DONALDSON AND ABEL COAL MINES

Bi-Annual Noise Monitoring
Half-year Ending July 2021

Prepared for:

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1 Introduction

1.1 Background

Donaldson Coal Pty Ltd has commissioned SLR Consulting Australia Pty Ltd (SLR) to conduct half-yearly noise monitoring surveys for the Donaldson Coal Mine and Abel Coal Mine during the July 2021 half in accordance with the *Donaldson Coal Mine and Abel Underground Coal Mine - Noise Management Plan Care and Maintenance* (the NMP) dated 3 June 2019.

1.2 Objectives of this Report

The objectives of the noise monitoring survey for this operating half-year were as follows:

- Measure the ambient noise levels at six focus receptor locations (potentially worst affected) surrounding Donaldson Coal Mine and Abel Coal Mine.
- Qualify all sources of noise within each of the attended surveys, including estimated contribution or maximum level of individual noise sources.
- Assess the noise emissions of Donaldson Coal Mine and Abel Coal Mine with respect to the limits contained in the Development Consent.

1.3 Acoustic Terminology

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

2 Development Consent Project Approval

Development consent was obtained by Donaldson Coal Pty Ltd for the Donaldson Mine in October 1999 following a Commission of Inquiry. Development Consent number N97/00147 was issued by the Minister for Urban Affairs pursuant to Section 101 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

Project Approval (Application No. 05_0136) granted by the Minister of Planning was obtained by Donaldson Coal Pty Ltd for Abel Coal Mine in 2007.

2.1 Donaldson Coal Mine Development Consent Conditions

The Development Consent nominates hours of operation and mine noise emission goals in the Sections entitled "*Operation of Development, Condition No. 3(1) and 3(2)*", and *"Noise and Vibrational Noise Limits: Condition No. 15*" as follows:

3.(1) Subject to (2) the approved hours of operation are as follows:

Works	*Period*	*Hours*
Construction, including construction of any bunds	*Monday to Friday* *Saturday*	*7 am to 6 pm* *8 am to 1 pm*
Mining operations, including mining, haulage of waste to dumps and coal processing	*Monday to Friday* *Saturday, Sunday*	*24 hours per day* *7 am to 6 pm*
Road Transportation and stockpiling of coal	*7 days per week*	*24 hours per day*
Rail loading of coal	*7 days per week*	*7 am to 10 pm*
Maintenance of mobile and fixed plant	*7 days per week*	*24 hours per day*
Blasting, not involving closure of John Renshaw Drive	*Monday to Saturday*	*7 am to 5 pm*
Blasting, involving closure of John Renshaw Drive	*Monday to Saturday*	*10 am to 2 pm*

Notes: Restrictions on Public Holidays are the same as Sundays

(2) The Applicant shall submit a report to the Director-General's satisfaction demonstrating the noise limits in Condition 15 can be met while rail loading of coal is occurring during the period from 6 pm to 10 pm. If that report does not demonstrate that the noise limits can be met to the Director-General's satisfaction, then the hours of operation for rail loading of coal shall be restricted to 7 am to 6 pm."

15. *Unless subject to a negotiated agreement in accordance with Condition 23, the Applicant shall ensure that the noise emission from construction or mining operations, when measured or computed at the boundary of any dwelling not owned by the applicant (or within 30 metres of the dwelling, if the boundary is more than 30 metres from the dwelling), shall not exceed the following noise limits:*

Location	*$L_{A10(15minute)}$ Noise Limits (dBA)*	
	Daytime	Night-time
Beresfield area (residential)	*45*	*35*
Steggles Poultry Farm	*50*	*40*
Ebenezer Park Area	*46*	*41*
Black Hill Area	*40*	*38*
Buchanan and Louth Park Area	*38*	*36*
Ashtonfield Area	*41*	*35*
Thornton Area	*48*	*40*

Note: Daytime is 7 am to 10 pm Monday-Saturday, and 8 am to 10 pm Sundays and Public Holidays. Night-time is 10 pm to 7 am Monday-Saturday, and 10 pm to 8 am Sundays and Public Holidays.

The noise limits apply for prevailing meteorological conditions (winds up to 3 m/s), except under conditions of temperature inversions."

Other Conditions of Consent relevant to noise are as follows:

18. *The applicant shall survey and investigate noise reduction measures from plant and equipment and set targets for noise reduction in each Annual Environmental Management Report (AEMR), taking into consideration valid noise complaints received in the previous year. The Report shall also include remedial measures.*

19. *The Applicant shall revise the Noise Management Plan as necessary and provide an updated Plan five years after commencement of mining to the Director-General, the independent noise expert (Condition 48), EPA, Councils and the Community Consultative Committee.*

2.2 Abel Coal Mine – Project Approval

Approved Operations

The following operations are approved under the Abel Coal Mine Project Approval:

- Extraction of up to 6.1 Mtpa of Run of Mine (ROM) coal from the Abel Underground Coal Mine.
- Transport coal to the existing Bloomfield Coal Handling and Preparation Plant by private haul roads, or by coal conveyor, or by a combination of both methods.
- Operate the Bloomfield Coal Handling Processing Plant (CHPP) to process coal extracted from the Abel Coal Mine and the Bloomfield and Donaldson Coal Mines.
- Transportation of product coal from the Bloomfield site by rail via the Bloomfield rail loading facility.

The Project Approval was modified in June 2010 (05_0136 MOD 1) allowing construction and operation of a downcast ventilation fan. In May 2011 the Project Approval was modified again (05_0136 MOD 2) to allow the construction and operation of an upcast ventilation fan (and associated facilities). In December 2013 the Project Approval was further modified (05_0136 MOD3) to account for the increase in coal extracted including the upgrade of the Bloomfield CHPP.

Consent Conditions

The relevant conditions relating to noise from the Abel Coal Mine approval are reproduced below.

Schedule 4

NOISE

Operational Noise Criteria

1. *The Proponent shall ensure that the noise generated by the Project does not exceed the criteria in Table 4 at any residence on privately-owned land.*

Table 4: Operational Noise Criteria dB(A)

Location	Receiver Area	Day	Evening	Night	
		$L_{Aeq(15minute)}$	$L_{Aeq(15minute)}$	$L_{Aeq(15minute)}$	$L_{A1(1minute)}$
Location I	Lord Howe Drive, Ashtonfield	*36*	*36*	*36*	*45*
Location K	Catholic Diocese Land	*37*	*37*	*37*	*45*
Location L	Kilshanny Avenue, Ashtonfield	*40*	*40*	*40*	*47*
All other Locations	All other privately owned Residences	*35*	*35*	*35*	*45*

Notes:

- *To interpret the locations referred to in Table 4, see plan in Appendix 3.*
- *Noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW Industrial Noise Policy. Appendix 4 sets out the meteorological conditions under which these criteria apply, and the requirements for evaluating compliance with these criteria.*

These noise criteria do not apply if the Proponent has an Agreement with the relevant landowner to generate higher noise levels, and the proponent has advised the Department in writing of the terms of this agreement.

Construction Noise Criteria

1. *The proponent shall ensure that the noise generated during the construction of the downcast ventilation shaft as described in EA (MOD3) does not exceed the criteria in Table 5.*

Table 5: Construction Noise Criteria dB(A)

Location	Receiver	Day
		$L_{Aeq(15minute)}$
Location R	*281 Lings Road, Buttai*	*50*
Location S	*189 Lings Road, Buttai*	*43*

Notes:

- *The criteria in Table 5 apply only whilst the downcast ventilation shaft is being constructed, and for a maximum of 12 weeks from the commencement of construction.*
- *To interpret the locations referred to in Table 5, see plan in Appendix 3* (attached to this report as **Appendix A**).
- *Noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW Industrial Noise Policy.*

However, these noise criteria do not apply if the Proponent has an Agreement with the relevant landowner to generate higher noise levels, and the proponent has advised the Department in writing of the terms of this agreement.

Rail Noise Criteria

1. *The proponent shall ensure that the noise from rail movements on the Bloomfield Rail Spur does not exceed the limits in Table 6 at any residence on privately owned land.*

Table 6: Rail Spur noise criteria dB (A)

Location	*Day*	*Evening*	*Night*
	$L_{Aeq(period)}$		
All privately-owned land	*55*	*45*	*40*

Cumulative Noise Criteria

1. *The proponent shall implement all reasonable and feasible measures to ensure that the noise generated by the project combined with noise generated by other mines does not exceed the criteria in Table 7 at any residence on privately-owned land.*

Table 7: Cumulative noise criteria dB (A)

Location	*Day*	*Evening*	*Night*
	$L_{Aeq(period)}$		
All privately-owned land	*55*	*45*	*40*

Notes: Cumulative noise is to be measured in accordance with the relevant requirements, and exemptions (including meteorological conditions), of the NSW Industrial Noise Policy. Appendix 4 sets out the metrological conditions under which these criteria apply and the requirements for evaluating compliance with these criteria.

Operating Conditions

1. *The proponent shall:*
    a. *Implement best management practise to minimise the construction, operational, road and rail noise of the project;*
    b. *Operate an on-site noise management system to ensure compliance with the relevant conditions of this approval;*
    c. *Minimise the noise impacts of the project during meteorological conditions under which the noise limits in this consent do not apply (see Appendix 4);*
    d. *Only receive and/or dispatch locomotives and rolling stock either on or from the site that are approved to operate on the NSW rail network in accordance with the noise limits in ARTC's EPL (No. 3142);*
    e. *Carry out regular monitoring to determine whether the project is complying with the noise criteria and other relevant conditions of approval, to the satisfaction of the Director-General.*

Noise Management Plan

2. *The proponent shall prepare and implement a Noise Management Plan for the project to the satisfaction of the Director-General. This plan must:*
    a. *Be prepared in consultation with the EPA, and be submitted to the Director-General for approval within 6 months of the date of approval of MOD 3;*
    b. *Describe the measures that would be implemented to ensure compliance with the noise criteria and operating conditions in this approval; Describe the proposed noise management system in detail; and*
    c. *Include a monitoring program that:*
        - *Uses attended monitoring to evaluate the compliance of the project against the noise criteria in this approval;*
        - *Evaluates and reports on:*
            - *The effectiveness of the on-site noise management system; and*
            - *Compliance against the noise operating conditions; and*

Defines what constitutes a noise incident, and includes protocol for identifying and notifying the Department and relevant stakeholders of any noise incidents. Appendix 4

Noise Compliance Assessment

Applicable Meteorological Conditions

1. *The noise criteria in Tables 4 and 7 are to apply under all metrological conditions except the following:*
    a. *During periods of rain or hail.*
    b. *Average wind speed at microphone height exceeds 5 m/s;*
    c. *Wind speeds greater than 3 m/s measured at 10m above ground level; or*
    d. *Temperature inversion conditions greater than $3^{o}C/100m$.*

Determination of metrological conditions

2. *Except for wind speed at microphone height, the data to be used for determining metrological conditions shall be that recorded by the meteorological station located on the site.*

Compliance monitoring

3. *Attended monitoring is to be used to evaluate compliance with the relevant conditions of this approval.*
4. *Unless otherwise agreed with the director-general, this monitoring is to be carried out in accordance with the relevant requirements for reviewing performance set out in the NSW Industrial Noise Policy (as amended from time to time), in particular the requirements relating to:*
    a. *Monitoring locations for the collection of representative noise data;*
    b. *Metrological conditions during which collection of noise data is not appropriate;*
    c. *Equipment used to collect noise data, and conformity with Australian Standards relevant to such equipment; and*
    d. *Modification to noise data collected, including for the exclusion of extraneous noise and/or penalties for modifying factors apart from adjustments for duration.*

Appendix 5

Statement of Commitments

3. Noise

3.1 Construction Activities

The following noise control measures will be implemented prior to commencement of construction of the Abel Underground Mine or the upgrade of the Bloomfield CHPP.

1. *Maintain all machinery and equipment in working order;*
    a. *No construction activities at the Abel pit top will take place on Sundays or Public Holidays;*
    b. *Where possible locate noisy site equipment behind structures that act as barriers or at the greatest distance from noise sensitive areas; and*
    c. *Orientate equipment so that noise emissions are directed away from noise sensitive areas.*

3.2 Noise Control Measures

a. *The following noise control measures will be implemented prior to the mining of coal from the Abel underground Mine:*
    i. *Orientation of the ventilation fans away from residential receivers and angle the output parallel to the ground.*
    ii. *The sound power level of the front end loader to be used near the portal should not exceed 113 dBA and will be fitted with a noise sensitive reversing alarm.*

b. *The following noise control measures will be implemented prior to the Bloomfield CHPP receiving any ROM coal from Able Underground Mine;*

i. Noise mitigation works including partial enclosure and noise screening of drives and conveyors of the Bloomfield CHPP to screen residences to the north of the site.

3.2 Monitoring

The Company will implement a Noise Monitoring Program for the Abel Underground Mine and the Bloomfield CHPP, to the satisfaction of the Director-General. The Noise Monitoring Program shall include a combination of real-time and supplementary attended monitoring measures, and a noise monitoring protocol for evaluating compliance with the noise environmental assessment. This plan will be integrated with the monitoring plans for the Tasman, Donaldson and Bloomfield Mines to provide a single integrated Noise Monitoring Program for all 4 mines.

3.4 Continuous Improvement

The Company shall:

a. Report on these investigations and implementation of any new noise mitigation measures on site in the AEMR, to the satisfaction of the Director General.

The operator of the Bloomfield CHPP shall:

b. Investigate ways to reduce the noise generated by the Bloomfield CHPP, including maximum noise levels which may result in sleep disturbance;

c. Implement all reasonable and feasible best practice noise mitigation measures on the site; and

d. Report on these investigations and the implementation of any new noise mitigation measures on site in the AEMR, to the satisfaction of the Director-General.

3 Noise Monitoring Methodology

3.1 General Requirements

The operational noise monitoring program was conducted with reference to Development Consent N97/00147 (Donaldson Coal Mine), Project Approval 05_0136 (Abel Coal Mine), the NMP and AS 1055-2018 *Acoustics - Description and Measurement of Environmental Noise*.

All acoustic instrumentation employed throughout the monitoring program has been designed to comply with the requirements of AS IEC 61672.1 – 2004 *Electroacoustics—Sound level meters – Specifications*, AS IEC 61672.2-2004, AS IEC 61672.3-2004 and carried current NATA or manufacturer calibration certificates. Certificates for acoustic instrumentation used during the July 2021 half is provided in **Appendix B**.

Instrument calibration was conducted before and after each measurement, with the variation in calibrated levels not exceeding ±0.5 dBA.

It is noted that availability and deployment of noise logging equipment was delayed due to COVID-19 and as such noise monitoring was conducted as soon as practicable in July 2021.

3.2 Monitoring Locations

Baseline and preceding operational half-yearly surveys have been conducted at 11 locations surrounding the Donaldson Mine and Abel Coal Mine sites. With the experience of these previous surveys, it was decided to concentrate noise monitoring at six focus locations that represent the potentially most noise affected areas from Donaldson Mine and Abel Coal Mine. The details of the monitoring locations are contained within **Table 1**.

It is relevant to note that Donaldson Open Cut Mine has ceased production and all major earthworks on the site have been finalised. Furthermore, Abel mine was placed in Care & Maintenance on 28th April 2016 and there were no operations onsite during the July 2021 noise monitoring period.

Table 1 Monitoring Locations

Noise Monitoring Location	Description
D	Black Hill School, Black Hill
F	Lot 684 Black Hill Road, Black Hill
G	156 Buchannan Road, Buchannan
I	Magnetic Drive, Ashtonfield
J	Parish Drive, Thornton
L	65 Tipperary Dr, Ashtonfield

A map giving the approximate location of the noise monitoring sites is contained within **Appendix C**.

3.3 Unattended Continuous Noise Monitoring

An environmental noise logger was deployed for a minimum of a seven day period between Thursday 1 July 2021 to Tuesday 13 July 2021 at each of the six (6) nominated locations given in **Table 1**.

All unattended monitoring equipment was programmed to continuously record statistical noise level indices in 15 minute intervals including the L_{Amax}, L_{A1}, L_{A10}, L_{A90}, L_{A99}, L_{Amin} and L_{Aeq}. The statistical noise exceedance levels (L_{AN}) are the levels exceeded for N% of the 15 minute interval. The L_{A90} represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level. The L_{A10} is the level exceeded for 10% of the time and is usually referred to as the average maximum noise level. The L_{Aeq} is the equivalent continuous sound pressure level and represents the steady sound level which is equal in energy to the fluctuating level over the interval period. The L_{Amax} is the maximum noise level recorded over the interval.

3.4 Operator Attended Noise Monitoring

Operator attended surveys were conducted at each of the six monitoring locations during the daytime, evening and night-time periods, to verify the unattended logging results and to determine the character and contribution of ambient noise sources.

4 Operator Attended Noise Monitoring

4.1 Results of Operator Attended Noise Monitoring

Operator attended noise measurements were commenced on Thursday 1 July 2021 and finished during the night-time period on Friday 2 July 2021. Operator attended noise surveys were conducted using a Brüel & Kjær Type 2270 (serial number 2679354).

Ambient noise levels given in the tables include all noise sources such as traffic, insects, birds, and mine operations as well as any other industrial operations.

The tables provide the following information:

- Monitoring location.
- Date and start time.
- Wind velocity (m/s) and Temperature (ºC) at the measurement location.
- Typical maximum (L_{Amax}) and contributed noise levels.

Mine contributions listed in the tables are from the Abel Coal Mine and are stated only when a contribution could be quantified.

Table 2 Location D, Black Hill Public School, Black Hill

Period	Date/ Start time/Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission, Typical Maximum Noise Levels (LAmax – dBA)
		LAmax	LA1	LA10	LA90	LAeq	
Day	01/07/2021 14:43 14°C 0.9 m/s WNW	77	66	52	39	54	Birdsong 45-63 Road traffic 40-77 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					
Evening	01/07/2021 18:24 13°C 0.1 m/s SW	76	63	48	43	52	Road traffic 40-76 Insects 42-47 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					
Night	1/07/2021 22:26 12°C 0.6 m/s WNW	54	49	46	42	44	Insects 41-51 Road traffic 35-54 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					

Table 3 Location F, Lot 684 Black Hill Road, Black Hill

Period	Date/ Start time/Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission, Typical Maximum Noise Levels (LAmax – dBA)
		LAmax	LA1	LA10	LA90	LAeq	
Day	1/7/2021 17:47 13°C 0.2 m/s W	81	69	56	48	58	Road traffic 48-81 Insects 36-42 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					
Evening	1/7/2021 18:03 13°C 0.2 m/s WSW	78	64	55	48	55	Insects 36-43 Road traffic 48-78 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					
Night	1/7/2021 22:48 12°C 1.0 m/s WNW	73	59	50	42	49	Road traffic 44-73 Insects 41-43 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					

Table 4 Location G, Buchanan Road, Buchanan

Period	Date/ Start time/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission, Typical Maximum Noise Levels (LAmax – dBA)
		LAmax	LA1	LA10	LA90	LAeq	
Day	1/7/2021 16:07 14°C 0.5 m/s SSW	62	51	49	44	47	Road traffic 43-58 Insects 28-30 Birdsong 42-62 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					
Evening	1/7/2021 19:38 13°C 0.8 m/s S	58	49	47	39	44	Road traffic 45-51 Insects 30-33 Aeroplane 49 Other industry 28-44 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					
Night	1/7/2021 23:54 12°C 1.2 m/s NNW	52	45	39	31	36	Road traffic 32-47 Insects 30-52 Other industry 26-30 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					

Table 5 Location I, Magnetic Drive, Ashtonfield

Period	Date/ Start time/Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission, Typical Maximum Noise Levels (LAmax – dBA)
		LAmax	LA1	LA10	LA90	LAeq	
Day	1/7/2021 16:55 13°C 0.7 m/s S	69	59	45	36	46	Road traffic 34-69 Birdsong 47-53 Insects 33-38 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					
Evening	1/7/2021 21:08 13°C 1.2 m/s NW	53	43	40	37	39	Traffic 35-53 Insects 37-40 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					
Night	2/7/2021 00:44 12°C 0.8 m/s WNW	51	41	38	33	36	Traffic 25-51 Insects 33-48 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					

Table 6 Location J, Parish Drive, Thornton

Period	Date/ Start time/Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission, Typical Maximum Noise Levels (LAmax – dBA)
		LAmax	LA1	LA10	LA90	LAeq	
Day	1/07/2021 17:18 13°C 1.0 m/s S	70	59	45	39	46	Road traffic 38-65 Resident 45-50 Birdsong 46-70 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					
Evening	1/7/2021 21:41 12°C 0.3 m/s W	59	42	41	39	40	Road traffic 37-59 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					
Night	1/7/2021 22:00 12°C 0.3 m/s SSW	66	45	42	36	40	Road traffic 40-57 Exhaust click 66 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					

Table 7 Location L, 65 Tipperary Drive, Ashtonfield

Period	Date/ Start time/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission, Typical Maximum Noise Levels (LAmax – dBA)
		LAmax	LA1	LA10	LA90	LAeq	
Day	1/07/2021 16:34 13°C 0.7 m/s SSW	74	67	50	37	53	Road traffic 40-74 Residents AC 37 Birdsong 42-59 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					
Evening	1/7/2021 20:08 13°C 1.2 m/s WNW	65	60	43	34	45	Road traffic 35-65- Residential noise 40-52 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					
Night	02/7/2021 00:22 12°C 0.5 m/s W	49	35	30	26	29	Road traffic 30-49 Residential noise 25-30 **Abel Mine Inaudible**
		Estimated Abel Mine Noise Contribution Inaudible					

4.2 Operator Attended Noise Monitoring Summary

4.2.1 Donaldson Mine

Donaldson Open Cut Mine has ceased production and all major earthworks on the site have been finalised. Therefore, compliance noise monitoring for the Donaldson Open Cut Mine is no longer required.

4.2.2 Abel Coal Mine

Abel mine was placed in Care & Maintenance on 28th April 2016 and there were no operations onsite, excluding that from the Bloomfield CHPP which operates under the Abel Coal Mine project consent conditions.

The Bloomfield CHPP and stockpile area were inaudible during all operator attended noise surveys. Noise generated by local and distant traffic was a significant contributor to ambient noise levels at all monitored locations as well as ‘natural’ noises such as birds, insects and wind related noise.

4.3 Compliance Assessment and Discussion of Results

4.3.1 Operations

Results of the operational compliance assessment are given in **Table 8**.

Table 8 Compliance Noise Assessment - Operations

Location	Estimated Abel $L_{Aeq(15minute)}$ Contribution dBA			Consent Conditions			Compliance		
	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night
D – Black Hill School, Black Hill	Inaudible	Inaudible	Inaudible	35	35	35	Yes	Yes	Yes
F – Black Hill Road, Black Hill	Inaudible	Inaudible	Inaudible	35	35	35	Yes	Yes	Yes
G – Buchanan Road, Buchanan	Inaudible	Inaudible	Inaudible	35	35	35	Yes	Yes	Yes
I – Magnetic Drive, Ashtonfield	Inaudible	Inaudible	Inaudible	36	36	36	Yes	Yes	Yes
J – Parish Drive, Thornton	Inaudible	Inaudible	Inaudible	35	35	35	Yes	Yes	Yes
L – 65 Tipperary Dr, Ashtonfield	Inaudible	Inaudible	Inaudible	40	40	40	Yes	Yes	Yes

Results presented in **Table 8** indicate that compliance with the relevant consent conditions was achieved at all noise monitoring locations during all periods.

4.3.2 Sleep Disturbance

Results of the sleep disturbance compliance assessment are given in **Table 9**.

Table 9 Compliance Noise Assessment – Sleep Disturbance

Location	Estimated Bloomfield $L_{A1(1minute)}$ Contribution dBA	Consent Conditions $L_{A1(1minute)}$ dBA	Compliance
D – Black Hill School, Black Hill	Inaudible	45	Yes
F – Black Hill Road, Black Hill	Inaudible	45	Yes
G – Buchanan Road, Buchanan	Inaudible	45	Yes
I – Magnetic Drive, Ashtonfield	Inaudible	45	Yes
J – Parish Drive, Thornton	Inaudible	45	Yes
L – 65 Tipperary Dr, Ashtonfield	Inaudible	47	Yes

Results presented in **Table 9** indicate that compliance with the sleep disturbance consent conditions was achieved at all noise monitoring locations during the night-time noise surveys.

5 Unattended Continuous Noise Monitoring

5.1 Results of Unattended Continuous Noise Monitoring

Unattended continuous noise monitoring was conducted between Thursday 1 July 2021 and Tuesday 13 July 2021 at each of the six monitoring locations given in **Table 10**.

Table 10 Noise Logger and Noise Monitoring Locations

Location	Noise Logger Serial Number	Date of Logging
D – Black Hill School, Black Hill	SVAN 957 20666	1/7/2021 to 13/7/2021
F – Black Hill Road, Black Hill	ARL 316 16-203-528	1/7/2021 to 13/7/2021
G – Buchanan Road, Buchanan	ARL NGARA 8781DD	1/7/2021 to 13/7/2021
I – Magnetic Drive, Ashtonfield	ARL EL316 16-203-521	1/7/2021 to 13/7/2021
L – 65 Tipperary Dr, Ashtonfield	ARL NGARA 878202	1/7/2021 to 13/7/2021
J – Parish Drive, Thornton[1]	SVAN 957 27523	1/7/2021 to 13/7/2021

The unattended ambient noise logger data from each monitoring location are presented graphically on a daily basis and are attached as **Appendix C**. A summary of the results of the unattended continuous noise monitoring is given in **Table 11**.

The ambient noise level data quantifies the overall noise level at a given location independent of its source or character.

The measured ambient noise levels were divided into three periods representing day, evening and night as designated in the NSW Noise Policy for Industry (NPfI).

Precautions were taken to minimise influences from extraneous noise sources (eg optimum placement of the loggers away from creeks, trees, houses, etc), however, not all these sources or their effects can be eliminated. This is particularly the case during the warmer times of year when noise from insects, frogs, birds and other animals can become quite prevalent.

Weather data for the subject area during the noise monitoring period was provided by Bloomfield Colliery. Noise data during periods of any rainfall and/or wind speeds in excess of 5 m/s were discarded in accordance with NPfI weather affected data exclusion methodology.

Table 11 Unattended Continuous Noise Monitoring Ambient Noise Levels (dBA)

Location	Period	Primary Noise Descriptor (dBA re 20 µPA)			
		L_{A1}	L_{A10}	L_{A90}	L_{Aeq}
D Black Hill School, Black Hill	Day	68	55	34	57
	Evening	57	45	38	50
	Night	48	44	37	48
F Lot 684 Black Hill Road, Black Hill	Day	72	57	45	59
	Evening	61	55	42	55
	Night	58	52	39	53
G 156 Buchanan Road, Buchanan	Day	51	49	40	47
	Evening	50	47	36	45
	Night	48	43	30	42
I 49 Magnetic Drive, Ashtonfield	Day	67	55	37	58
	Evening	56	46	38	49
	Night	47	40	34	45
L 65 Tipperary Dr, Ashtonfield	Day	61	51	37	51
	Evening	56	40	30	46
	Night	40	34	27	41
J 220 Parish Drive, Thornton	Day	52	47	38	46
	Evening	48	45	37	44
	Night	46	42	32	42

5.2 Long term Unattended Continuous Monitoring Summary for Donaldson Mine and Abel Coal Mine

5.2.1 Ambient LA90 Noise Levels

The long term ambient L_{A90} noise levels collected from each monitoring location are presented graphically in **Figure 1**, **Figure 2** and **Figure 3** for the daytime, evening and night-time periods respectively.

Figure 1 Long Term Daytime LA90 Noise Levels

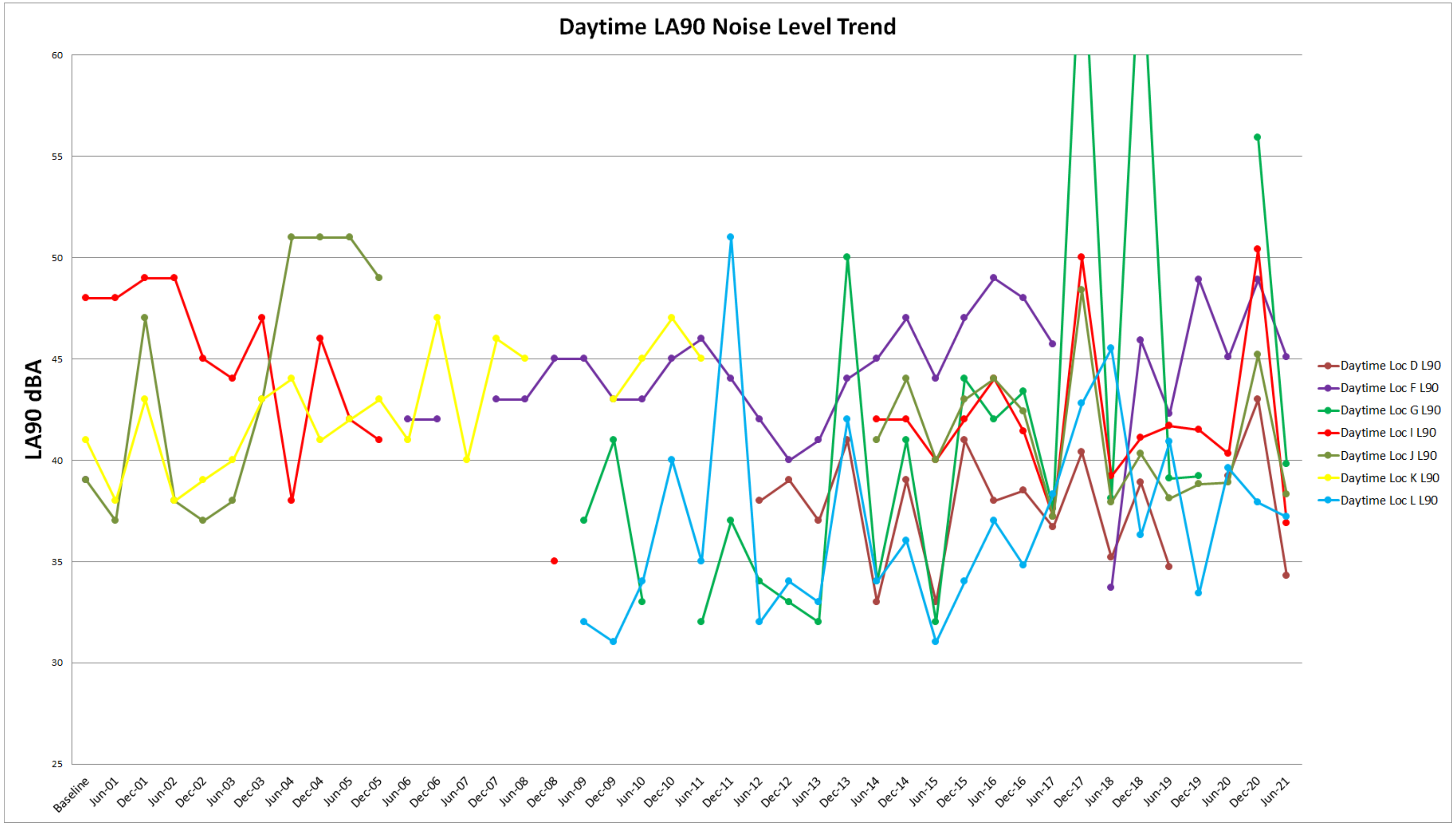


Figure 2 Long Term Evening L_{A90} Noise Levels

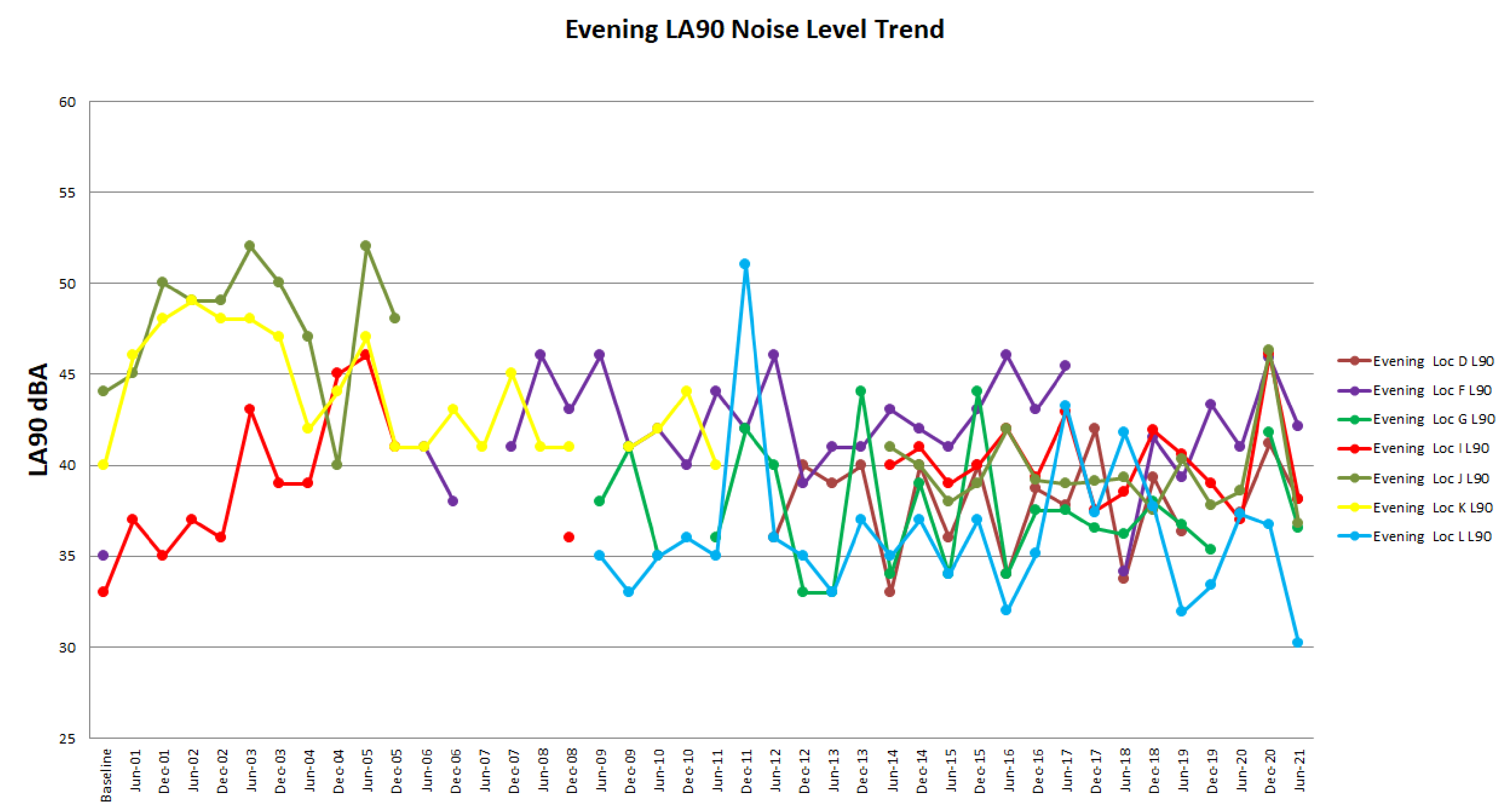
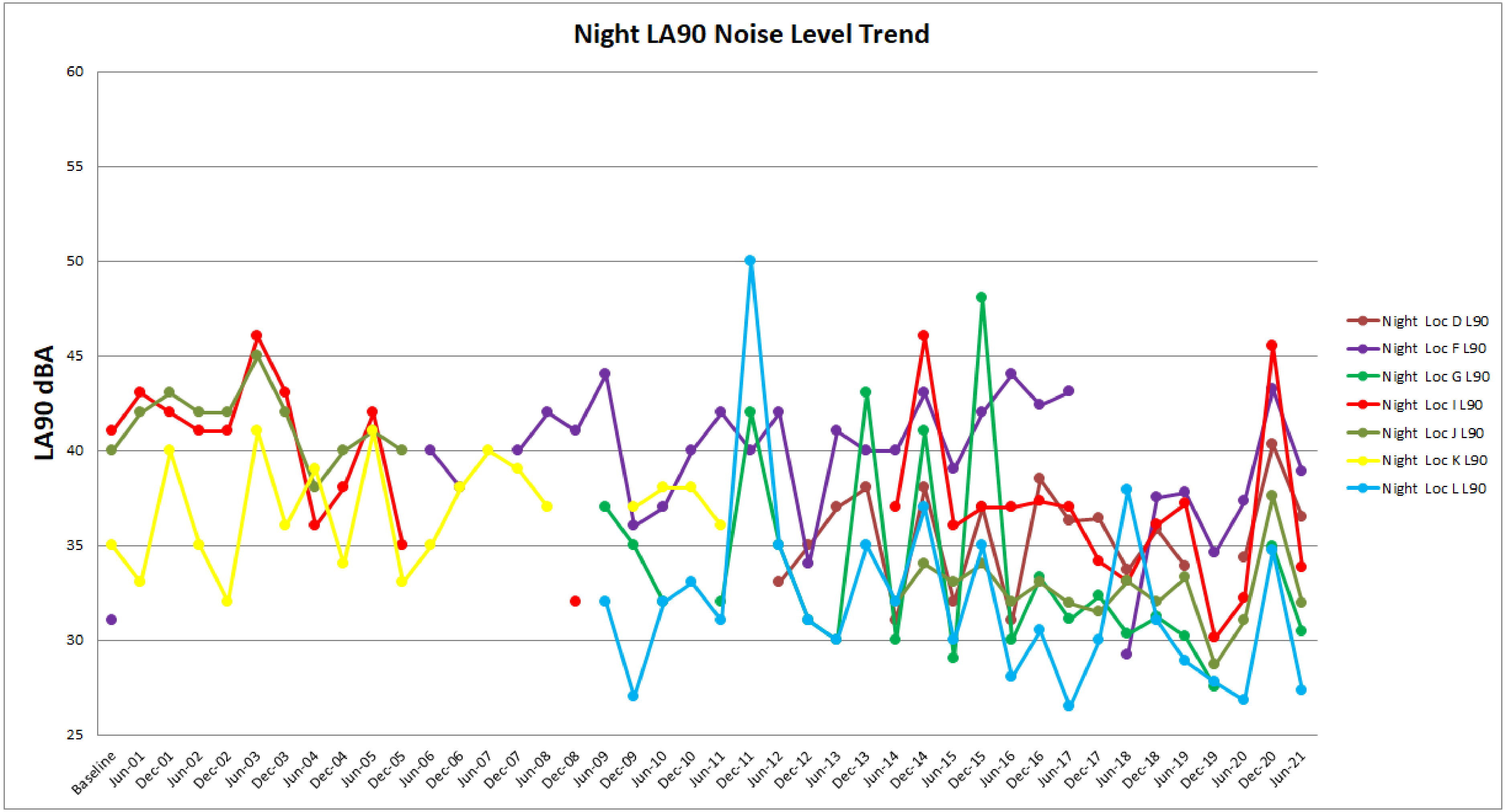


Figure 3 Long Term Night-time LA90 Noise Levels



5.2.1.1 Baseline

The summary of results in **Table 12** shows the ambient LA90 noise levels recorded for the current monitoring period compared to the levels recorded during the baseline monitoring process (ie. prior to commencement of mining operation at Donaldson).

Table 12 LA90 Results Comparison - Baseline

Monitoring Location	Period[1]	Long term Night-time LA90 Noise Levels		Difference dB[3]
		Baseline	**July 2021**	
D Black Hill School, Black Hill	Day	N/A[2]	34	N/A[2]
	Evening	N/A[2]	38	N/A[2]
	Night	N/A[2]	37	N/A[2]
F Lot 684 Black Hill Road, Black Hill	Day	39	45	6
	Evening	35	42	7
	Night	31	39	8
G 156 Buchanan Road, Buchanan	Day	N/A[2]	40	N/A[2]
	Evening	N/A[2]	37	N/A[2]
	Night	N/A[2]	30	N/A[2]
I 49 Magnetic Drive, Ashtonfield	Day	48	37	-11
	Evening	33	38	5
	Night	41	34	-7
L 65 Tipperary Drive, Ashtonfield	Day	N/A[2]	37	N/A[2]
	Evening	N/A[2]	30	N/A[2]
	Night	N/A[2]	27	N/A[2]
J 220 Parish Drive, Thornton	Day	39	38	-1
	Evening	44	37	-7
	Night	40	32	-8

Note 1: Periods are as detailed the NPfI and are Daytime - 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening - 6.00 pm 10.00 pm; Night - 10.00 pm to 7.00 am pm Monday to Saturday, 10.00 pm to 8.00 am Sunday.

Note 2: No data was available during baseline measurements, no comparisons can be made.

Note 3: Rounded to the nearest whole dB.

5.2.1.2 Previous Half-year

Table 13 presents the ambient LA10 noise levels recorded for the current monitoring period compared to those measured during the previous monitoring period.

Table 13 LA90 Results Comparison – Previous Half-year

Monitoring Location	Period[1]	Long term Night-time LA10 Noise Levels		Difference dB[2]
		December 2020	**July 2021**	
D Black Hill School, Black Hill	Day	43	34	-9
	Evening	41	38	-3
	Night	40	37	-4
F Lot 684 Black Hill Road, Black Hill	Day	49	45	-4
	Evening	46	42	-4
	Night	43	39	-4
G 156 Buchanan Road, Buchanan	Day	56	40	-16
	Evening	42	37	-5
	Night	35	30	-5
I 49 Magnetic Drive, Ashtonfield	Day	50	37	-14
	Evening	46	38	-8
	Night	46	34	-12
L 65 Tipperary Drive, Ashtonfield	Day	38	37	-1
	Evening	37	30	-7
	Night	35	27	-7
J 220 Parish Drive, Thornton	Day	45	38	-7
	Evening	46	37	-10
	Night	38	32	-6

Note 1: 1. Periods are as detailed in the Industrial Noise Policy (INP) and are Daytime - 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening - 6.00 pm 10.00 pm; Night - 10.00 pm to 7.00 am pm Monday to Saturday, 10.00 pm to 8.00 am Sunday.

Note 2: Rounded to the nearest whole dB.

5.2.1.3 Coinciding Period last Year

Table 14 presents the ambient L_{A90} noise levels recorded for the current monitoring period compared to those measured during the coinciding monitoring period last year.

Table 14 L_{A90} Results Comparison – Coinciding Period Last Year

Monitoring Location	Period[1]	Long term Night-time L_{A90} Noise Levels		Difference dB[2]
		December 2019	**December 2020**	
D Black Hill School, Black Hill	Day	39	34	-5
	Evening	37	38	1
	Night	34	37	2
F Lot 684 Black Hill Road, Black Hill	Day	45	45	-
	Evening	41	42	1
	Night	37	39	2
G 156 Buchanan Road, Buchanan	Day	0	40	40
	Evening	0	37	37
	Night	0	30	30
I 49 Magnetic Drive, Ashtonfield	Day	40	37	-3
	Evening	37	38	1
	Night	32	34	2
L 65 Tipperary Drive, Ashtonfield	Day	40	37	-2
	Evening	37	30	-7
	Night	27	27	1
J 220 Parish Drive, Thornton	Day	39	38	-1
	Evening	39	37	-2
	Night	31	32	1

Note 1: Periods are as detailed in the Industrial Noise Policy (INP) and are Daytime - 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening - 6.00 pm 10.00 pm; Night - 10.00 pm to 7.00 am pm Monday to Saturday, 10.00 pm to 8.00 am Sunday.

Note 2: Rounded to the nearest whole dB.

5.2.2 Ambient L_{A10} Noise Comparison

The long term ambient L_{A10} noise levels collected from each monitoring location are presented graphically in **Figure 4**, **Figure 5** and **Figure 6** for the daytime, evening and night-time respectively.

