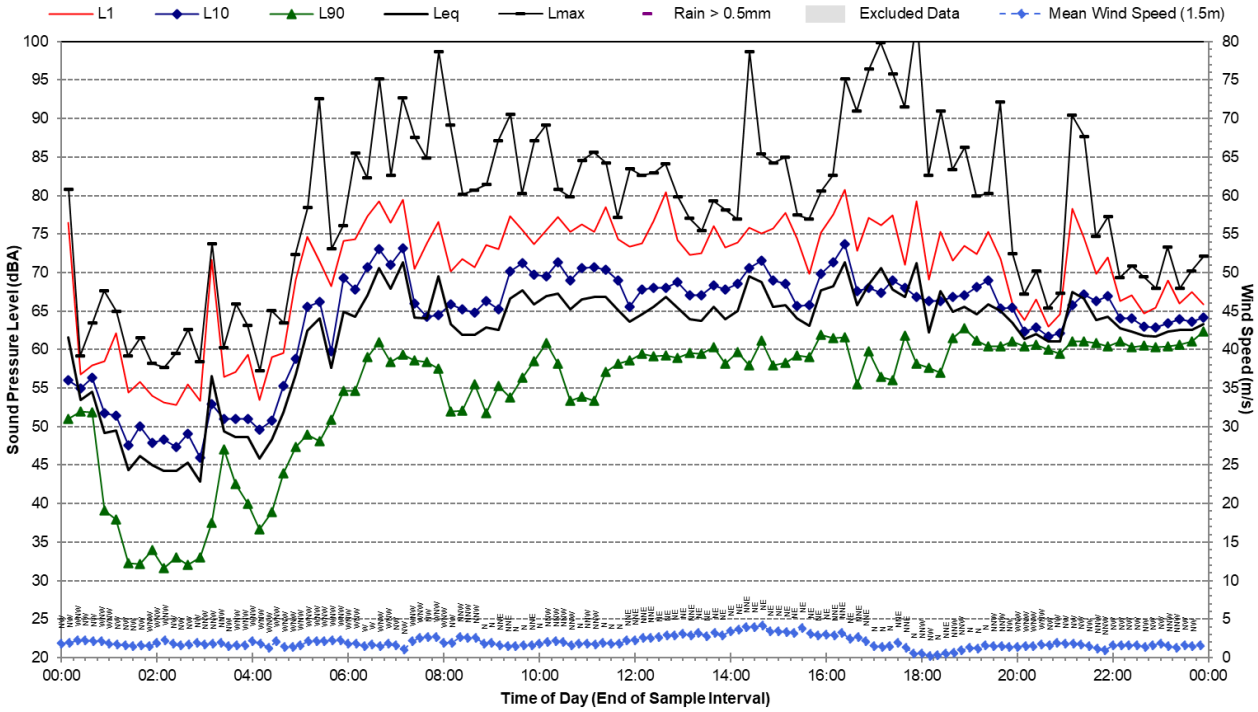

Statistical Ambient Noise Levels
L03 - Processing Area - Monday, 31 July 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Processing Area - Tuesday, 1 August 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Processing Area - Wednesday, 2 August 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