Figure 4 Long Term Daytime LA10 Noise Levels

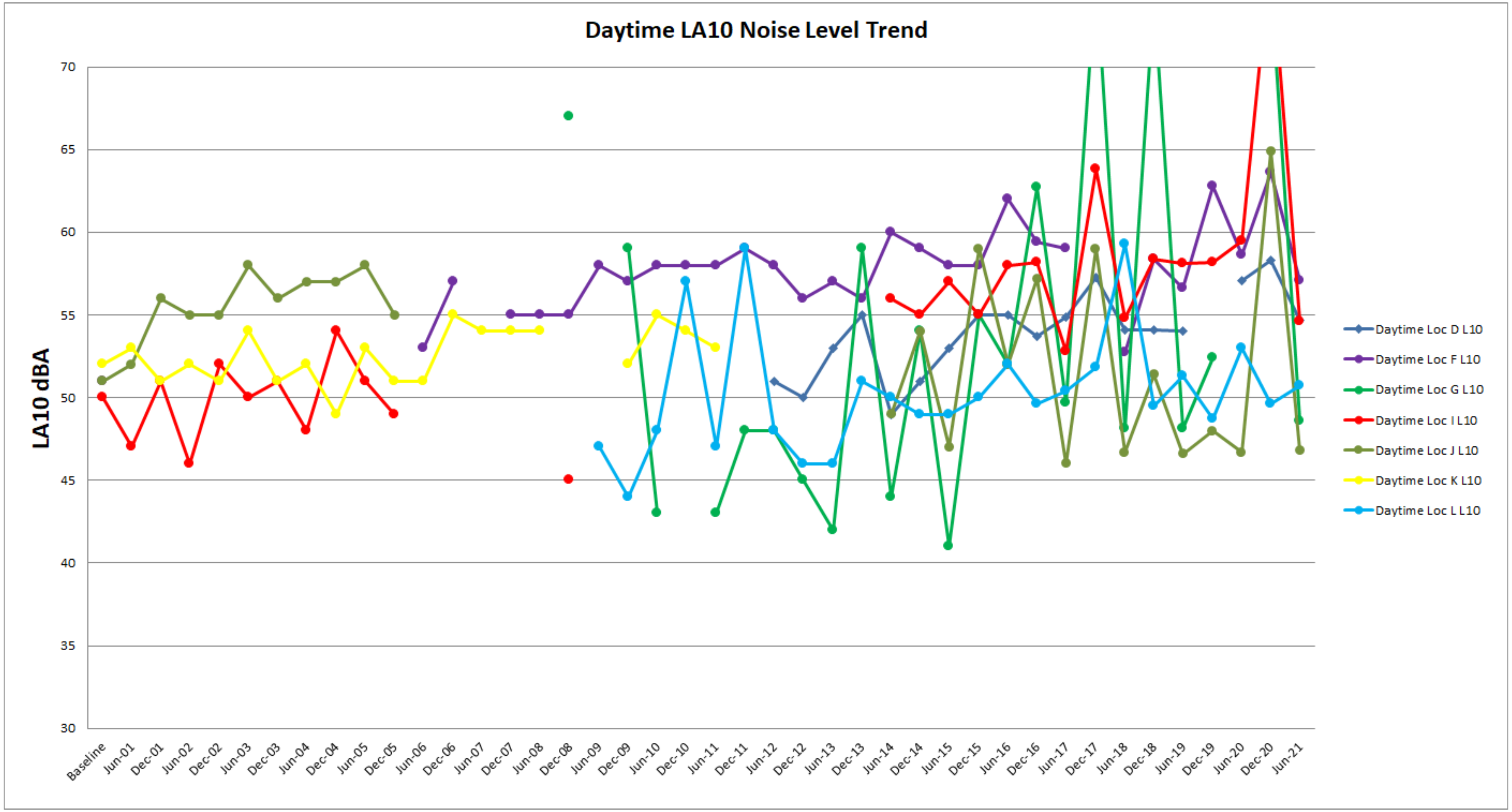


Figure 5 Long term Evening LA10 Noise Levels

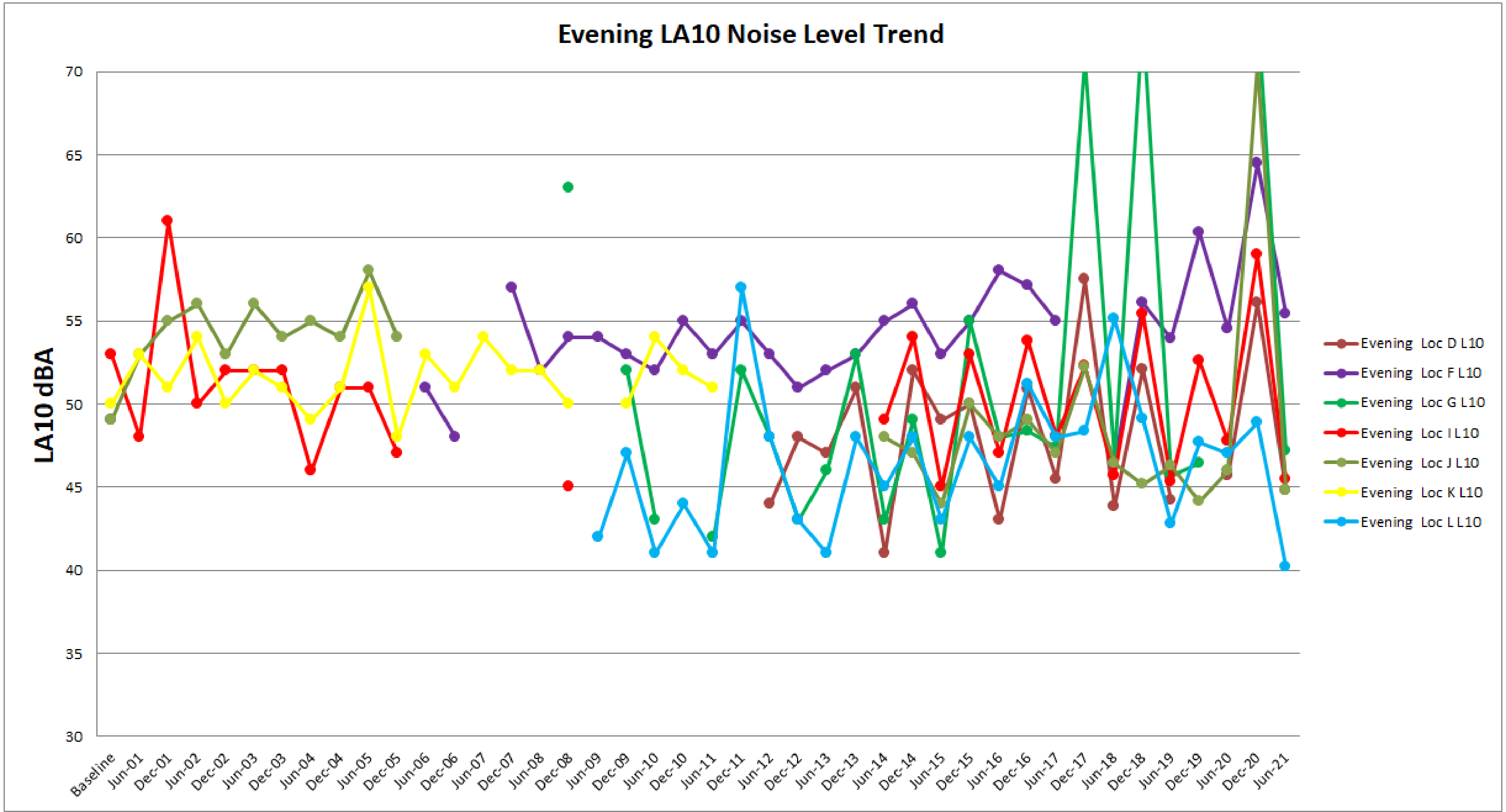
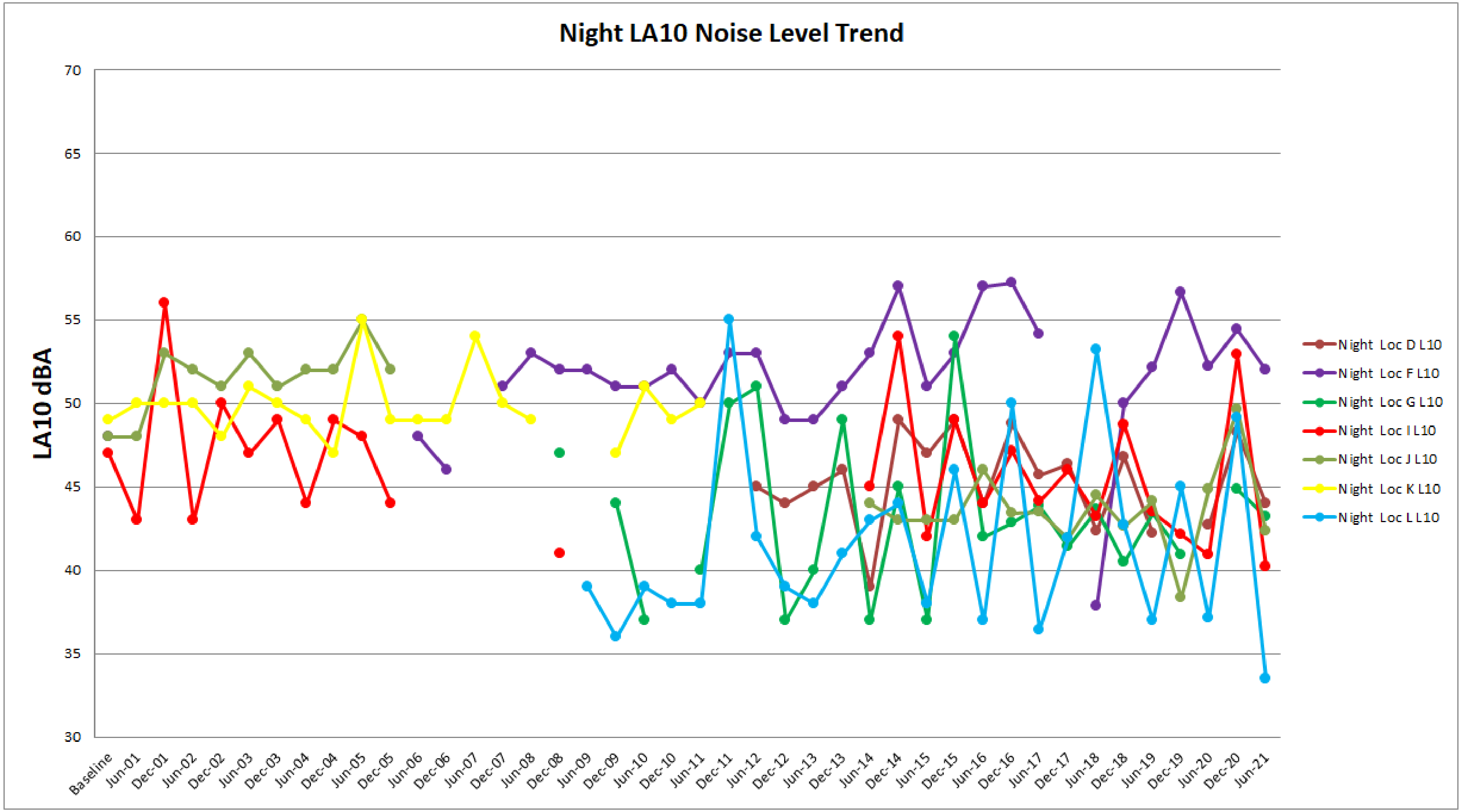


Figure 6 Long term Night LA10 Noise Levels



5.2.2.1 Baseline

Table 15 presents the ambient LA10 noise levels recorded for the current monitoring period compared to the levels recorded during the baseline monitoring period.

Table 15 LA10 Results Comparison – Baseline

Monitoring Location	Period[1]	Long term Night-time LA10 Noise Levels		Difference dB[3]
		Baseline	July 2021	
D Black Hill School, Black Hill	Day	N/A[2]	55	N/A
	Evening	N/A[2]	45	N/A
	Night	N/A[2]	44	N/A
F Lot 684 Black Hill Road, Black Hill	Day	51	57	6
	Evening	49	55	6
	Night	48	52	4
G 156 Buchanan Road, Buchanan	Day	N/A[2]	49	N/A
	Evening	N/A[2]	47	N/A
	Night	N/A[2]	43	N/A
I 49 Magnetic Drive, Ashtonfield	Day	50	55	5
	Evening	53	46	-8
	Night	47	40	-7
L 65 Tipperary Drive, Ashtonfield	Day	N/A[2]	51	N/A
	Evening	N/A[2]	40	N/A
	Night	N/A[2]	34	N/A
J 220 Parish Drive, Thornton	Day	51	47	-4
	Evening	49	45	-4
	Night	48	42	-6

Note 1: Periods are as detailed in the Industrial Noise Policy (INP) and are Daytime - 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening - 6.00 pm 10.00 pm; Night - 10.00 pm to 7.00 am pm Monday to Saturday, 10.00 pm to 8.00 am Sunday.

Note 2: No data was available during baseline measurements, no comparisons can be made.

Note 3: Difference rounded to the nearest whole dB.

5.2.2.2 Previous Half-year

Table 16 presents the ambient L_{A10} noise levels recorded for the current monitoring period compared to those measured during the previous monitoring period.

Table 16 L_{A10} Results Comparison – Previous Half-year

Monitoring Location	Period[1]	Long term Night-time L_{A10} Noise Levels		Difference dB[2]
		December 2020	**July 2021**	
D Black Hill School, Black Hill	Day	58	55	-4
	Evening	56	45	-11
	Night	48	44	-4
F Lot 684 Black Hill Road, Black Hill	Day	64	57	-7
	Evening	65	55	-9
	Night	54	52	-2
G 156 Buchanan Road, Buchanan	Day	75	49	-27
	Evening	74	47	-26
	Night	45	43	-2
I 49 Magnetic Drive, Ashtonfield	Day	77	55	-22
	Evening	59	46	-14
	Night	53	40	-13
L 65 Tipperary Drive, Ashtonfield	Day	50	51	1
	Evening	49	40	-9
	Night	49	34	-16
J 220 Parish Drive, Thornton	Day	65	47	-18
	Evening	71	45	-26
	Night	50	42	-7

Note 1: Periods are as detailed in the Industrial Noise Policy (INP) and are Daytime - 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening - 6.00 pm 10.00 pm; Night - 10.00 pm to 7.00 am pm Monday to Saturday, 10.00 pm to 8.00 am Sunday.

Note 2: Difference Rounded to the nearest whole dB.

5.2.2.3 Coinciding Period Last Year

Table 17 presents the ambient L_{A10} noise levels recorded for the current monitoring period compared to those measured during the coinciding monitoring period last year.

Table 17 L_{A10} Result Comparison – Coinciding Period Last Year

Monitoring Location	Period[1]	Long term Night-time L_{A10} Noise Levels		Difference dB[2]
		June 2020	July 2021	
D Black Hill School, Black Hill	Day	57	55	-2
	Evening	46	45	-1
	Night	43	44	1
F Lot 684 Black Hill Road, Black Hill	Day	59	57	-2
	Evening	55	55	1
	Night	52	52	0
G 156 Buchanan Road, Buchanan	Day	0	49	49
	Evening	0	47	47
	Night	0	43	43
I 49 Magnetic Drive, Ashtonfield	Day	60	55	-5
	Evening	48	46	-2
	Night	41	40	-1
L 65 Tipperary Dr, Ashtonfield	Day	53	51	-2
	Evening	47	40	-7
	Night	37	34	-4
J 220 Parish Drive, Thornton	Day	47	47	0
	Evening	46	45	-1
	Night	45	42	-3

Note 1: Periods are as detailed in the Industrial Noise Policy (INP) and are Daytime - 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening - 6.00 pm 10.00 pm; Night - 10.00 pm to 7.00 am pm Monday to Saturday, 10.00 pm to 8.00 am Sunday.

Note 2: Rounded to the nearest whole dB.

5.3 Rail Noise Monitoring

In order to determine compliance with the rail noise criteria, a noise logger was positioned at Location J. No rail movements were recorded over the noise monitoring period and as such noise levels from the Bloomfield Rail Spur were in compliance with the Abel Mine Project Approval during the noise monitoring period.

6 Conclusion

SLR was engaged by Donaldson Coal Pty Ltd to conduct half-yearly noise monitoring surveys for Donaldson Coal Mine and Abel Coal Mine in accordance with the NMP, dated 3 June 2019.

Abel mine was placed in Care & Maintenance on 28th April 2016 and there were no operations onsite, excluding that from the Bloomfield CHPP which operates under the Abel Coal Mine project consent conditions.

Operator-attended and unattended noise measurements were conducted for the July 2021 half at six focus locations surrounding the mine.

Abel portal operations were not observed to be audible at any locations during the monitoring period with CHPP operations audible at Location L during the daytime attended noise survey. Contributed noise levels from Abel Mine did not exceed noise emission goals and compliance with the Abel Mine *Project Approval* was indicated at all locations.

A comparison of ambient L_{A10} and L_{A90} noise levels recorded during the current monitoring period (July 2021), the baseline monitoring period, the last monitoring period (December 2020), and the coinciding monitoring period from last year (June 2020) has been conducted.

Rail noise levels from the Bloomfield Rail Spur were considered to be in compliance with the Abel Mine Project Approval during the noise monitoring period.

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 x 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

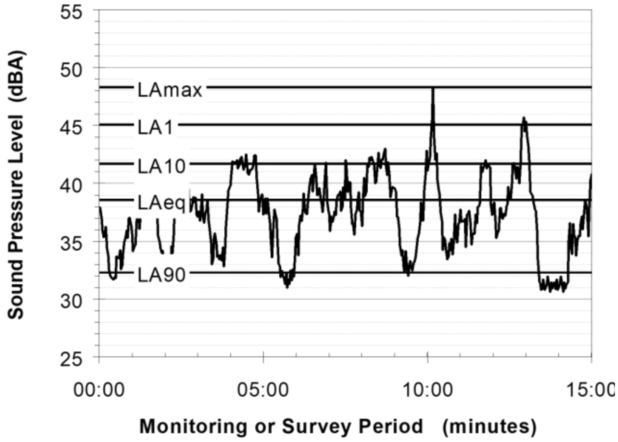
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

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

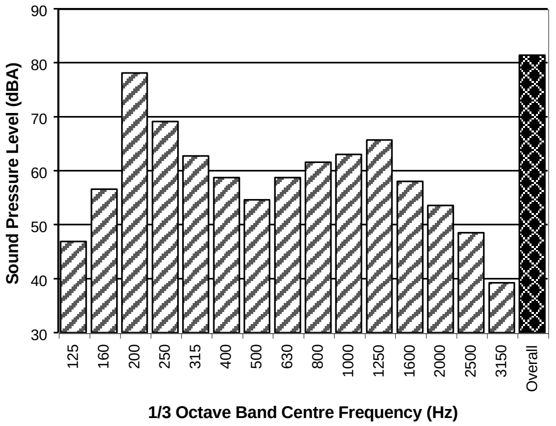
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

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

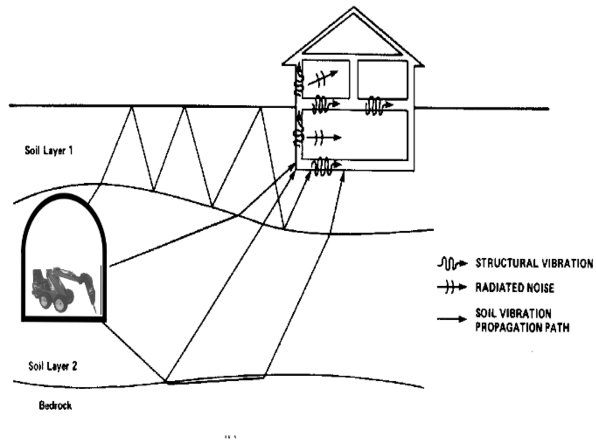
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience 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).

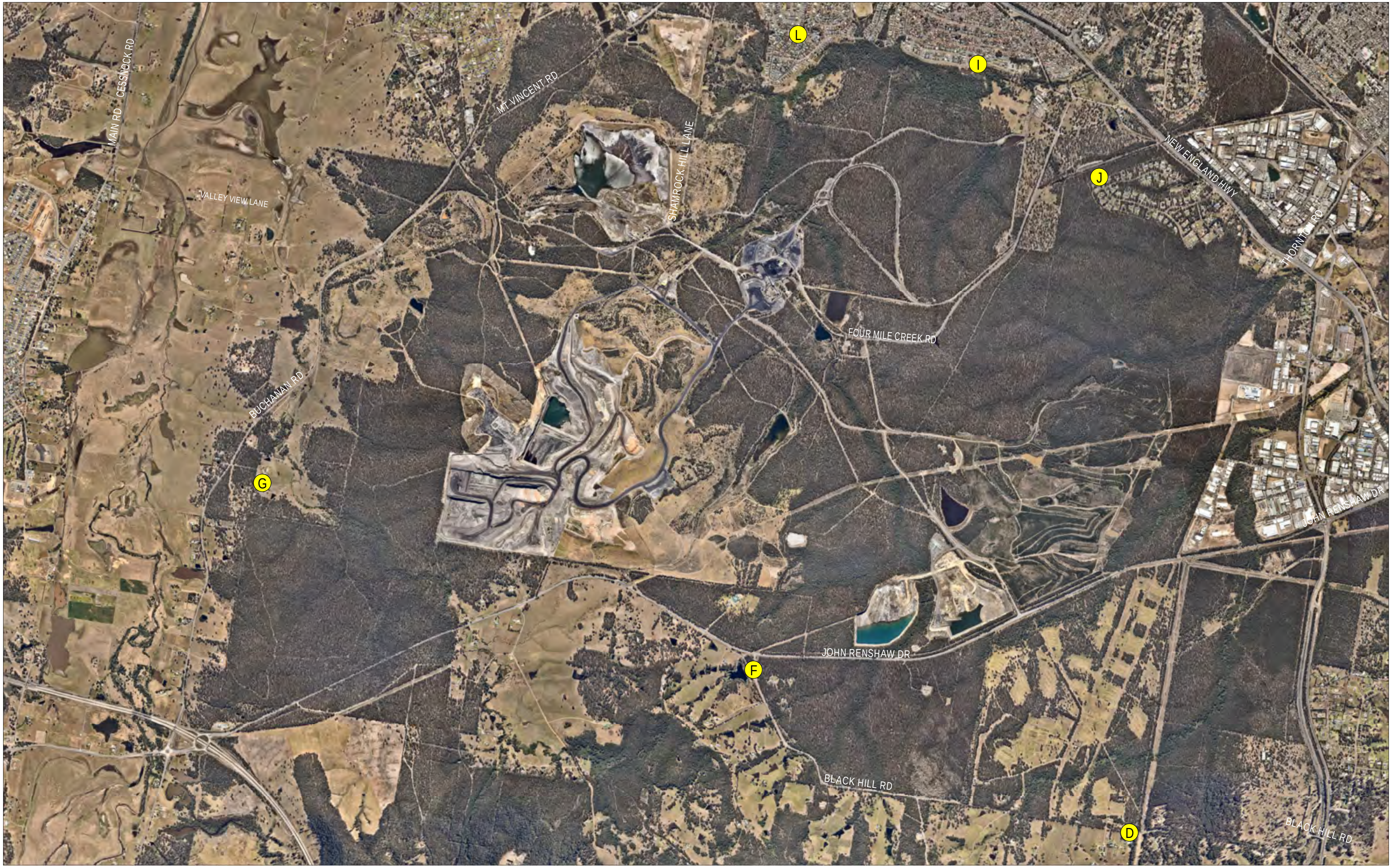
The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



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 Locations



D:\Quick Jobs\Martin Davenport\Donaldson\SLR630010530120_AB_MonitoringLocations_01.mxd

SLR
10 KINGS ROAD
NEW LAMBTON
NEW SOUTH WALES 2305
AUSTRALIA
T: 61 2 4037 3200
F: 61 2 4037 3201
www.slrconsulting.com

Project No.:	630.01053.01200
Date:	11/01/2018
Drawn by:	NT
Scale:	1:45,000
Sheet Size:	A4
Projection:	GDA 1994 MGA Zone 56

LEGEND

Noise Monitoring Locations

N W E S

0 500 1,000 1,500 2,000 m

Donaldson Coal

Noise Monitoring

Noise Monitoring Locations

APPENDIX B

APPENDIX C

Calibration Certificates

Acoustic Research Labs Pty Ltd
Unit 36/14 Loyalty Rd
North Rocks NSW AUSTRALIA 2151
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter
IEC 61672-3.2013
Calibration Certificate

Calibration Number C21186

Client Details SLR Consulting Pty Ltd
Level 11, 176 Wellington Parade
East Melbourne VIC 3002

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 8781DD
Microphone Serial Number : 322476
Pre-amplifier Serial Number : 28502

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	22.5°C	**Ambient Temperature :**	22.7°C
Relative Humidity :	51.7%	**Relative Humidity :**	52.2%
Barometric Pressure :	101.3kPa	**Barometric Pressure :**	101.2kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 1 Apr 2021
Secondary Check: Max Moore
Report Issue Date : 1 Apr 2021

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*N/A*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.12dB*	*Temperature*	*±0.2°C*
1kHz	*±0.11dB*	*Relative Humidity*	*±2.4%*
8kHz	*±0.13dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests	*±0.10dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

Acoustic Research Labs Pty Ltd
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North Rocks NSW AUSTRALIA 2151
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Sound Level Meter
IEC 61672-3.2013
Calibration Test Report

Calibration Number C21186

Client Details SLR Consulting Pty Ltd
Level 11, 176 Wellington Parade
East Melbourne VIC 3002

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 8781DD
Microphone Serial Number : 322476
Pre-amplifier Serial Number : 28502

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	22.5°C	**Ambient Temperature :**	22.7°C
Relative Humidity :	51.7%	**Relative Humidity :**	52.2%
Barometric Pressure :	101.3kPa	**Barometric Pressure :**	101.2kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 1 Apr 2021
Secondary Check: Max Moore
Report Issue Date : 1 Apr 2021

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*N/A*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.12dB*	*Temperature*	*±0.2°C*
1kHz	*±0.11dB*	*Relative Humidity*	*±2.4%*
8kHz	*±0.13dB*	*Barometric Pressure*	*±0.015 kPa*
Electrical Tests	*±0.10dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

NATA
WORLD RECOGNISED ACCREDITATION

This report applies only to the item tested and shall only be reproduced in full, unless approved in writing by Acoustic Research Labs.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

1. OVERVIEW

This report presents the calibration test results of a ARL Ngara Sound Level Meter, and associated equipment. Calibration is carried out in accordance with *IEC 61672-3.2013, Electroacoustics - Sound Level Meters - Part 3: Periodic Tests*.

Relevant clauses from this standard have been used for periodic testing in conjunction with Acoustic Research Labs internal test methods described in Section 2 of the calibration work instruction manual.

1.1 UNCERTAINTIES

For each test performed, the associated measurement uncertainties are derived at the 95% confidence level and are given with a coverage factor of 2.

The uncertainty applies at the time of measurement only, and takes no account of any drift or other effects that may apply afterwards. When estimating uncertainty at any later time, other relevant information should also be considered, including, where possible, the history of the performance of the instrument and the manufacturer's specifications.

1.2 DOCUMENT CONVENTIONS

Test results which highlight non-conformances relative to the standard, and the sound level meter type specified by the manufacturer have been marked with an **F** in the respective tests.

Any tests that are not required, due to sound level meter configuration, are marked N/A.

2. GENERAL

2.1 ENVIRONMENTAL CONDITIONS DURING TEST

No corrections have been applied to any results obtained to compensate for the environmental conditions.

2.2 CALIBRATION TESTS

Where applicable the following tests were performed in accordance with the requirements of *IEC 61672-3.2013*. These clauses are used to define the periodic testing of Sound Level Meters.

Clause 10	Indication at the Calibration Check Frequency
Clause 11	Self Generated Noise
Clause 12	Acoustical Signal Tests of Frequency Weighting
Clause 13	Electrical Signal Tests of Frequency Weightings
Clause 14	Frequency and Time Weightings at 1kHz
Clause 15	Long Term Stability
Clause 16	Level Linearity on the Reference Level Range
Clause 17	Level Linearity including the level range control
Clause 18	Toneburst Response
Clause 19	Peak C Sound Level
Clause 20	Overload Indication
Clause 21	High Level Stability

2.3 TEST EQUIPMENT USED

All test equipment used during periodic testing are calibrated every 12months by an accredited laboratory, traceable to SI units.

The performance of all equipment during these calibrations and the effects of instrument stability are used to determine the measurement uncertainty of each reported result.

2.3.1 Multi-function Acoustic Calibrator

A Bruel & Kjaer 4226 Multi-function calibrator (S/N - 2985012) was used for frequency response testing of the entire instrument (including microphone). This instrument was used as a reference calibrator and for frequency response verification.

2.3.2 Microphone Electrical Equivalent Circuit

Calibration of most instrument parameters is carried out using electrical signals fed to the unit via a two-port electrical equivalent circuit of the microphone.

A 12pF capacitance dummy microphone was used during testing.

2.3.3 Adjustable Attenuator

A means for varying the attenuation of electrical signals via the dummy microphone was provided by a JFW Industries dual rotary attenuator (S/N - 761637). The attenuator is switchable in 1dB steps between 0dB and 60dB.

2.3.4 Arbitrary Function Generator

A Hewlett Packard 33120A (S/N - US36047448) was used to generate the required electrical signals.

2.3.5 Environmental Monitoring

A MHB-382SD (S/N – AG44204) was used for measuring environmental conditions during device calibration. It is capable of providing temperature, relative humidity and pressure measurements.

3. CALIBRATION TEST RESULTS

3.1 INDICATION AT THE CALIBRATION CHECK FREQUENCY

The indication of the sound level meter at the calibration check frequency was checked by application of an acoustic signal at the reference sound pressure level and frequency.

Stated reference conditions as found in manual are

Reference Level : 94.0 dB

Reference Frequency : 1000.0 Hz

Indications before and after adjustments were recorded and are shown in Table 1 (all measurements in dB) -

Table 1 - Check Frequency Calibration Results

Frequency Weighting	Initial Response	B&K 4226 Corrected	FreeField Corrected	Final Corrected Response
A	93.97	94.05	94.03	94.00
C	93.92	94.01	93.98	93.95
Z	N/A	N/A	N/A	N/A

Free field adjustment data as provided by the manufacturer. Windscreen correction factors applied.

3.2 SELF GENERATED NOISE

3.2.1 Microphone Installed

Self generated noise was measured with the microphone installed on the sound level meter, in the configuration submitted for periodic testing. The sound level meter was set to the most-sensitive level range and with frequency weighting A selected.

Ten (10) time weighted observations were made over a period of 60 seconds.

Random Readings dB(A)

18.70	18.90	19.00	19.00	19.00
18.80	18.80	18.80	18.90	18.90

Acoustic Noise Floor : 18.9 dB(A)

3.2.2 Electrical Input Signal Device

With the microphone replaced by the electrical input signal device and terminated as specified, the sound level meter was set to the most-sensitive level range and with frequency weightings Z, C and A selected as provided.

Ten (10) time weighted observations were made over a period of 60 seconds.

Random Readings dB(A)

16.80	16.70	16.80	16.80	17.00
16.90	16.50	16.90	17.00	16.80

Random Readings dB(C)

19.20	19.20	19.20	19.10	19.30
19.30	19.40	19.20	19.10	19.20

Random Readings dB(Z)

N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A

	dB(A)	dB(C)	dB(Z)
Electric Noise Floor :	16.8	19.2	N/A

3.3 ACOUSTICAL SIGNAL TESTS OF A FREQUENCY WEIGHTING

The sound level meter was set to measure frequency weighting C with a FAST response. The test was carried out using a multi-function acoustic calibrator set to pressure mode.

Three (3) readings were made at each test frequency. The average of the readings was then corrected to the multi-function acoustic calibrator.

Table 2 - Frequency Weighting C Response

Freq Hz	Reading 1	Reading 2	Reading 3	U95
125	93.9	93.9	93.9	0.12
1 000	94.0	94.0	94.0	0.11
8 000	88.6	88.6	88.6	0.13

Actual Freq Hz	B&K 4226 Corrections	Corrected Response dB(C)		Uexp
		Actual	re 1kHz	
125.90	-0.03	93.87	-0.08	0.12
1005.10	-0.05	93.95	0.00	0.11
7915.10	-0.03	88.57	-5.38	0.13

Adjustments were then applied to correct for free field and sound level meter body effects with data supplied by the manufacturer as per Table 3. Windscreen correction factors applied.

Table 3 - Correction Data

Actual Freq Hz	FreeField Corrections	U95	BodyEffects Corrections	U95	Windscreen Corrections	U95
125.90	-0.11	0.25	0.00	0.00	0.000	0.250
1005.10	0.02	0.25	0.00	0.00	0.000	0.250
7915.10	2.74	0.35	0.00	0.00	0.100	0.350

Finally, the corrected responses are normalised to the response at 1kHz and compared to the tolerances stated in Table 2 of IEC 61672.1-2013.

Table 4 - Acoustic C Response

Actual Freq (Hz)	Corrected Response dB(C)		Expected Response dB(C)		Deviation	P/F	Uexp
	Actual	re 1kHz	re 1kHz	Tolerance			
125.90	93.76	-0.21	-0.2	±1.0	-0.01	P	0.38
1005.10	93.97	0.00	0.0	±0.7	0.00	P	0.37
7915.10	91.41	-2.56	-3.0	+1.5 / -2.5	0.44	P	0.52

3.4 ELECTRICAL SIGNAL TESTS OF FREQUENCY WEIGHTINGS

Frequency weighting responses for Z, C and A were determined relative to the response at 1kHz using steady sinusoidal electrical input signals.

On the reference level range, and for each frequency weighting under test, the level of a 1kHz input signal was adjusted to yield 75dB. At test frequencies other than 1kHz, the input signal level was adjusted to compensate for the design goal attenuations as specified in Table 2 of IEC 61672.1-2013.

Table 5 - Measured Electrical Frequency Response

Freq Hz	A Weighting (dB)	C Weighting (dB)	Z Weighting (dB)	U95
63	74.8	74.8	N/A	0.10
125	74.8	75.0	N/A	0.10
250	74.9	75.0	N/A	0.10
500	74.9	75.0	N/A	0.10
1 000	75.0	75.0	N/A	0.10
2 000	75.0	75.1	N/A	0.10
4 000	75.0	75.0	N/A	0.10
8 000	74.9	74.9	N/A	0.10
15 850	72.2	72.1	N/A	0.10

Adjustments were then applied to correct for a uniform free field response and sound level meter body effects with data supplied by the manufacturer as per Table 6. Windscreen correction factors applied.

Table 6 - Correction Data

Freq Hz	Ufreq	U95	Body Effects	U95	WS Effects	U95
63	0.000	0.250	0.000	0.000	0.000	0.250
125	0.000	0.250	0.000	0.000	0.000	0.250
250	0.000	0.250	0.000	0.000	0.000	0.250
500	0.000	0.250	0.000	0.000	0.000	0.250
1 000	0.000	0.250	0.000	0.000	0.000	0.250
2 000	0.000	0.250	0.000	0.000	0.000	0.250
4 000	0.100	0.250	0.000	0.000	0.100	0.250
8 000	0.100	0.350	0.000	0.000	0.100	0.350
15 850	0.800	0.450	0.000	0.000	0.800	0.450

Finally, the corrected responses were referenced to the response at 1kHz and compared to the tolerances stated in Table 2 of IEC 61672.1-2013.

Table 7 - A Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	74.80	-0.20	±1.0	P	0.37
125	74.80	-0.20	±1.0	P	0.37
250	74.90	-0.10	±1.0	P	0.37
500	74.90	-0.10	±1.0	P	0.37
1 000	75.00	0.00	±0.7	P	0.37
2 000	75.00	0.00	±1.0	P	0.37
4 000	75.20	0.20	±1.0	P	0.37
8 000	75.10	0.10	+1.5 / -2.5	P	0.51
15 850	73.80	-1.20	+2.5 / –16	P	0.65

Table 8 - C Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	74.80	-0.20	±1.0	P	0.37
125	75.00	0.00	±1.0	P	0.37
250	75.00	0.00	±1.0	P	0.37
500	75.00	0.00	±1.0	P	0.37
1 000	75.00	0.00	±0.7	P	0.37
2 000	75.10	0.10	±1.0	P	0.37
4 000	75.20	0.20	±1.0	P	0.37
8 000	75.10	0.10	+1.5 / -2.5	P	0.51
15 850	73.70	-1.30	+2.5 / –16	P	0.65

Table 9 - Z Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	N/A	N/A	±1.0	N/A	0.37
125	N/A	N/A	±1.0	N/A	0.37
250	N/A	N/A	±1.0	N/A	0.37
500	N/A	N/A	±1.0	N/A	0.37
1 000	N/A	N/A	±0.7	N/A	0.37
2 000	N/A	N/A	±1.0	N/A	0.37
4 000	N/A	N/A	±1.0	N/A	0.37
8 000	N/A	N/A	+1.5 / -2.5	N/A	0.51
15 850	N/A	N/A	+2.5 / –16	N/A	0.65

3.5 FREQUENCY AND TIME WEIGHTINGS AT 1KHZ

A steady sinusoidal electrical input signal of 1kHz at the reference sound pressure level was applied to the reference level range.

The deviations of the indicated level of C and Z frequency weightings were recorded, along with the deviations of the indication of A weighted time averaged, and SLOW weighted response.

Table 10 - Frequency and Time Weighting Results

Frequency Weighting	Time Weighting	Response (dB)	Deviation (dB)	P/F	Tolerance (dB)	U95
A	Fast	94.0	0.0	P	±0.2	0.10
	Leq	94.0	0.0	P	±0.2	0.10
	Slow	94.0	0.0	P	±0.2	0.10
C	Fast	94.0	0.0	P	±0.2	0.10
Z	Fast	N/A	N/A	N/A	±0.2	0.10

3.6 LONG-TERM STABILITY

Long-term stability was tested by comparing a steady sinusoidal electrical signal applied at the start, and at the end of testing. The applied signal level was set to the reference level and frequency and was maintained constant. The difference between the indicated levels was recorded.

Table 11 - Frequency and Time Weighting Results

Signal Level (mV)	Initial Response (dB)	Final Response (dB)	Deviation (dB)	P/F	Tolerance (dB)	U95
70.9	94	94.0	0.0	P	±0.1	0.10

3.7 LEVEL LINEARITY ON THE REFERENCE LEVEL RANGE

Level linearity was tested with a steady sinusoidal electrical signal at a frequency of 8kHz, with the meter set to display frequency weighted A, FAST response.

The starting point for level linearity testing was set to 94.0dB as stated in the instruction manual.

Level linearity was measured in 5dB steps of increasing input signal level from the starting point up to within 5dB of the stated upper limit, then at 1dB steps up to (but not including) the first indication of overload.

Table 12 - Level Linearity - Increasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
94.0	94.0	0.0	±0.8	P	0.1
99.0	99.0	0.0	±0.8	P	0.1
104.0	104.0	0.0	±0.8	P	0.1
109.0	109.0	0.0	±0.8	P	0.1
114.0	114.0	0.0	±0.8	P	0.1
115.0	115.0	0.0	±0.8	P	0.1
116.0	116.0	0.0	±0.8	P	0.1
117.0	117.0	0.0	±0.8	P	0.1
118.0	118.0	0.0	±0.8	P	0.1
119.0	119.0	0.0	±0.8	P	0.1
120.0	120.0	0.0	±0.8	P	0.1

Overload indication at 121.0dB.

Level linearity test was the continued in 5dB steps of decreasing input signal level from the starting point up to within 5dB of the stated lower limit, then at 1dB steps up to (but not including) the first indication of under range.

Table 13 - Level Linearity - Decreasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
94.0	94.0	0.0	±0.8	P	0.1
89.0	89.0	0.0	±0.8	P	0.1
84.0	84.0	0.0	±0.8	P	0.1
79.0	79.0	0.0	±0.8	P	0.1
74.0	74.0	0.0	±0.8	P	0.1
69.0	69.0	0.0	±0.8	P	0.1
64.0	64.0	0.0	±0.8	P	0.1
59.0	59.0	0.0	±0.8	P	0.1
54.0	54.0	0.0	±0.8	P	0.1
49.0	49.0	0.0	±0.8	P	0.1
44.0	44.0	0.0	±0.8	P	0.1
39.0	39.0	0.0	±0.8	P	0.1
34.0	34.1	0.1	±0.8	P	0.1
30.0	30.2	0.2	±0.8	P	0.1
29.0	29.2	0.2	±0.8	P	0.1
28.0	28.2	0.2	±0.8	P	0.1
27.0	27.3	0.3	±0.8	P	0.1
26.0	26.4	0.4	±0.8	P	0.1
25.0	25.6	0.6	±0.8	P	0.1

No under range indicated.

3.8 TONEBURST RESPONSE

The response of the sound level meter to short-duration signals was tested on the reference range with 4kHz tone bursts.

The tone bursts were generated from a steady sinusoidal signal at a level of 117.0dB.

Table 14 - FAST Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	116.0	0.0	±0.5	P	0.1
2ms	99.0	0.0	+1.0 / -1.5	P	0.1
0.25ms	89.9	-0.1	+1.0 / -3	P	0.1

Table 15 - SLOW Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	109.6	0.0	±0.5	P	0.1
2ms	90.0	0.0	+1.0 / -3	P	0.1

Table 16 - Sound Exposure Level Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	N/A	N/A	N/A	N/A	N/A
2ms	N/A	N/A	N/A	N/A	N/A
0.25ms	N/A	N/A	N/A	N/A	N/A

3.9 PEAK C RESPONSE

Indication of Peak C sound level was tested on the least sensitive level range. Test signals used were -

- A single complete cycle of an 8kHz sinusoid, starting and stopping at zero crossings
- Positive and negative half cycles of a 500Hz sinusoid, starting and stopping at zero crossings.

The level of the steady 8kHz sinusoid was adjusted to display dB(C).

3.10 OVERLOAD INDICATION

The overload indication was tested on the least sensitive level range, with the sound level meter set to display frequency weighted A, time averaged values.

Positive and negative half cycle sinusoidal electrical signals at 4kHz were used. The test began at an indicated time averaged level of119.0dB(A).

Using the positive half cycle signal, the signal level was increased in steps of 0.5dB up to, but not including, the first indication of overload. The level of the input signal was then increased in steps of 0.1dB until the first indication of overload. These steps were repeated using the negative half cycle signal.

Table 17 - Overload Indication

Signal Orientation	Overload Response	Difference	Tolerance	P/F	Uncertainty
Positive	120.1	0.0	±1.5	P	0.1
Negative	120.0				

Overload indication was verified.

Overload latch indication was verified.

3.11 HIGH LEVEL STABILITY

High level stability was tested by measuring the response of the meter to high signal levels. The result was evaluated as the difference between the A-Weighted indicated levels in response to a steady 1kHz signal applied over 5 minutes.

Table 18 - FAST Weighted Response

Time Weighting	Initial Response (dB)	Final Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
Fast	119.0	119.0	0.0	±0.1	P	0.10
Slow	N/A	N/A	N/A	±0.1	N/A	0.10
Leq	119.0	119.0	0.0	±0.1	P	0.10

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Sound Level Meter

IEC 61672-3.2013

Calibration Certificate

Calibration Number C21184

Client Details	SLR Consulting Pty Ltd Level 11, 176 Wellington Parade East Melbourne VIC 3002
Equipment Tested/ Model Number :	ARL Ngara
Instrument Serial Number :	878202
Microphone Serial Number :	322453
Pre-amplifier Serial Number :	28495

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	23.2°C	**Ambient Temperature :**	23.1°C
Relative Humidity :	50.3%	**Relative Humidity :**	50%
Barometric Pressure :	101.45kPa	**Barometric Pressure :**	101.43kPa

Calibration Technician :	Lucky Jaiswal	**Secondary Check:**	Max Moore
Calibration Date :	1 Apr 2021	**Report Issue Date :**	1 Apr 2021

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	*Pass*	17: Level linearity incl. the level range control	*Pass*
13: Electrical Sig. tests of frequency weightings	*Pass*	18: Toneburst response	*Pass*
14: Frequency and time weightings at 1 kHz	*Pass*	19: C Weighted Peak Sound Level	*N/A*
15: Long Term Stability	*Pass*	20: Overload Indication	*Pass*
16: Level linearity on the reference level range	*Pass*	21: High Level Stability	*Pass*

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
125Hz	*±0.12dB*	*Temperature*	*±0.2°C*
1kHz	*±0.11dB*	*Relative Humidity*	*±2.4%*
8kHz	*±0.13dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests	*±0.10dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

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Sound Level Meter
IEC 61672-3.2013
Calibration Test Report

Calibration Number C21184

Client Details SLR Consulting Pty Ltd
Level 11, 176 Wellington Parade
East Melbourne VIC 3002

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 878202
Microphone Serial Number : 322453
Pre-amplifier Serial Number : 28495

Pre-Test Atmospheric Conditions		**Post-Test Atmospheric Conditions**	
Ambient Temperature :	23.2°C	**Ambient Temperature :**	23.1°C
Relative Humidity :	50.3%	**Relative Humidity :**	50%
Barometric Pressure :	101.45kPa	**Barometric Pressure :**	101.43kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 1 Apr 2021
Secondary Check: Max Moore
Report Issue Date : 1 Apr 2021

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
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8kHz	*±0.13dB*	*Barometric Pressure*	*±0.015 kPa*
Electrical Tests	*±0.10dB*		

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1. OVERVIEW

This report presents the calibration test results of a ARL Ngara Sound Level Meter, and associated equipment. Calibration is carried out in accordance with *IEC 61672-3.2013, Electroacoustics - Sound Level Meters - Part 3: Periodic Tests*.

Relevant clauses from this standard have been used for periodic testing in conjunction with Acoustic Research Labs internal test methods described in Section 2 of the calibration work instruction manual.

1.1 UNCERTAINTIES

For each test performed, the associated measurement uncertainties are derived at the 95% confidence level and are given with a coverage factor of 2.

The uncertainty applies at the time of measurement only, and takes no account of any drift or other effects that may apply afterwards. When estimating uncertainty at any later time, other relevant information should also be considered, including, where possible, the history of the performance of the instrument and the manufacturer's specifications.

1.2 DOCUMENT CONVENTIONS

Test results which highlight non-conformances relative to the standard, and the sound level meter type specified by the manufacturer have been marked with an **F** in the respective tests.

Any tests that are not required, due to sound level meter configuration, are marked N/A.

2. GENERAL

2.1 ENVIRONMENTAL CONDITIONS DURING TEST

No corrections have been applied to any results obtained to compensate for the environmental conditions.

2.2 CALIBRATION TESTS

Where applicable the following tests were performed in accordance with the requirements of *IEC 61672-3.2013*. These clauses are used to define the periodic testing of Sound Level Meters.

Clause 10	Indication at the Calibration Check Frequency
Clause 11	Self Generated Noise
Clause 12	Acoustical Signal Tests of Frequency Weighting
Clause 13	Electrical Signal Tests of Frequency Weightings
Clause 14	Frequency and Time Weightings at 1kHz
Clause 15	Long Term Stability
Clause 16	Level Linearity on the Reference Level Range
Clause 17	Level Linearity including the level range control
Clause 18	Toneburst Response
Clause 19	Peak C Sound Level
Clause 20	Overload Indication
Clause 21	High Level Stability

2.3 TEST EQUIPMENT USED

All test equipment used during periodic testing are calibrated every 12months by an accredited laboratory, traceable to SI units.

The performance of all equipment during these calibrations and the effects of instrument stability are used to determine the measurement uncertainty of each reported result.

2.3.1 Multi-function Acoustic Calibrator

A Bruel & Kjaer 4226 Multi-function calibrator (S/N - 2985012) was used for frequency response testing of the entire instrument (including microphone). This instrument was used as a reference calibrator and for frequency response verification.

2.3.2 Microphone Electrical Equivalent Circuit

Calibration of most instrument parameters is carried out using electrical signals fed to the unit via a two-port electrical equivalent circuit of the microphone.

A 12pF capacitance dummy microphone was used during testing.

2.3.3 Adjustable Attenuator

A means for varying the attenuation of electrical signals via the dummy microphone was provided by a JFW Industries dual rotary attenuator (S/N - 761637). The attenuator is switchable in 1dB steps between 0dB and 60dB.

2.3.4 Arbitrary Function Generator

A Hewlett Packard 33120A (S/N - US36047448) was used to generate the required electrical signals.

2.3.5 Environmental Monitoring

A MHB-382SD (S/N – AG44204) was used for measuring environmental conditions during device calibration. It is capable of providing temperature, relative humidity and pressure measurements.

3. CALIBRATION TEST RESULTS

3.1 INDICATION AT THE CALIBRATION CHECK FREQUENCY

The indication of the sound level meter at the calibration check frequency was checked by application of an acoustic signal at the reference sound pressure level and frequency.

Stated reference conditions as found in manual are

Reference Level : 94.0 dB

Reference Frequency : 1000.0 Hz

Indications before and after adjustments were recorded and are shown in Table 1 (all measurements in dB) -

Table 1 - Check Frequency Calibration Results

Frequency Weighting	Initial Response	B&K 4226 Corrected	FreeField Corrected	Final Corrected Response
A	94.00	94.05	94.03	94.00
C	93.94	94.01	93.98	93.95
Z	N/A	N/A	N/A	N/A

Free field adjustment data as provided by the manufacturer. Windscreen correction factors applied.

3.2 SELF GENERATED NOISE

3.2.1 Microphone Installed

Self generated noise was measured with the microphone installed on the sound level meter, in the configuration submitted for periodic testing. The sound level meter was set to the most-sensitive level range and with frequency weighting A selected.

Ten (10) time weighted observations were made over a period of 60 seconds.

Random Readings dB(A)

19.40	19.40	19.50	19.60	19.50
19.30	19.50	19.60	19.70	19.50

Acoustic Noise Floor : 19.5 dB(A)

3.2.2 Electrical Input Signal Device

With the microphone replaced by the electrical input signal device and terminated as specified, the sound level meter was set to the most-sensitive level range and with frequency weightings Z, C and A selected as provided.

Ten (10) time weighted observations were made over a period of 60 seconds.

Random Readings dB(A)

17.30	17.50	17.40	17.50	17.50
17.40	17.20	17.20	17.40	17.60

Random Readings dB(C)

19.30	19.40	19.50	19.50	19.60
19.20	19.40	19.60	19.40	19.70

Random Readings dB(Z)

N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A

	dB(A)	dB(C)	dB(Z)
Electric Noise Floor :	17.4	19.5	N/A

3.3 ACOUSTICAL SIGNAL TESTS OF A FREQUENCY WEIGHTING

The sound level meter was set to measure frequency weighting C with a FAST response. The test was carried out using a multi-function acoustic calibrator set to pressure mode.

Three (3) readings were made at each test frequency. The average of the readings was then corrected to the multi-function acoustic calibrator.

Table 2 - Frequency Weighting C Response

Freq Hz	Reading 1	Reading 2	Reading 3	U95
125	93.9	93.9	93.9	0.12
1 000	94.0	94.0	94.0	0.11
8 000	88.4	88.4	88.4	0.13

Actual Freq Hz	B&K 4226 Corrections	Corrected Response dB(C)		Uexp
		Actual	re 1kHz	
125.90	-0.03	93.87	-0.08	0.12
1005.10	-0.05	93.95	0.00	0.11
7915.10	-0.03	88.32	-5.63	0.13

Adjustments were then applied to correct for free field and sound level meter body effects with data supplied by the manufacturer as per Table 3. Windscreen correction factors applied.

Table 3 - Correction Data

Actual Freq Hz	FreeField Corrections	U95	BodyEffects Corrections	U95	Windscreen Corrections	U95
125.90	-0.11	0.25	0.00	0.00	0.000	0.250
1005.10	0.02	0.25	0.00	0.00	0.000	0.250
7915.10	2.74	0.35	0.00	0.00	0.100	0.350

Finally, the corrected responses are normalised to the response at 1kHz and compared to the tolerances stated in Table 2 of IEC 61672.1-2013.

Table 4 - Acoustic C Response

Actual Freq (Hz)	Corrected Response dB(C)		Expected Response dB(C)		Deviation	P/F	Uexp
	Actual	re 1kHz	re 1kHz	Tolerance			
125.90	93.76	-0.21	-0.2	±1.0	-0.01	P	0.38
1005.10	93.97	0.00	0.0	±0.7	0.00	P	0.37
7915.10	91.16	-2.81	-3.0	+1.5 / -2.5	0.19	P	0.52

3.4 ELECTRICAL SIGNAL TESTS OF FREQUENCY WEIGHTINGS

Frequency weighting responses for Z, C and A were determined relative to the response at 1kHz using steady sinusoidal electrical input signals.

On the reference level range, and for each frequency weighting under test, the level of a 1kHz input signal was adjusted to yield 75dB. At test frequencies other than 1kHz, the input signal level was adjusted to compensate for the design goal attenuations as specified in Table 2 of IEC 61672.1-2013.

Table 5 - Measured Electrical Frequency Response

Freq Hz	A Weighting (dB)	C Weighting (dB)	Z Weighting (dB)	U95
63	74.8	74.8	N/A	0.10
125	74.9	75.0	N/A	0.10
250	74.9	75.0	N/A	0.10
500	75.0	75.0	N/A	0.10
1 000	75.0	75.0	N/A	0.10
2 000	75.0	75.1	N/A	0.10
4 000	75.0	75.0	N/A	0.10
8 000	74.9	74.9	N/A	0.10
15 850	72.3	72.2	N/A	0.10

Adjustments were then applied to correct for a uniform free field response and sound level meter body effects with data supplied by the manufacturer as per Table 6. Windscreen correction factors applied.

Table 6 - Correction Data

Freq Hz	Ufreq	U95	Body Effects	U95	WS Effects	U95
63	0.000	0.250	0.000	0.000	0.000	0.250
125	0.000	0.250	0.000	0.000	0.000	0.250
250	0.000	0.250	0.000	0.000	0.000	0.250
500	0.000	0.250	0.000	0.000	0.000	0.250
1 000	0.000	0.250	0.000	0.000	0.000	0.250
2 000	0.000	0.250	0.000	0.000	0.000	0.250
4 000	0.100	0.250	0.000	0.000	0.100	0.250
8 000	0.100	0.350	0.000	0.000	0.100	0.350
15 850	0.800	0.450	0.000	0.000	0.800	0.450

Finally, the corrected responses were referenced to the response at 1kHz and compared to the tolerances stated in Table 2 of IEC 61672.1-2013.

Table 7 - A Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	74.80	-0.20	±1.0	P	0.37
125	74.90	-0.10	±1.0	P	0.37
250	74.90	-0.10	±1.0	P	0.37
500	75.00	0.00	±1.0	P	0.37
1 000	75.00	0.00	±0.7	P	0.37
2 000	75.00	0.00	±1.0	P	0.37
4 000	75.20	0.20	±1.0	P	0.37
8 000	75.10	0.10	+1.5 / -2.5	P	0.51
15 850	73.90	-1.10	+2.5 / –16	P	0.65

Table 8 - C Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	74.80	-0.20	±1.0	P	0.37
125	75.00	0.00	±1.0	P	0.37
250	75.00	0.00	±1.0	P	0.37
500	75.00	0.00	±1.0	P	0.37
1 000	75.00	0.00	±0.7	P	0.37
2 000	75.10	0.10	±1.0	P	0.37
4 000	75.20	0.20	±1.0	P	0.37
8 000	75.10	0.10	+1.5 / -2.5	P	0.51
15 850	73.80	-1.20	+2.5 / –16	P	0.65

Table 9 - Z Weighted Electrical Response

Freq Hz	Response		Tolerance (dB)	P/F	Uexp
	Corrected	re 1kHz			
63	N/A	N/A	±1.0	N/A	0.37
125	N/A	N/A	±1.0	N/A	0.37
250	N/A	N/A	±1.0	N/A	0.37
500	N/A	N/A	±1.0	N/A	0.37
1 000	N/A	N/A	±0.7	N/A	0.37
2 000	N/A	N/A	±1.0	N/A	0.37
4 000	N/A	N/A	±1.0	N/A	0.37
8 000	N/A	N/A	+1.5 / -2.5	N/A	0.51
15 850	N/A	N/A	+2.5 / –16	N/A	0.65

3.5 FREQUENCY AND TIME WEIGHTINGS AT 1KHZ

A steady sinusoidal electrical input signal of 1kHz at the reference sound pressure level was applied to the reference level range.

The deviations of the indicated level of C and Z frequency weightings were recorded, along with the deviations of the indication of A weighted time averaged, and SLOW weighted response.

Table 10 - Frequency and Time Weighting Results

Frequency Weighting	Time Weighting	Response (dB)	Deviation (dB)	P/F	Tolerance (dB)	U95
A	Fast	94.0	0.0	P	±0.2	0.10
	Leq	94.0	0.0	P	±0.2	0.10
	Slow	94.0	0.0	P	±0.2	0.10
C	Fast	94.0	0.0	P	±0.2	0.10
Z	Fast	N/A	N/A	N/A	±0.2	0.10

3.6 LONG-TERM STABILITY

Long-term stability was tested by comparing a steady sinusoidal electrical signal applied at the start, and at the end of testing. The applied signal level was set to the reference level and frequency and was maintained constant. The difference between the indicated levels was recorded.

Table 11 - Frequency and Time Weighting Results

Signal Level (mV)	Initial Response (dB)	Final Response (dB)	Deviation (dB)	P/F	Tolerance (dB)	U95
62.9	94	94.0	0.0	P	±0.1	0.10

3.7 LEVEL LINEARITY ON THE REFERENCE LEVEL RANGE

Level linearity was tested with a steady sinusoidal electrical signal at a frequency of 8kHz, with the meter set to display frequency weighted A, FAST response.

The starting point for level linearity testing was set to 94.0dB as stated in the instruction manual.

Level linearity was measured in 5dB steps of increasing input signal level from the starting point up to within 5dB of the stated upper limit, then at 1dB steps up to (but not including) the first indication of overload.

Table 12 - Level Linearity - Increasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
94.0	94.0	0.0	±0.8	P	0.1
99.0	99.0	0.0	±0.8	P	0.1
104.0	104.0	0.0	±0.8	P	0.1
109.0	109.0	0.0	±0.8	P	0.1
114.0	114.0	0.0	±0.8	P	0.1
115.0	115.0	0.0	±0.8	P	0.1
116.0	116.0	0.0	±0.8	P	0.1
117.0	117.0	0.0	±0.8	P	0.1
118.0	118.0	0.0	±0.8	P	0.1
119.0	118.9	-0.1	±0.8	P	0.1
120.0	119.9	-0.1	±0.8	P	0.1
121.0	120.9	-0.1	±0.8	P	0.1
122.0	121.8	-0.2	±0.8	P	0.1

Overload indication at 123.0dB.

Level linearity test was the continued in 5dB steps of decreasing input signal level from the starting point up to within 5dB of the stated lower limit, then at 1dB steps up to (but not including) the first indication of under range.

Table 13 - Level Linearity - Decreasing

Ideal (dB)	Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
94.0	94.0	0.0	±0.8	P	0.1
89.0	89.0	0.0	±0.8	P	0.1
84.0	84.0	0.0	±0.8	P	0.1
79.0	79.0	0.0	±0.8	P	0.1
74.0	74.0	0.0	±0.8	P	0.1
69.0	69.0	0.0	±0.8	P	0.1
64.0	64.0	0.0	±0.8	P	0.1
59.0	59.0	0.0	±0.8	P	0.1
54.0	54.0	0.0	±0.8	P	0.1
49.0	49.0	0.0	±0.8	P	0.1
44.0	44.0	0.0	±0.8	P	0.1
39.0	39.0	0.0	±0.8	P	0.1
34.0	34.0	0.0	±0.8	P	0.1
30.0	30.2	0.2	±0.8	P	0.1
29.0	29.3	0.3	±0.8	P	0.1
28.0	28.3	0.3	±0.8	P	0.1
27.0	27.4	0.4	±0.8	P	0.1
26.0	26.6	0.6	±0.8	P	0.1
25.0	25.7	0.7	±0.8	P	0.1

No under range indicated.

3.8 TONEBURST RESPONSE

The response of the sound level meter to short-duration signals was tested on the reference range with 4kHz tone bursts.

The tone bursts were generated from a steady sinusoidal signal at a level of 117.0dB.

Table 14 - FAST Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	116.0	0.0	±0.5	P	0.1
2ms	99.0	0.0	+1.0 / -1.5	P	0.1
0.25ms	89.9	-0.1	+1.0 / -3	P	0.1

Table 15 - SLOW Weighted Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	109.6	0.0	±0.5	P	0.1
2ms	90.0	0.0	+1.0 / -3	P	0.1

Table 16 - Sound Exposure Level Response

Burst Length	Response dB(A)	Deviation (dB)	Tolerance (dB)	P/F	U95
200ms	N/A	N/A	N/A	N/A	N/A
2ms	N/A	N/A	N/A	N/A	N/A
0.25ms	N/A	N/A	N/A	N/A	N/A

3.9 PEAK C RESPONSE

Indication of Peak C sound level was tested on the least sensitive level range. Test signals used were -

- A single complete cycle of an 8kHz sinusoid, starting and stopping at zero crossings
- Positive and negative half cycles of a 500Hz sinusoid, starting and stopping at zero crossings.

The level of the steady 8kHz sinusoid was adjusted to display dB(C).

3.10 OVERLOAD INDICATION

The overload indication was tested on the least sensitive level range, with the sound level meter set to display frequency weighted A, time averaged values.

Positive and negative half cycle sinusoidal electrical signals at 4kHz were used. The test began at an indicated time averaged level of119.0dB(A).

Using the positive half cycle signal, the signal level was increased in steps of 0.5dB up to, but not including, the first indication of overload. The level of the input signal was then increased in steps of 0.1dB until the first indication of overload. These steps were repeated using the negative half cycle signal.

Table 17 - Overload Indication

Signal Orientation	Overload Response	Difference	Tolerance	P/F	Uncertainty
Positive	121.4	0.0	±1.5	P	0.1
Negative	121.3				

Overload indication was verified.

Overload latch indication was verified.

3.11 HIGH LEVEL STABILITY

High level stability was tested by measuring the response of the meter to high signal levels. The result was evaluated as the difference between the A-Weighted indicated levels in response to a steady 1kHz signal applied over 5 minutes.

Table 18 - FAST Weighted Response

Time Weighting	Initial Response (dB)	Final Response (dB)	Deviation (dB)	Tolerance (dB)	P/F	U95
Fast	119.0	119.0	0.0	±0.1	P	0.10
Slow	N/A	N/A	N/A	±0.1	N/A	0.10
Leq	119.0	119.0	0.0	±0.1	P	0.10

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Sound Level Meter
AS 1259.1:1990 - AS 1259.2:1990
Calibration Certificate

Calibration Number C20480

Client Details SLR Consulting Pty Ltd
5/21 Parap Road
Darwin NT 0820

Equipment Tested/ Model Number : ARL EL-316
Instrument Serial Number : 16-203-528
Microphone Serial Number : 305010
Pre-amplifier Serial Number : 26964

Atmospheric Conditions
Ambient Temperature : 21.6°C
Relative Humidity : 34.8%
Barometric Pressure : 101.88kPa

Calibration Technician : Jeff Yu
Calibration Date : 26 Aug 2020
Secondary Check: Max Moore
Report Issue Date : 1 Sep 2020

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	*Pass*	10.3.4: Inherent system noise level	*Pass*
10.2.3: Frequency weighting	*Pass*	10.4.2: Time weighting characteristic F and S	*Pass*
10.3.2: Overload indications	*Pass*	10.4.3: Time weighting characteristic I	*Pass*
10.3.3: Accuracy of level range control	*Pass*	10.4.5: R.M.S performance	*Pass*
8.9: Detector-indicator linearity	*Pass*	9.3.2: Time averaging	*Pass*
8.10: Differential level linearity	*Pass*	9.3.5: Overload indication	*Pass*

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.13dB*	*Temperature*	*±0.2°C*
12.5kHz	*±0.19dB*	*Relative Humidity*	*±2.4%*
16kHz	*±0.31dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.1dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

The sound level meter under test has been shown to conform to the type 1 requirements for periodic testing as described in AS 1259.1:1990 and AS 1259.2:1990 for the tests stated above.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

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Sound Level Meter
AS 1259.1:1990 - AS 1259.2:1990
Calibration Test Report

Calibration Number C20480

Client Details SLR Consulting Pty Ltd
5/21 Parap Road
Darwin NT 0820

Equipment Tested/ Model Number : ARL EL-316
Instrument Serial Number : 16-203-528
Microphone Serial Number : 305010
Pre-amplifier Serial Number : 26964

Atmospheric Conditions
Ambient Temperature : 21.6°C
Relative Humidity : 34.8%
Barometric Pressure : 101.88kPa

Calibration Technician : Jeff Yu
Calibration Date : 26 Aug 2020
Secondary Check: Max Moore
Report Issue Date : 1 Sep 2020

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	*Pass*	10.3.4: Inherent system noise level	*Pass*
10.2.3: Frequency weighting	*Pass*	10.4.2: Time weighting characteristic F and S	*Pass*
10.3.2: Overload indications	*Pass*	10.4.3: Time weighting characteristic I	*Pass*
10.3.3: Accuracy of level range control	*Pass*	10.4.5: R.M.S performance	*Pass*
8.9: Detector-indicator linearity	*Pass*	9.3.2: Time averaging	*Pass*
8.10: Differential level linearity	*Pass*	9.3.5: Overload indication	*Pass*

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.13dB*	*Temperature*	*±0.2°C*
12.5kHz	*±0.19dB*	*Relative Humidity*	*±2.4%*
16kHz	*±0.31dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.1dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

The sound level meter under test has been shown to conform to the type 1 requirements for periodic testing as described in AS 1259.1:1990 and AS 1259.2:1990 for the tests stated above.

1. OVERVIEW

This report presents the calibration test results of a ARL EL-316 Sound Level Meter, and associated equipment. Calibration is carried out in accordance with *AS1259.1:1990, Sound Level Meters, Non Integrating*, and if applicable, *AS1259.2:1990, Sound Level Meters, Integrating-averaging*.

Relevant clauses from this standard have been used for periodic testing in conjunction with Acoustic Research Labs internal test methods described in Section 2 of the calibration work instruction manual.

1.1 UNCERTAINTIES

For each test performed, the associated measurement uncertainties are derived at the 95% confidence level and are given with a coverage factor of 2.

The uncertainty applies at the time of measurement only, and takes no account of any drift or other effects that may apply afterwards. When estimating uncertainty at any later time, other relevant information should also be considered, including, where possible, the history of the performance of the instrument and the manufacturer's specifications.

1.2 DOCUMENT CONVENTIONS

Test results which highlight non-conformances relative to the standard, and the sound level meter type specified by the manufacturer have been marked with an **F** in the respective tests.

Any tests that are not required, due to sound level meter configuration, are marked N/A.

2. GENERAL

2.1 ENVIRONMENTAL CONDITIONS DURING TEST

No corrections have been applied to any results obtained to compensate for the above environmental conditions.

2.2 CALIBRATION TESTS

Where applicable the following tests were performed in accordance with AS1259.1:1990. These clauses are used for periodic calibration testing of Sound Level Meters, Non-integrating.

Clause 8.9	Detector-Indicator linearity
Clause 8.10	Differential level linearity
Clause 10.2.2	Absolute sensitivity
Clause 10.2.3	Frequency weighting
Clause 10.3.2	Overload indication
Clause 10.3.3	Accuracy of level range control
Clause 10.3.4	Inherent weighted system noise level
Clause 10.4.2	Time-weighting characteristics F and S
Clause 10.4.3	Time weighting characteristics I
Clause 10.4.4	Time weighting characteristics P
Clause 10.4.5	RMS performance

Where the sound level meter includes an integrating or averaging function, the following additional tests were performed in accordance with AS1259.2:1990. These clauses are used for periodic calibration testing of Sound Level Meters, Integrating-averaging.

Clause 9.3.2	Time Averaging
Clause 9.3.5	Overload Indication

2.3 TEST EQUIPMENT USED

All test equipment used during periodic testing are calibrated every 12months by an accredited laboratory, traceable to SI units.

The performance of all equipment during these calibrations and the effects of instrument stability are used to determine the measurement uncertainty of each reported result.

2.3.1 Multi-function Acoustic Calibrator

A Bruel & Kjaer 4226 Multi-function calibrator (S/N - 2985012) was used for frequency response testing of the entire instrument (including microphone). This instrument was used as a reference calibrator and for frequency response verification.

2.3.2 Microphone Electrical Equivalent Circuit

Calibration of most instrument parameters is carried out using electrical signals fed to the unit via a two-port electrical equivalent circuit of the microphone.

A 12pF capacitance dummy microphone was used during testing.

2.3.3 Adjustable Attenuator

A means for varying the attenuation of electrical signals via the dummy microphone was provided by a JFW Industries dual rotary attenuator (S/N - 761637). The attenuator is switchable in 1dB steps between 0dB and 60dB.

2.3.4 Arbitrary Function Generator

A Hewlett Packard 33120A (S/N - US36047448) was used to generate the required electrical signals.

2.3.5 Environmental Monitoring

A MHB-382SD (S/N –AG44204) was used for measuring environmental conditions during device calibration. It is capable of providing temperature, relative humidity and pressure measurements.

3. CALIBRATION TEST RESULTS

3.1 ACOUSTIC CALIBRATION TEST RESULTS

The following tests were performed on the complete sound level meter with the associated pre-amplifier and microphone attached. A multi-function acoustic calibrator was used for providing test signals for testing the acoustic measurement capabilities.

3.1.1 Absolute Sensitivity

The absolute sensitivity test was performed by providing an acoustic signal at the reference frequency and reference level at the reference direction of the sound level meter as specified by the manufacturer and recording the results. The instrument's absolute sensitivity was then adjusted according to manufacturer's specifications and a post adjustment measurement was taken.

Table 1 – Pre-Adjustment Absolute sensitivity test results

Frequency Weighting	Sound Pressure Level (dB)
A	94.2
C	94.1
Linear	N/A

Table 2 – Post-Adjustment Absolute sensitivity test results

Frequency Weighting	Sound Pressure Level (dB)
A	94.2
C	94.0
Linear	N/A

The measurement uncertainty for the above tests, derived at the 95% confidence level is 0.11dB.

3.1.2 Frequency Weighting

The frequency weighting test was performed by providing an acoustic signal at the reference level of the sound level meter as specified by the manufacturer.

Frequencies were then altered in nominal full octave steps to test the frequency weighting performance.

Table 3 - Acoustic frequency response test

Frequency (Hz)	A Weighted Response (dB)	C Weighted Response (dB)	Lin Weighted Response (dB)	Uncertainty (dB)
31.6	55.0	91.2	N/A	0.1
63.1	68.1	93.3	N/A	0.1
125.9	78.1	94.0	N/A	0.1
251.3	85.2	94.0	N/A	0.1
502.5	90.5	94.0	N/A	0.1
1005.1	94.2	94.0	N/A	0.1
1978.8	95.8	94.1	N/A	0.1
3957.5	95.9	93.9	N/A	0.1
7915.1	93.6	91.6	N/A	0.1
12664.1	89.5	87.2	N/A	0.2
15830.2	86.6	84.5	N/A	0.3

The measurement uncertainties for this test, derived at the 95% confidence level are as shown in Table 3.

3.1.3 Overload Indication Test - Acoustic Inverse A Weighting Test

The overload indication test was performed by providing an acoustic signal at the reference level and reference frequency. The frequency level was altered in octave steps, and the level was adjusted, according to the A weighting filter response in order to maintain the same sound pressure level display.

Where the sound pressure level is not within the A weighting tolerance, a clear overload indication is to be displayed.

Table 4 - Acoustic inverse A weighting test

Frequency (Hz)	Inverse A Weighting Level (dB)	Deviation From Expected Response (dB)	Overload Indicated (Y/N?)	Uncertainty (dB)
20.0	N/A	N/A	N/A	0.1
31.6	N/A	N/A	N/A	0.1
63.1	N/A	N/A	N/A	0.1
125.9	N/A	N/A	N/A	0.1
251.2	114.8	0.2	Y	0.1
501.2	114.8	0.2	N	0.1
1000.0	115.0	0.0	N	0.1

The measurement uncertainties for this test, derived at the 95% confidence level are as shown in Table 4.

3.2 ELECTRICAL CALIBRATION TEST RESULTS

Electrical testing was performed by removing the microphone and substituting an equivalent electrical impedance by use of a dummy microphone. Electrical signals were then provided by an arbitrary waveform generator, via an adjustable attenuator to provide appropriate input levels.

3.2.1 Detector-Indicator Linearity

Detector-indicator linearity tests were performed by providing an electrical signal at the reference level of the sound level meter as specified by the manufacturer. Sound pressure levels were then altered to test the linearity of the sound level meter.

Tests were also performed at 31.5Hz and 8000Hz.

Table 5 - Detector-indicator linearity test

Amplitude (dB)	1000 Hz Response (dB)	8000 Hz Response (dB)	31.5 Hz Response (dB)
110.0	110.1	110.2	110.3
100.0	99.9	99.8	99.9
90.0	90.0	89.9	90.0
80.0	80.0	80.1	80.1
70.0	69.8	69.8	69.8
60.0	59.9	59.9	59.9
50.0	49.9	50.0	50.0

The measurement uncertainties for this test, derived at the 95% confidence level is 0.1dB for 1000Hz, 0.1db for 8000Hz tests and 0.1dB for 31.5Hz tests.

3.2.2 Differential Level Linearity

Differential level linearity tests were performed by providing an electrical signal at the Reference Level of the sound level meter as specified by the manufacturer. Sound pressure levels were then altered to test the linearity of the sound level meter.

Tests were also performed at 31.5Hz and 8000Hz.

Table 6 - Differential level linearity test

Amplitude (dB)	1000 Hz Response (dB)	8000 Hz Response (dB)	31.5 Hz Response (dB)
99.0	99.0	99.1	99.1
98.0	98.0	98.0	98.0
97.0	97.0	96.9	97.0
96.0	95.9	95.9	95.9
95.0	95.0	95.0	95.0
94.0	94.0	94.0	94.0
93.0	93.0	93.0	93.0
92.0	92.0	92.0	92.0
91.0	91.1	91.1	91.1
90.0	89.9	89.9	90.0
89.0	88.9	89.0	89.0

The measurement uncertainties for this test, derived at the 95% confidence level is 0.1dB for 1000Hz, 0.1db for 8000Hz tests and 0.1dB for 31.5Hz tests.

3.2.3 Frequency Weighting

The frequency weighting test was performed by providing an electrical signal at the reference level of the sound level meter as specified by the manufacturer.

Frequency levels were then altered in exact one third octave steps to test the frequency weighting performance.

Table 7 - Electrical frequency response test

Frequency (Hz)	A Weighted Response (dB)	C Weighted Response (dB)	Lin Weighted Response (dB)	Uncertainty (dB)
10.0	26.4	77.4	N/A	0.1
12.6	30.4	81.3	N/A	0.1
15.9	36.4	84.6	N/A	0.1
20.0	43.0	87.2	N/A	0.1
25.1	49.0	89.3	N/A	0.1
31.6	54.4	90.8	N/A	0.1
39.8	59.4	91.9	N/A	0.1
50.1	63.7	92.7	N/A	0.1
63.1	67.8	93.2	N/A	0.1
79.4	71.6	93.5	N/A	0.1
100.0	75.0	93.7	N/A	0.1
125.9	77.9	93.8	N/A	0.1
158.5	80.6	93.9	N/A	0.1
199.5	82.9	93.9	N/A	0.1
251.2	85.1	93.9	N/A	0.1
316.2	87.0	93.9	N/A	0.1
398.1	88.8	94.0	N/A	0.1
501.2	90.3	94.0	N/A	0.1
631.0	91.9	94.0	N/A	0.1
794.3	93.0	94.0	N/A	0.1
1000.0	94.0	94.0	N/A	0.1
1259.0	94.5	94.0	N/A	0.1
1585.0	95.0	93.9	N/A	0.1
1995.0	95.3	93.9	N/A	0.1
2512.0	95.5	93.7	N/A	0.1
3162.0	95.5	93.5	N/A	0.1
3981.0	95.3	93.2	N/A	0.1
5012.0	94.9	92.7	N/A	0.1
6310.0	94.3	92.1	N/A	0.1
7943.0	93.3	91.1	N/A	0.1
10000.0	91.9	89.8	N/A	0.1
12590.0	90.1	88.0	N/A	0.1
15850.0	88.1	85.8	N/A	0.1
19950.0	85.7	82.9	N/A	0.1

The measurement uncertainties for this test, derived at the 95% confidence level are as shown in Table 7.

3.2.4 Overload Indication - Electrical Rectangular Pulse Test

The overload indication was tested electrically by applying rectangular test pulses of various crest factors at a level 2dB below the upper limit of the primary indicator range.

Where the response is not within the crest factor tolerance, a clear overload indication is to be displayed.

Table 8 - Electrical rectangular pulse test

Pulse Direction and Crest Factor	Response (dB)	Overload Indicated (Y/N?)
CF3 Positive	108.1	N
CF3 Negative	108.1	N
CF5 Positive	N/A	N/A
CF5 Negative	N/A	N/A
CF10 Positive	N/A	N/A
CF10 Negative	N/A	N/A

The measurement uncertainty for this test, derived at the 95% confidence level is 0.2dB.

3.2.5 Accuracy of Level Range Control

The accuracy of the level range control was tested by applying a sound pressure level half way between the maximum and minimum of the highest scale. The sound pressure level was then reduced by half of the scale range, each time reducing the level range by one step.

Table 9 - Accuracy of level range control - C Weighting

Range (dB)	20 Hz Level (dB)	31.5 Hz Level (dB)	1000 Hz Level (dB)	8000 Hz Level (dB)	12500 Hz Level (dB)
50 - 120	N/A	N/A	N/A	N/A	N/A

The measurement uncertainties for this test, derived at the 95% confidence level are 0.1dB for 20Hz-31.5Hz tests and 0.1dB for 1000Hz-12500Hz tests.

3.2.6 Inherent Weighted System Noise Level

The weighted inherent system noise level (electrical noise floor) was tested by removing any input signal to the dummy microphone, and electrically shorting the input to this device.

Table 10 - Inherent weighted system noise level

Frequency Weighting	Level (dB)	Under Range
A	24.7	N
C	23.9	N
Lin	N/A	N/A

3.2.7 Time Weighting Characteristics - Fast and Slow

3.2.7.1 Onset Transient Characteristics

Onset Transient Characteristics were tested by applying single sinusoidal tonebursts of specified duration and amplitude, and recording the maximum response sound pressure level.

Table 11 - Onset transient characteristics

Continuous Level (dB)	Fast Weighting Response (dB) (200ms Toneburst)	Slow - 500ms Toneburst (dB) (500ms Toneburst)
106.0	105.2	N/A
96.0	95.0	N/A
86.0	85.1	N/A
76.0	75.0	N/A
66.0	64.9	N/A
56.0	55.0	N/A

The measurement uncertainty for this test, derived at the 95% confidence level is 0.1dB.

3.2.7.2 Overshoot

Overshoot was tested by suddenly increasing the sound pressure level by 20dB, and recording the maximum response sound pressure level.

Table 12 - Overshoot

Continuous Level (dB)	Fast Weighting Response (dB) (200ms Toneburst)	Slow - 500ms Toneburst (dB) (500ms Toneburst)
106.0	106.0	N/A
96.0	96.0	N/A
86.0	86.0	N/A
76.0	76.0	N/A
66.0	66.0	N/A
56.0	56.0	N/A

The measurement uncertainty for this test, derived at the 95% confidence level is 0.1dB.

3.2.7.3 Decay Time

Decay times were tested by measuring the amount of time taken for the sound pressure level to fall by 10dB, after an input signal is suddenly withdrawn.

Table 13 - Decay Time

Continuous Level (dB)	Fast Weighting Response 10dB Decay Time (s)	Slow Weighting Response 10dB Decay Time (s)
106.0	0.3	N/A

The measurement uncertainty for this test, derived at the 95% confidence level is 0.1dB.

3.2.8 Time Weighting Characteristic - Impulse

3.2.8.1 Response to a Single Burst

The time weighting characteristic I was tested by applying single sinusoidal tonebursts of specified duration and amplitude, and recording the maximum response sound pressure level.

Table 14 - Response to a single burst

Amplitude (dB)	20ms Burst Response (dB)	5ms Burst Response (dB)	Increase in reading for +5dB input for 5ms Burst (dB)	2ms Burst Response (dB)	Increase in reading for +10dB input for 2ms Burst (dB)
100.0	N/A	N/A	N/A	N/A	N/A
90.0	N/A	N/A	N/A	N/A	N/A
80.0	N/A	N/A	N/A	N/A	N/A
70.0	N/A	N/A	N/A	N/A	N/A
60.0	N/A	N/A	N/A	N/A	N/A

3.2.8.2 Response to a Continuous Sequence of Bursts

The time weighting characteristic I was tested by applying a continuous sequence of bursts of a fixed reference amplitude, frequency and duration at various burst frequencies. The sound pressure level was recorded for each burst frequency at various levels.

Table 15 - Response to a continuous sequence of bursts

Amplitude (dB)	100Hz Response (dB)	20Hz Response (dB)	2Hz Response (dB)	Increase in reading for +5dB input for 2Hz (dB)
100.0	N/A	N/A	N/A	N/A
90.0	N/A	N/A	N/A	N/A
80.0	N/A	N/A	N/A	N/A
70.0	N/A	N/A	N/A	N/A
60.0	N/A	N/A	N/A	N/A

3.2.8.3 Decay Time

Decay rate for impulse response was tested by measuring the amount of time taken for the sound pressure level to fall by 10dB, after an input signal is suddenly withdrawn.

Table 16 - Decay Time

Continuous Level (dB)	Impulse Response Decay Rate (dB/s)
100.0	N/A

3.2.9 Time Weighting Characteristic - Peak

The time weighting characteristic P was tested by applying a rectangular test pulse equal to the onset time as specified by the manufacturer. The onset time was then calculated by reducing the width of the test pulse until the instrument indicated a level 2dB less than that of the Reference Test Pulse.

Table 17 - Onset time pulse test

	Positive Pulse	**Negative Pulse**
Reference Test Pulse (dB)	N/A	N/A
Onset Time (μs)	N/A	N/A

3.2.10 RMS Performance

3.2.10.1 Rectangular Pulse Test

The RMS Performance was tested by producing repetitive short term rectangular pulses of different crest factors with an equal RMS level to that of a reference continuous sinusoidal signal. The output level of the rectangular pulse was measured in order to verify the RMS performance.

Table 18 - RMS performance for rectangular pulse

Amplitude (dB)	**CF = 3 Positive Pulse Response (dB)**	**CF = 3 Negative Pulse Response (dB)**	**CF = 5 Positive Pulse Response (dB)**	**CF = 5 Negative Pulse Response (dB)**	**CF = 10 Positive Pulse Response (dB)**	**CF = 10 Negative Pulse Response (dB)**
108.0	108.1	108.1	N/A	N/A	N/A	N/A
98.0	98.0	98.0	N/A	N/A	N/A	N/A
88.0	87.9	87.9	N/A	N/A	N/A	N/A
78.0	78.0	78.0	N/A	N/A	N/A	N/A
68.0	67.9	67.9	N/A	N/A	N/A	N/A
58.0	57.6	57.6	N/A	N/A	N/A	N/A

The measurement uncertainty for this test, derived at the 95% confidence level is 0.2dB.

3.2.10.2 Continuous Toneburst Test

The RMS performance was tested by applying a continuous sequence of bursts of a fixed reference amplitude and burst frequency. The burst count was altered in order to provide various signals of different crest factor.

The sound pressure level was recorded for each test signal of different crest factor at different levels.

Table 19 - RMS performance for continuous toneburst

Amplitude (dB)	CF = 3 Response (dB)	CF = 5 Response (dB)	CF = 10 Response (dB)
108.0	107.8	N/A	N/A
98.0	97.7	N/A	N/A
88.0	87.7	N/A	N/A
78.0	77.8	N/A	N/A
68.0	67.7	N/A	N/A
58.0	57.6	N/A	N/A

The measurement uncertainty for this test, derived at the 95% confidence level is 0.2dB.

3.2.11 Time Averaging

3.2.11.1 Leq Test

The time averaging (Leq) function of the sound level meter is tested by applying continuous toneburst signals of a fixed amplitude, frequency and burst frequency. The duty cycle of the signal is adjusted, and the Leq display is recorded at the end of the integration period, specified by the manufacturer, up to a maximum of 1 hour.

Table 20 - Leq performance for continuous tonebursts

Burst Duty Cycle	Increase in Gain (dB)	Response (dB)	Uncertainty (dB)
"1/10"	10.0	70.1	0.1
"1/100"	20.0	70.0	0.1
"1/1000"	30.0	69.8	0.1
"1/10000"	40.0	69.8	0.1

The measurement uncertainties for this test, derived at the 95% confidence level are as shown in Table 20.

3.2.11.2 SEL Test

The sound exposure level (SEL) function of the sound level meter is tested by applying the same signals as for the Leq test above.

Table 21 - SEL performance for continuous tonebursts

Burst Duty Cycle	Increase in Gain (dB)	Response (dB)	Uncertainty (dB)
"1/10"	10.0	N/A	0.1
"1/100"	20.0	N/A	0.1
"1/1000"	30.0	N/A	0.1
"1/10000"	40.0	N/A	0.1

The measurement uncertainties for this test, derived at the 95% confidence level are as shown in Table 21.

3.2.12 Overload Indication - Time Averaging

The overload indication for time averaging is tested by applying individual toneburst signals of a specified duration and frequency, and increasing the level until such time an overload indication occurs. Once an overload is indicated, the level was reduced below the point of threshold, and the overload indication was checked to make sure the indication remains until reset.

Overload Indication remains ON until reset ?	Y

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Sound Level Meter

AS 1259.1:1990 - AS 1259.2:1990

Calibration Certificate

Calibration Number C20410

Client Details SLR Consulting Australia Pty Ltd
5/21 Parap Road
Darwin NT 0820

Equipment Tested/ Model Number : ARL EL-316
Instrument Serial Number : 16-203-531
Microphone Serial Number : 322709
Pre-amplifier Serial Number : 26968

Atmospheric Conditions
Ambient Temperature : 24.6°C
Relative Humidity : 42.1%
Barometric Pressure : 101.1kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 30 Jul 2020
Secondary Check: Max Moore
Report Issue Date : 4 Aug 2020

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	*Pass*	10.3.4: Inherent system noise level	*Pass*
10.2.3: Frequency weighting	*Pass*	10.4.2: Time weighting characteristic F and S	*Pass*
10.3.2: Overload indications	*Pass*	10.4.3: Time weighting characteristic I	*Pass*
10.3.3: Accuracy of level range control	*Pass*	10.4.5: R.M.S performance	*Pass*
8.9: Detector-indicator linearity	*Pass*	9.3.2: Time averaging	*Pass*
8.10: Differential level linearity	*Pass*	9.3.5: Overload indication	*Pass*

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.14dB*	*Temperature*	*±0.2°C*
12.5kHz	*±0.16dB*	*Relative Humidity*	*±2.4%*
16kHz	*±0.22dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.1dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

The sound level meter under test has been shown to conform to the type 1 requirements for periodic testing as described in AS 1259.1:1990 and AS 1259.2:1990 for the tests stated above.

This calibration certificate is to be read in conjunction with the calibration test report.

NATA
WORLD RECOGNISED
ACCREDITATION

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to SI units.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

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Service Report

Report Number:	20096
Date:	4/08/2020
Equipment:	ARL EL-316 SN: 16-203-531
Client Name:	SLR Consulting Australia Pty Ltd (Darwin)
Contact Name:	Gemma Sheridan (SLR)

Accesories:

UC-53A SN:322262, NH-17 SN:26968, post mic, windshield, pvc pipe and case.

1. Information from customer:

IIC reseting.

2. Condition of the instrument:

Faulty.

3. Corrective action required:

Replaced crystal and capacitors on DAP board.
Found microphone is faulty(fails acoustic frequency sweep).
Replaced UC-53A microphone.
Old UC-53A microphone SN: 322262.
New UC-53A microphone SN: 322709.
Logger adjusted to suit new microphone.

4. Tests conducted to ensure fault rectification

Ngara links and displays status correctly.
Test logging returned expected results.

Certificate Of Calibration

Certificate No.: **SLM 25532 & FILT 5408**

Equipment Description:	Sound Level Meter		
Manufacturer:	B & K		
Model No:	2270	**Serial No:**	2679354
Microphone Type:	4189	**Serial No:**	2695417
Preamplifier Type:	ZC0032	**Serial No:**	12254
Filter Type:	1/3 Octave	**Serial No:**	2679354

Comments: All tests passed for class 1.
(See over for details)

Owner: SLR Consulting Australia Pty Ltd
Level 2, 2 Lincoln Street
Lane Cove, NSW 2066

Ambient Pressure: 998 hPa ±1.5 hPa

Temperature: 23 °C ±2° C **Relative Humidity:** 26% ±5%

Date of Calibration: 09/09/2019 **Issue Date:** 09/09/2019

Acu-Vib Test Procedure: AVP10 (SLM) & AVP06 (Filters)

Checked by: IKB **Authorised Signature:** ....
Jack Kielt

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

NATA
WORLD RECOGNISED ACCREDITATION

ACU-VIB
ELECTRONICS

HEAD OFFICE
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
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Mobile: 0413 809806
web site: www.acu-vib.com.au

Accredited Lab. No. 9262
Acoustic and Vibration Measurements

CERTIFICATE NO.: **SLM 25532 & FILT 5408**

The performance characteristics listed below were tested. The tests are based on the relevant clauses of IEC 61672-3:2013

Tests Performed:	*Clause*	*Result*
Absolute Calibration	10	Pass
Acoustical Frequency Weighting	12	Pass
Self Generated Noise	11.1	Entered
Electrical Noise	11.2	Entered
Long Term Stability	15	Pass
Electrical Frequency Weightings	13	Pass
Frequency and Time Weightings	14	Pass
Reference Level Linearity	16	Pass
Range Level Linearity	17	NA
Toneburst	18	Pass
Peak C Sound Level	19	Pass
Overload Indicator	20	Pass
High Level Stability	21	Pass

Statement of Compliance: The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC61672-1:2013.
A full technical report is available if required.

This Sound Level Meter included an Octave Filter Set. Tests were based on IEC 1260: 1995 and AS/NZS 4476 - 1997 and were conducted to test the following performance characteristics:

1. Relative attenuation clause 5.3

Date of Calibration: 09/09/2019 **Issue Date:** 09/09/2019

Checked by: MKB

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO: **25534**

EQUIPMENT TESTED: 1/2" Microphone
Manufacturer: B & K
Type No: 4197 **Serial No:** 3077697 (Part 2)
Owner: SLR Consulting Australia Pty Ltd
Level 2, 2 Lincoln Street
Lane Cove, NSW 2066
Tests Performed: Acoustic Microphone Frequency Response with Inverse A Weighting

CONDITION OF TEST:

Ambient Pressure: 997 hPa ±1.5 hPa **Relative Humidity:** 24 % ±5%
Temperature: 23 °C ±2° C
Date of Calibration: 09/09/2019 **Issue Date** 09/09/2019
Acu-Vib Test Procedure: AVP05 (Microphone Acoustic Frequency Response)

CHECKED BY: VKB **AUTHORISED SIGNATURE:** ....
Jack Kielt

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.
The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.

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Acoustic and Vibration Measurements

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Acoustic Tests, Microphone response

Job No: 13678 Test No: 255334

Microphone type: B&K 4197 Serial No,: 3077697 (Part 2)

Preamplifier type: 2683 Serial No. : 2792513

SLM body (if appropriate): SVAN 912 AE Serial No: 4396

Ambient Temperature: 23C ±2° C, Relative Humidity: 997 RH ±5% RH,

Ambient Pressure: 24 hPa ±1.5 hPa

Frequency Hz	Deviation re 1 kHz	Type 2 Tol.	Type 1 Tol.	U95 dB	P/F
31.5 Hz	0.11dB	± 3.0 dB	± 1.5 dB dB	0.12	P
63 Hz	-0.01dB	± 2.0 dB	± 1.5 dB dB	0.10	P
125 Hz	-0.08dB	± 1.5 dB	± 1.0 dB dB	0.09	P
250 Hz	-0.15dB	± 1.5 dB	± 1.0 dB dB	0.09	P
500 Hz	-0.14dB	± 1.5 dB	± 1.0 dB dB	0.09	P
1 kHz Ref	0.00dB	± 1.5 dB	± 1.0 dB dB	0.09	P
2 kHz	0.05dB	± 2.0 dB	± 1.0 dB dB	0.07	P
4 kHz	-0.25dB	± 3.0 dB	± 1.0 dB dB	0.13	P
8 kHz	-0.21dB	± 5.0 dB	+1.5;-3.0 dB	0.13	P
12.5 kHz	-0.10dB	+ 5.0; - ∞ dB	+3.0;-6.0 dB	0.19	P
16 kHz	0.61dB	+ 5.0; - ∞ dB	+ 3.0; - ∞ dB	0.30	P

Tolerances from AS1259-1990 part 1, (IEC 60651).

Notes:

Signed (Testing Officer) __________ Date:09/09/2019

Checked by: VKB Date:09/09/2019

Acoustic test WS 1 results

Certificate Of Calibration

Certificate No: 25533

Equipment Tested: 1/2" Microphone
Manufacturer: B & K
Type No: 4197 **Serial No:** 3077697 (Part 1)
Owner: SLR Consulting Australia Pty Ltd
Level 2, 2 Lincoln Street
Lane Cove, NSW 2066
Tests Performed: Acoustic Microphone Frequency Response with Inverse A Weighting

Condition Of Test:

Ambient Pressure: 997 hPa ±1.5 hPa **Relative Humidity:** 24 % ±5%
Temperature: 23 °C ±2° C
Date of Calibration: 09/09/2019 **Issue Date** 09/09/2019
Acu-Vib Test Procedure: AVP05 (Microphone Acoustic Frequency Response)

Checked by: RB **Authorised Signature:** ....
Jack Kielt

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.
The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.