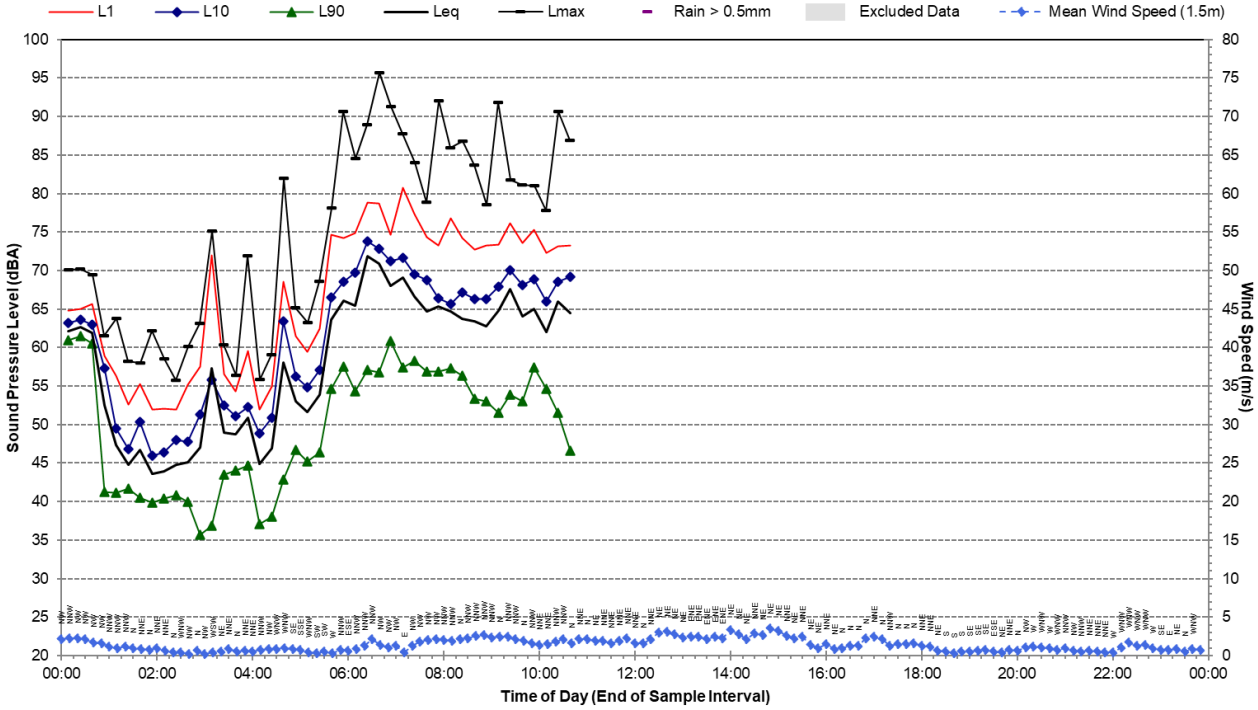
Statistical Ambient Noise Levels

L03 - Processing Area - Thursday, 3 August 2023

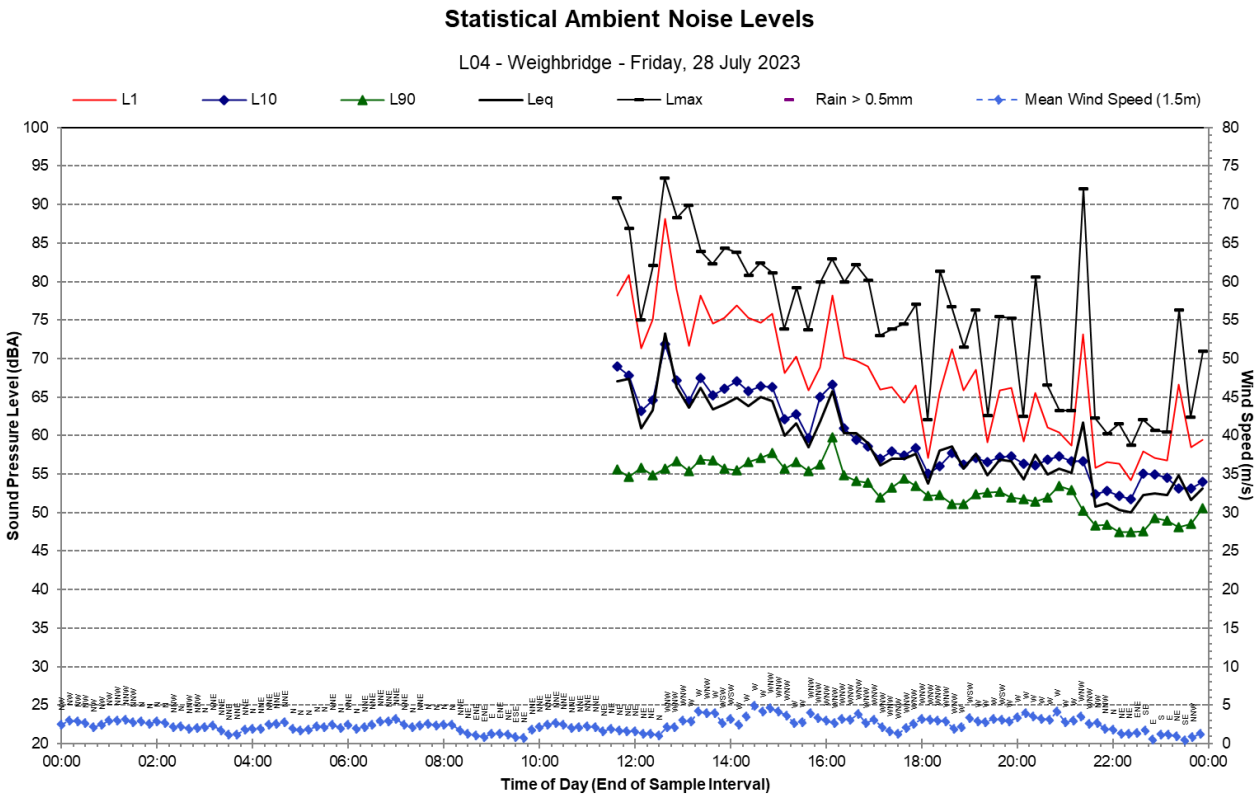