NATA
WORLD RECOGNISED ACCREDITATION

Accredited Lab. 9262
Acoustic and Vibration Measurements

ACU-VIB
ELECTRONICS
HEAD OFFICE
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
Tel: (02) 96808133 Fax: (02)96808233
Mobile: 0413 809806
Web site: www.acu-vib.com.au

Acoustic Tests, Microphone response

Job No: 13678 Test No: 25533

Microphone type: B&K 4197 Serial No,: 3077697 (Part 1)

Preamplifier type: 2683 Serial No. : 2792513

SLM body (if appropriate): SVAN 912 AE Serial No: 4396

Ambient Temperature: 23C ±2° C, Relative Humidity: 997 RH ±5% RH,

Ambient Pressure: 24 hPa ±1.5 hPa

Frequency Hz	Deviation re 1 kHz	Type 2 Tol.	Type 1 Tol.	U95 dB	P/F
31.5 Hz	0.11dB	± 3.0 dB	± 1.5 dB dB	0.12	P
63 Hz	-0.11dB	± 2.0 dB	± 1.5 dB dB	0.10	P
125 Hz	-0.18dB	± 1.5 dB	± 1.0 dB dB	0.09	P
250 Hz	-0.25dB	± 1.5 dB	± 1.0 dB dB	0.09	P
500 Hz	-0.24dB	± 1.5 dB	± 1.0 dB dB	0.09	P
1 kHz Ref	0.00dB	± 1.5 dB	± 1.0 dB dB	0.09	P
2 kHz	0.05dB	± 2.0 dB	± 1.0 dB dB	0.07	P
4 kHz	-0.25dB	± 3.0 dB	± 1.0 dB dB	0.13	P
8 kHz	-0.31dB	± 5.0 dB	+1.5;-3.0 dB	0.13	P
12.5 kHz	-0.20dB	+ 5.0; - ∞ dB	+3.0;-6.0 dB	0.19	P
16 kHz	0.51dB	+ 5.0; - ∞ dB	+ 3.0; - ∞ dB	0.30	P

Tolerances from AS1259-1990 part 1, (IEC 60651).

Notes:

Signed (Testing Officer) ____________ Date:09/09/2019

Checked by: ____________ Date:09/09/2019

Acoustic test WS 1 results

Certificate Of Calibration

Certificate No.: **SLM 27099 & FILT 5849**

Equipment Description: Sound & Vibration Analyser

Manufacturer: Svantek

Model No: Svan-957 **Serial No:** 27523

Microphone Type: 7052E **Serial No:** 50326

Preamplifier Type: SV12L **Serial No:** 25996

Filter Type: 1/3 Octave **Serial No:** 27523

Comments: All tests passed for class 1.
(See over for details)

Owner: SLR Consulting Australia Pty Ltd
120 High Street
North Sydney, NSW 2060

Ambient Pressure: 1010 hPa ±1.5 hPa

Temperature: 23 °C ±2° C **Relative Humidity:** 43% ±5%

Date of Calibration: 16/06/2020 **Issue Date:** 16/06/2020

Acu-Vib Test Procedure: AVP10 (SLM) & AVP06 (Filters)

Checked by: JK **Authorised Signature:** ....

Jack Kielt

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

NATA
WORLD RECOGNISED ACCREDITATION

ACU-VIB
ELECTRONICS

Accredited Lab. No. 9262
Acoustic and Vibration Measurements

HEAD OFFICE
Unit 14, 22 Hudson Ave. Castle Hill NSW 2154
Tel: (02) 96808133 Fax: (02)96808233
Mobile: 0413 809806
web site: www.acu-vib.com.au

Certificate No.: SLM 27099 & FILT 5849

The performance characteristics listed below were tested. The tests are based on the relevant clauses of IEC 61672-3:2013

Tests Performed:	*Clause*	*Result*
Absolute Calibration	10	Pass
Acoustical Frequency Weighting	12	Pass
Self Generated Noise	11.1	Observed
Electrical Noise	11.2	Observed
Long Term Stability	15	Pass
Electrical Frequency Weightings	13	Pass
Frequency and Time Weightings	14	Pass
Reference Level Linearity	16	Pass
Range Level Linearity	17	Pass
Toneburst	18	Pass
Peak C Sound Level	19	Pass
Overload Indicator	20	Pass
High Level Stability	21	Pass

Statement of Compliance: The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2013, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013, the sound level meter submitted for testing conforms to the class 1 requirements of IEC61672-1:2013.

This Sound Level Meter included an Octave Filter Set. Tests were based on IEC 1260: 1995 and AS/NZS 4476 - 1997 and were conducted to test the following performance characteristics:

1. Relative attenuation — clause 5.3

A full technical report is available if required.

Date of Calibration: 16/06/2020 **Issue Date:** 16/06/2020

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

Certificate of Calibration – Sound Level Meter

Report Reference:	SLM/19/08/011	**Date of calibration:**	16/08/2019

Client: SLR Consulting Australia Pty. Ltd.
Address: 503 Murray Street, Perth WA 6000

Sound Level Meter:	Svantek SVAN 957	**Microphone:**	ACO 7052E
Meter Serial No:	20666	**Microphone Serial No:**	54741
Meter Class:	1	**Preamplifier:**	Svantek SV 12L
Hardware Version:	6.16.3	**Preamplifier Serial No:**	10690
Software Version:	6.16.3	**Filters:**	Integral Octave & 1/3 Octave Band
Channel/s tested:	N/A		

Procedures from IEC 61672-3:2006 were used to perform periodic tests.

Clause 9	Indication at the calibration check frequency	**Complied**
Clause 10	Self-generated noise	**Checked**
Clause 11	Acoustical tests of frequency weighting	**Complied**
Clause 12	Electrical tests of frequency weightings	**Complied**
Clause 13	Frequency and time weighting at 1kHz	**Complied**
Clause 14	Level linearity on the reference level range	**Complied**
Clause 15	Level linearity including level range control	**N/A**
Clause 16	Toneburst response	**Complied**
Clause 17	Peak C sound level	**Complied**
Clause 18	Overload indication	**Complied**

Where the instrument includes an Octave Band or 1/3 Octave Band Filter Set, performance characteristics were checked against the requirements of the following clauses of AS/NZS4476:1997:

Clause 4.4, 5.3	Relative Attenuation	**Complied**

Primary test equipment:

Bruel & Kjaer type 4226 multifunction calibrator S/N 1899898
Agilent Technologies HP33120A Waveform generator S/N US36006913
Agilent Technologies HP8903E Distortion Analyser S/N 2818A00472

Environmental conditions – start of test 22.3 deg C, 101.9 kPa, 43.1 %RH
Environmental conditions – end of test: 22.5 deg C, 101.7 kPa, 45.6 %RH

The sound level meter submitted for testing has successfully completed the Class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002 [AS IEC 61672.1-2004], the sound level meter submitted for testing conforms to the Class 1 requirements of IEC 61672-1:2002 [AS IEC 61672.1-2004].

The calibration procedures followed are in accordance with the terms of the NATA accreditation of this laboratory.

NATA
WORLD RECOGNISED ACCREDITATION

Accredited for compliance with ISO/IEC 17025 - Calibration.
Measurement results are traceable to SI and IEC 61672.3. Reference equipment has been calibrated by the National Measurement Institute or NATA accredited laboratories.
Accreditation No. 12604

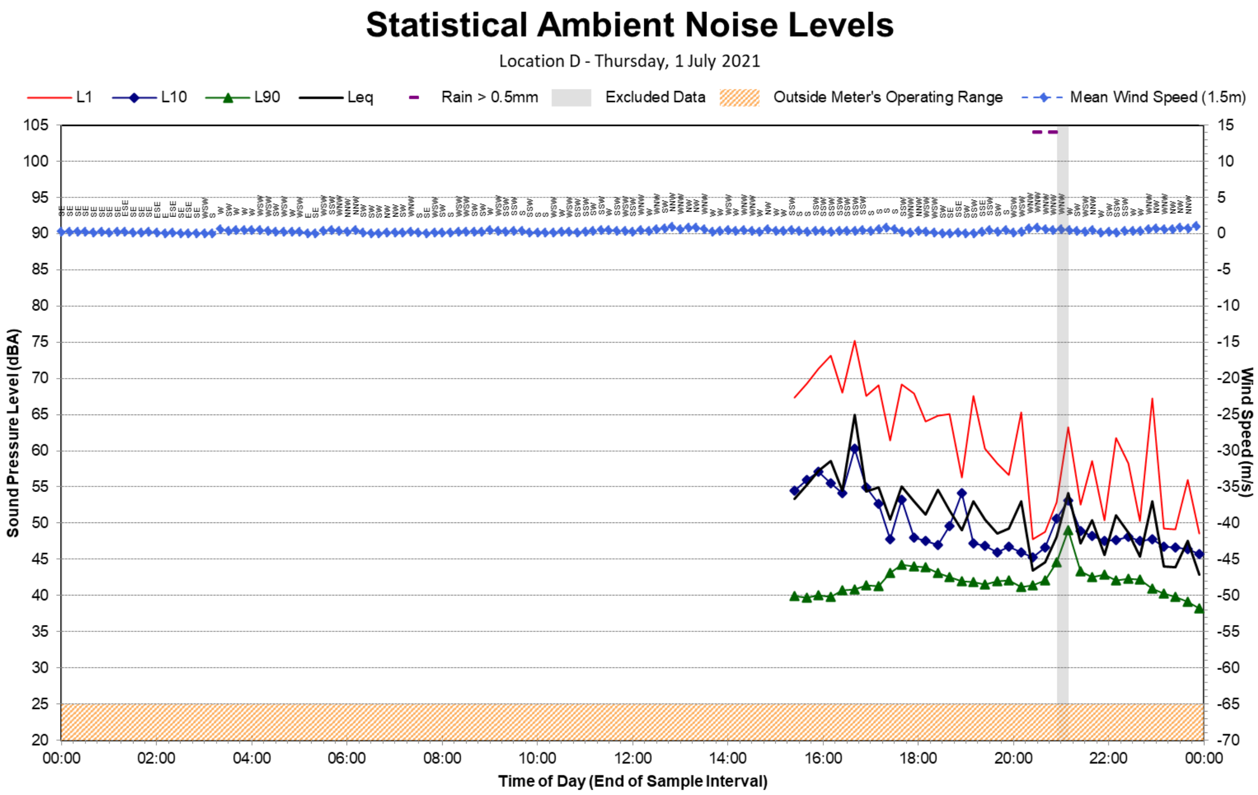
Authorised Signatory

16/8/19
Date of Issue

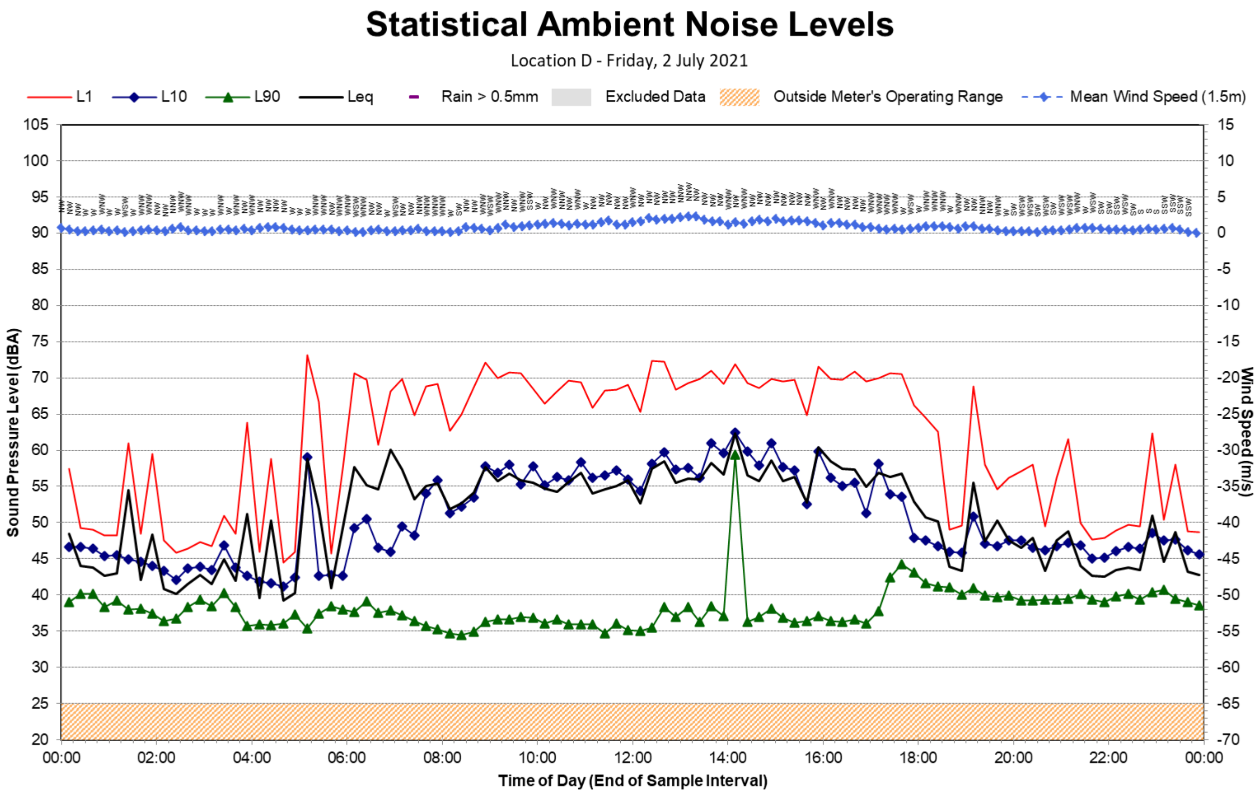
Noise & Vibration Measurement Systems Pty Ltd
433 Vincent Street West, West Leederville, WA 6007, Australia
PO Box 514, Wembley, WA 6913
Phone: (08) 9380 6933
Fax: (08) 9388 2631
e-mail: sales@nvms.com.au

APPENDIX D

Statistical Ambient Noise Levels



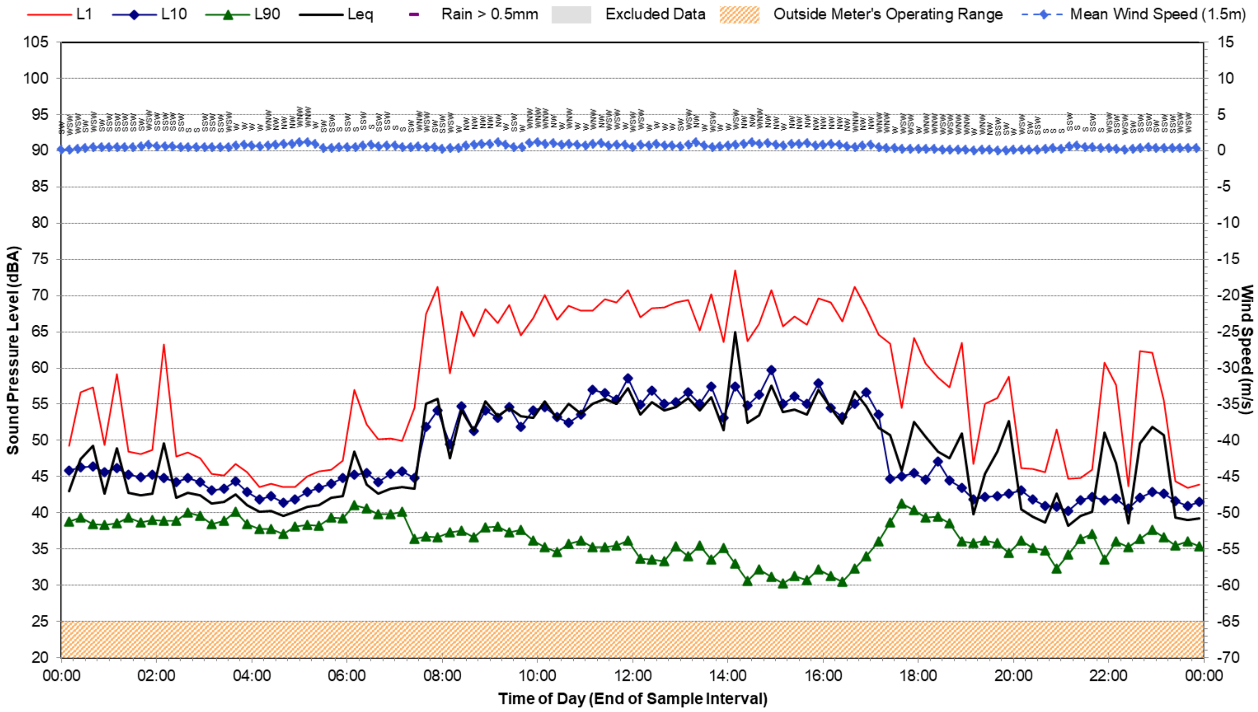
Statistical Ambient Noise Levels
Location D - Thursday, 1 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
Location D - Friday, 2 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

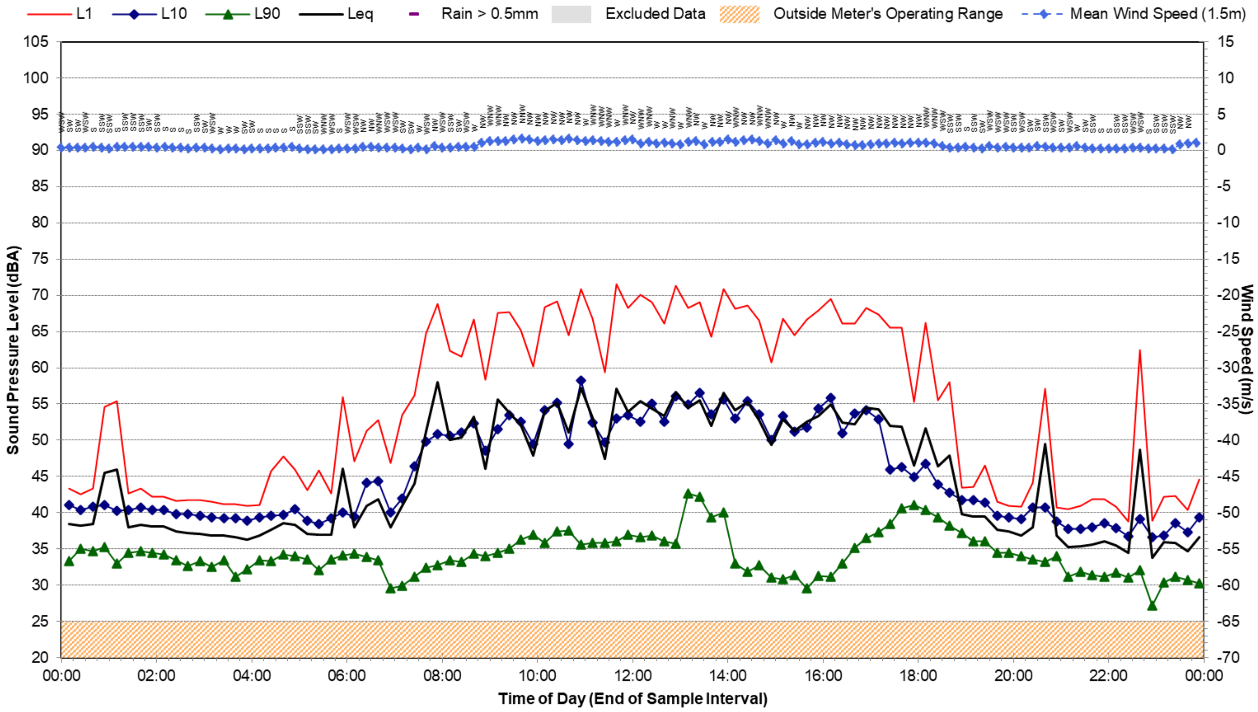
Statistical Ambient Noise Levels

Location D - Saturday, 3 July 2021



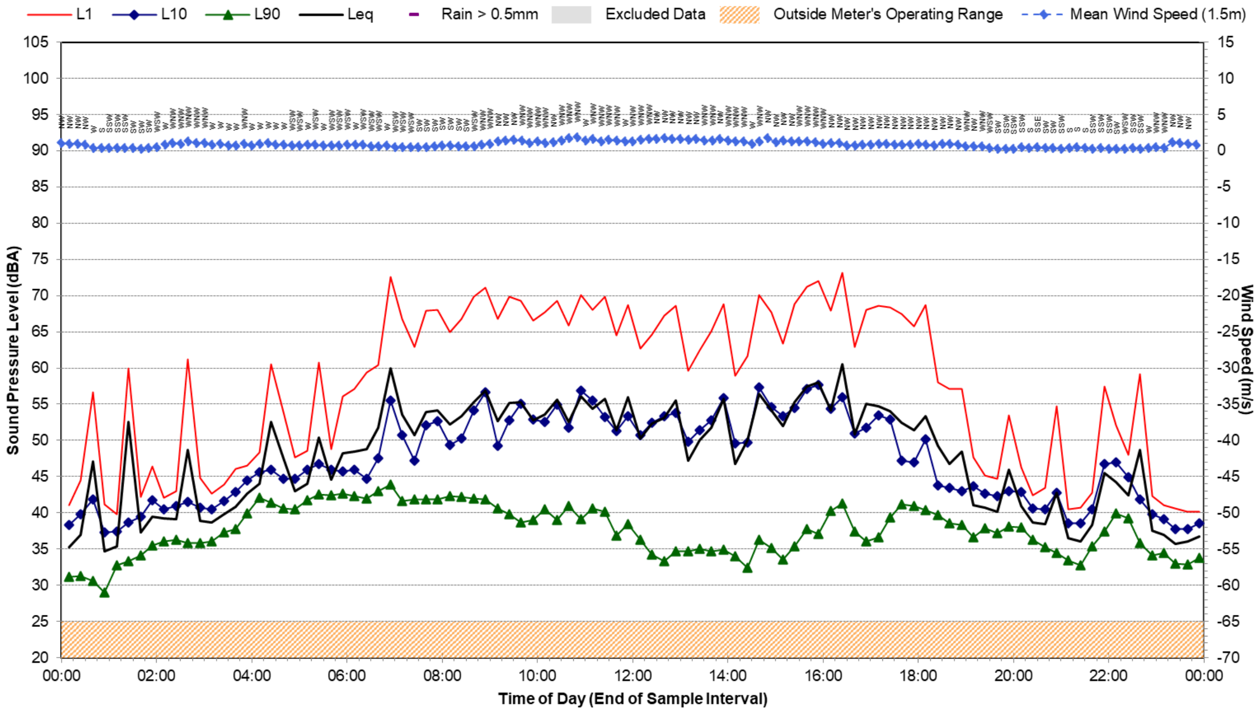
Statistical Ambient Noise Levels

Location D - Sunday, 4 July 2021



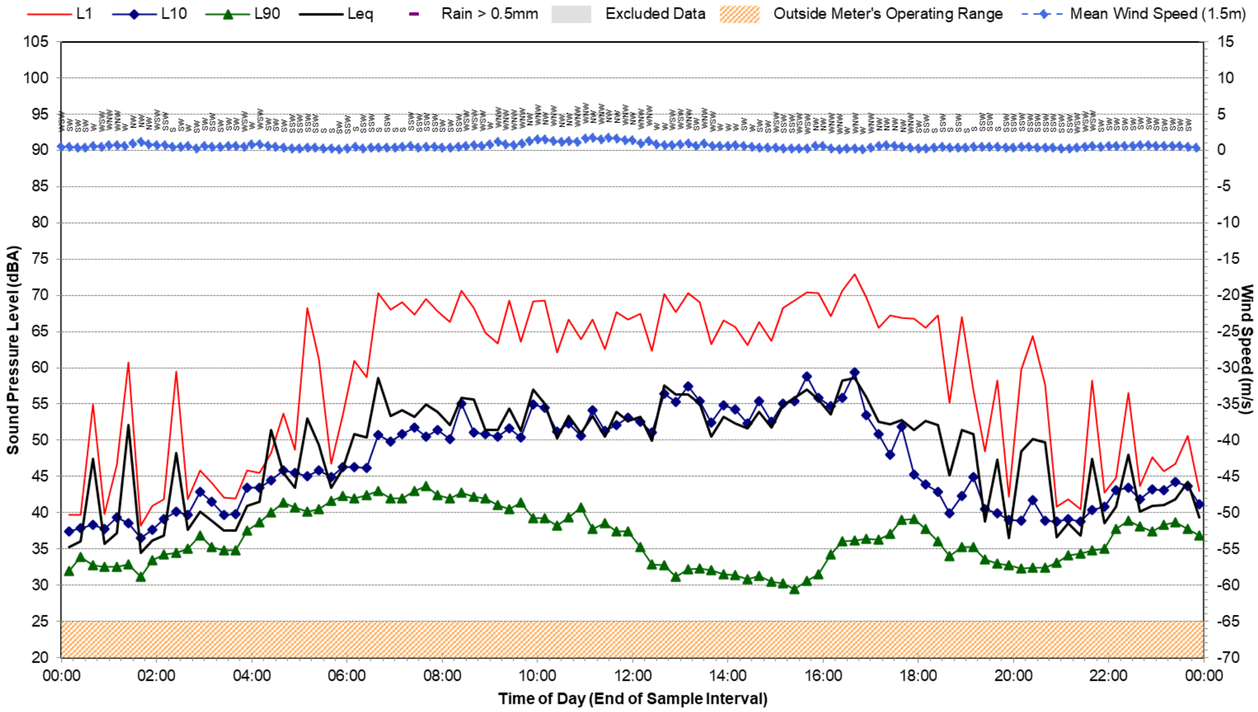
Statistical Ambient Noise Levels

Location D - Monday, 5 July 2021



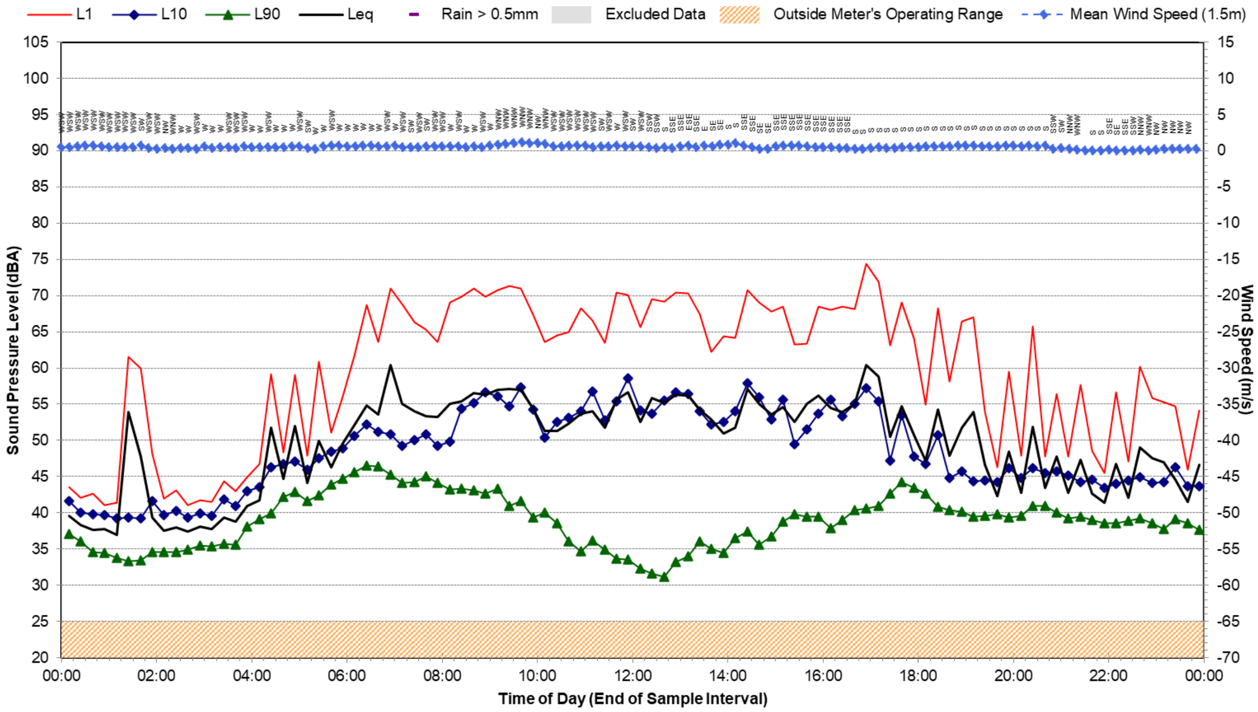
Statistical Ambient Noise Levels

Location D - Tuesday, 6 July 2021



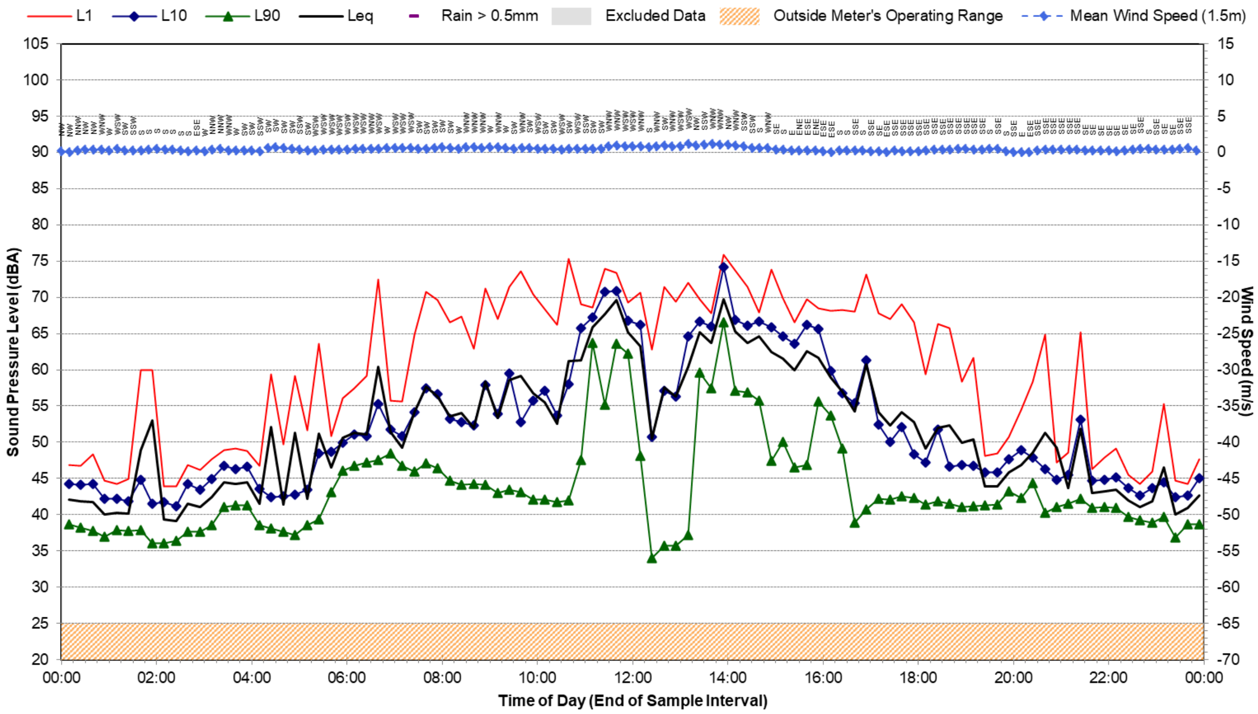
Statistical Ambient Noise Levels

Location D - Wednesday, 7 July 2021



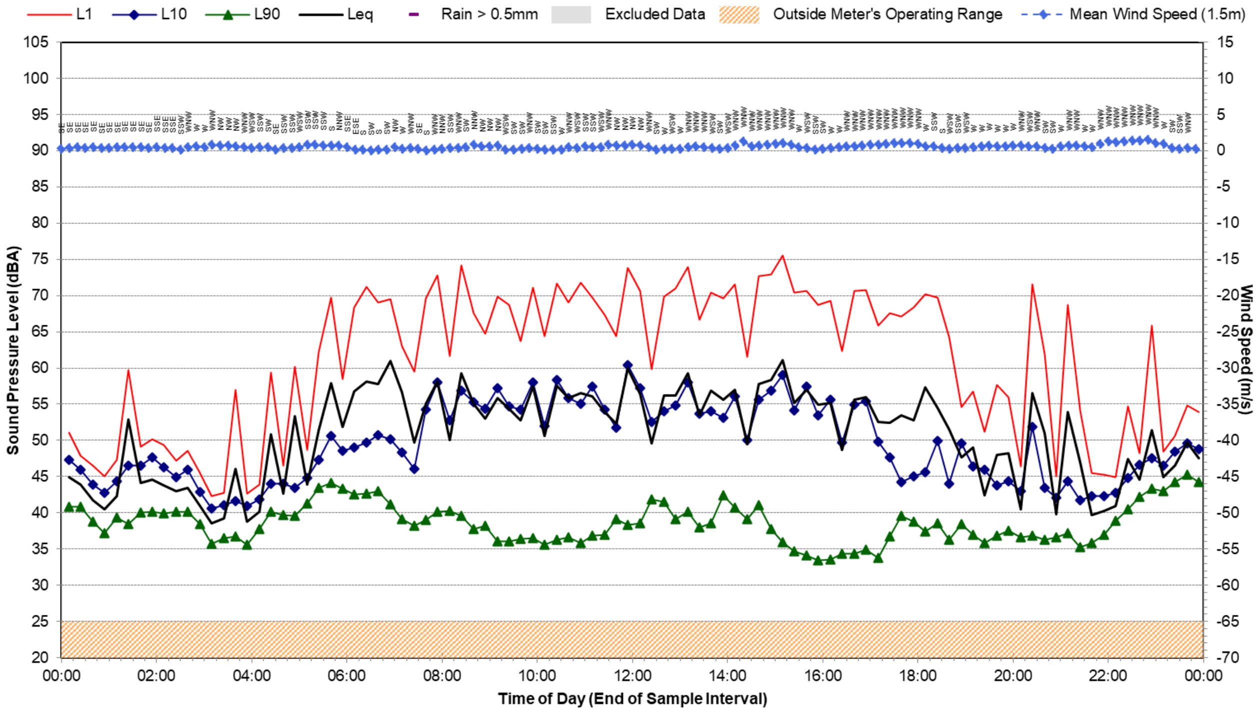
Statistical Ambient Noise Levels

Location D - Thursday, 8 July 2021



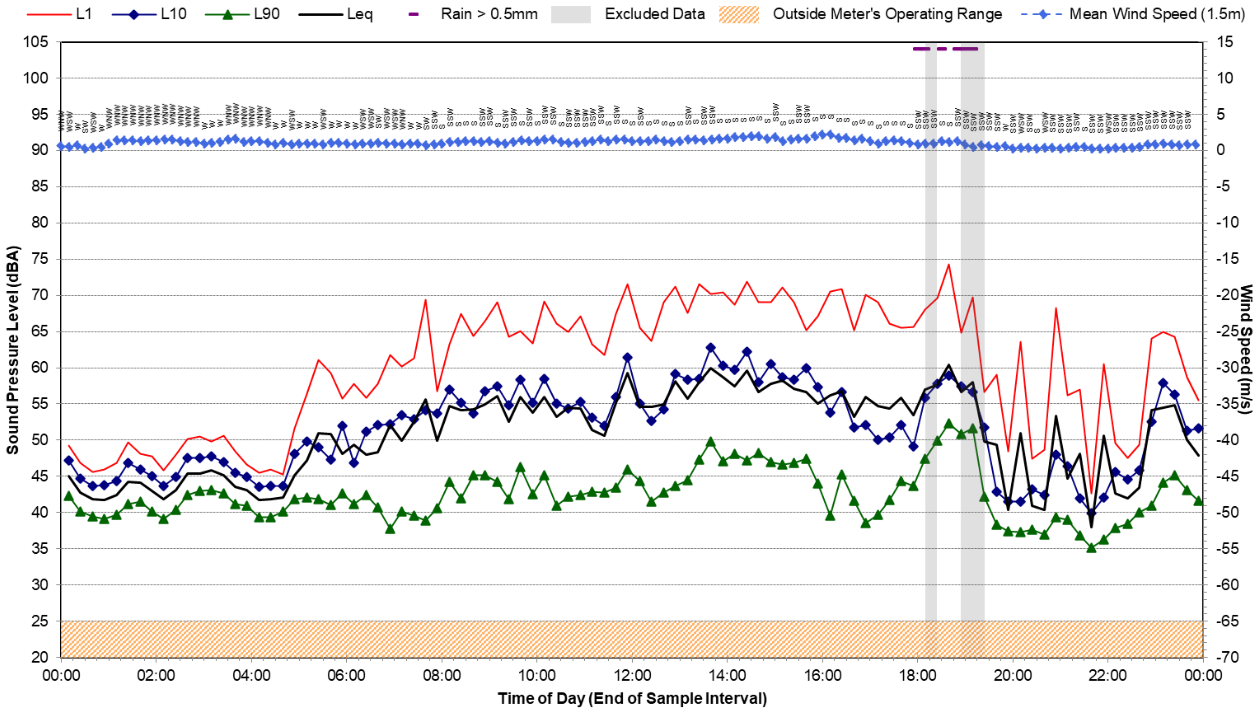
Statistical Ambient Noise Levels

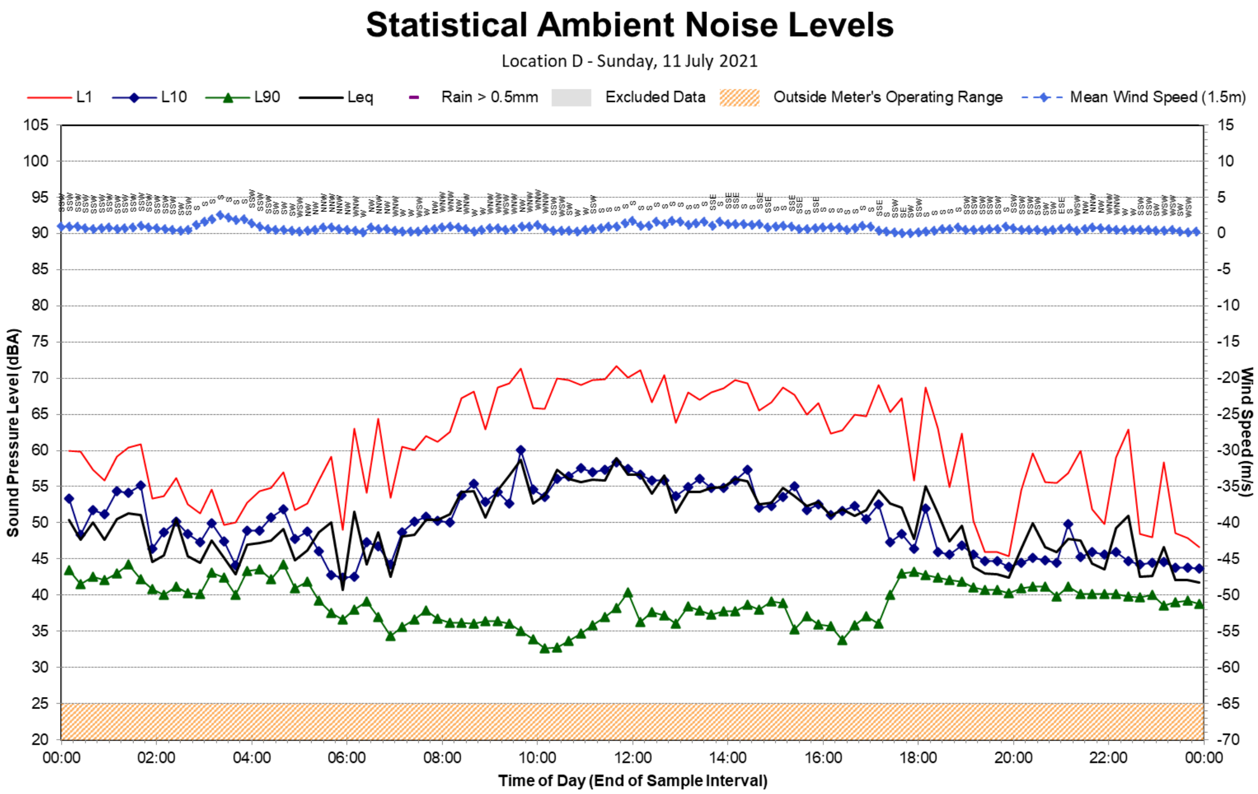
Location D - Friday, 9 July 2021



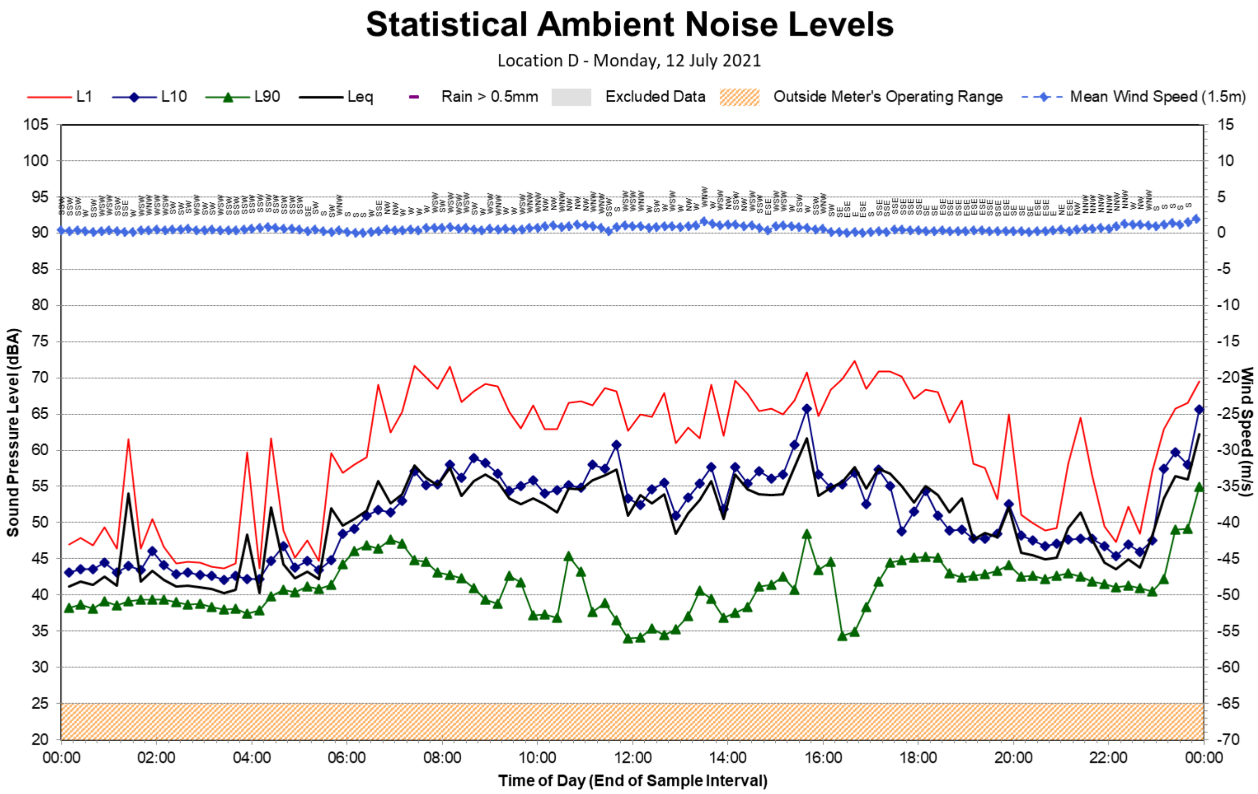
Statistical Ambient Noise Levels

Location D - Saturday, 10 July 2021

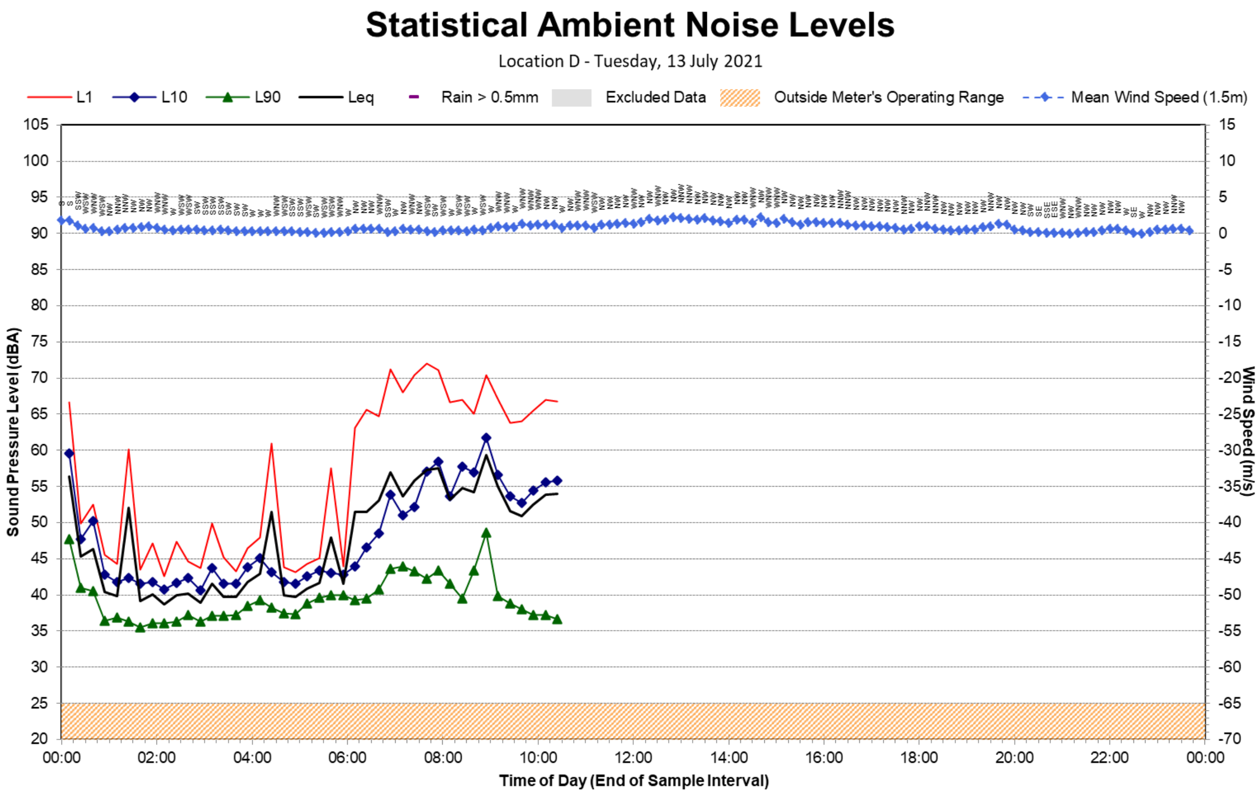


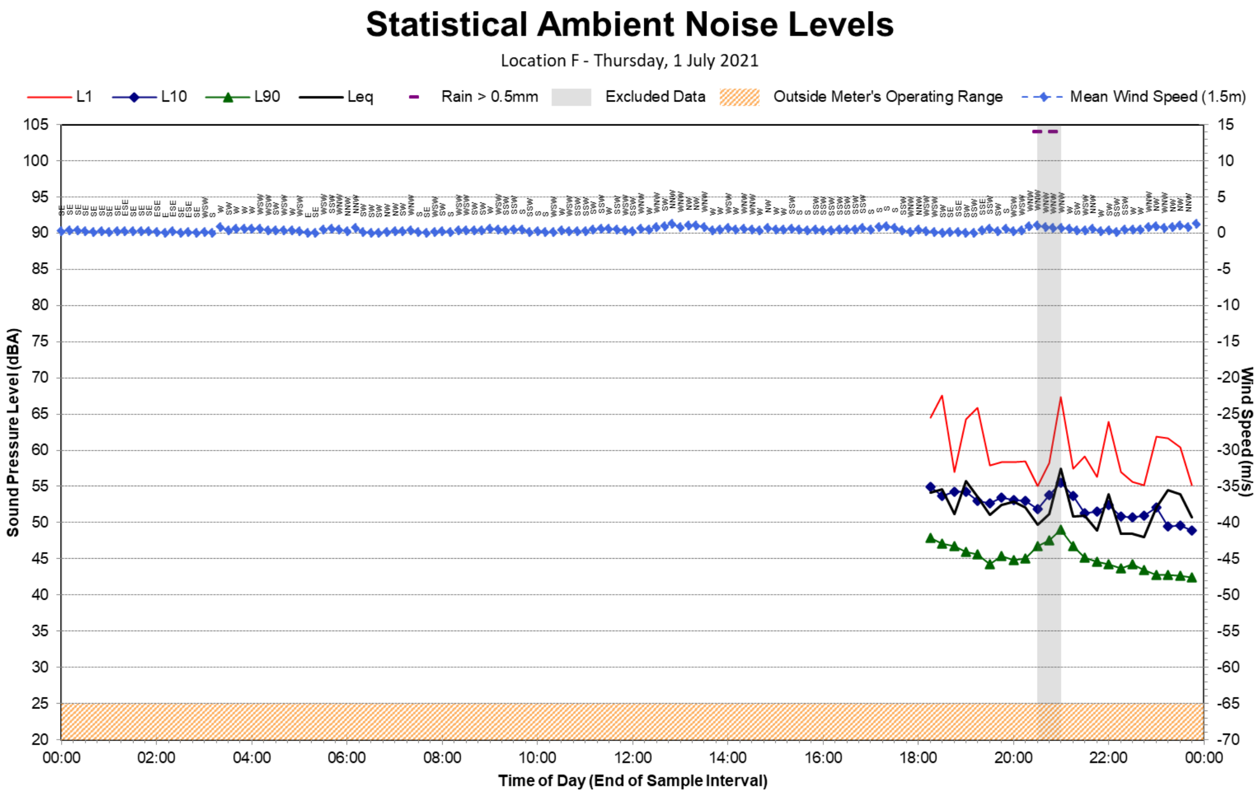


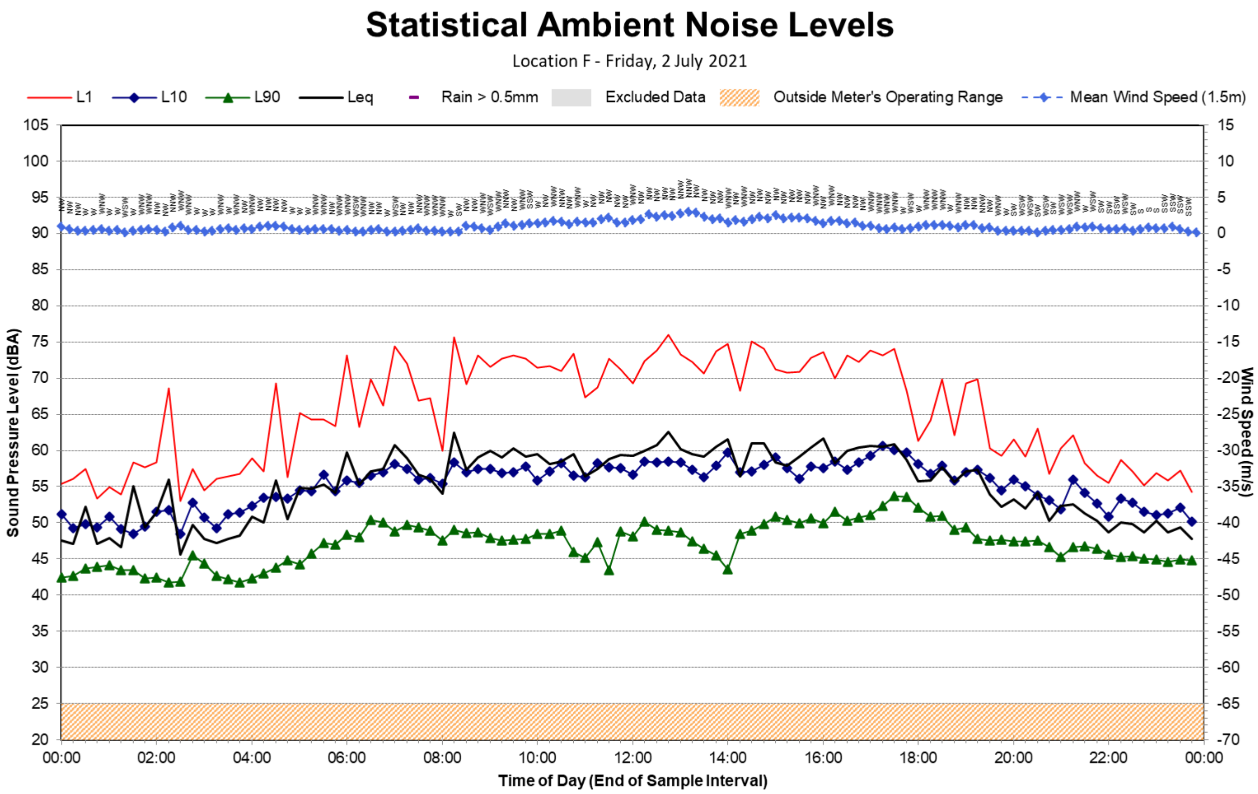
Statistical Ambient Noise Levels
Location D - Sunday, 11 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

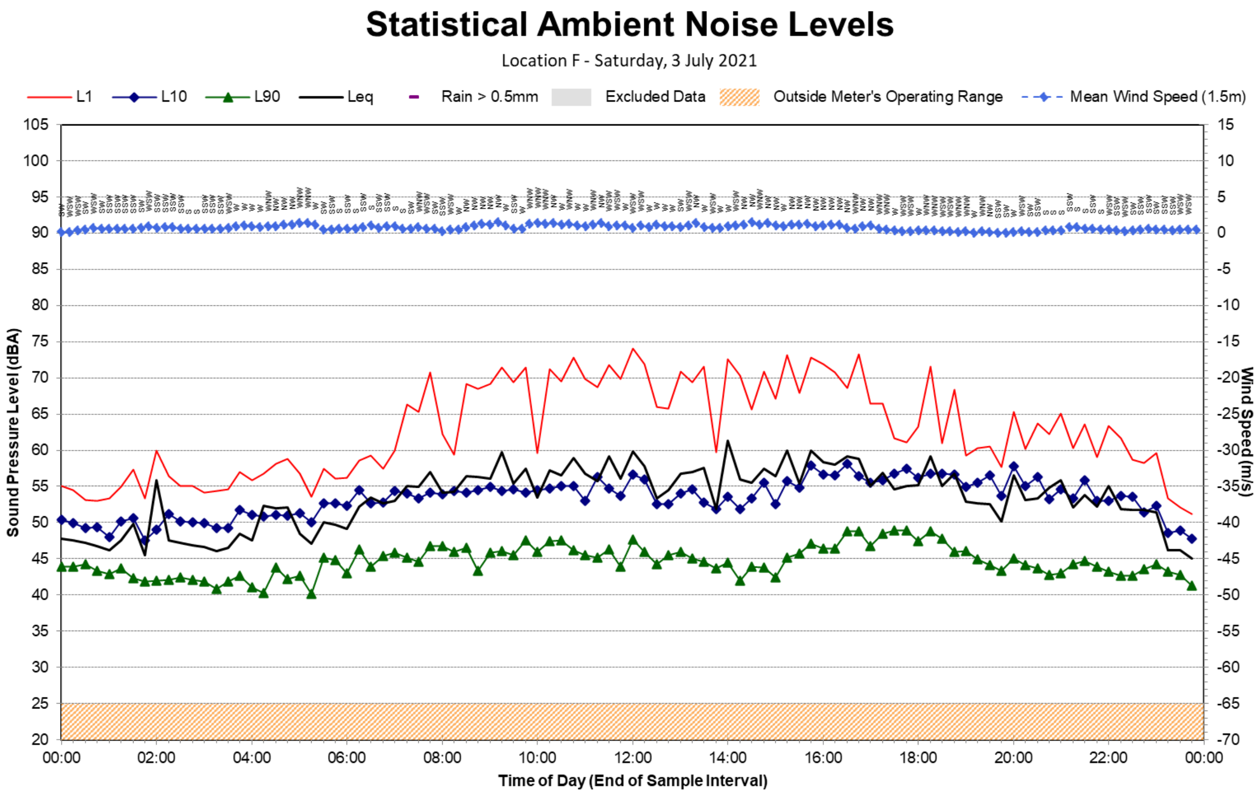


Statistical Ambient Noise Levels
Location D - Monday, 12 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location D - Tuesday, 13 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

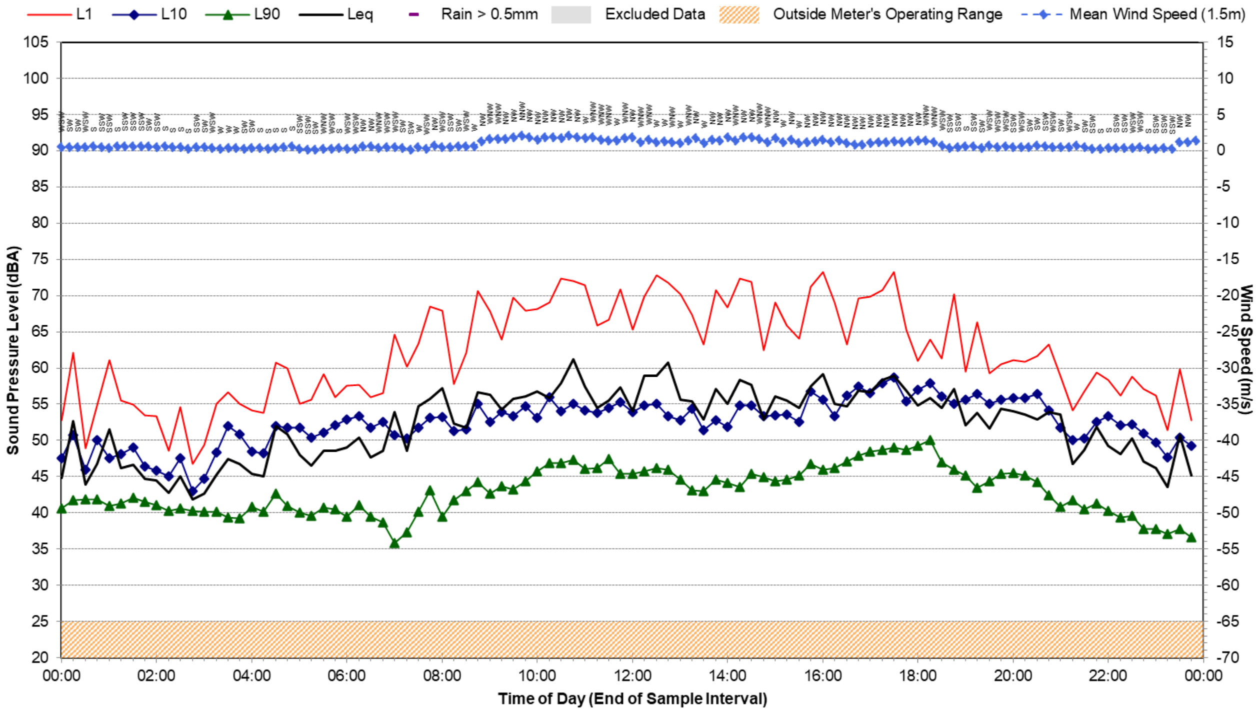

Statistical Ambient Noise Levels
Location F - Thursday, 1 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location F - Friday, 2 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location F - Saturday, 3 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

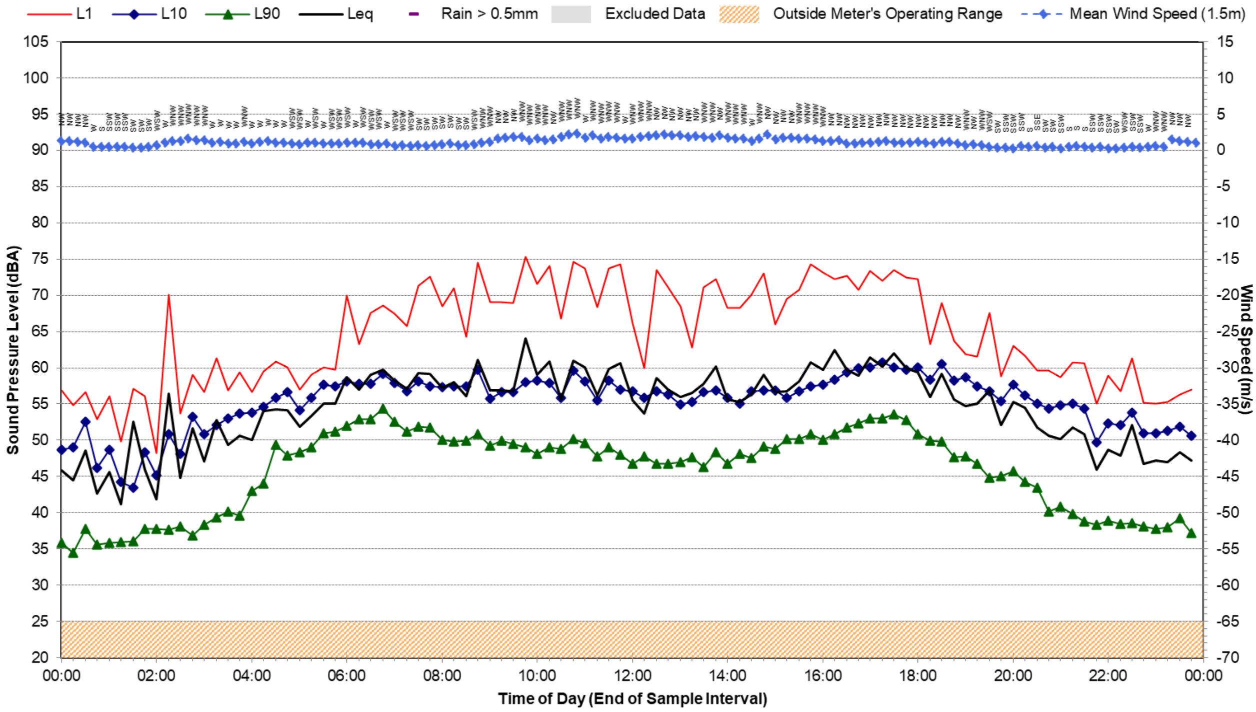
Statistical Ambient Noise Levels

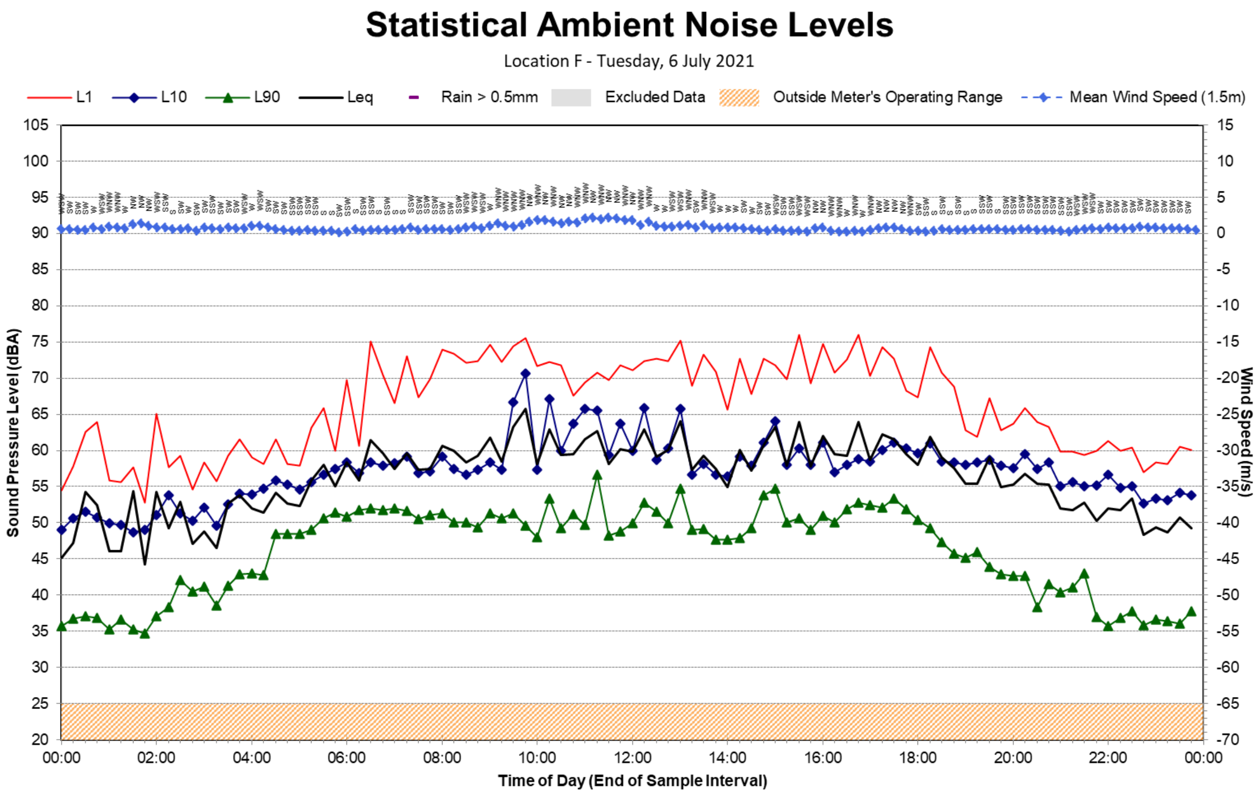
Location F - Sunday, 4 July 2021

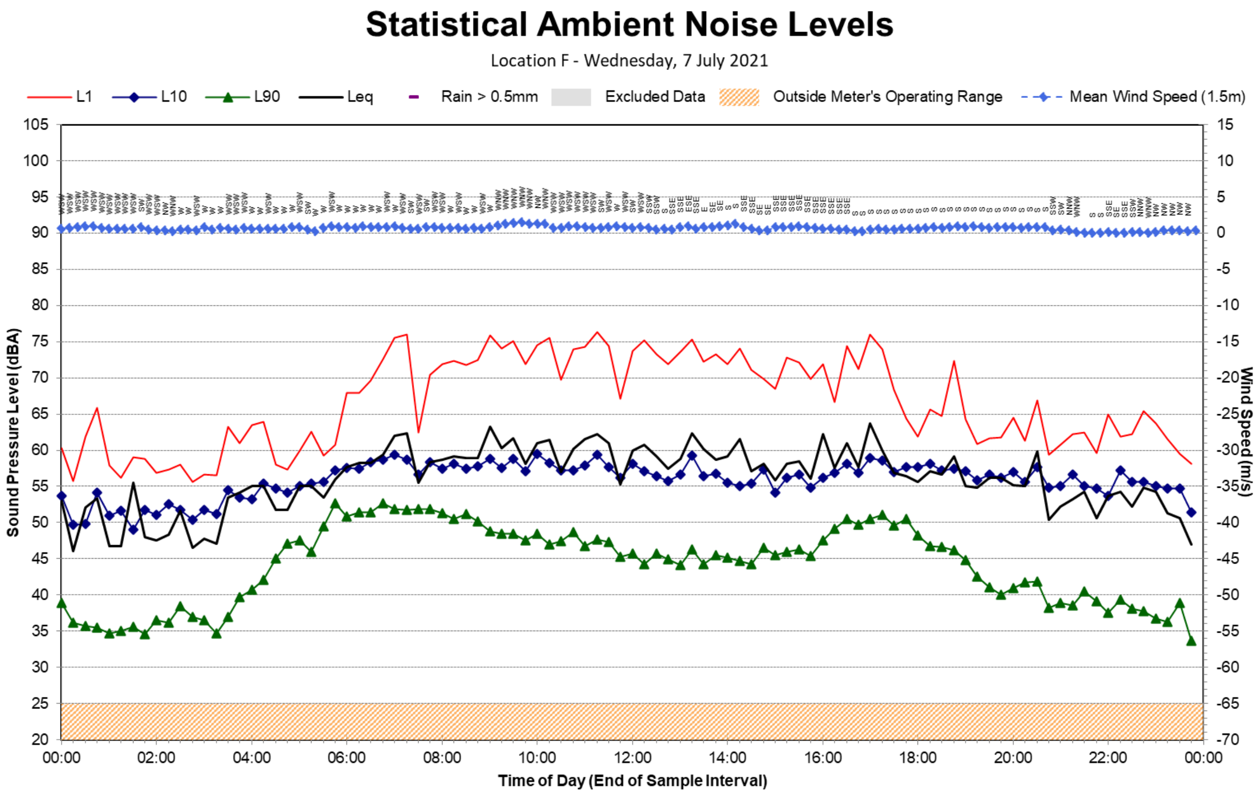


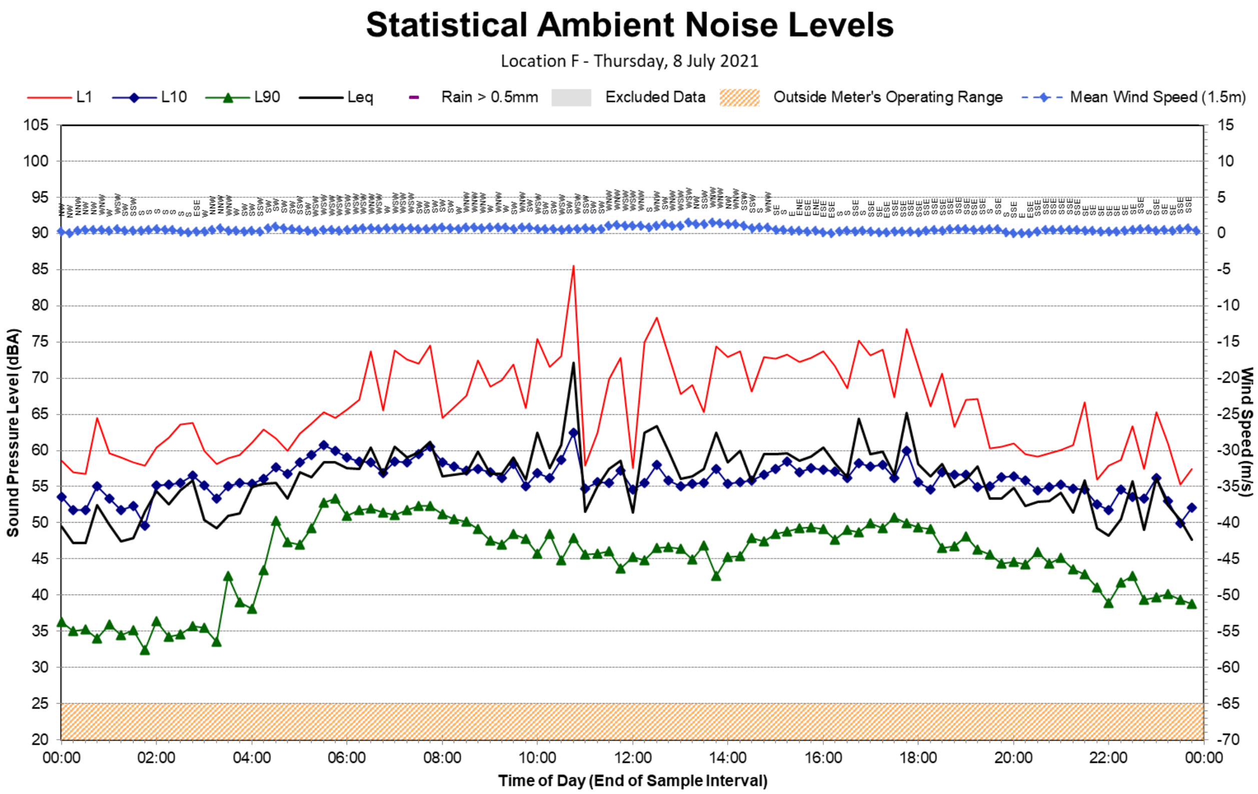
Statistical Ambient Noise Levels

Location F - Monday, 5 July 2021

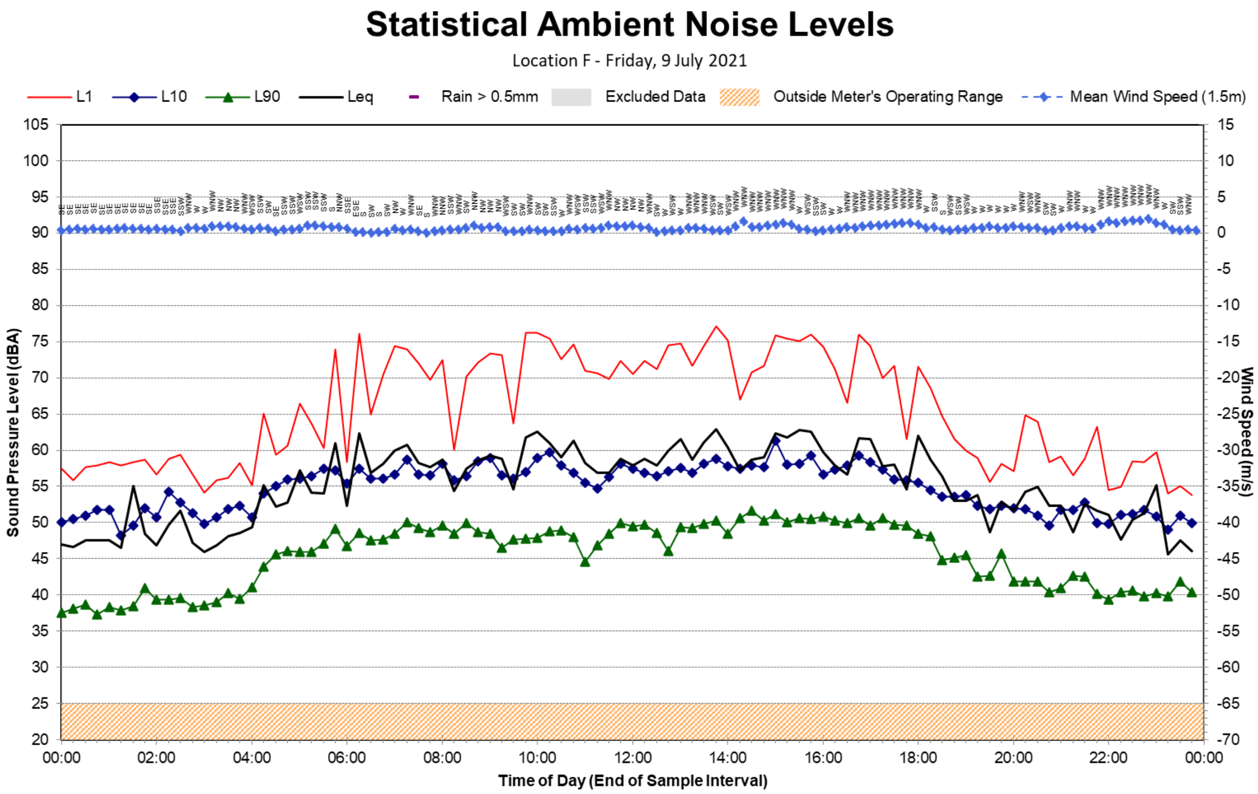



Statistical Ambient Noise Levels
Location F - Tuesday, 6 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location F - Wednesday, 7 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



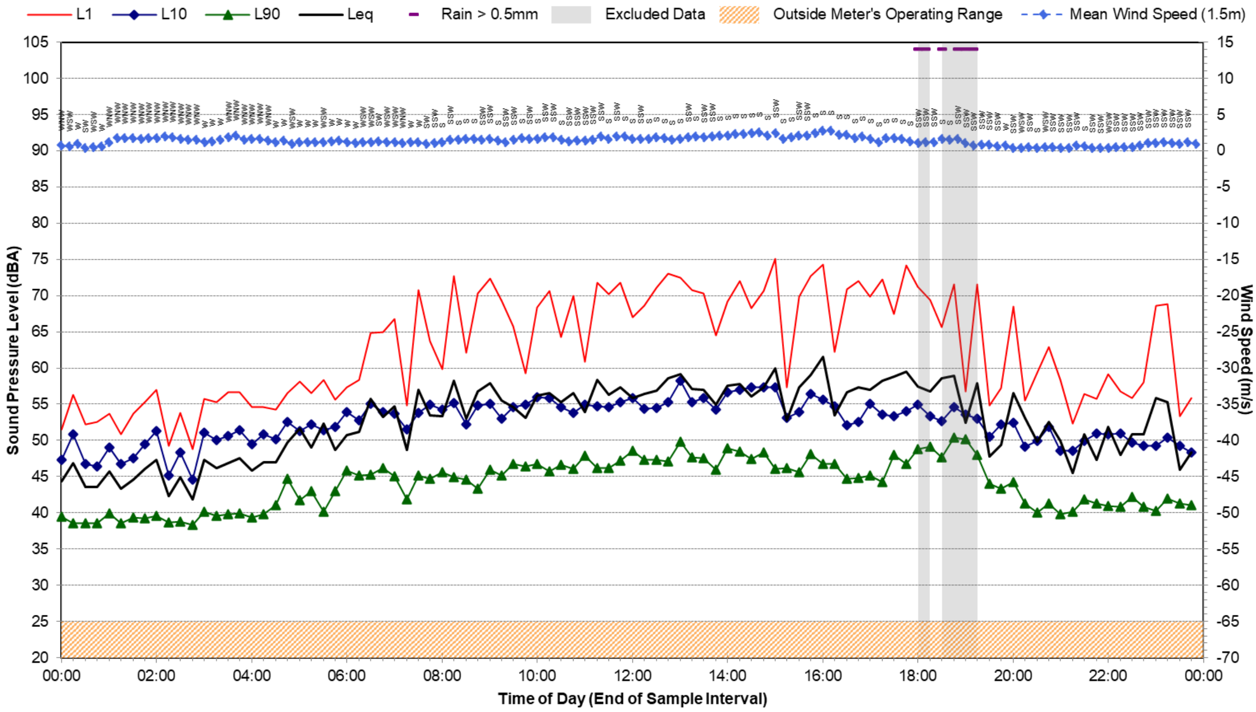
Statistical Ambient Noise Levels
Location F - Thursday, 8 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
Location F - Friday, 9 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

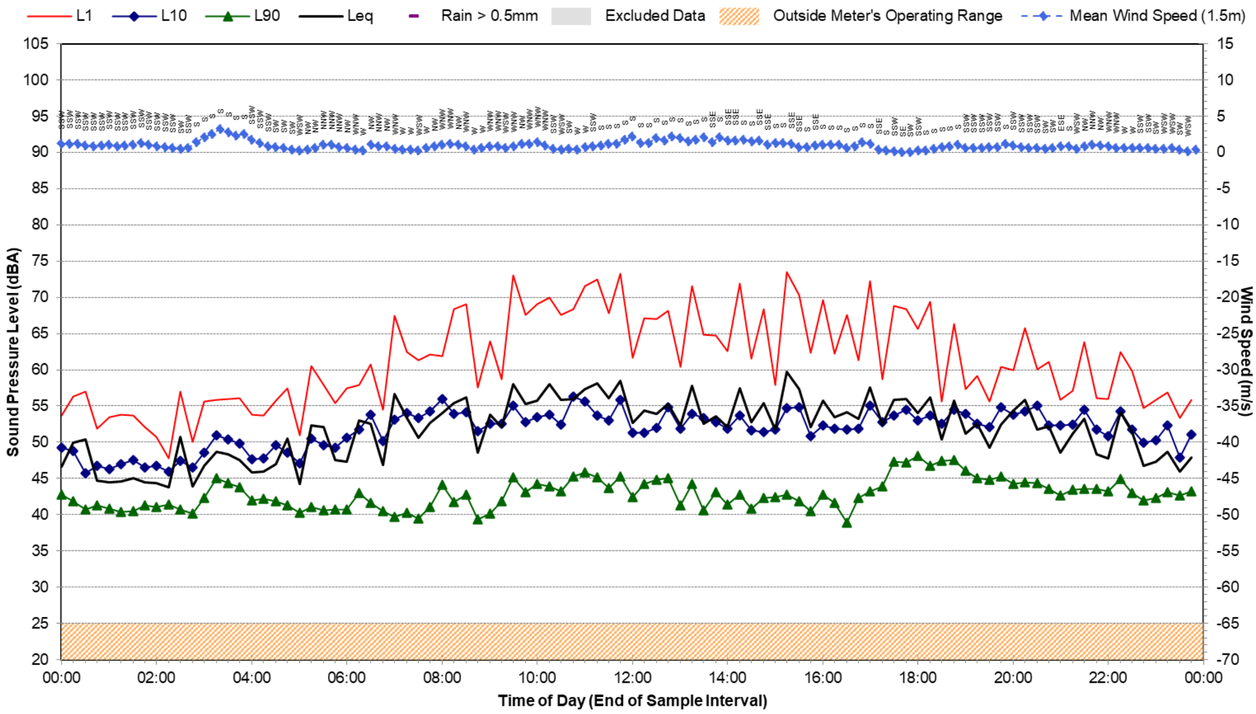
Statistical Ambient Noise Levels

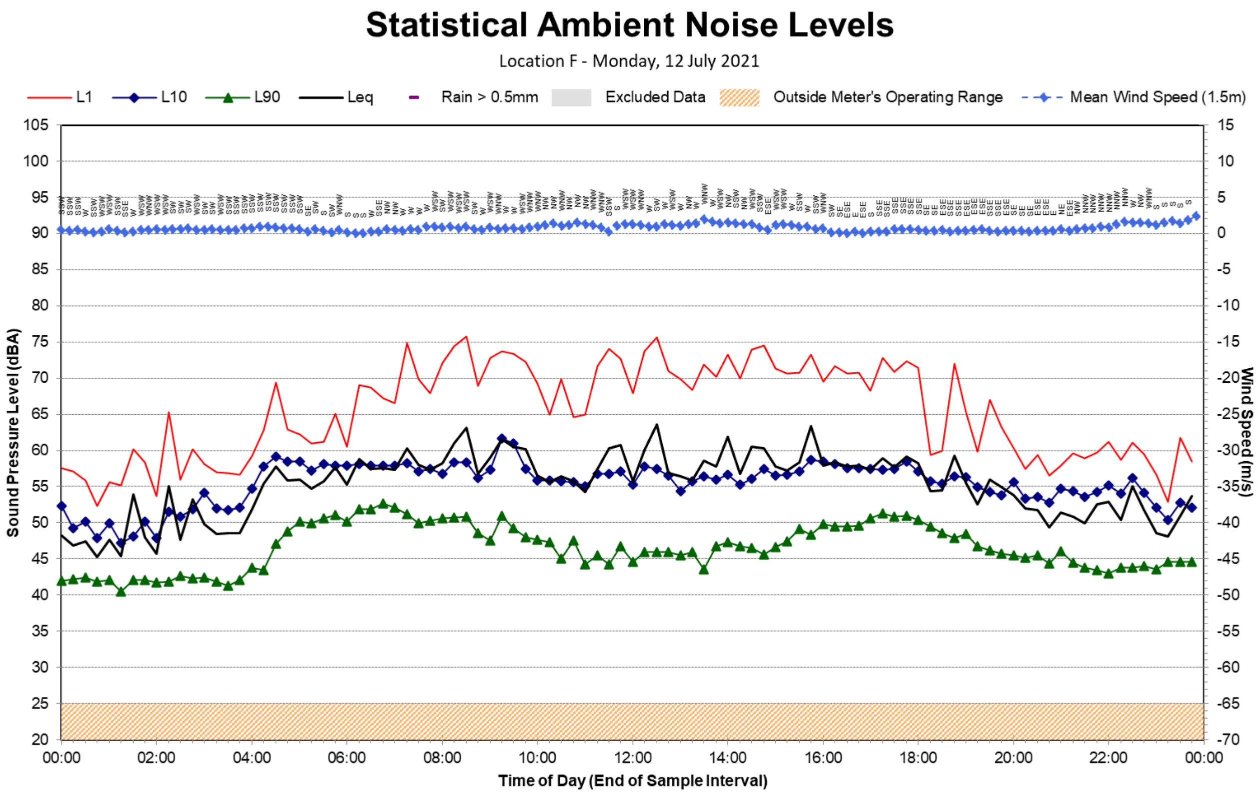
Location F - Saturday, 10 July 2021

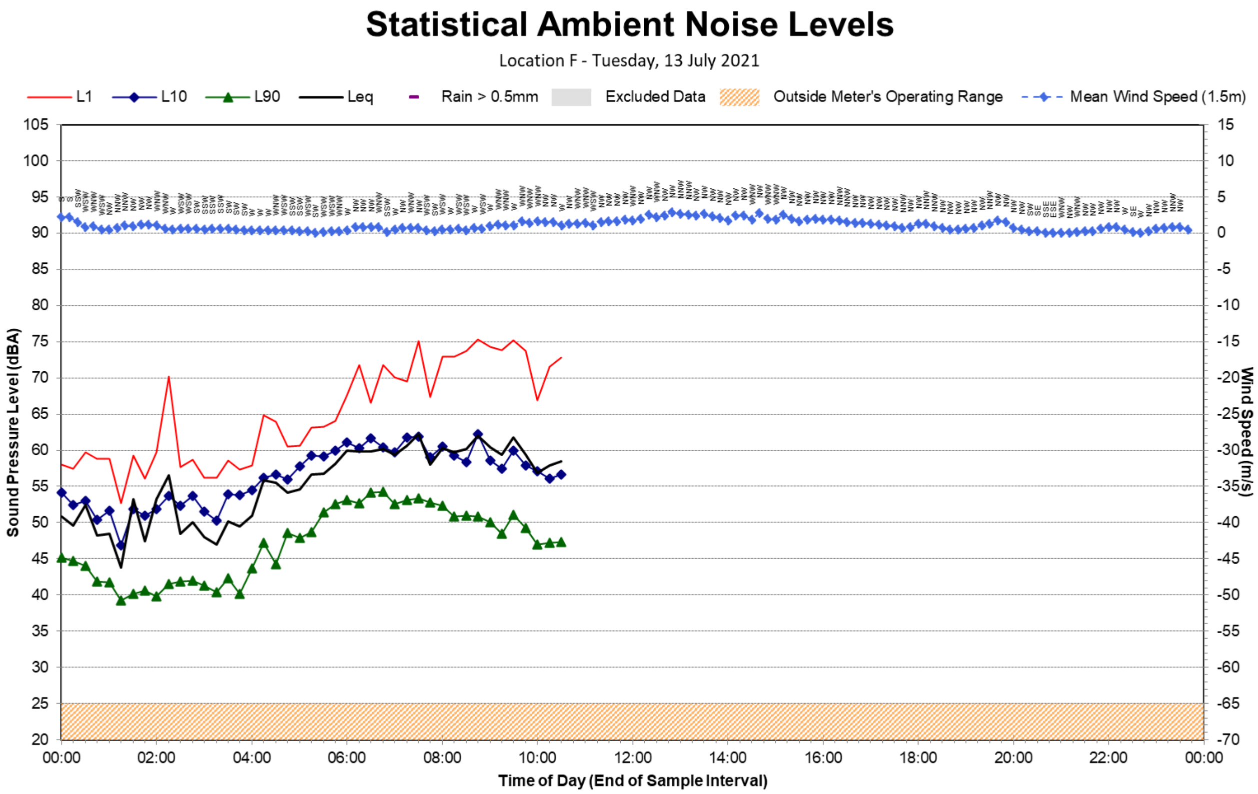


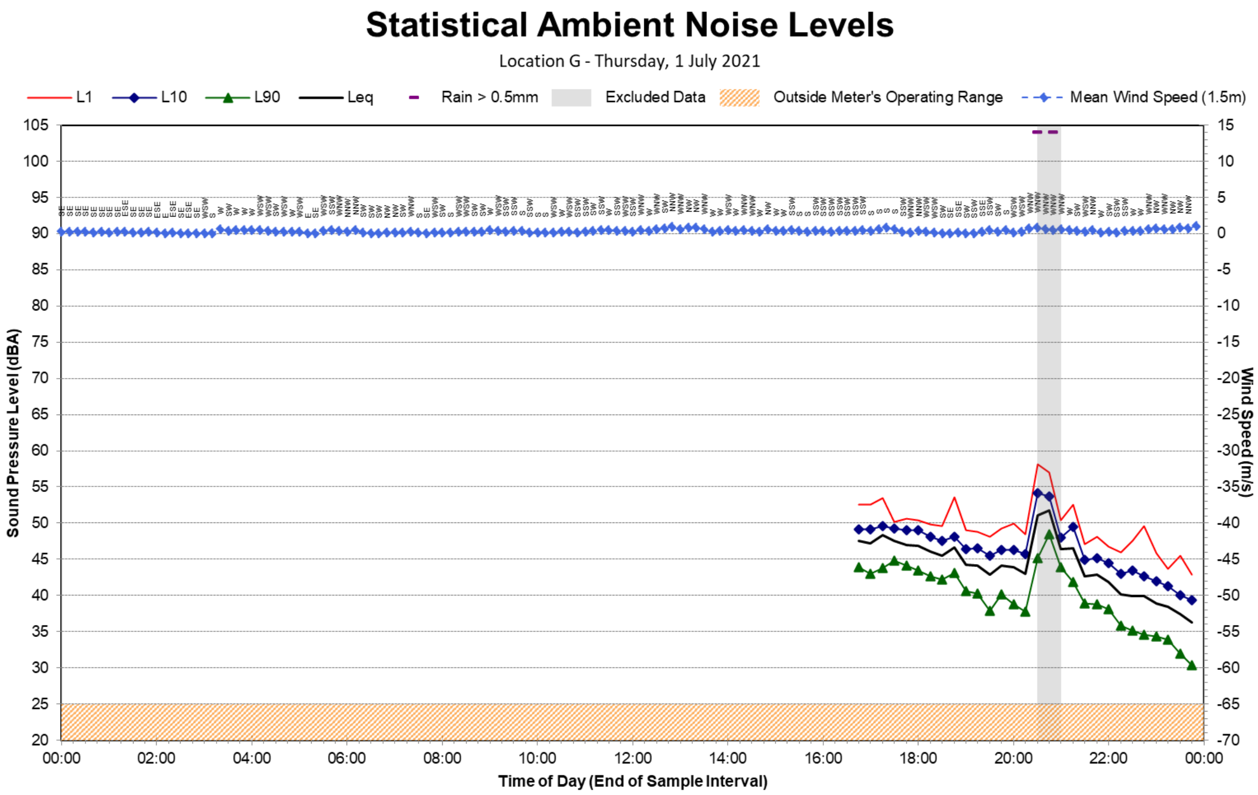
Statistical Ambient Noise Levels

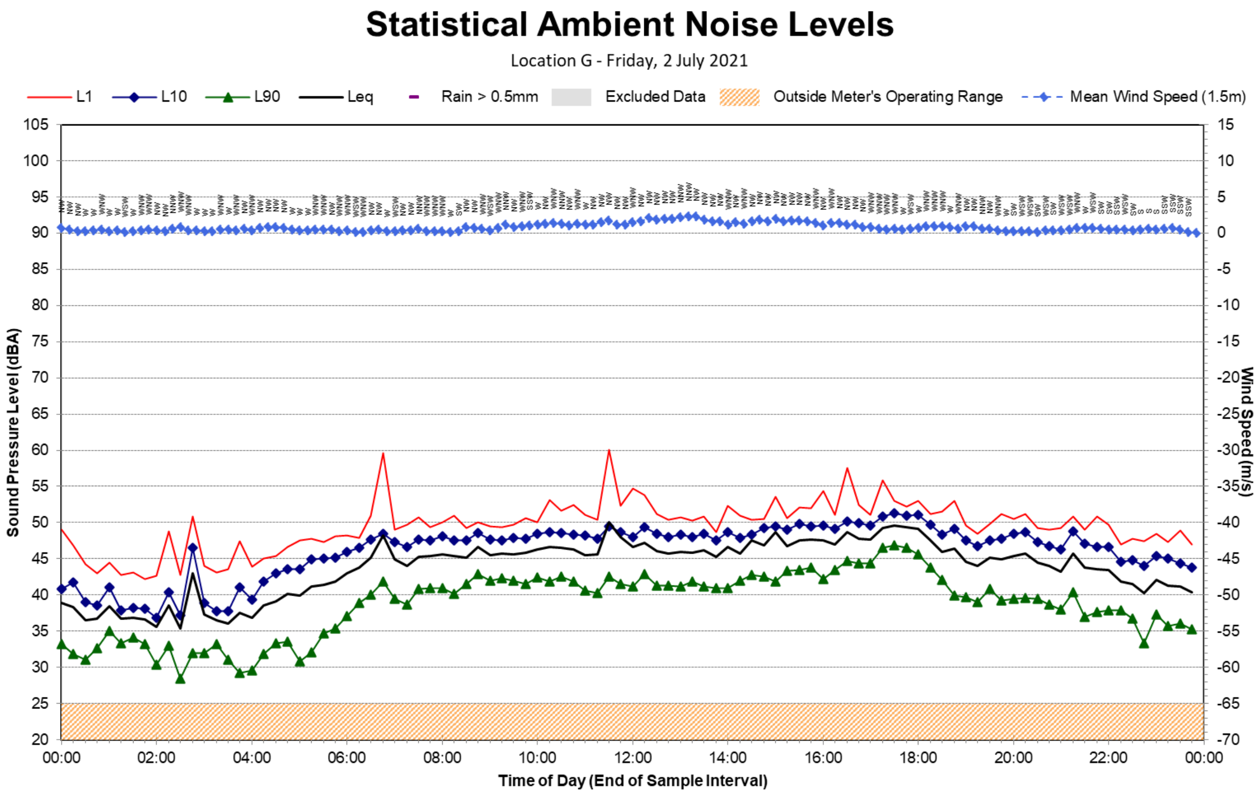
Location F - Sunday, 11 July 2021




Statistical Ambient Noise Levels
Location F - Monday, 12 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