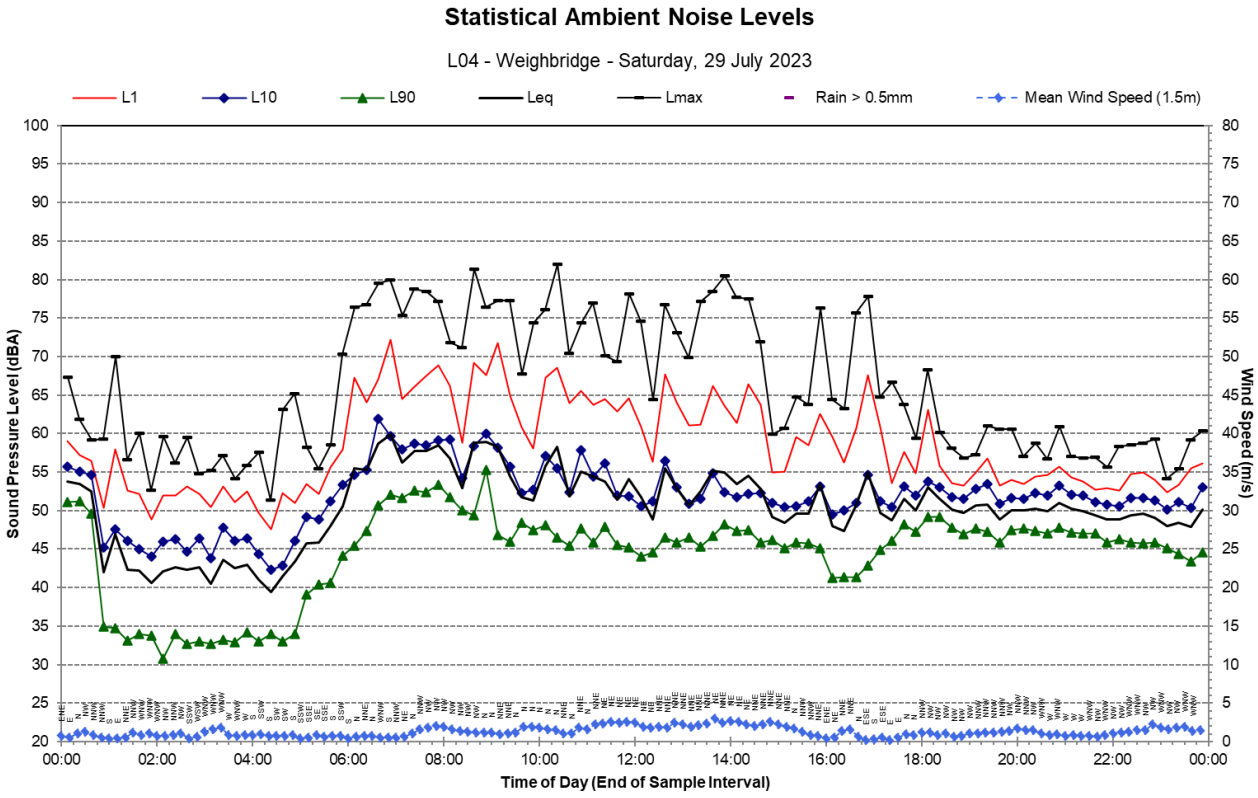
Statistical Ambient Noise Levels

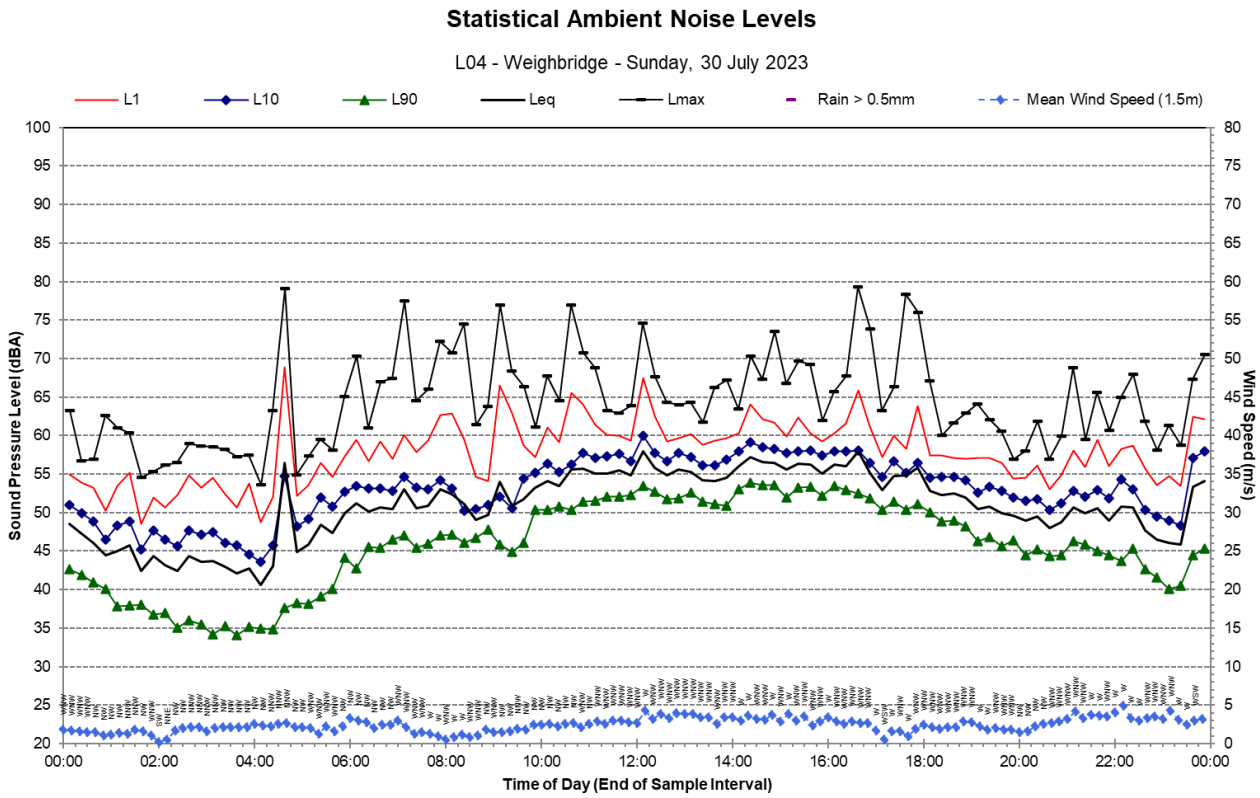
L03 - Processing Area - Friday, 4 August 2023