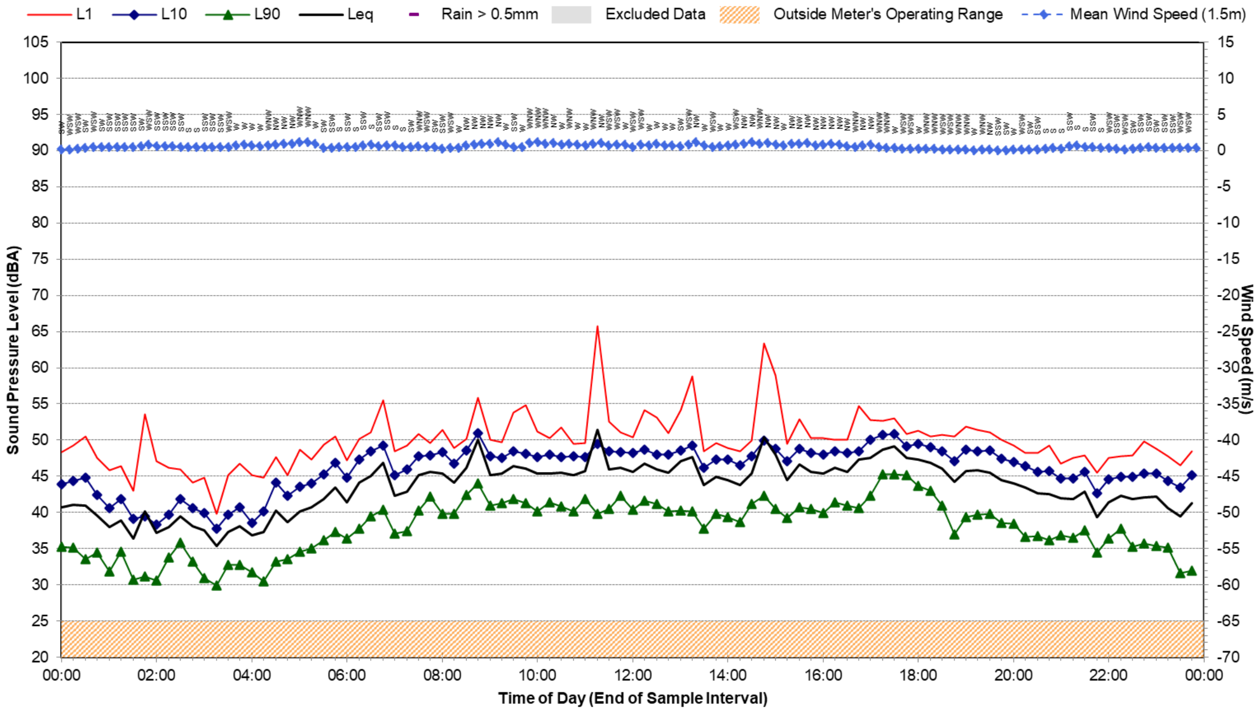

Statistical Ambient Noise Levels
Location F - Tuesday, 13 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location G - Thursday, 1 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location G - Friday, 2 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

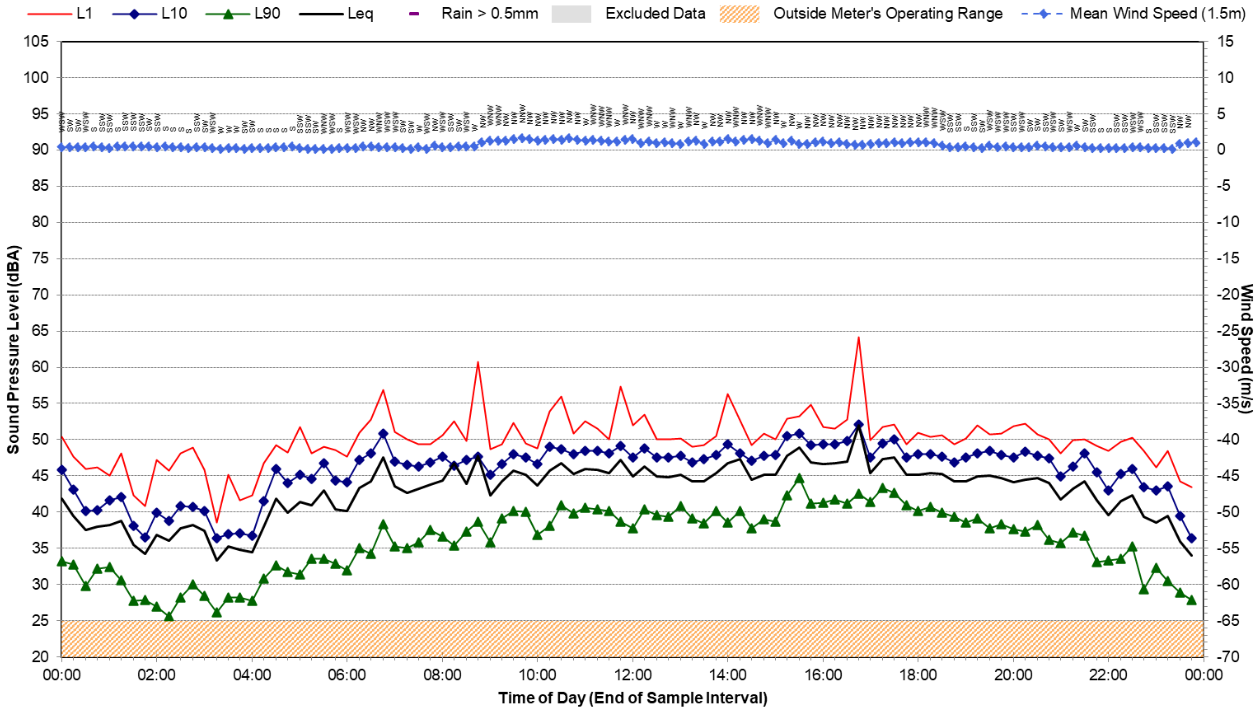
Statistical Ambient Noise Levels

Location G - Saturday, 3 July 2021



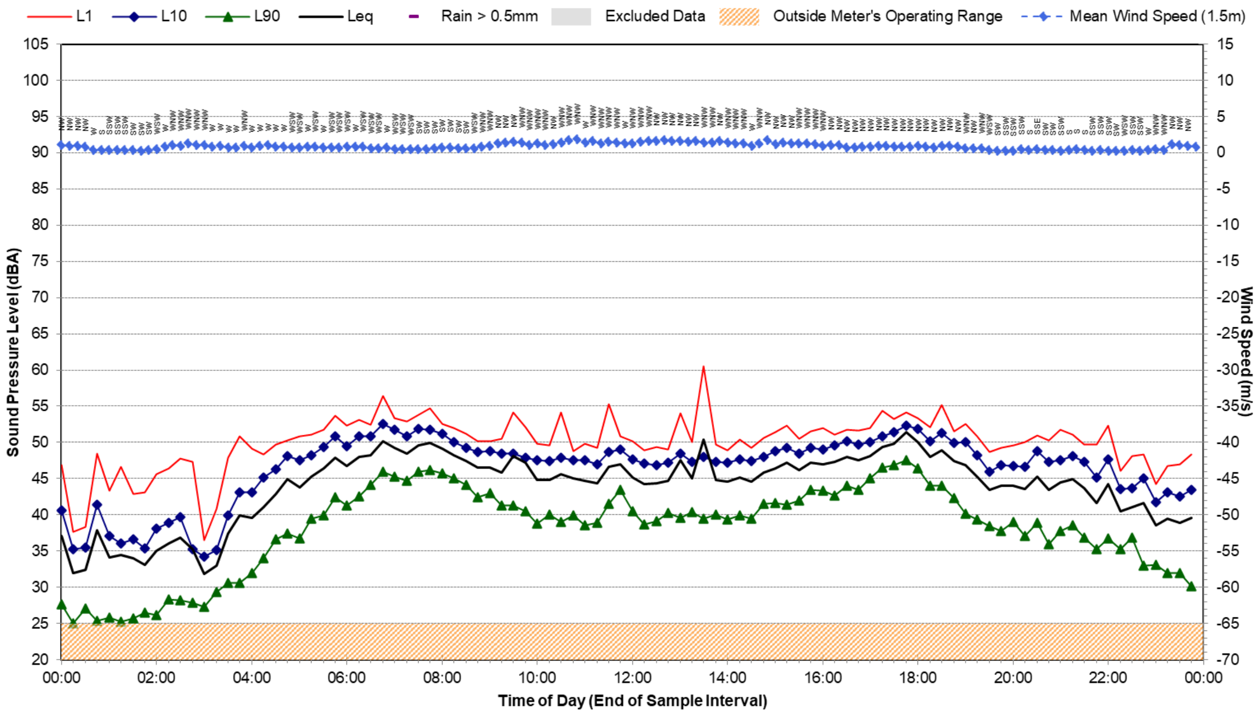
Statistical Ambient Noise Levels

Location G - Sunday, 4 July 2021



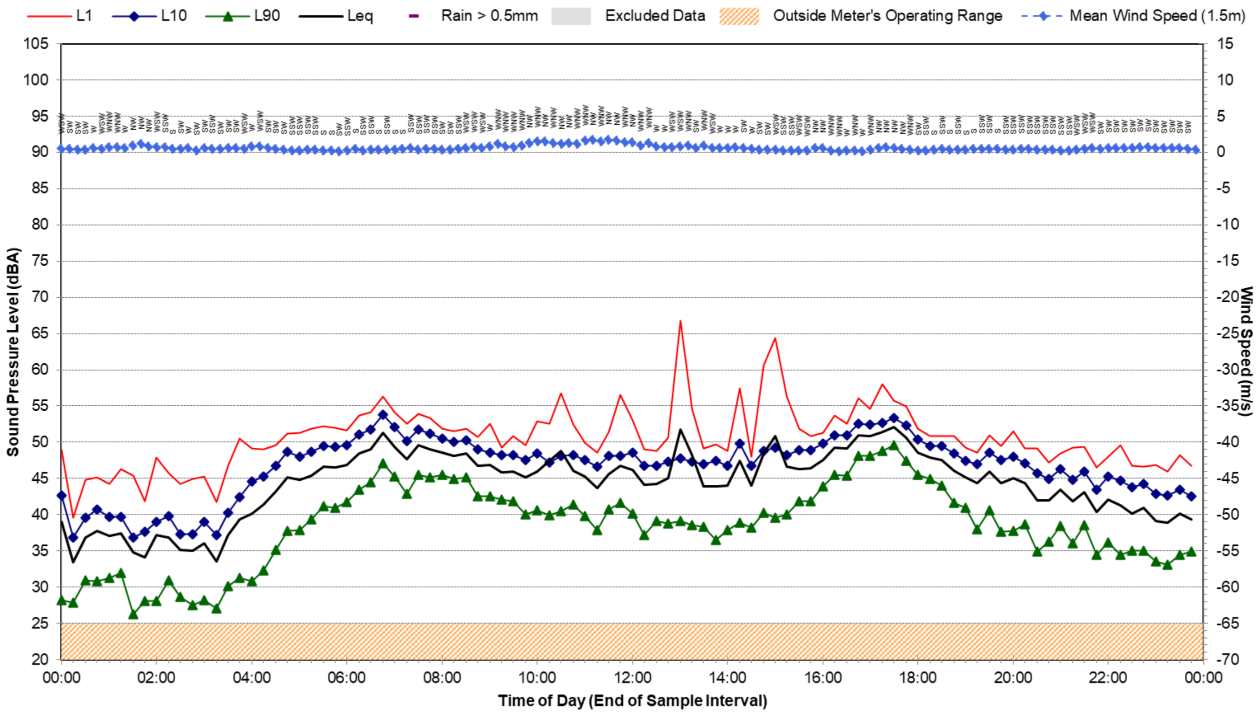
Statistical Ambient Noise Levels

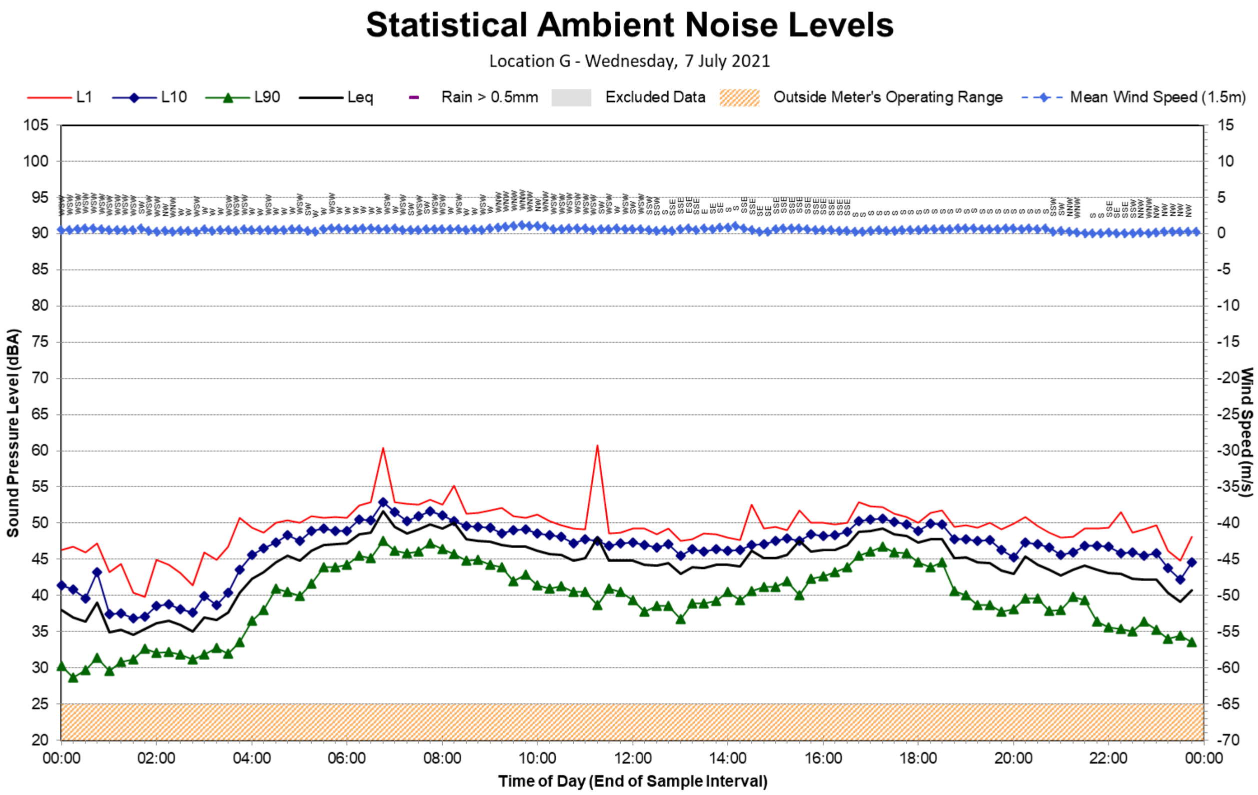
Location G - Monday, 5 July 2021

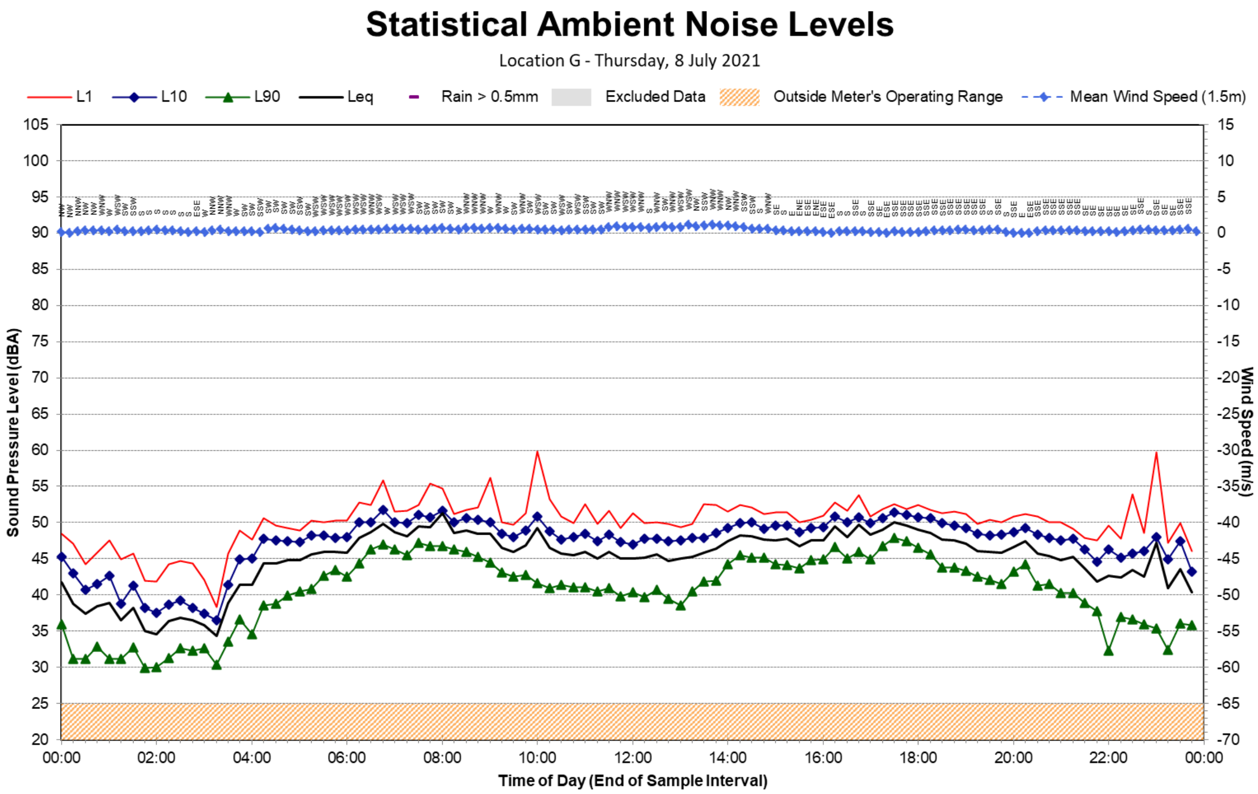


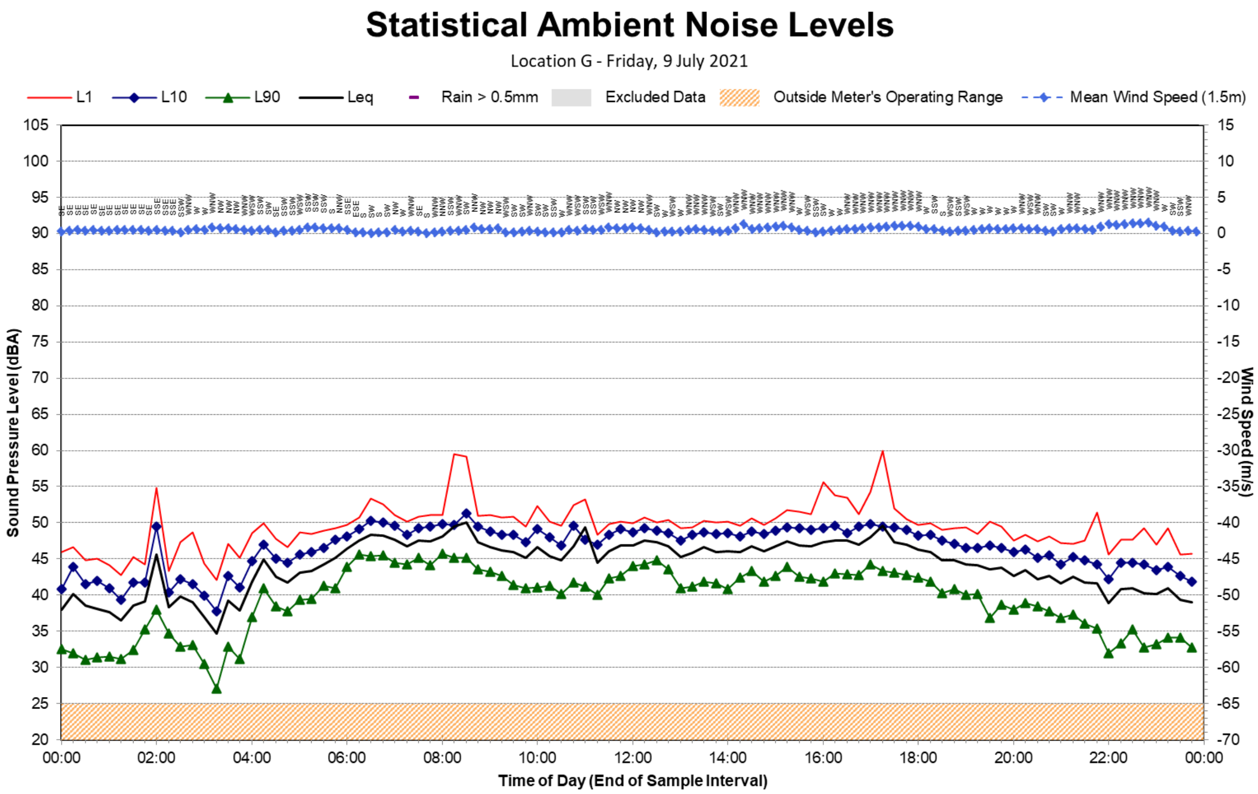
Statistical Ambient Noise Levels

Location G - Tuesday, 6 July 2021

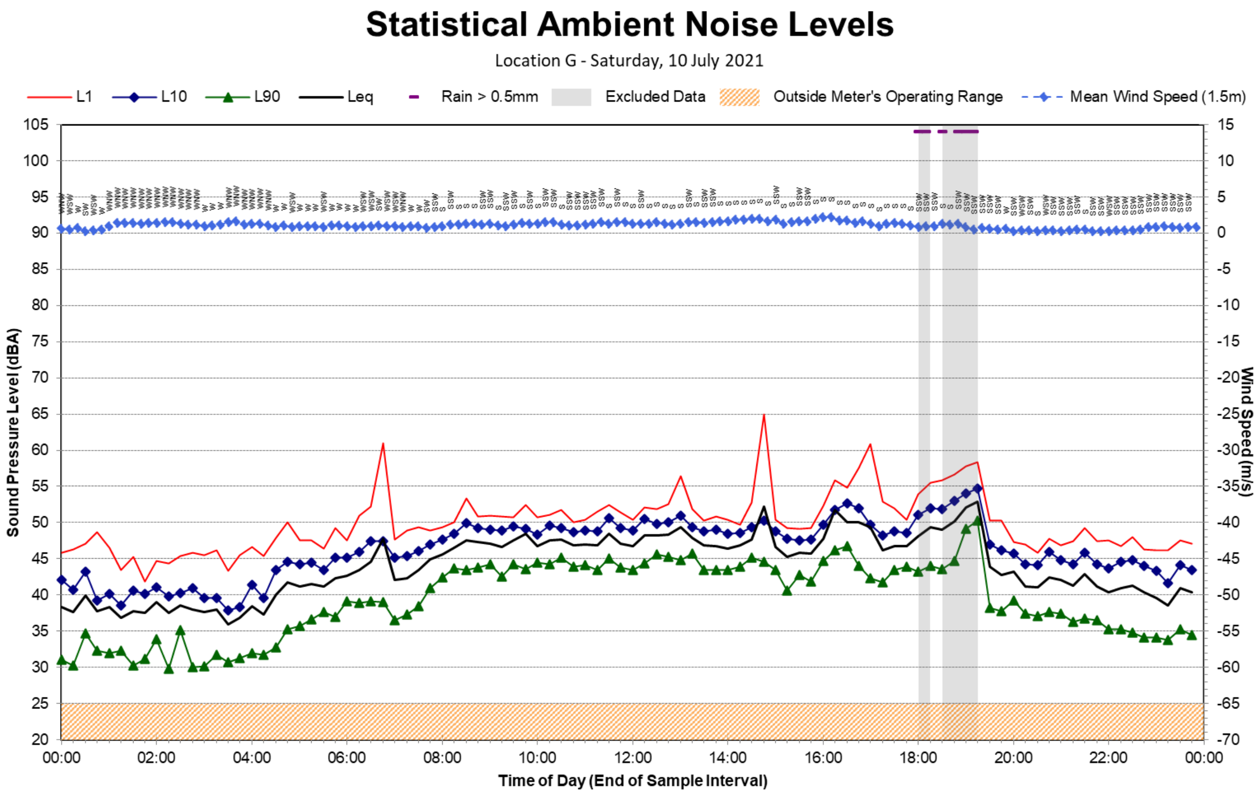



Statistical Ambient Noise Levels
Location G - Wednesday, 7 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

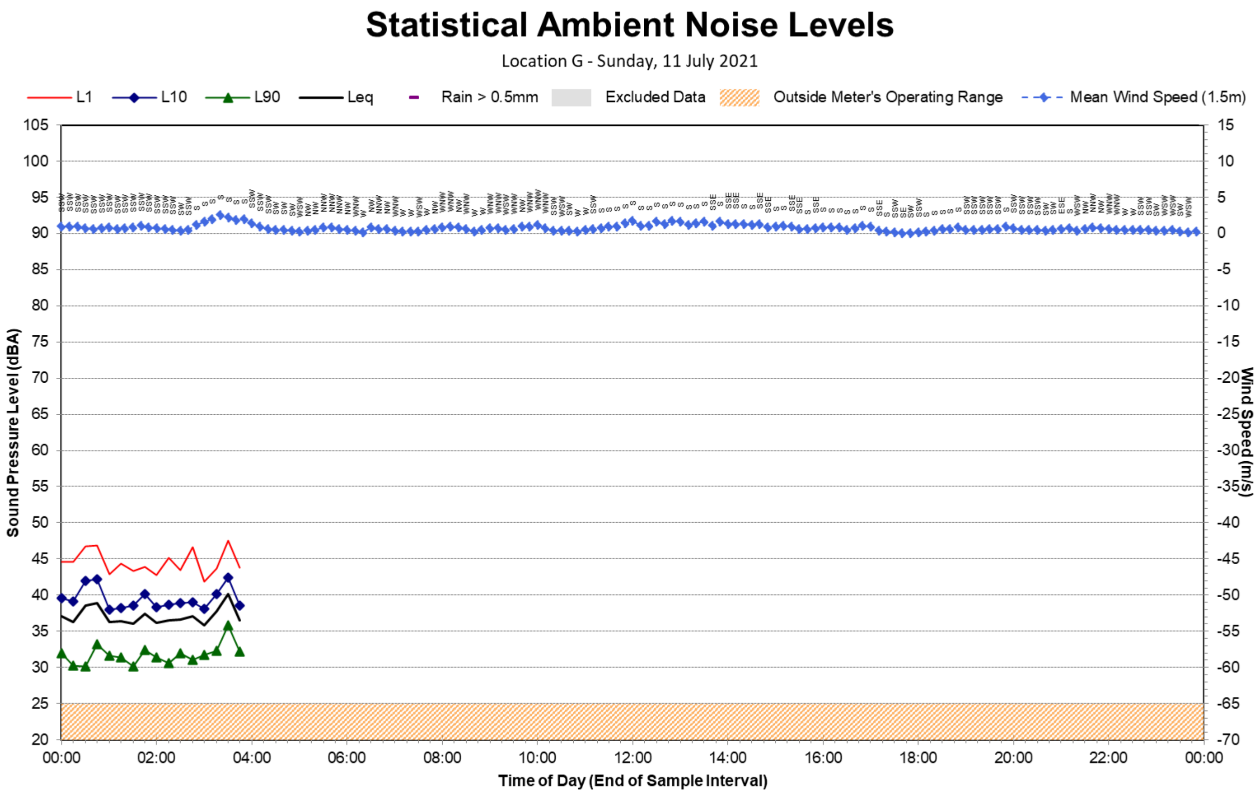

Statistical Ambient Noise Levels
Location G - Thursday, 8 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



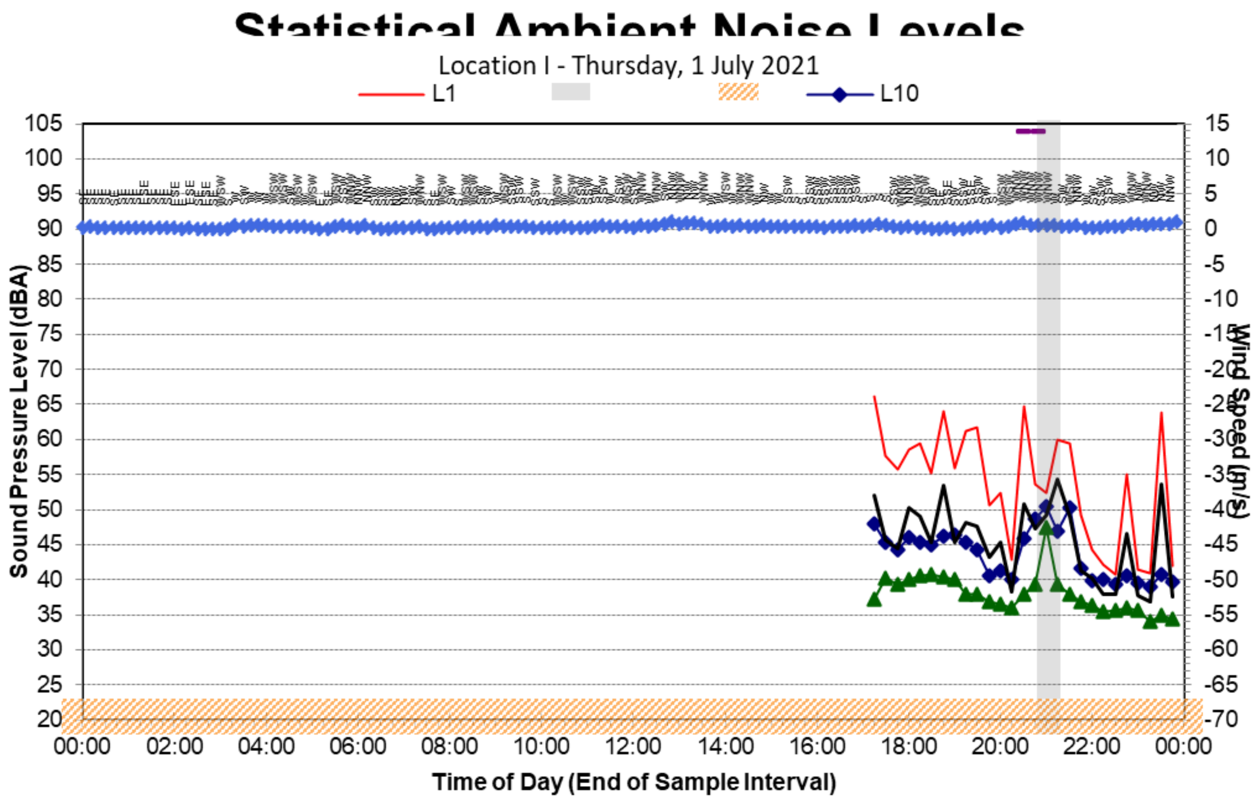
Statistical Ambient Noise Levels
Location G - Friday, 9 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



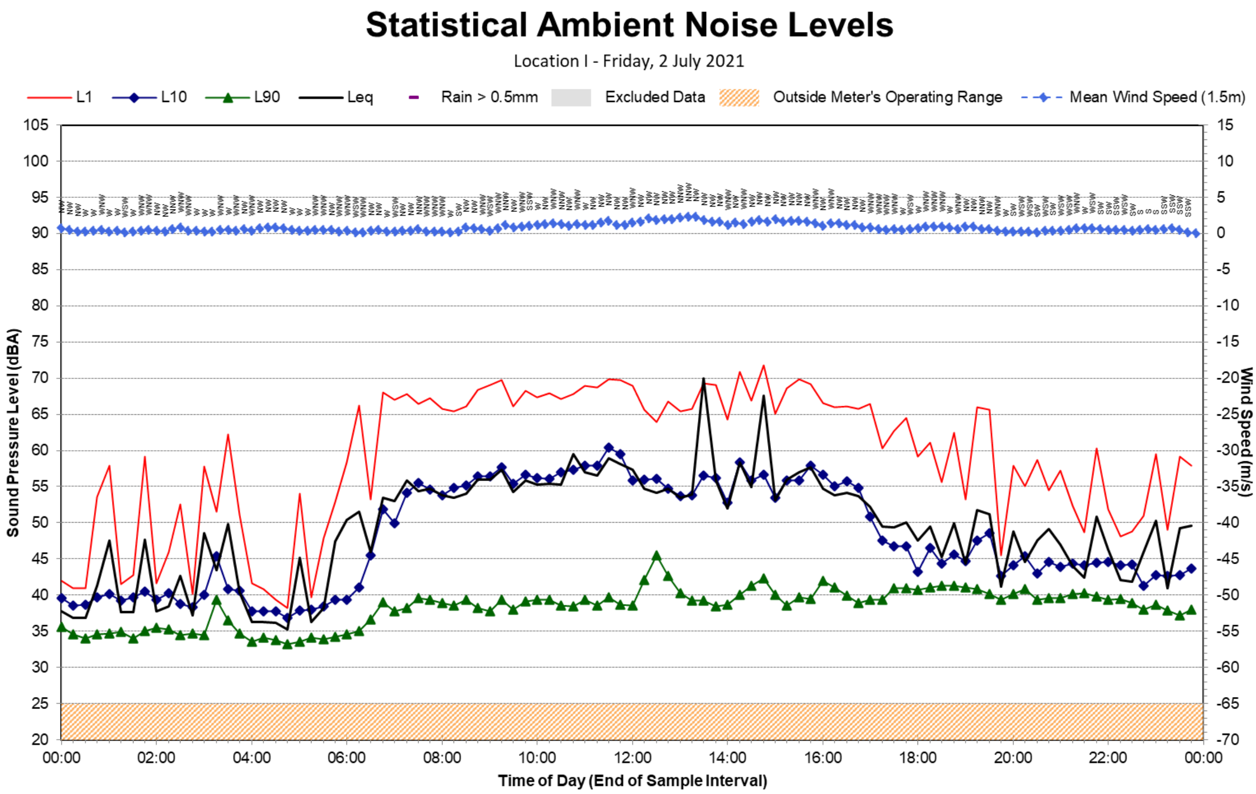
Statistical Ambient Noise Levels
Location G - Saturday, 10 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

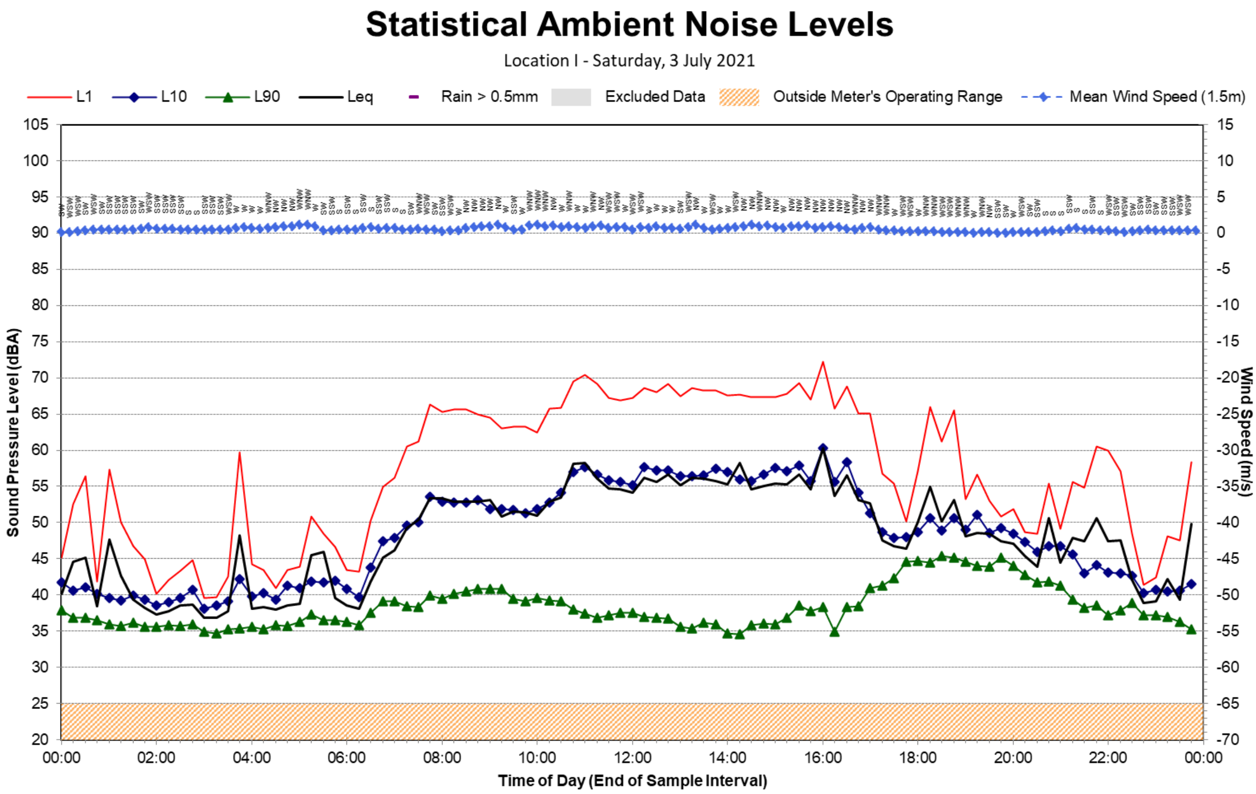


Statistical Ambient Noise Levels
Location G - Sunday, 11 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



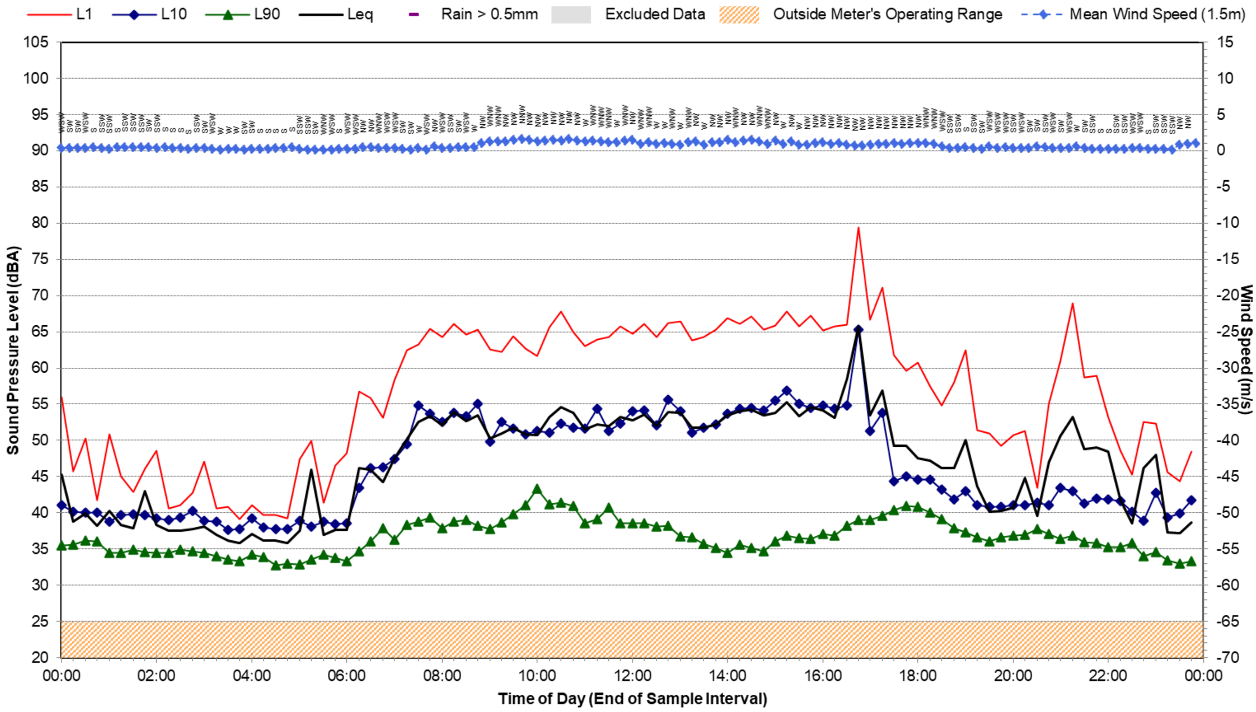
Statistical Ambient Noise Levels
Location I - Thursday, 1 July 2021
L1
L10
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location I - Friday, 2 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location I - Saturday, 3 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