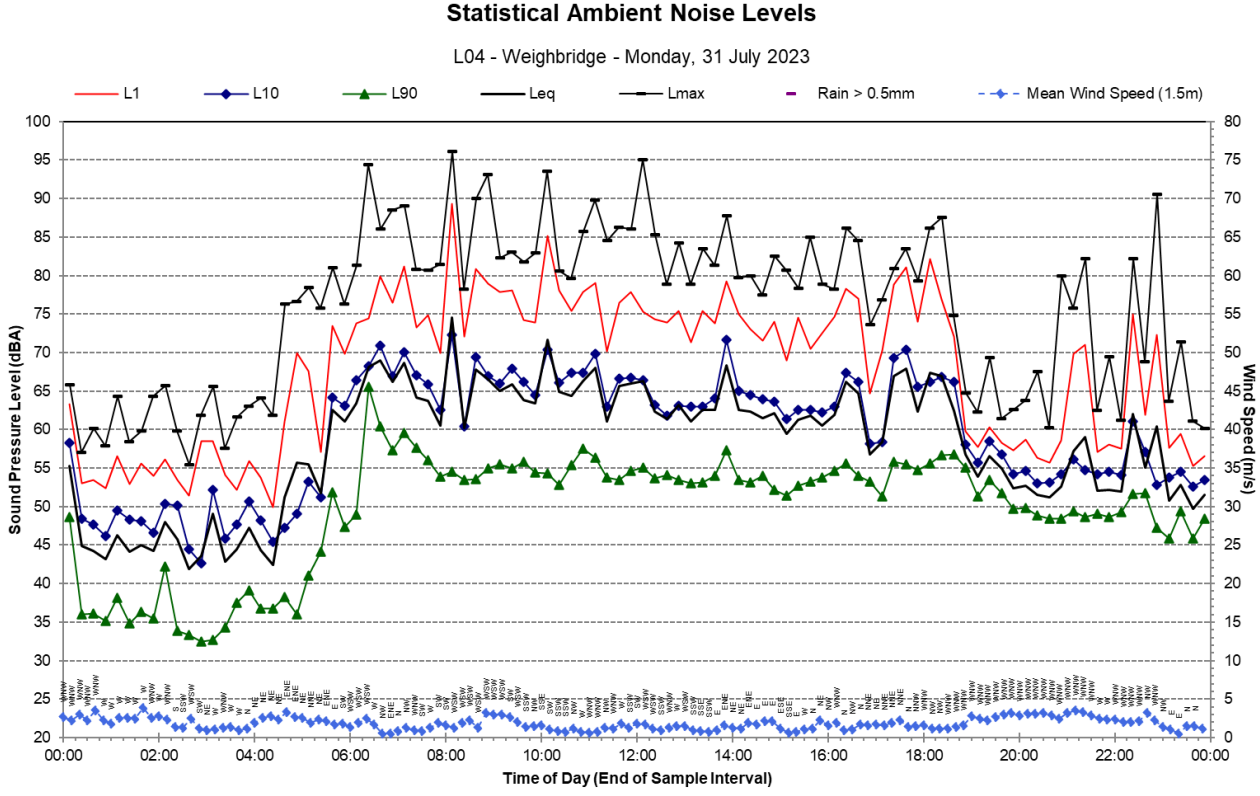


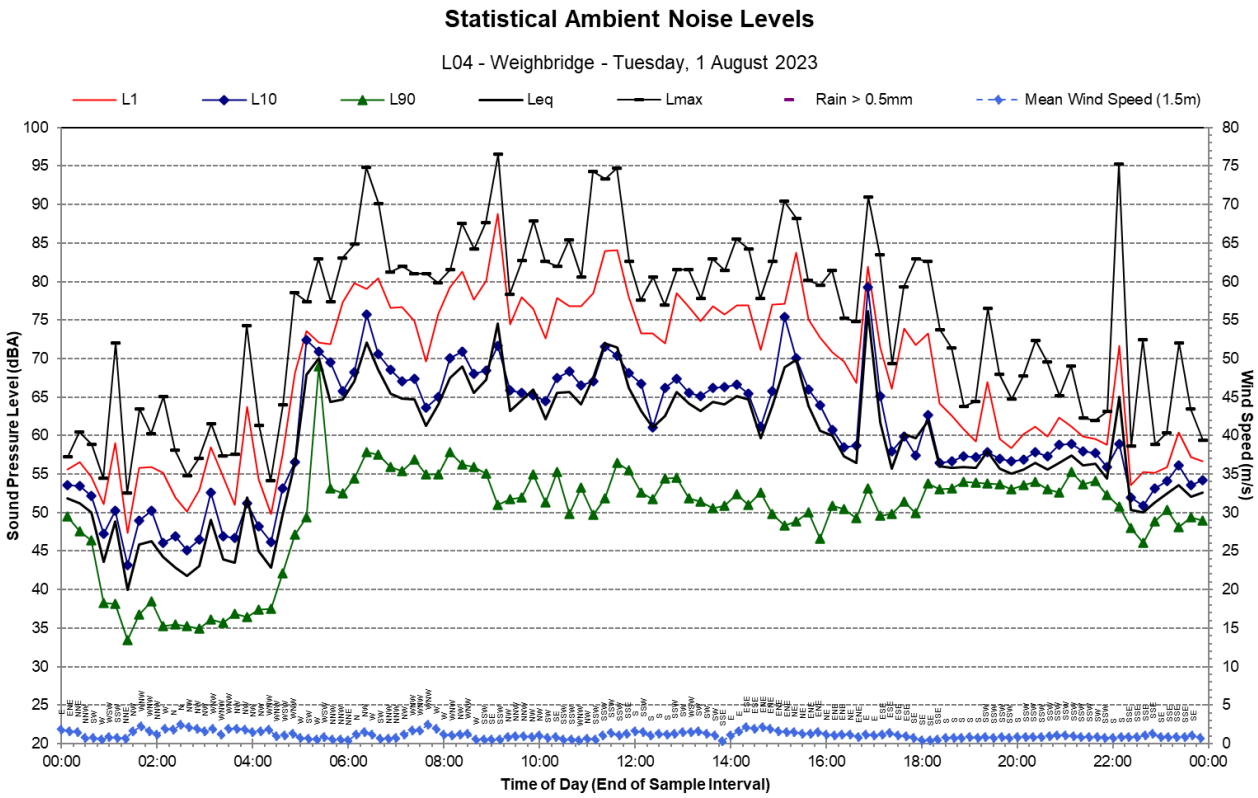
L04 – Weighbridge

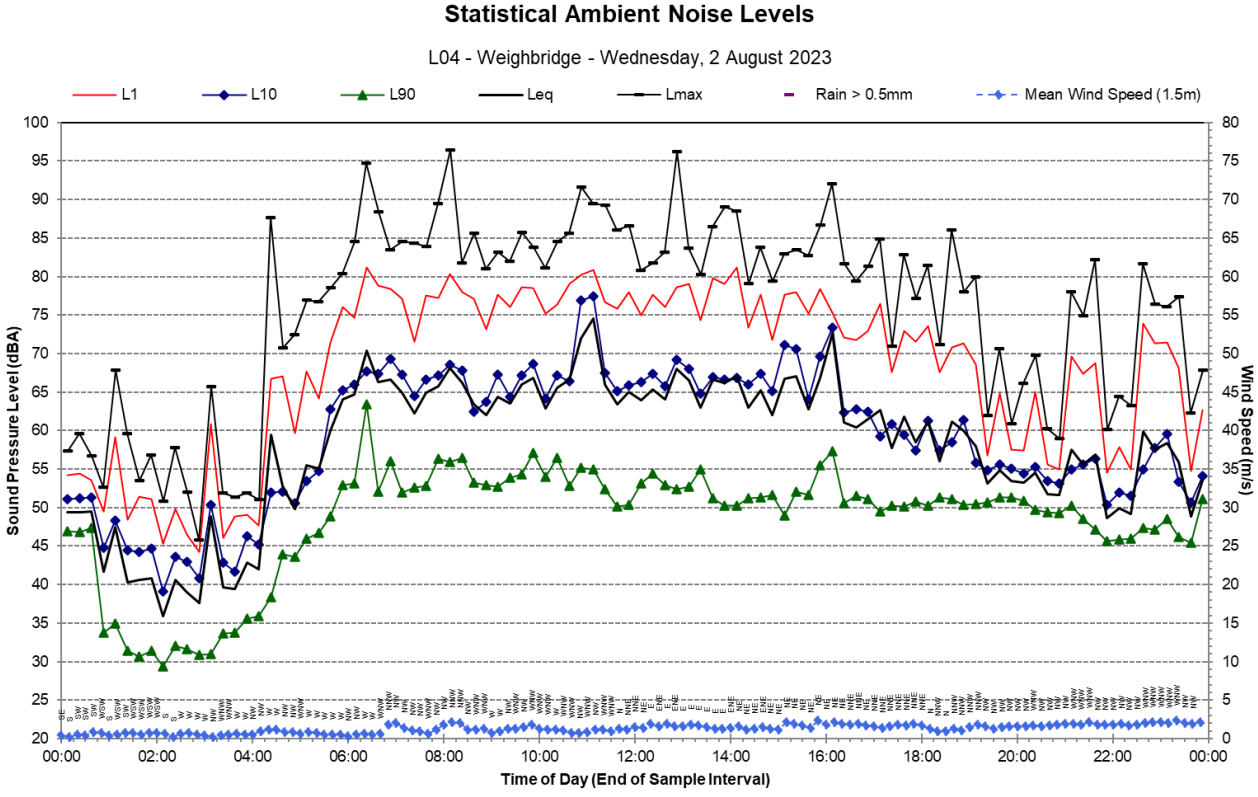


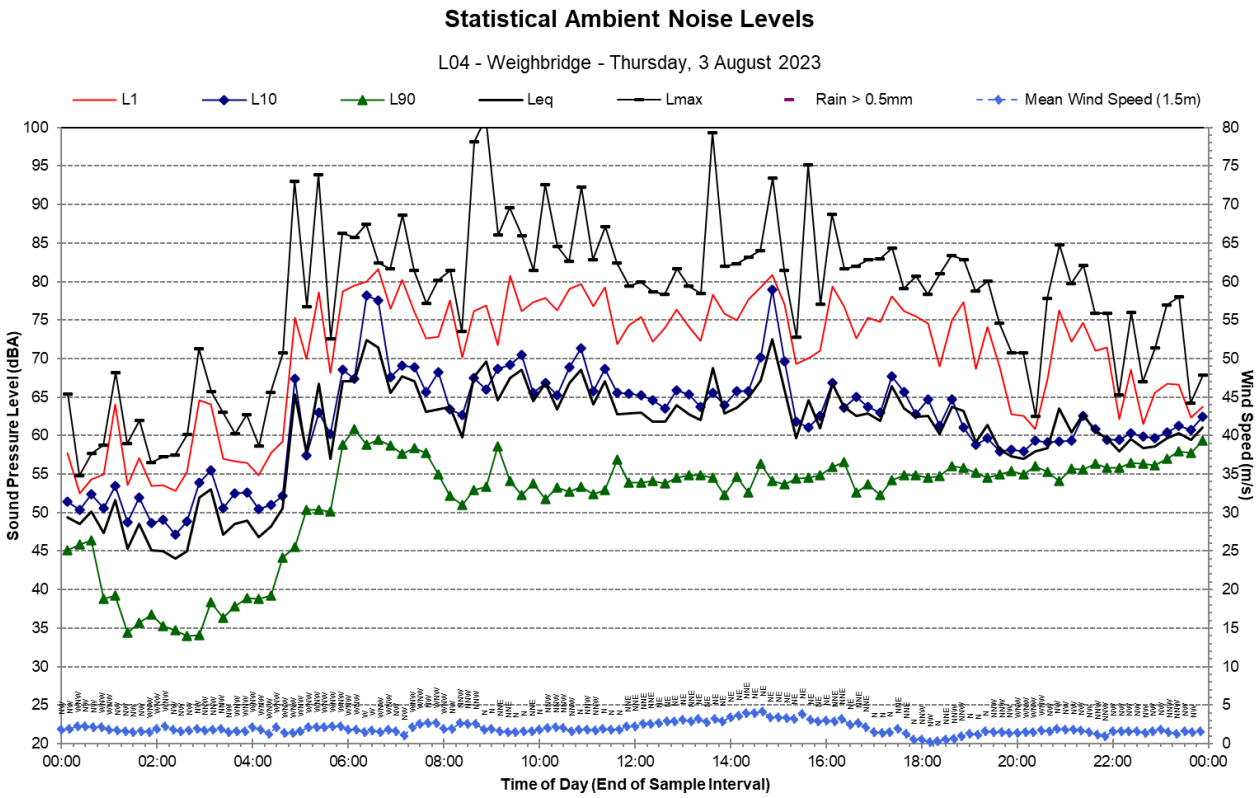