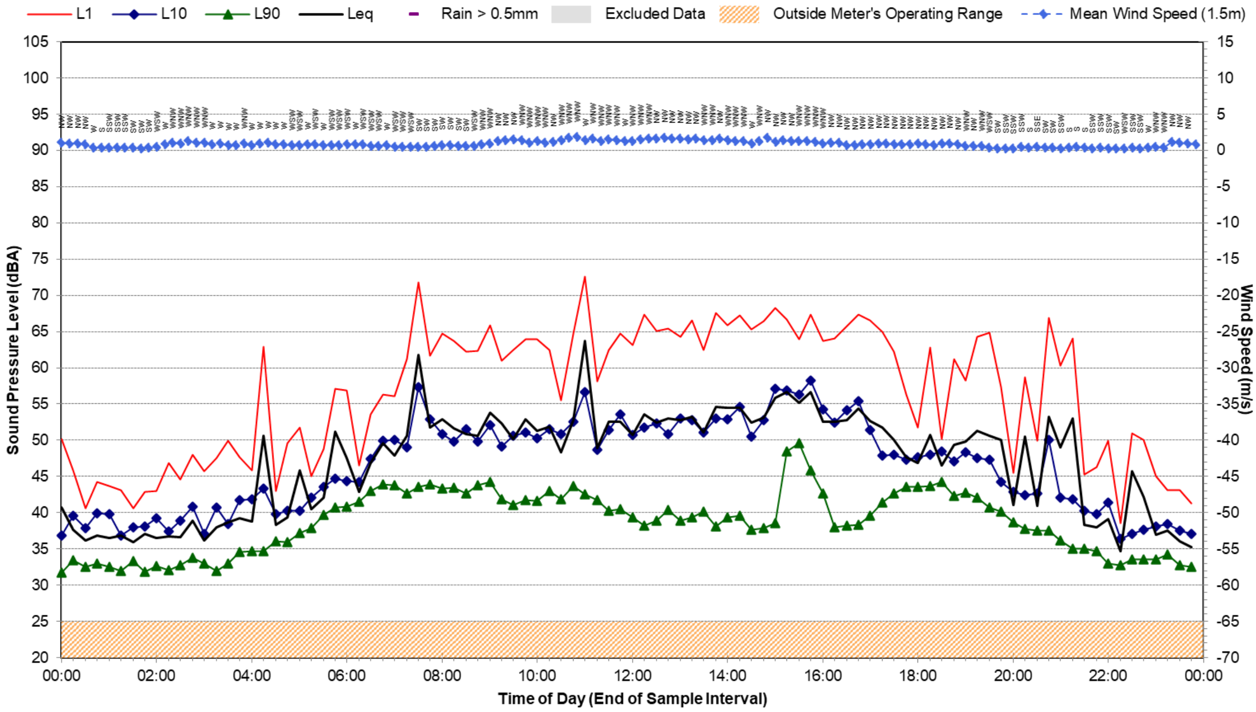
Statistical Ambient Noise Levels

Location I - Sunday, 4 July 2021



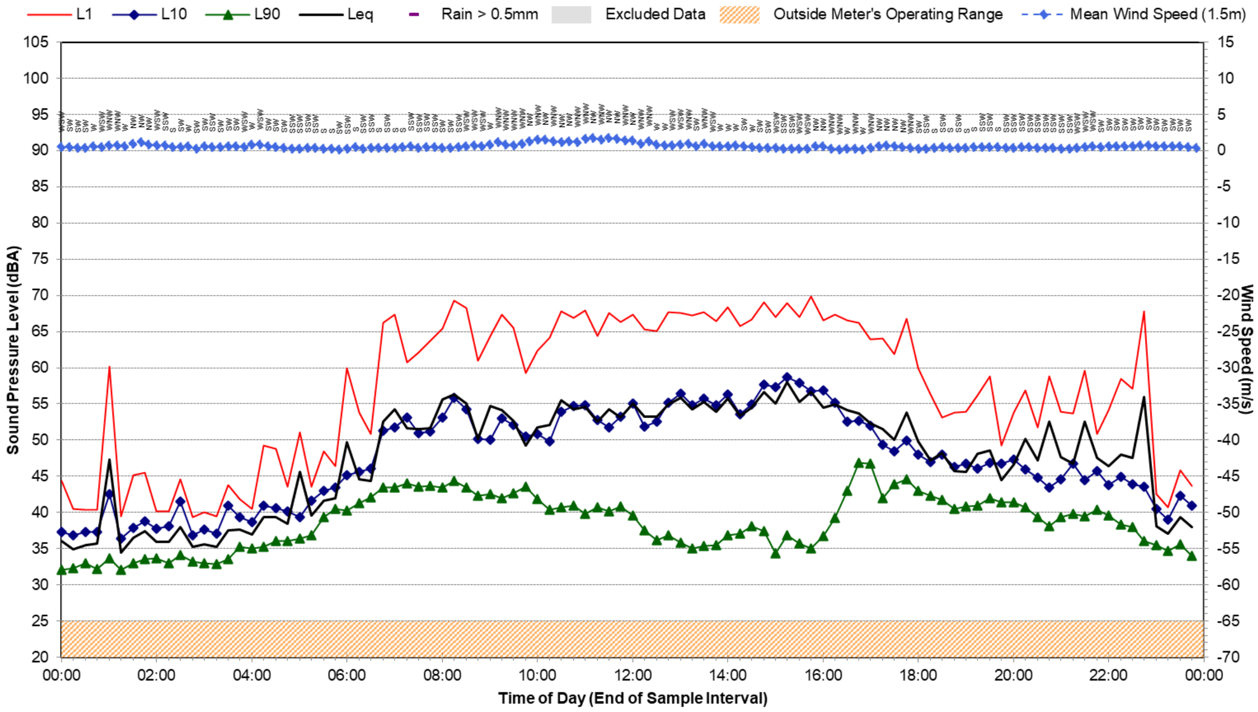
Statistical Ambient Noise Levels

Location I - Monday, 5 July 2021



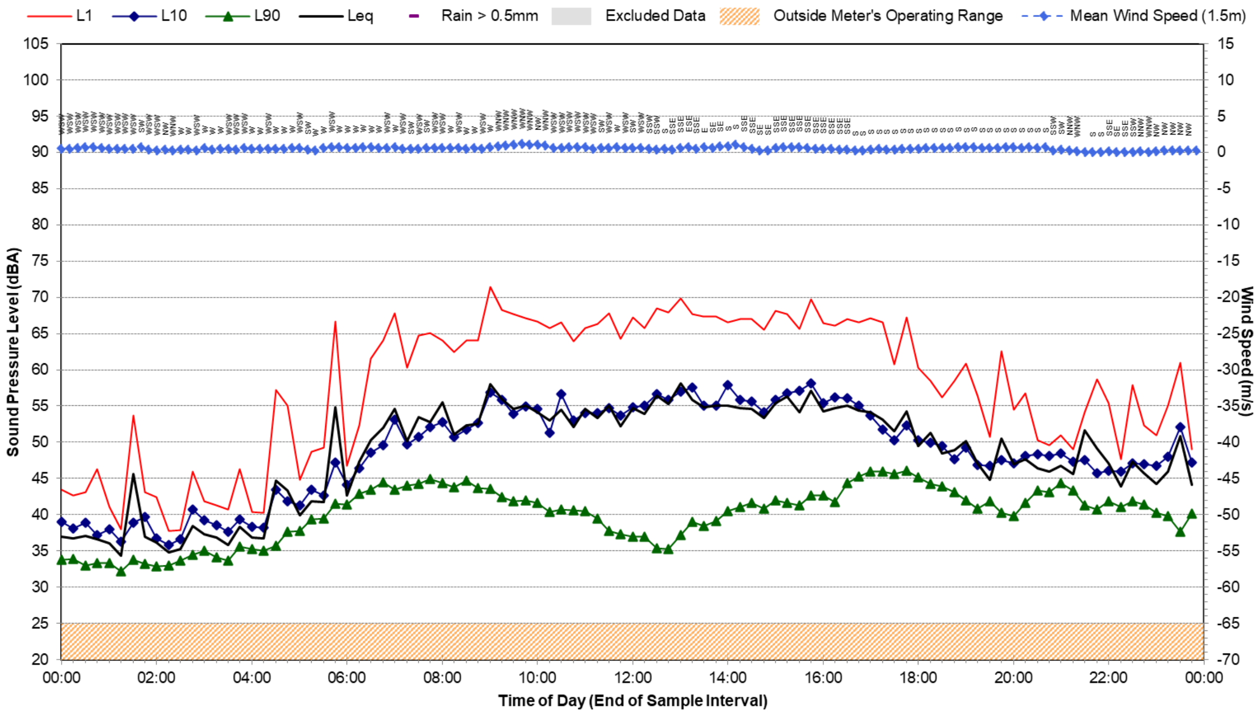
Statistical Ambient Noise Levels

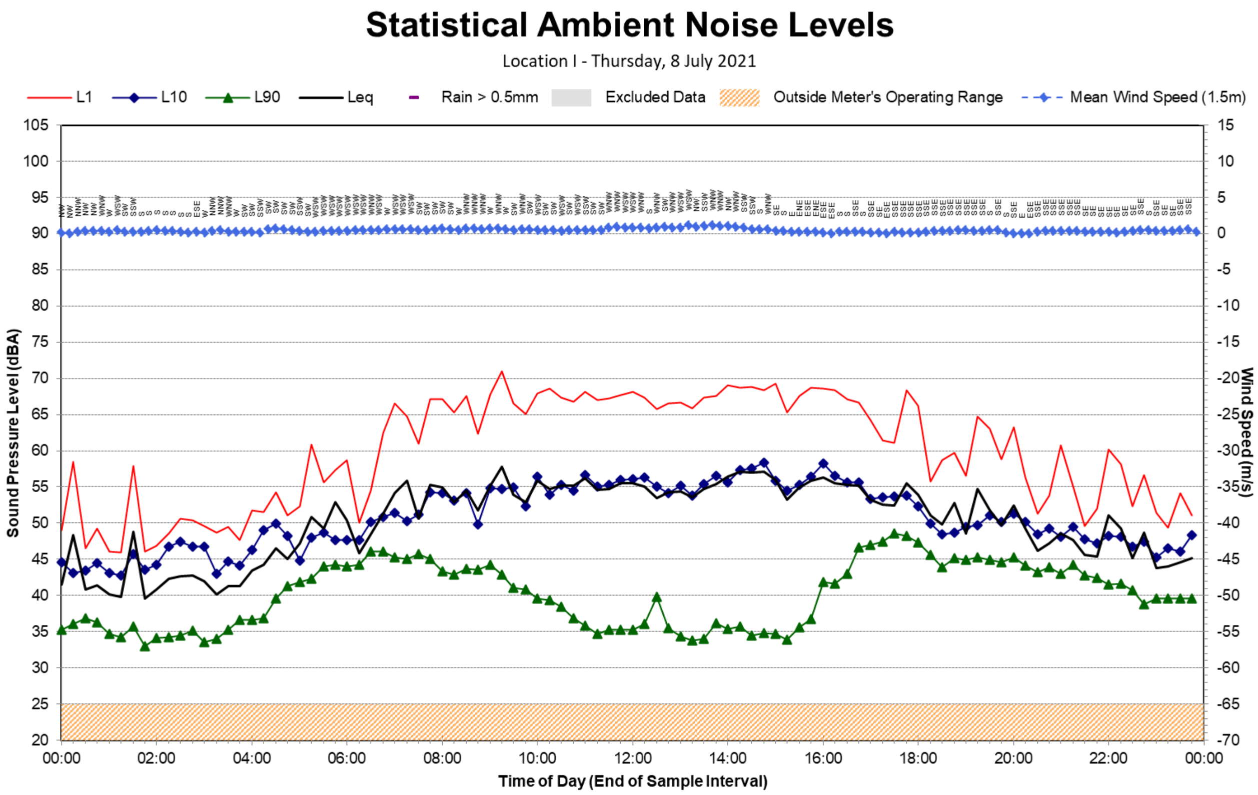
Location I - Tuesday, 6 July 2021

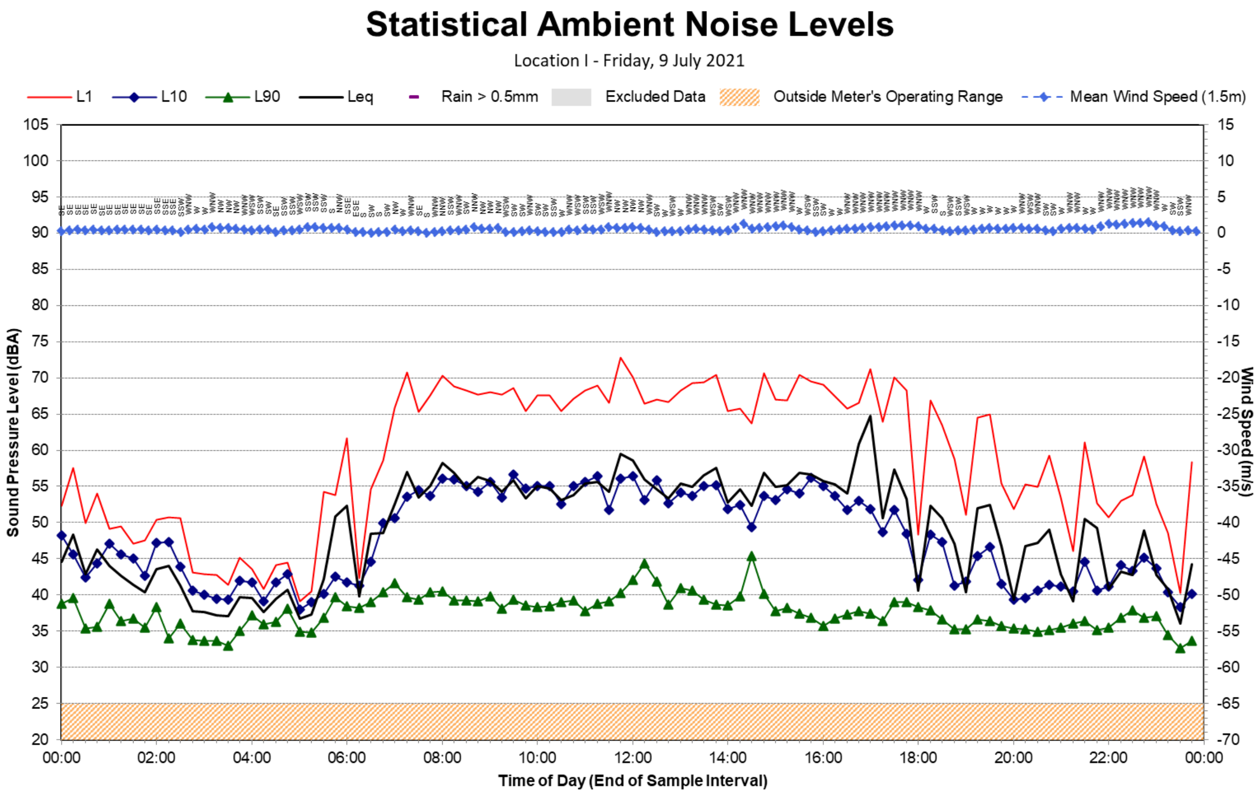


Statistical Ambient Noise Levels

Location I - Wednesday, 7 July 2021

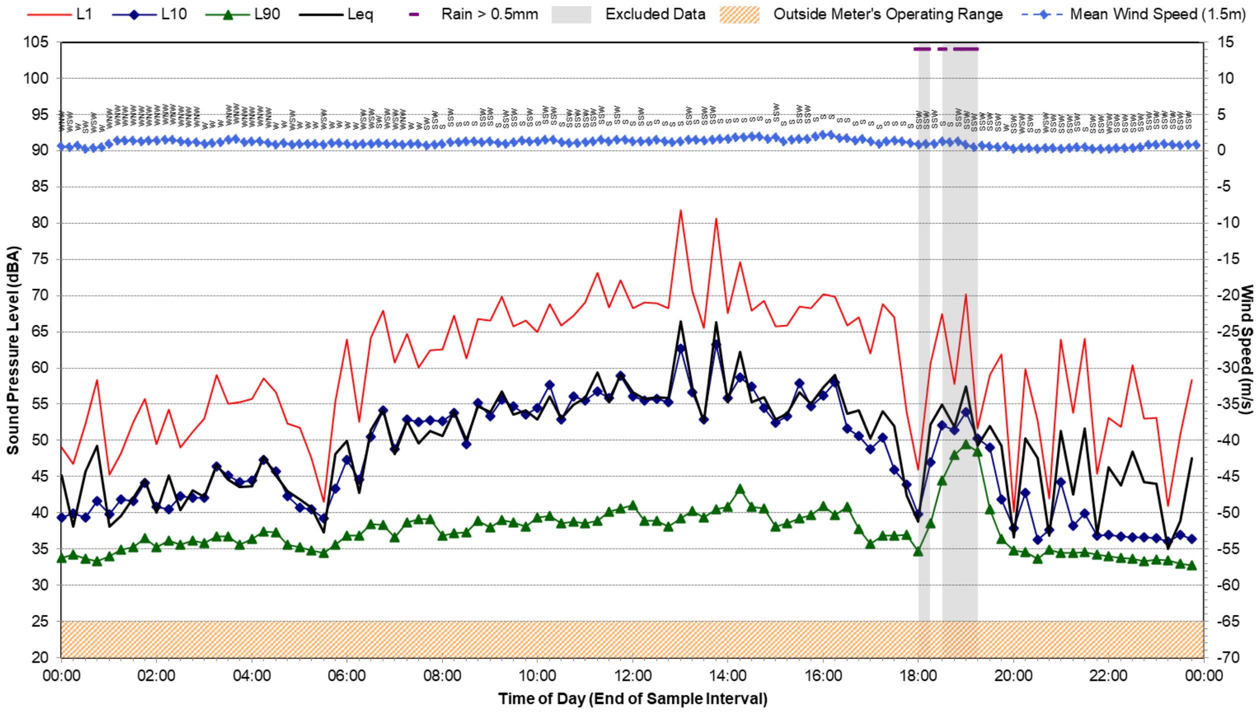



Statistical Ambient Noise Levels
Location I - Thursday, 8 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Statistical Ambient Noise Levels
Location I - Friday, 9 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

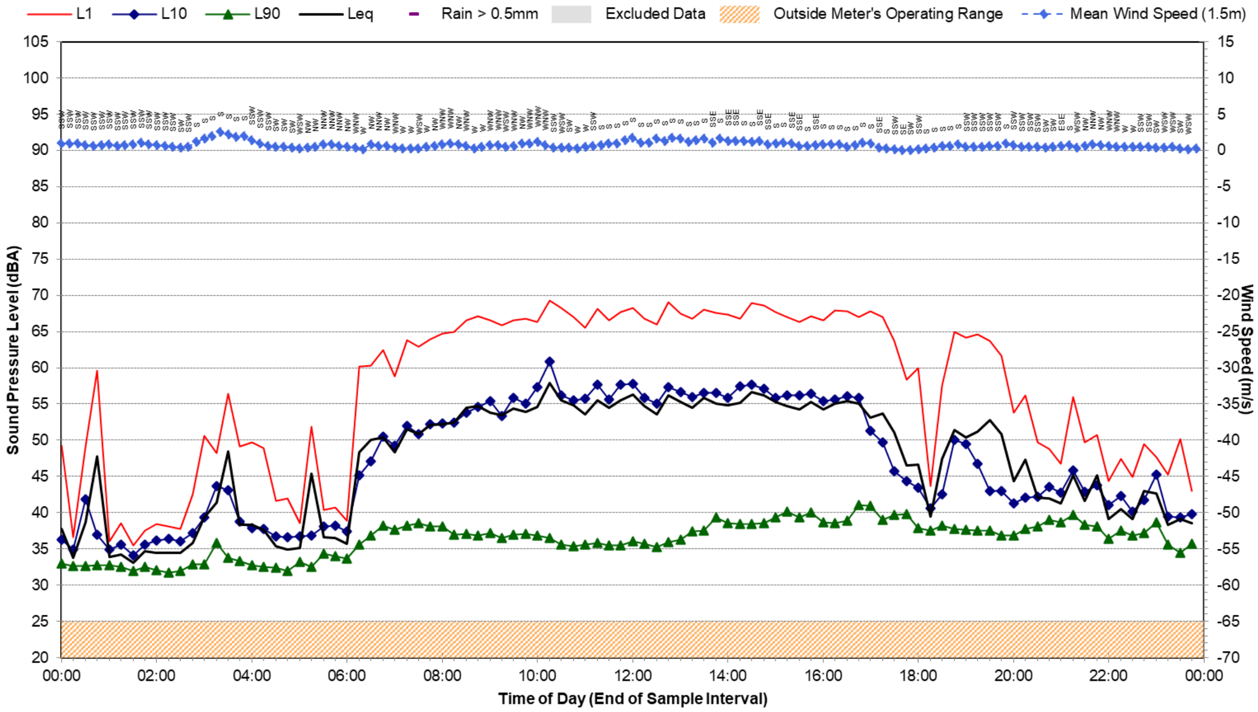
Statistical Ambient Noise Levels

Location I - Saturday, 10 July 2021



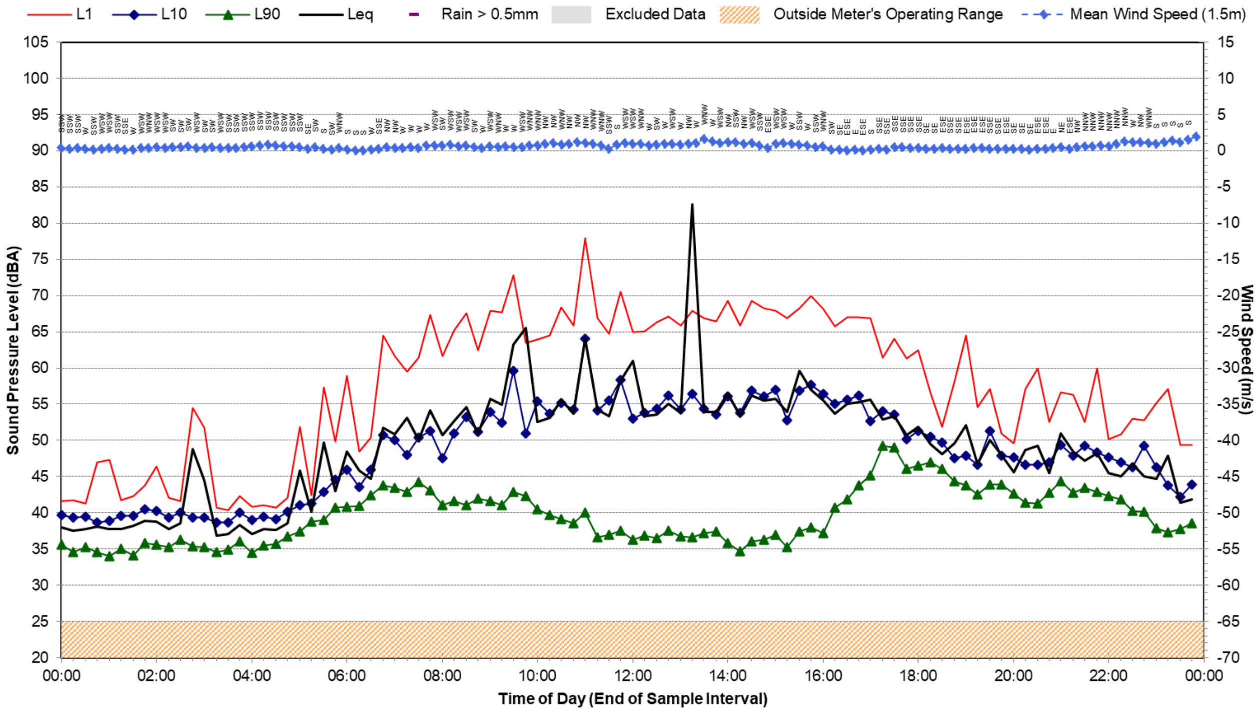
Statistical Ambient Noise Levels

Location I - Sunday, 11 July 2021



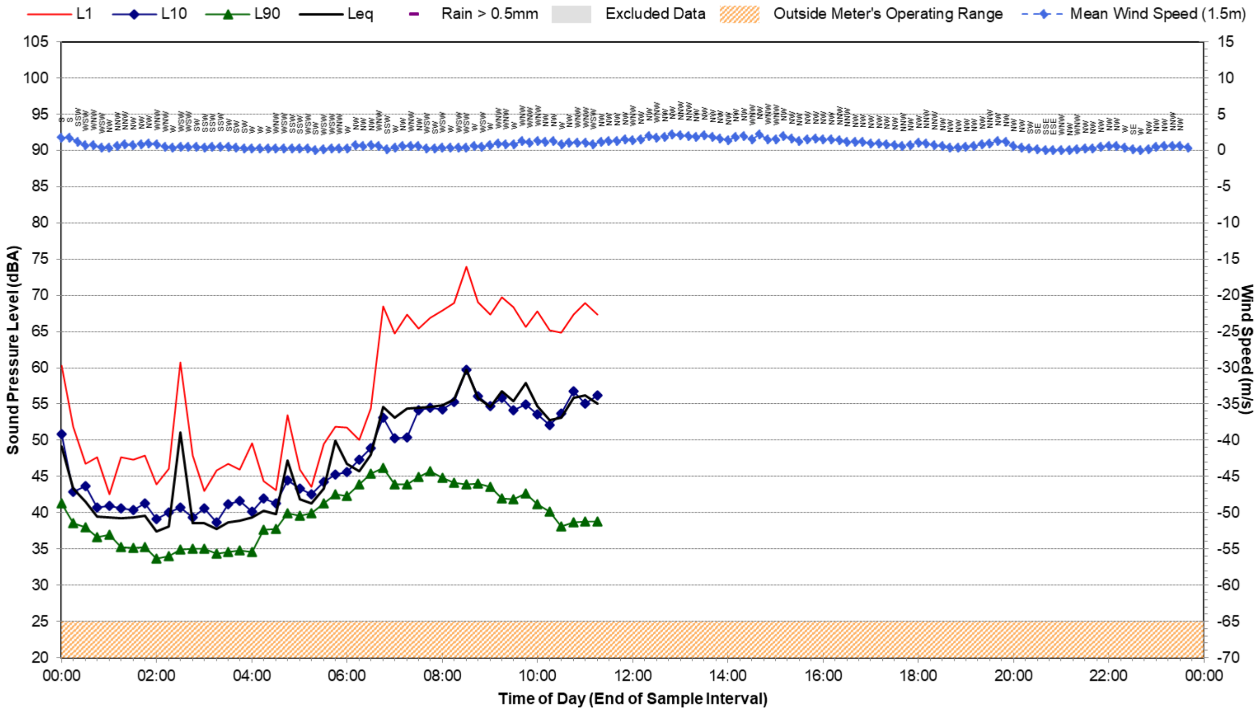
Statistical Ambient Noise Levels

Location I - Monday, 12 July 2021



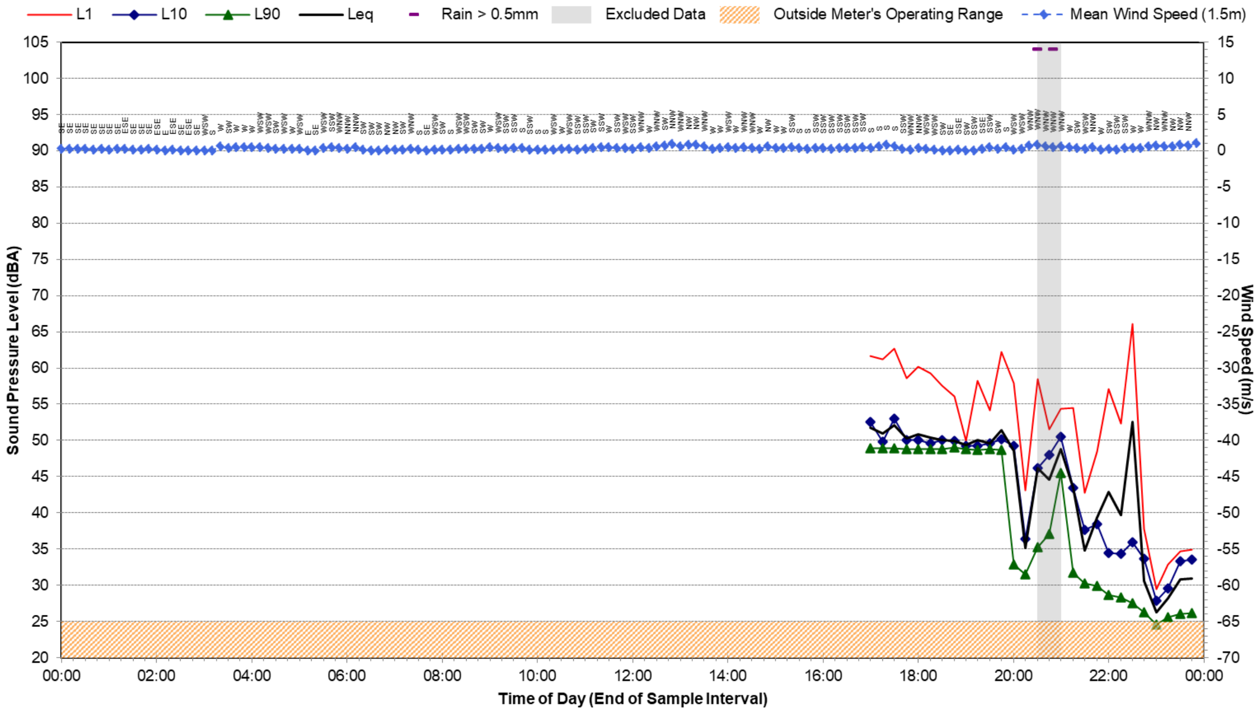
Statistical Ambient Noise Levels

Location I - Tuesday, 13 July 2021



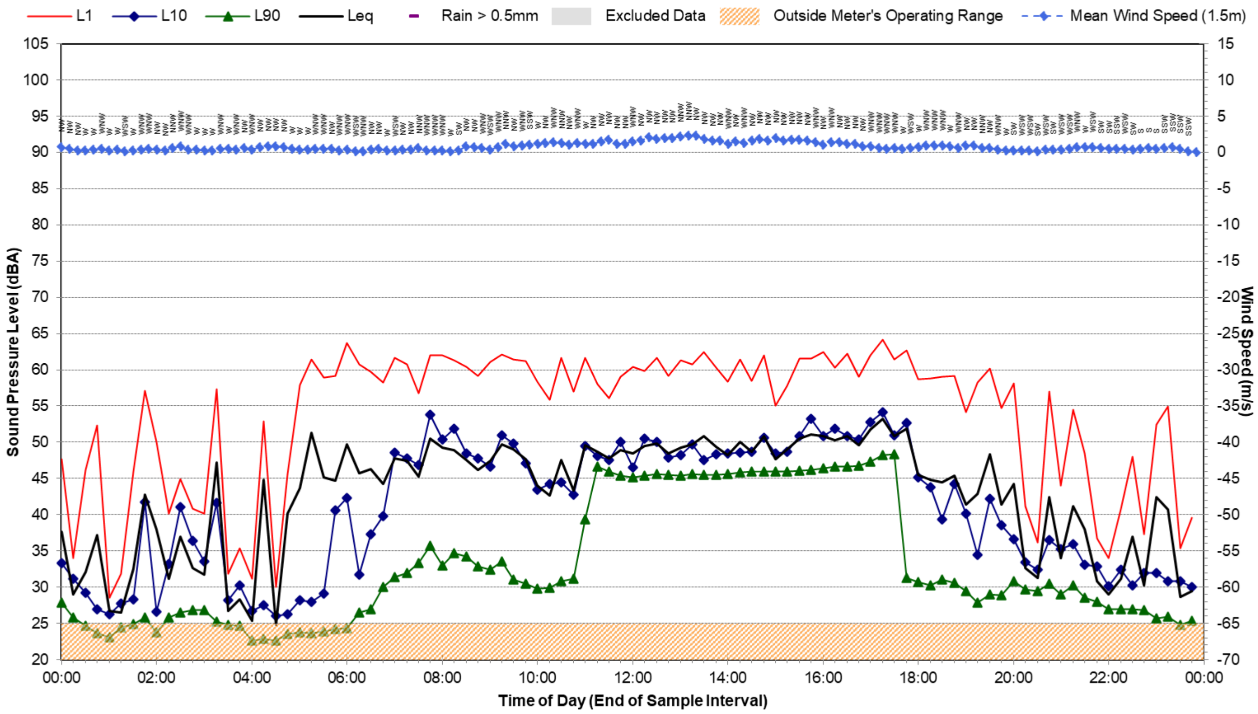
Statistical Ambient Noise Levels

Location L - Thursday, 1 July 2021



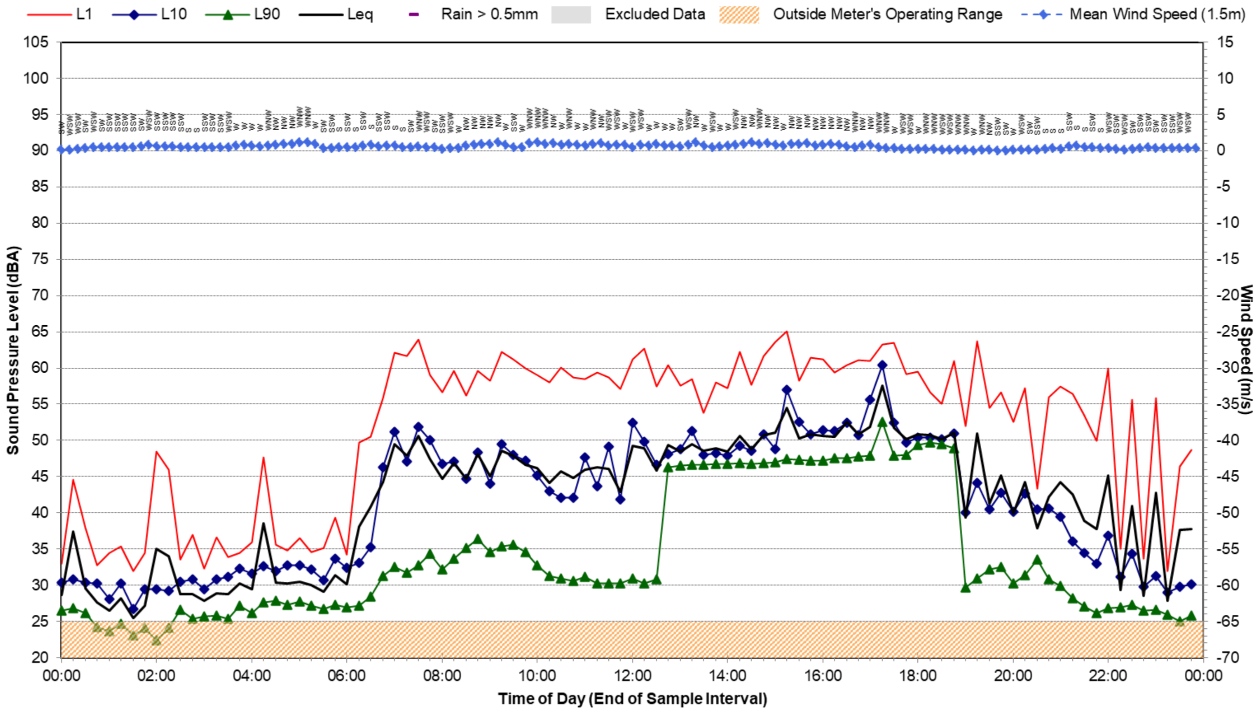
Statistical Ambient Noise Levels

Location L - Friday, 2 July 2021



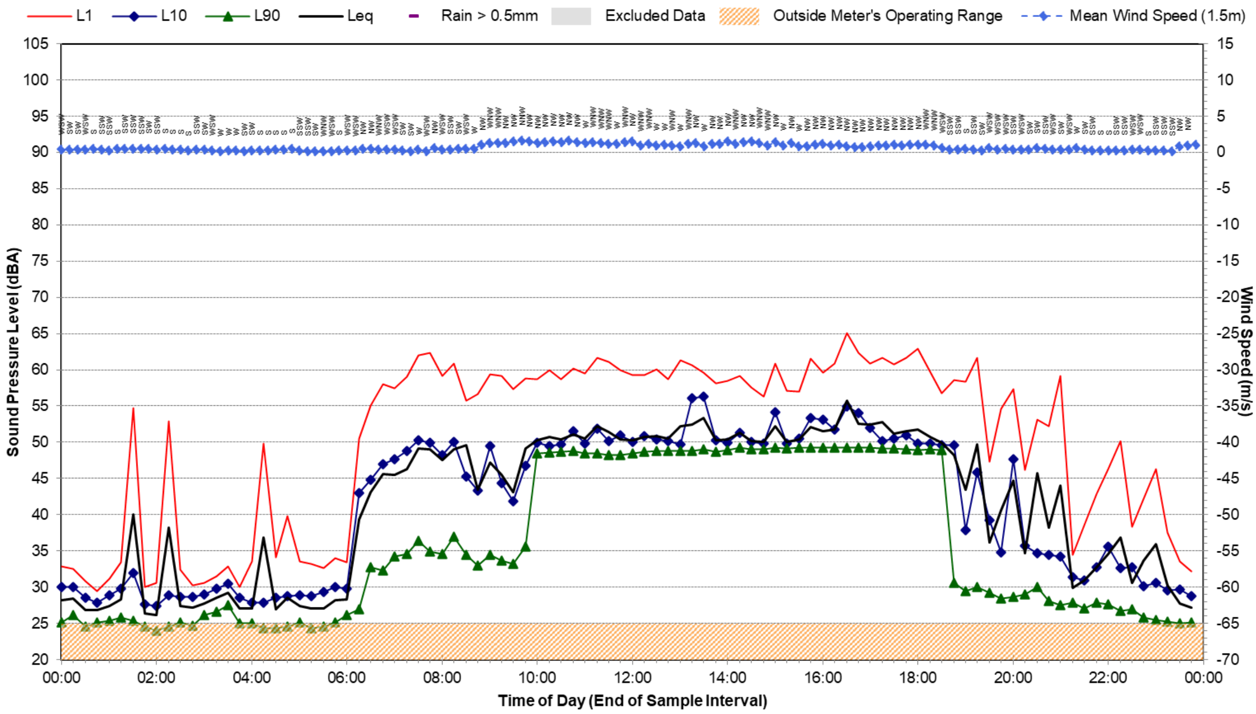
Statistical Ambient Noise Levels

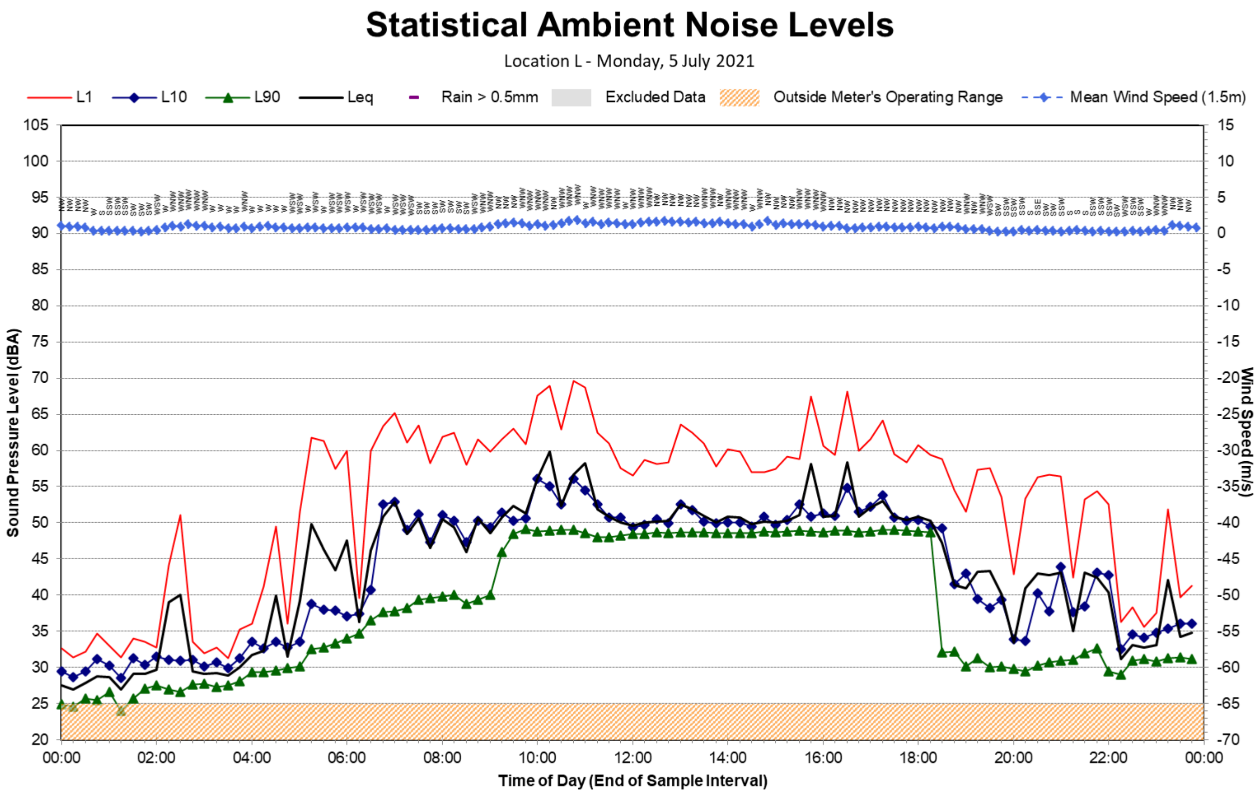
Location L - Saturday, 3 July 2021

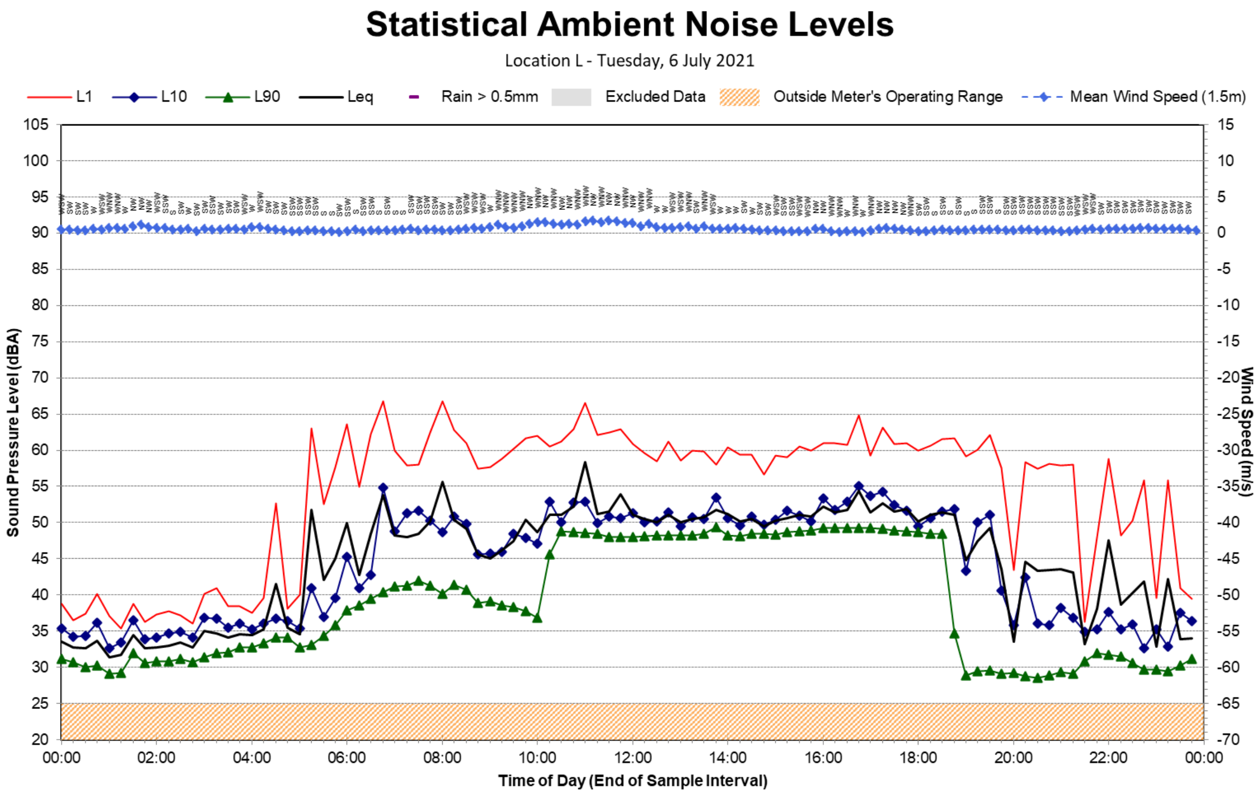


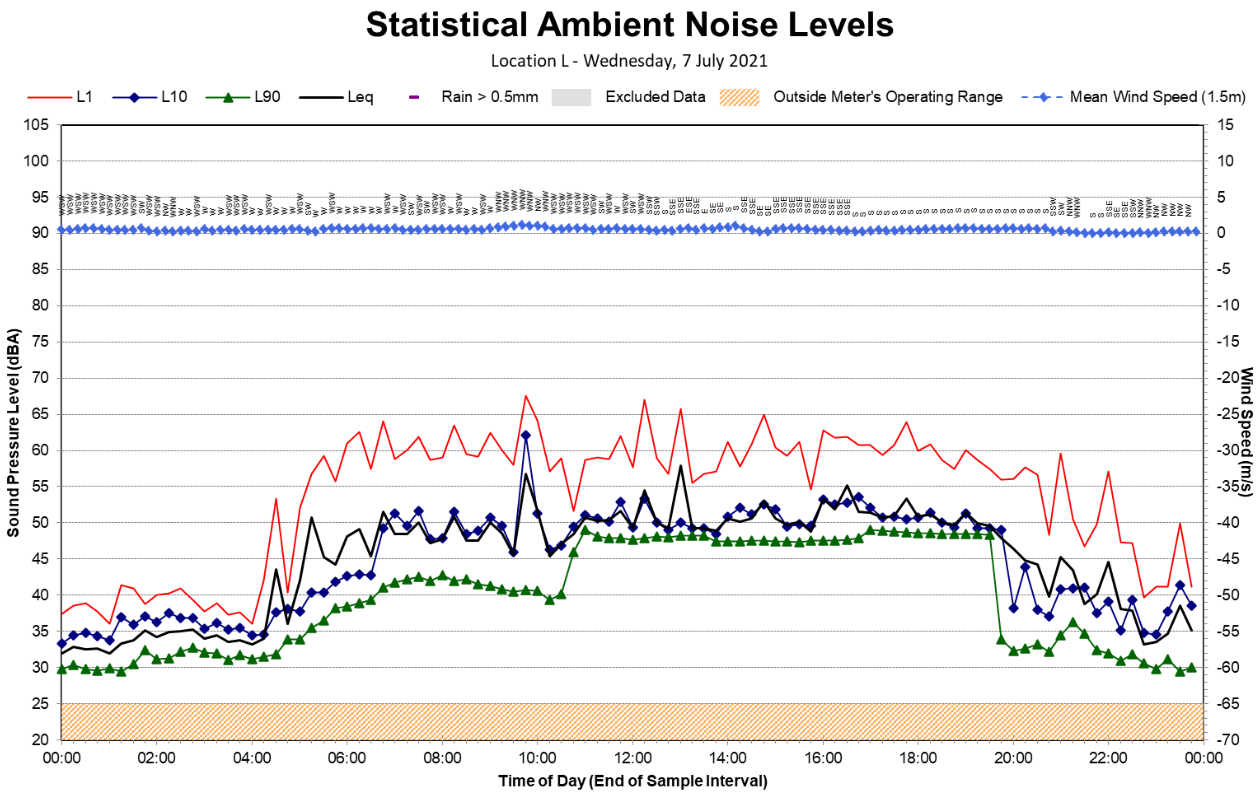
Statistical Ambient Noise Levels

Location L - Sunday, 4 July 2021




Statistical Ambient Noise Levels
Location L - Monday, 5 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location L - Tuesday, 6 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location L - Wednesday, 7 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
00:00
02:00
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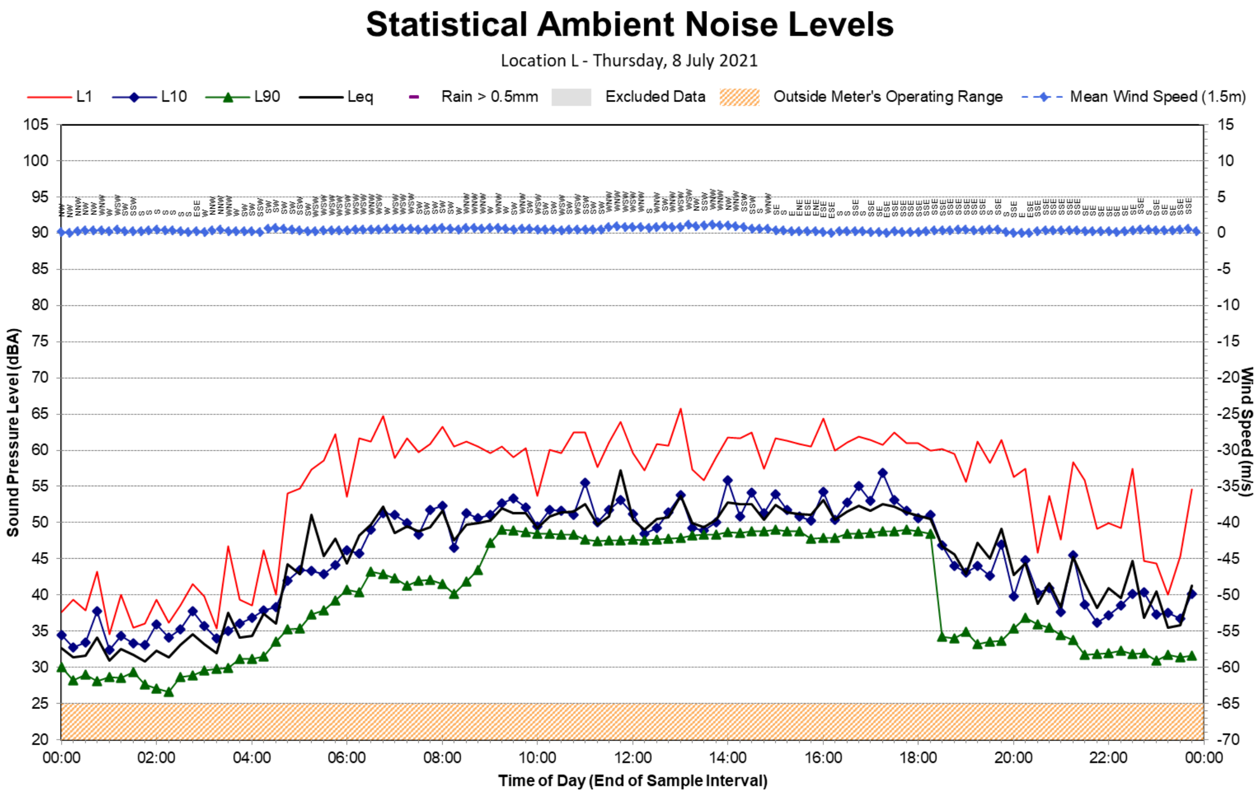
20:00
22:00
00:00