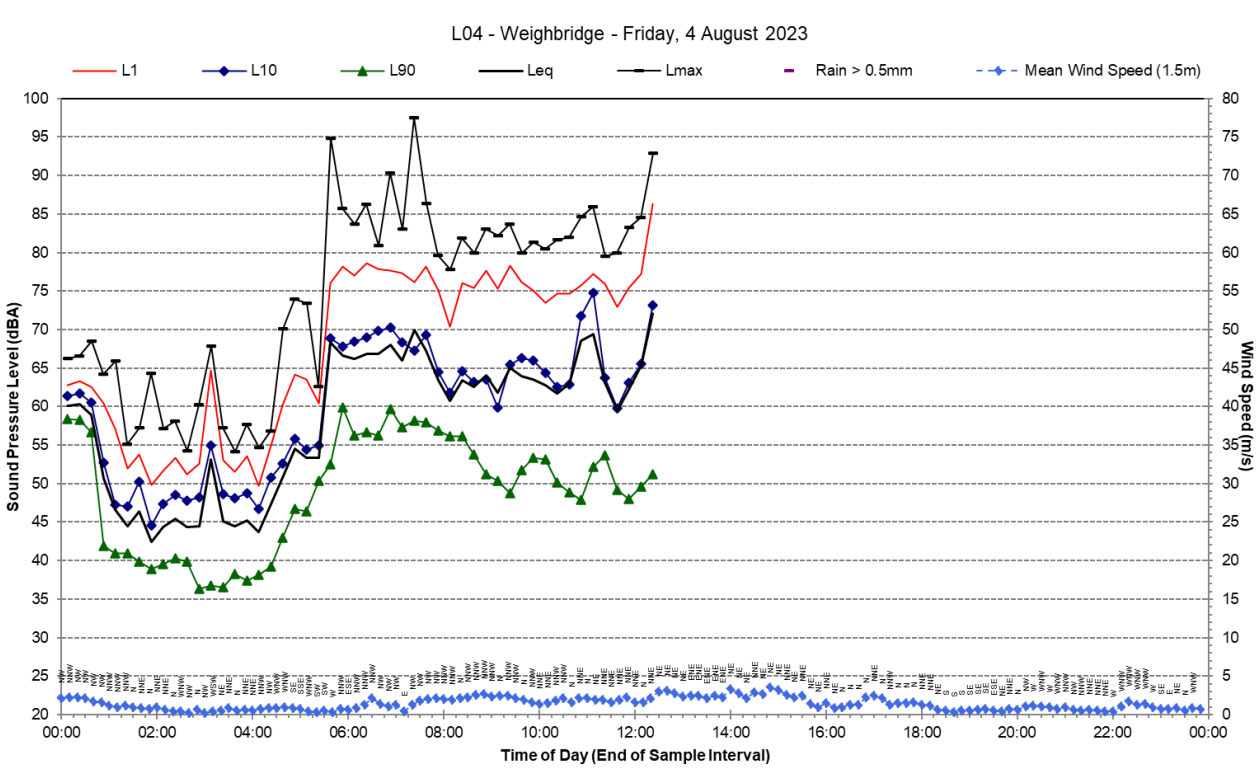

Statistical Ambient Noise Levels
L04 - Weighbridge - Sunday, 30 July 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L04 - Weighbridge - Monday, 31 July 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L04 - Weighbridge - Tuesday, 1 August 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L04 - Weighbridge - Wednesday, 2 August 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

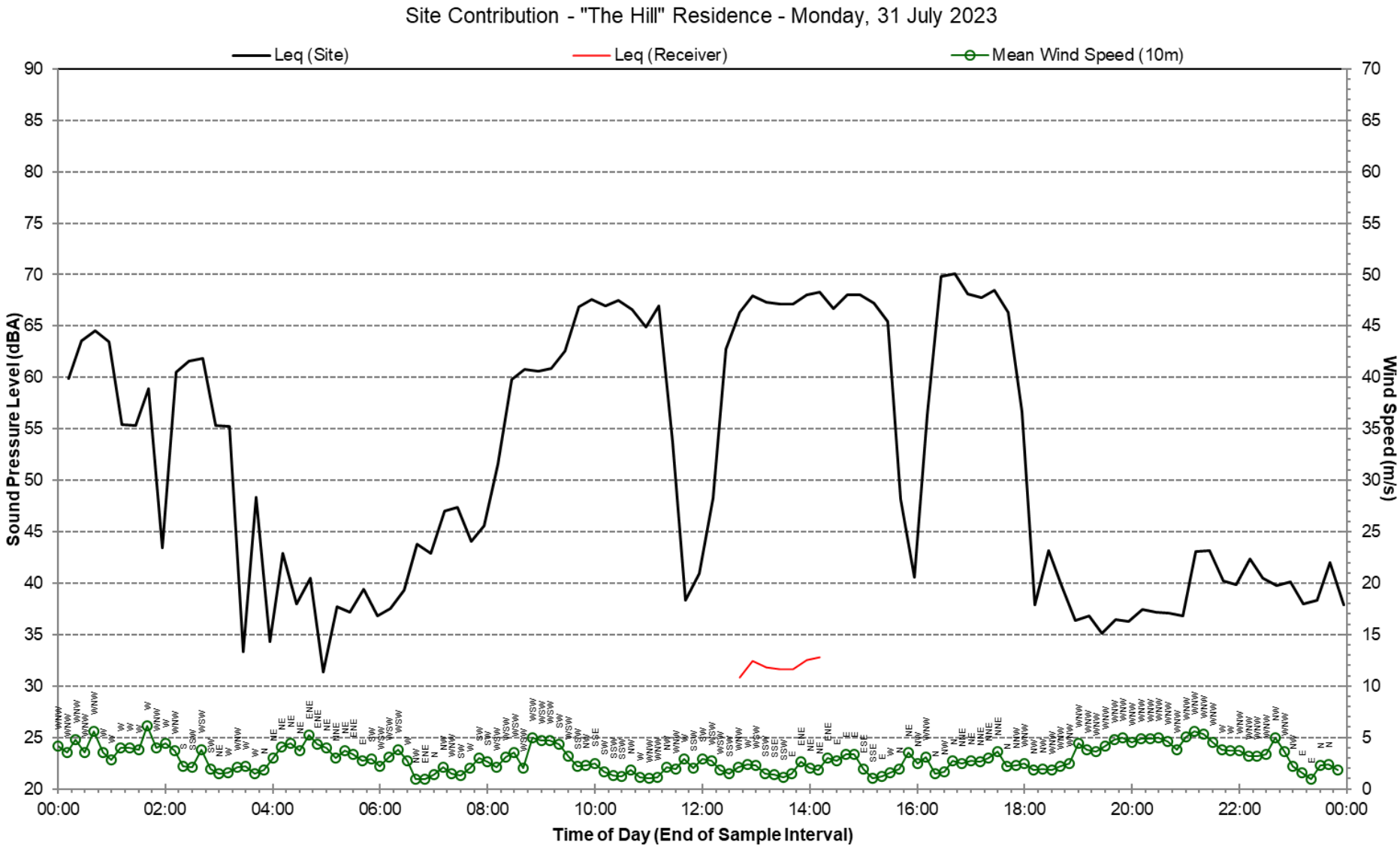

Statistical Ambient Noise Levels
L04 - Weighbridge - Thursday, 3 August 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L04 - Weighbridge - Friday, 4 August 2023
L1
L10
L90
Leq
Lmax
Rain > 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

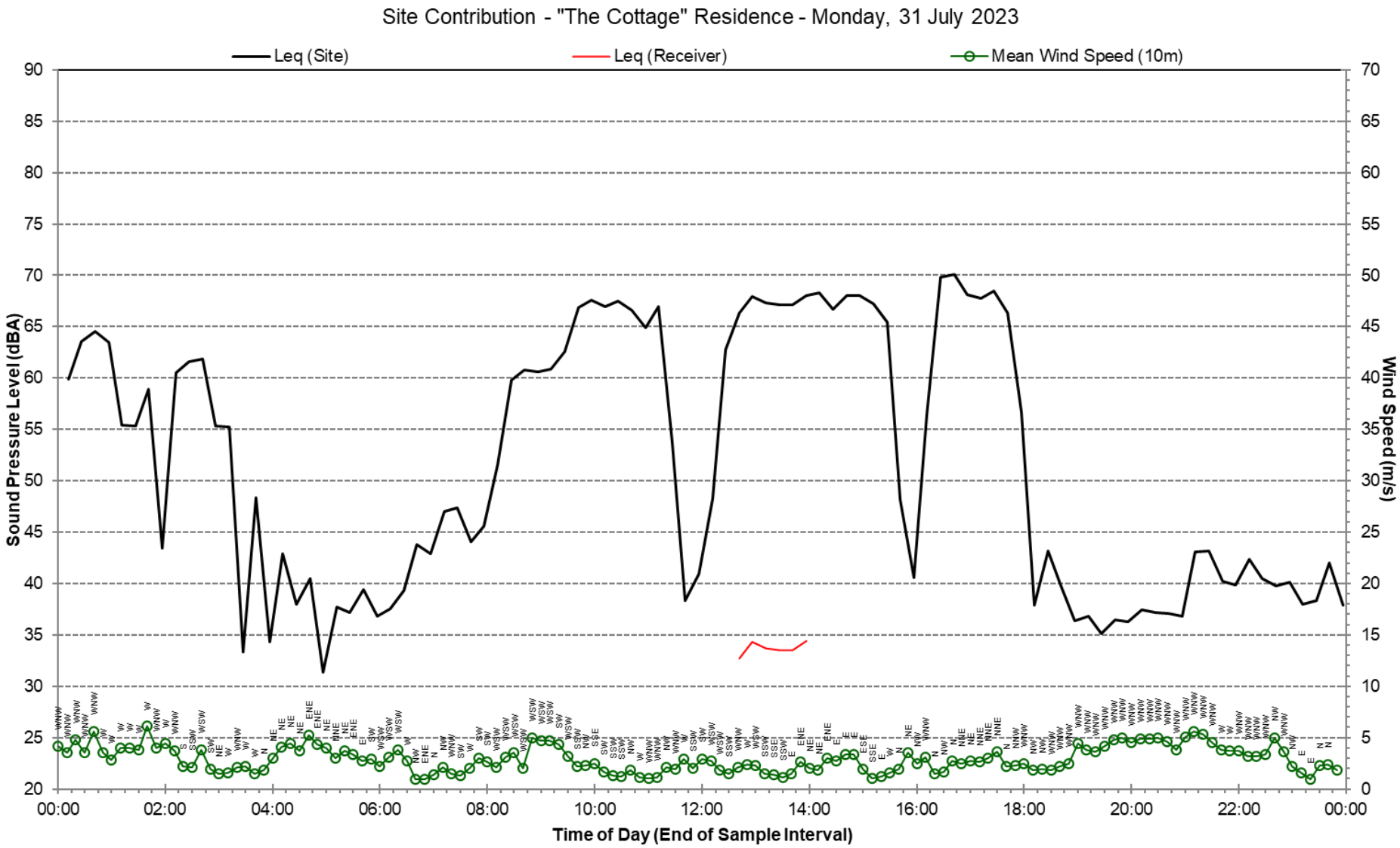
Appendix C:

Site Contributions at Receivers

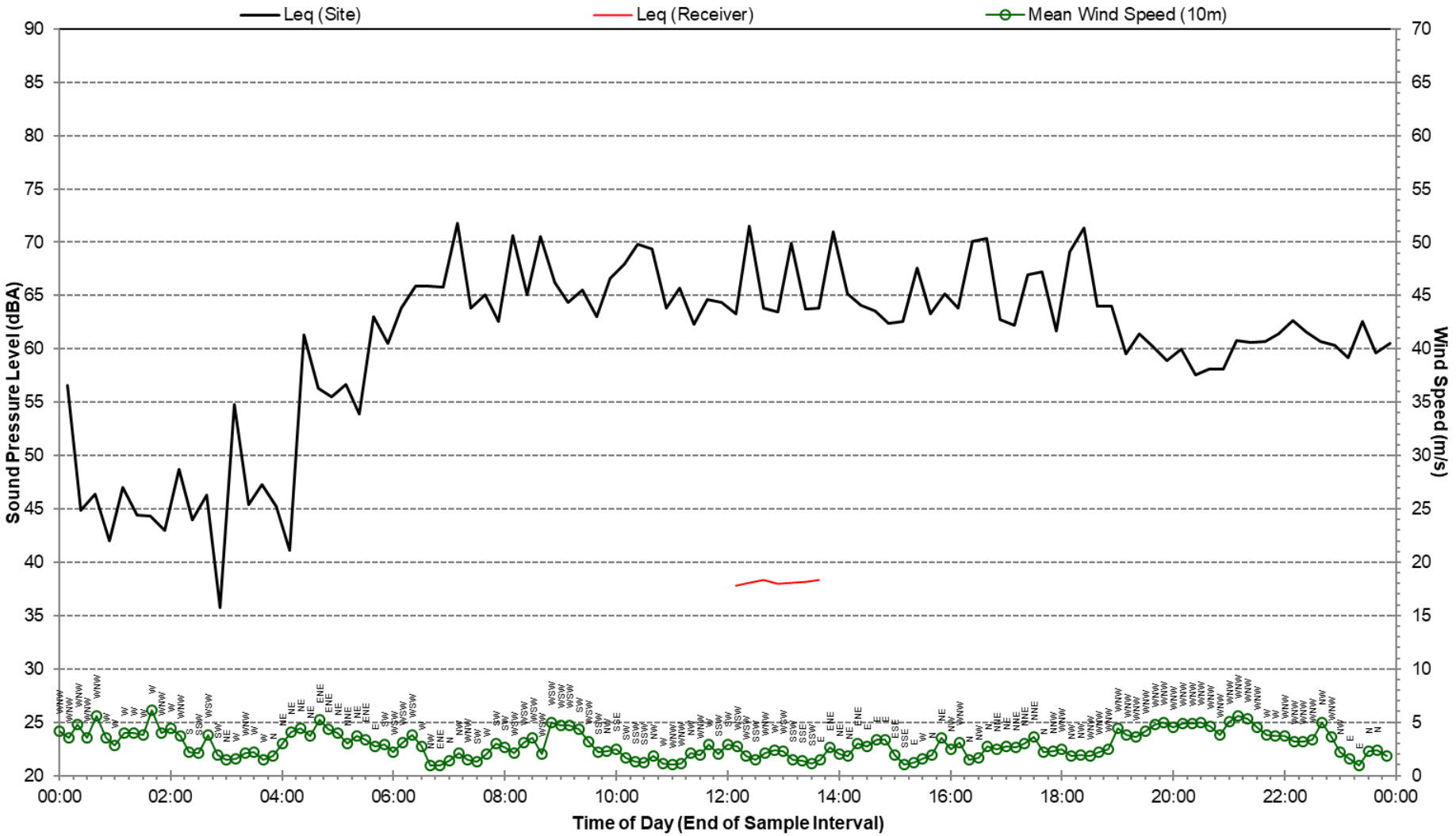
Statistical Ambient Noise Levels



Statistical Ambient Noise Levels



Statistical Ambient Noise Levels



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