Statistical Ambient Noise Levels
Location L - Thursday, 8 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
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02:00
04:00
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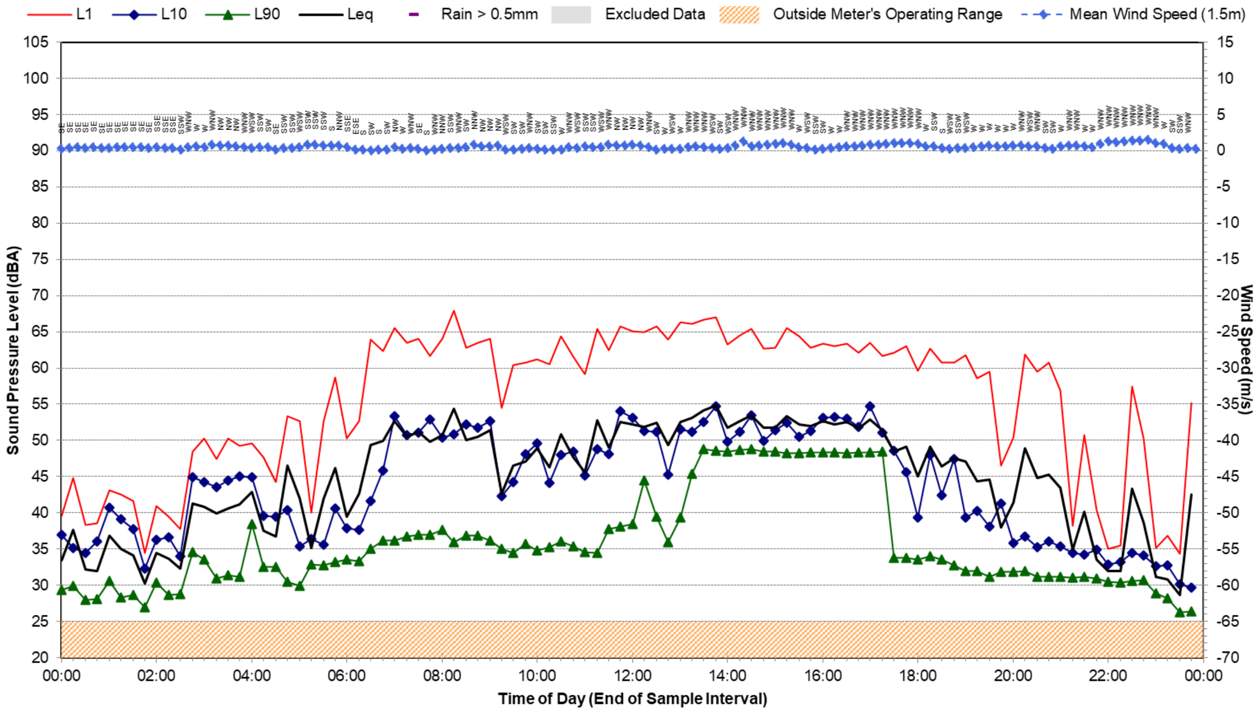
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

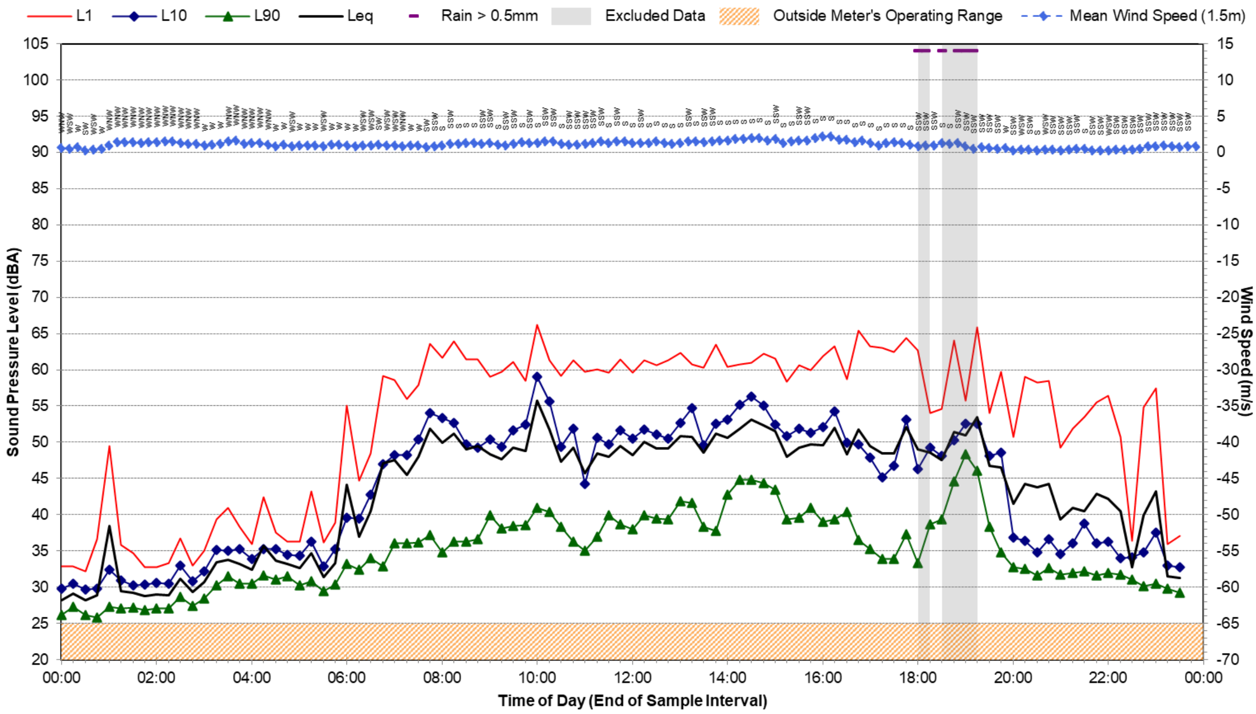
Statistical Ambient Noise Levels

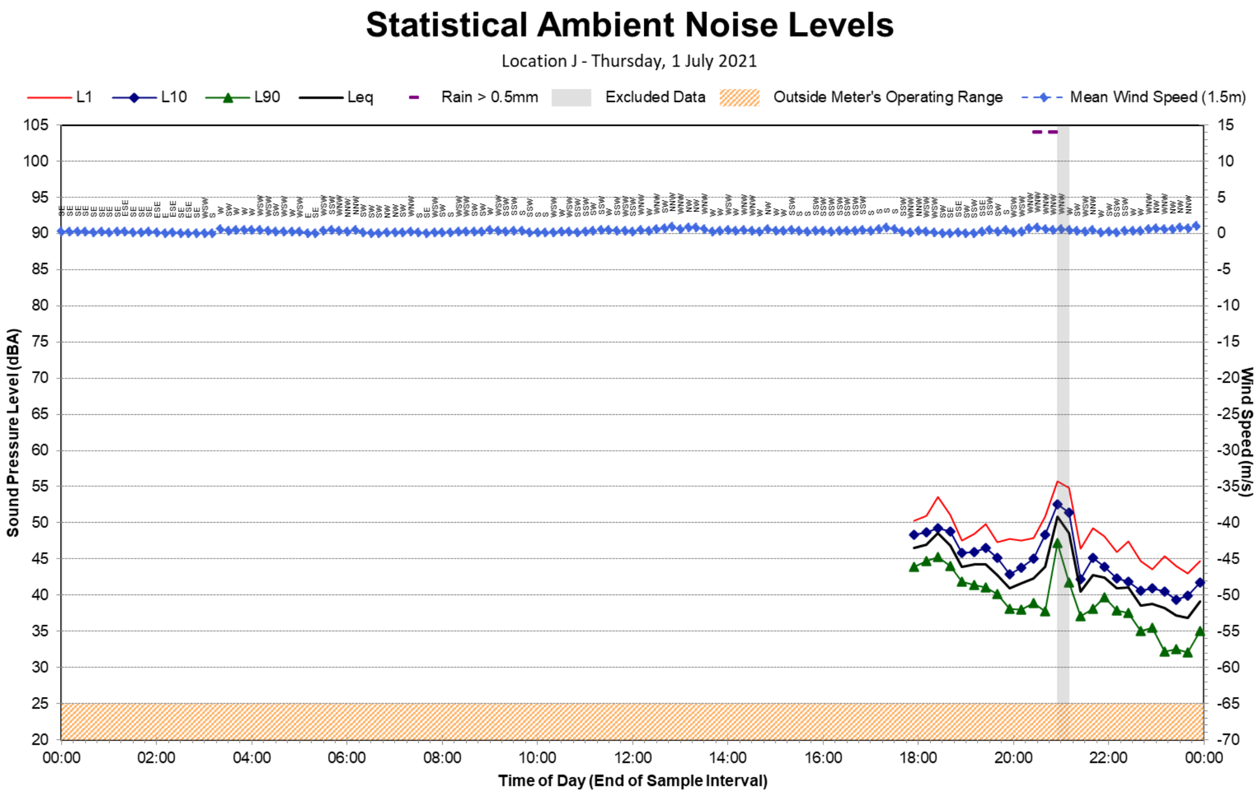
Location L - Friday, 9 July 2021

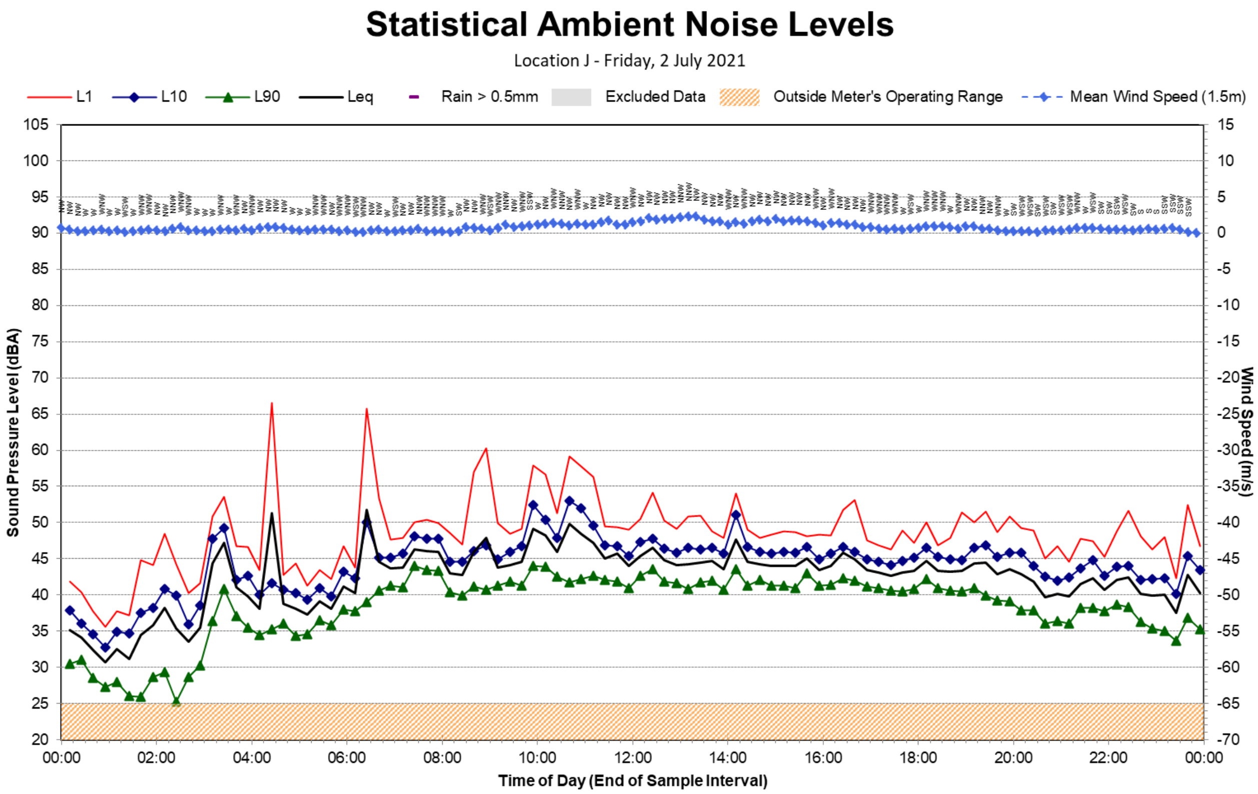


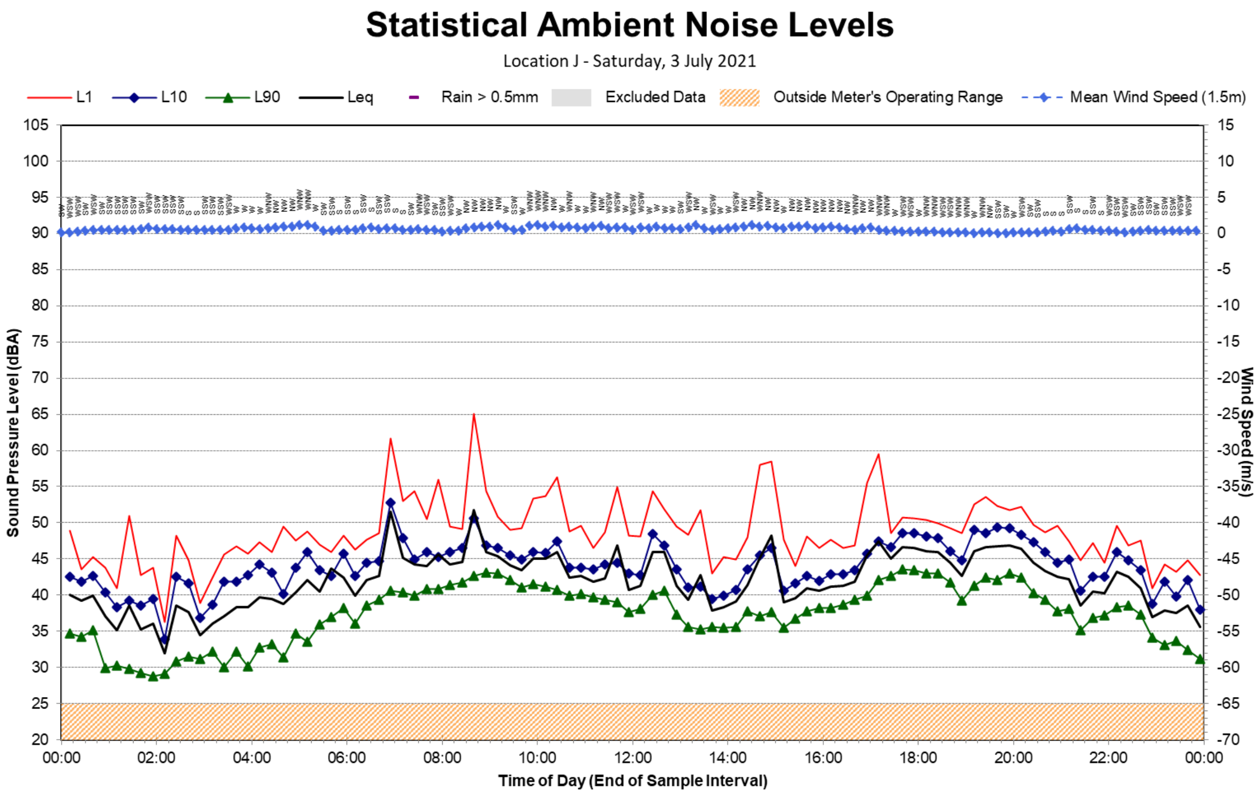
Statistical Ambient Noise Levels

Location L - Saturday, 10 July 2021

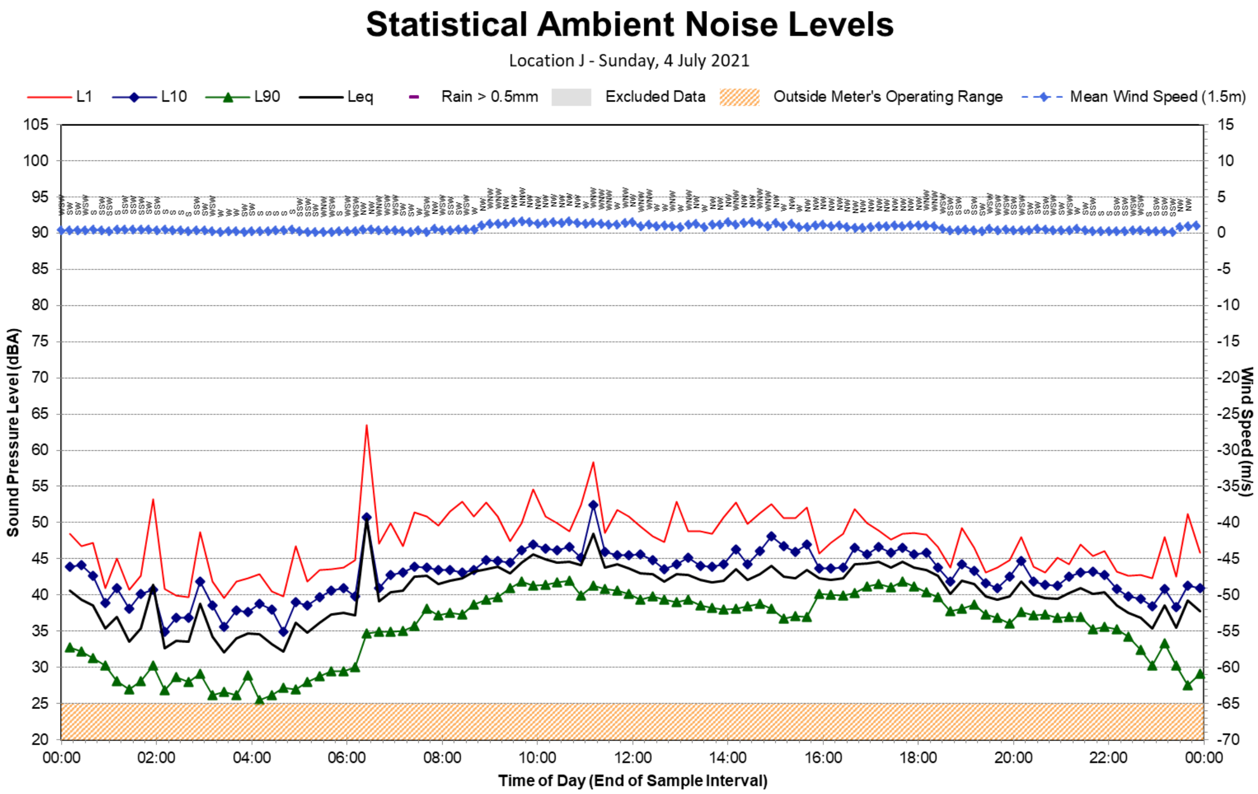



Statistical Ambient Noise Levels
Location J - Thursday, 1 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

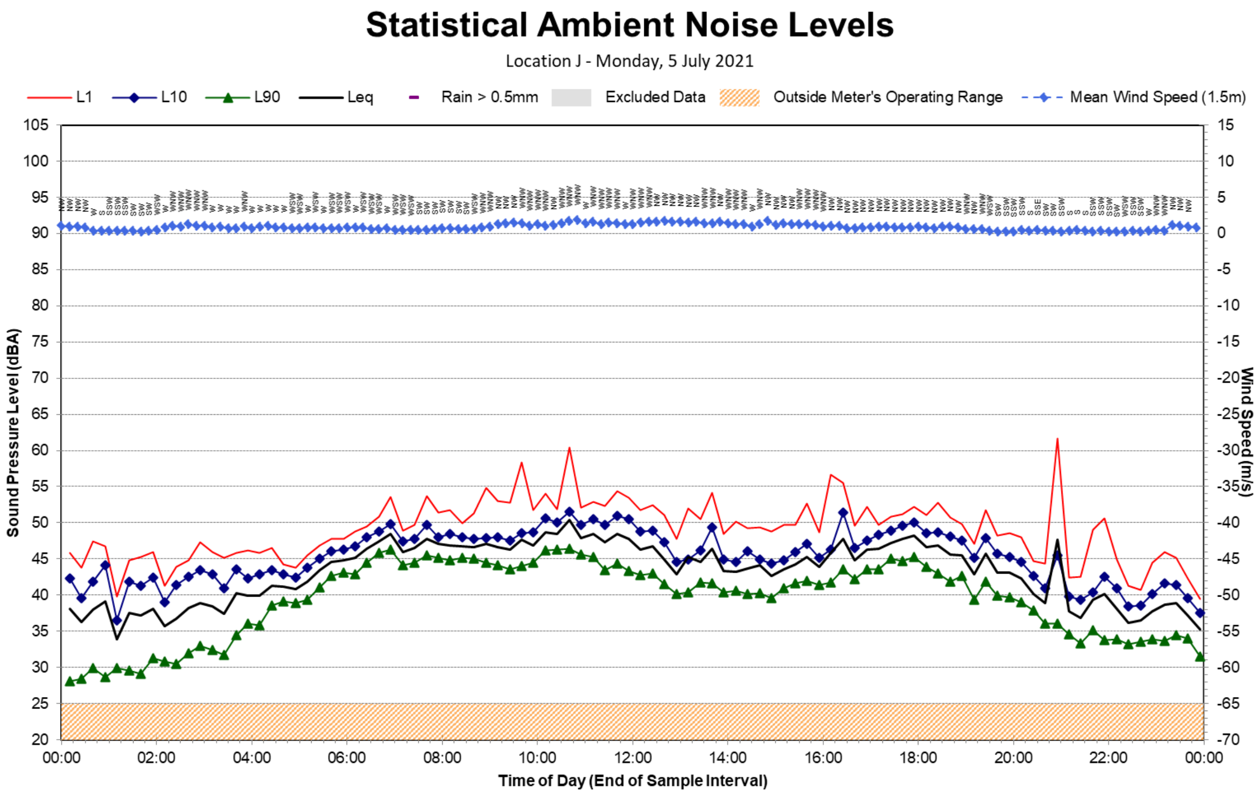

Statistical Ambient Noise Levels
Location J - Friday, 2 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
Location J - Saturday, 3 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
Location J - Sunday, 4 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location J - Monday, 5 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
00:00
02:00
04:00
06:00
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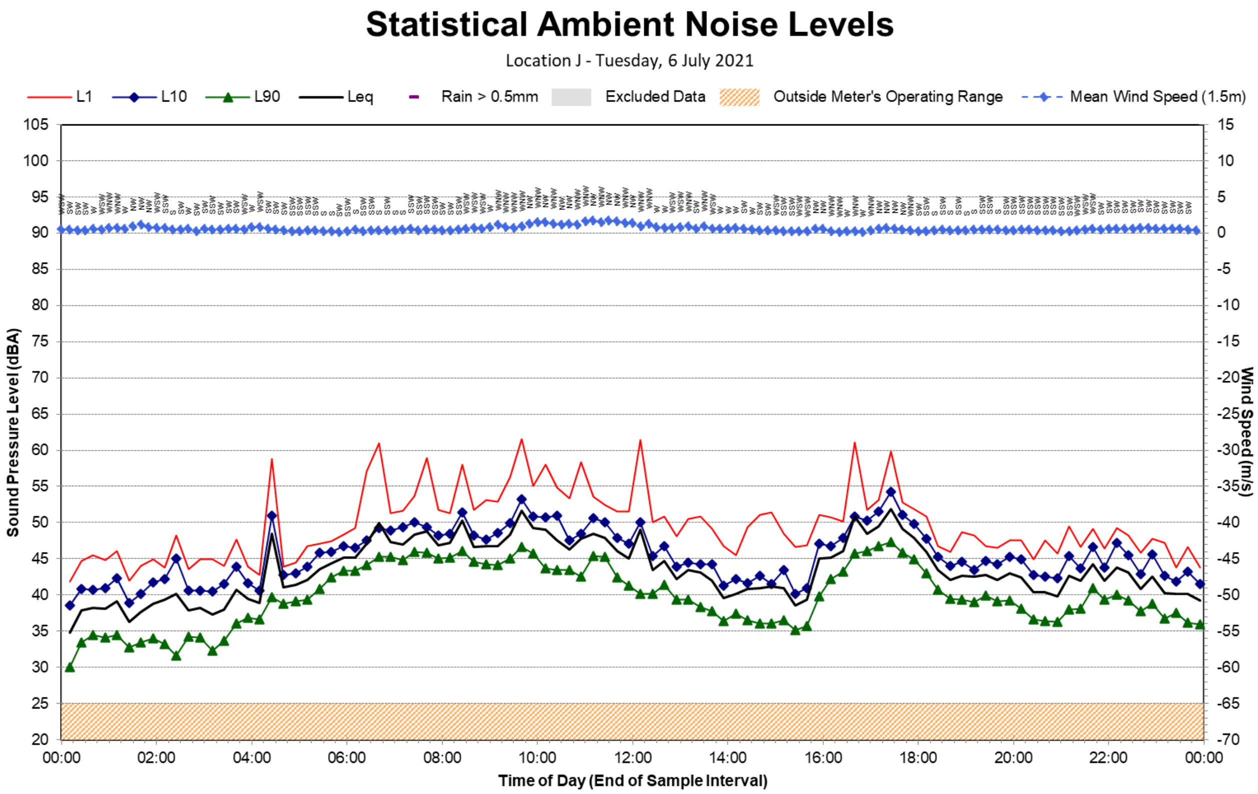
20:00
22:00
00:00


Statistical Ambient Noise Levels
Location J - Tuesday, 6 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
00:00
02:00
04:00
06:00
08:00
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12:00
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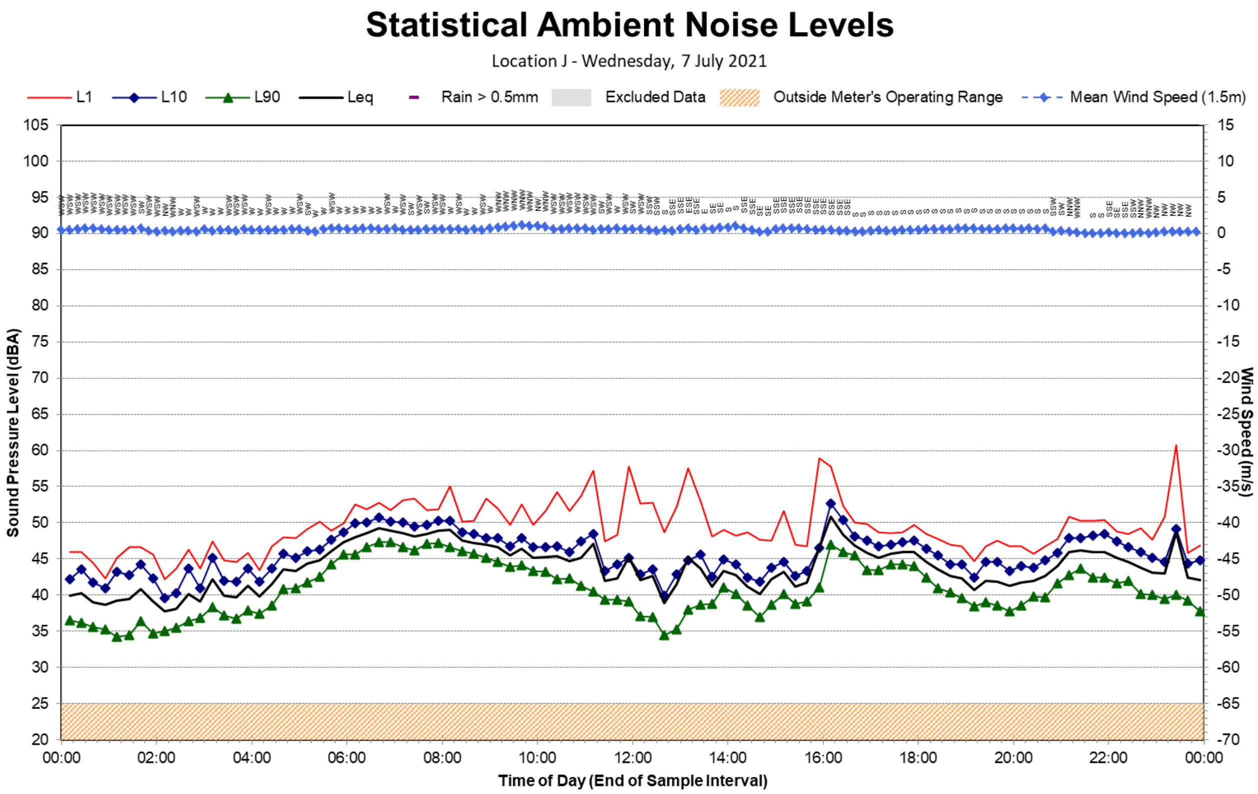
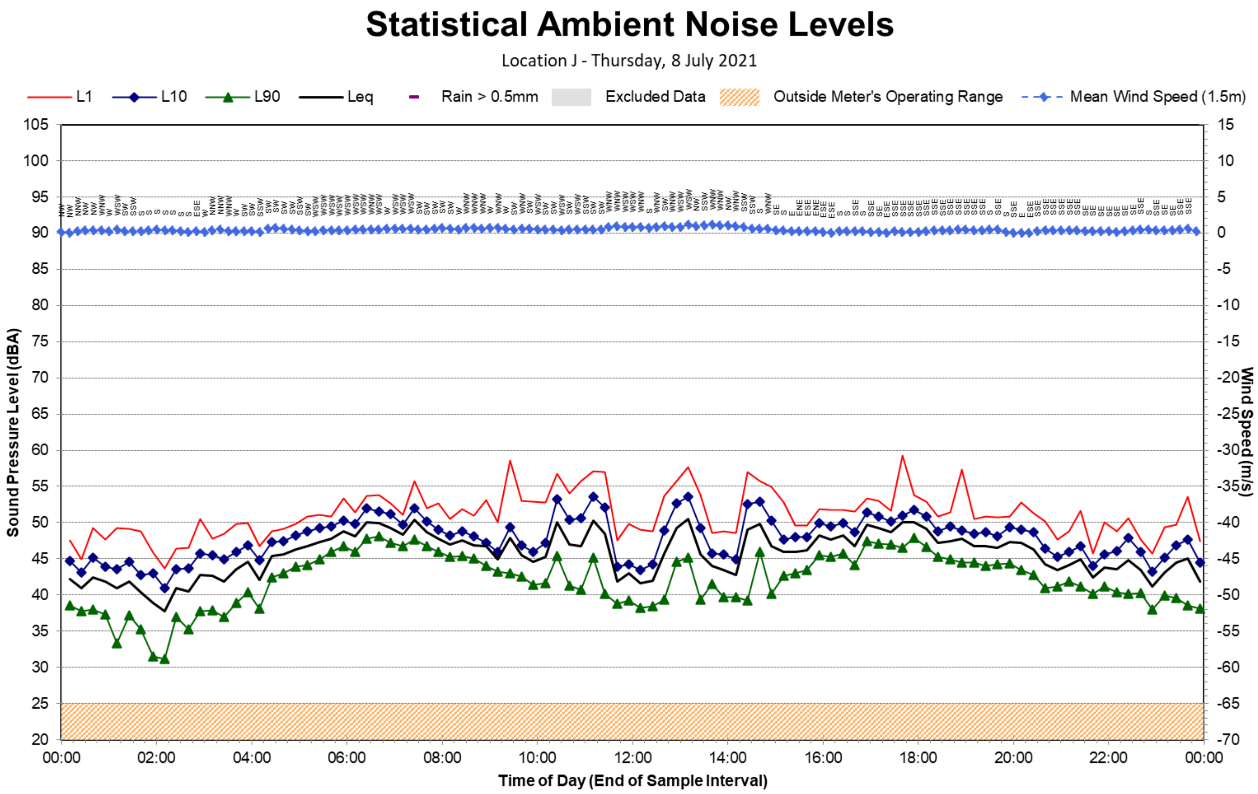
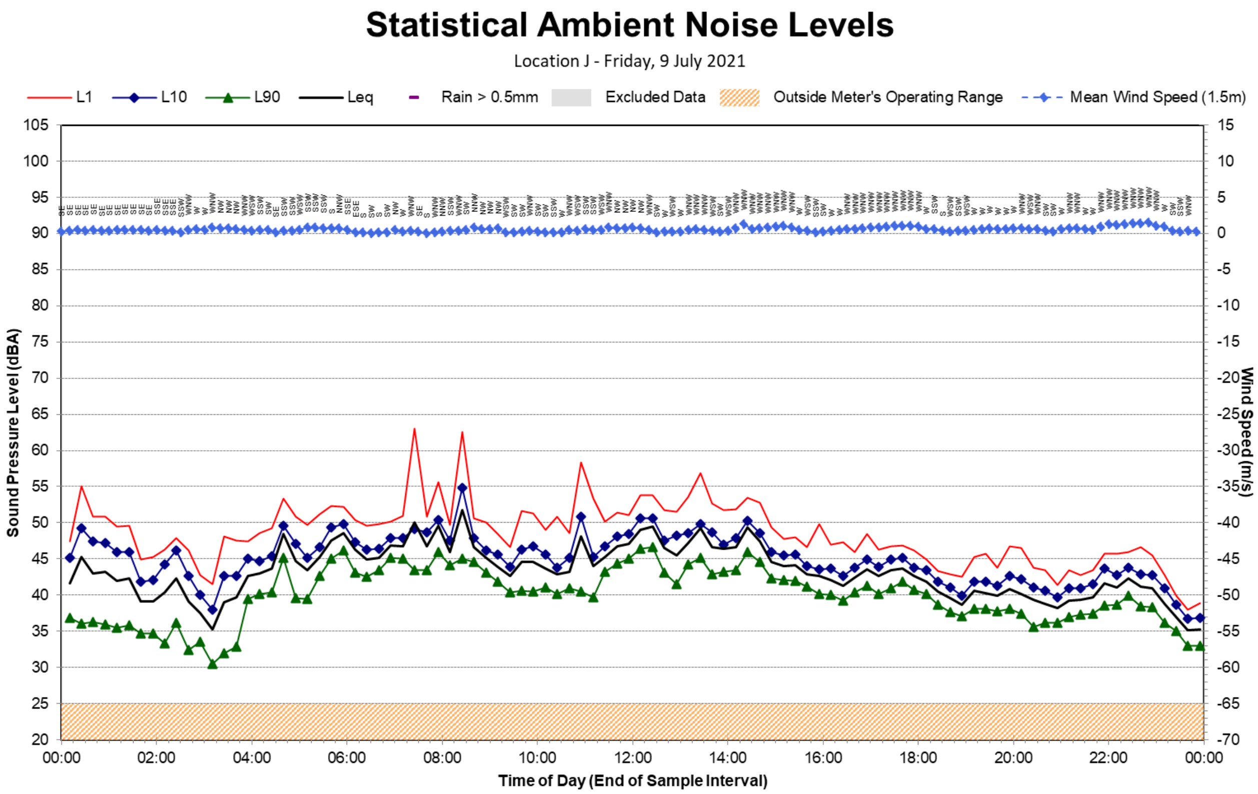
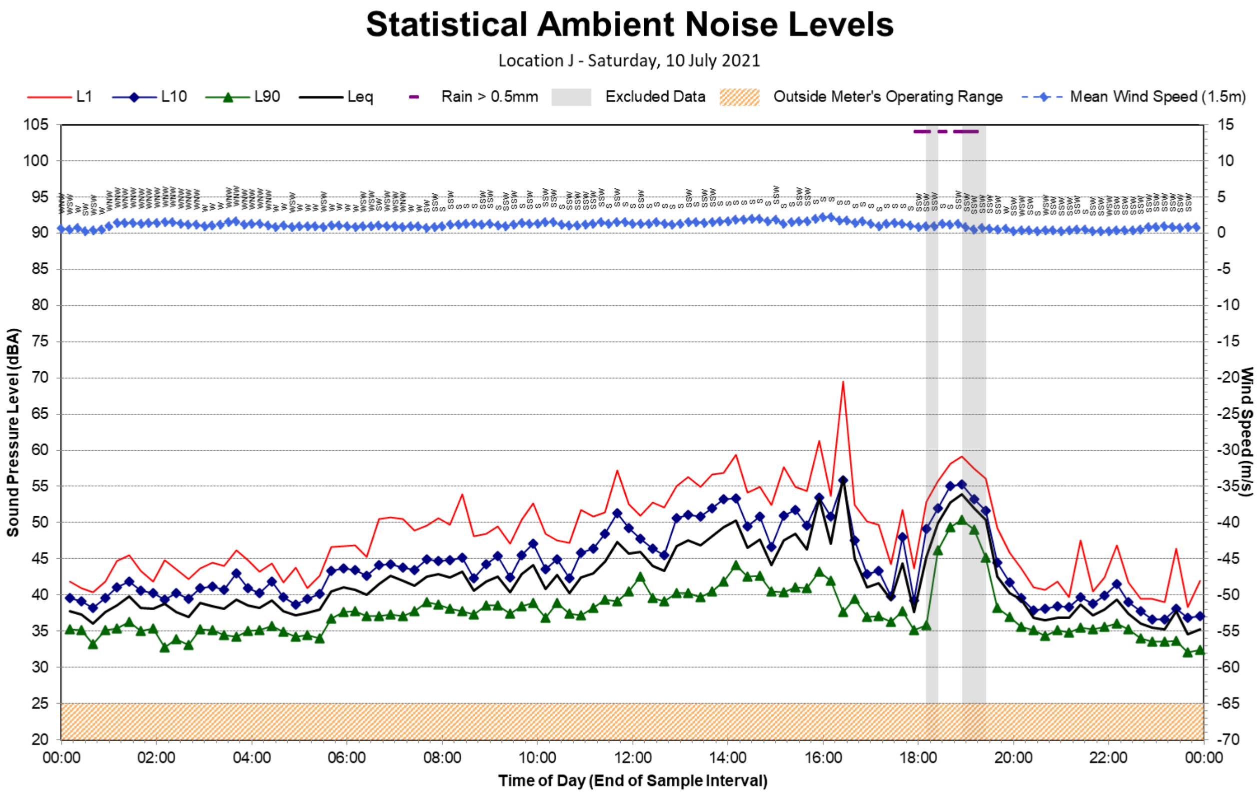
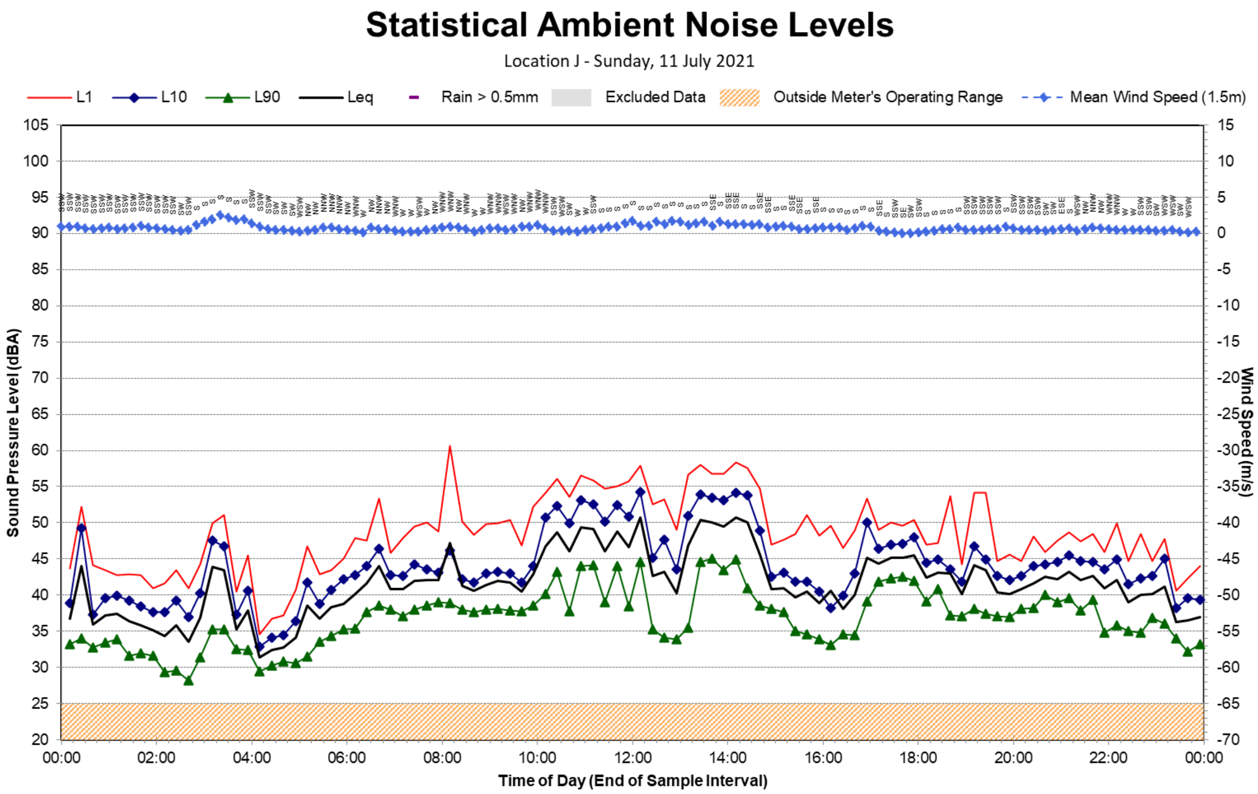
16:00
18:00
20:00
22:00
00:00


Statistical Ambient Noise Levels
Location J - Wednesday, 7 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

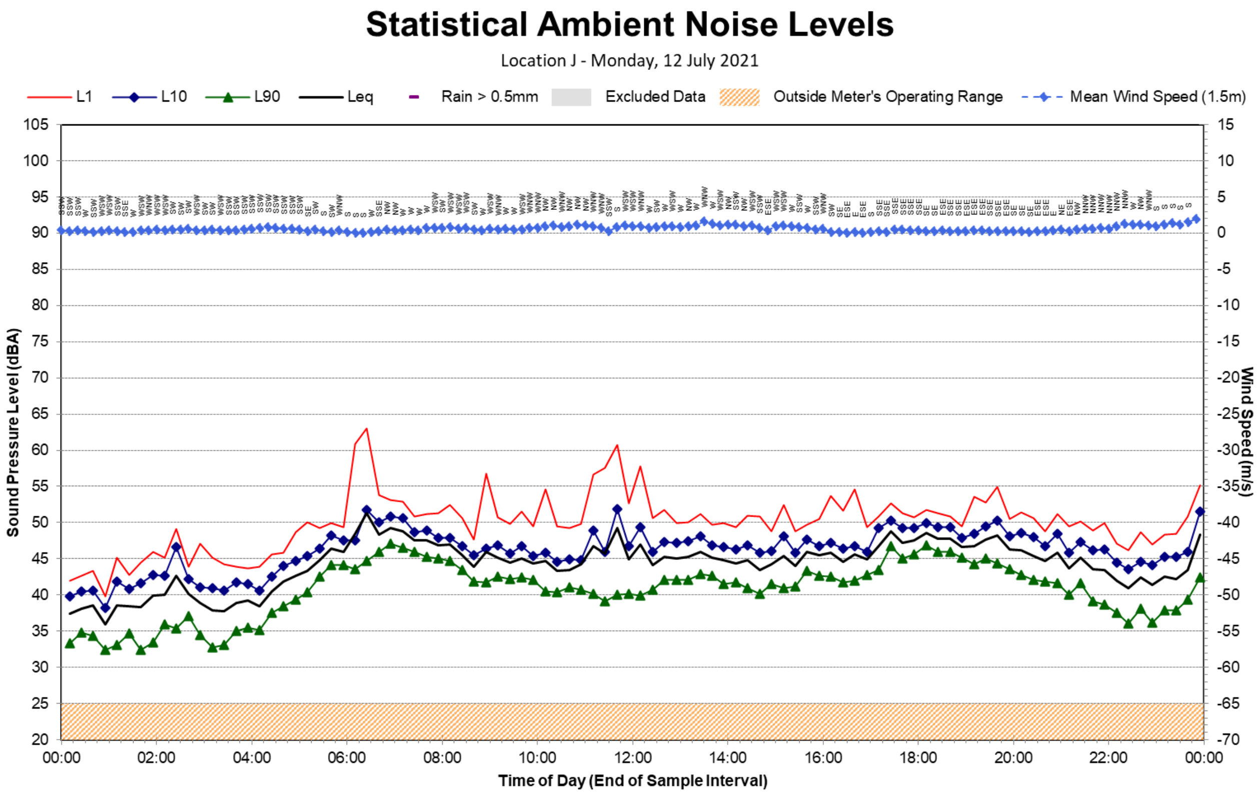

Statistical Ambient Noise Levels
Location J - Thursday, 8 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location J - Friday, 9 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

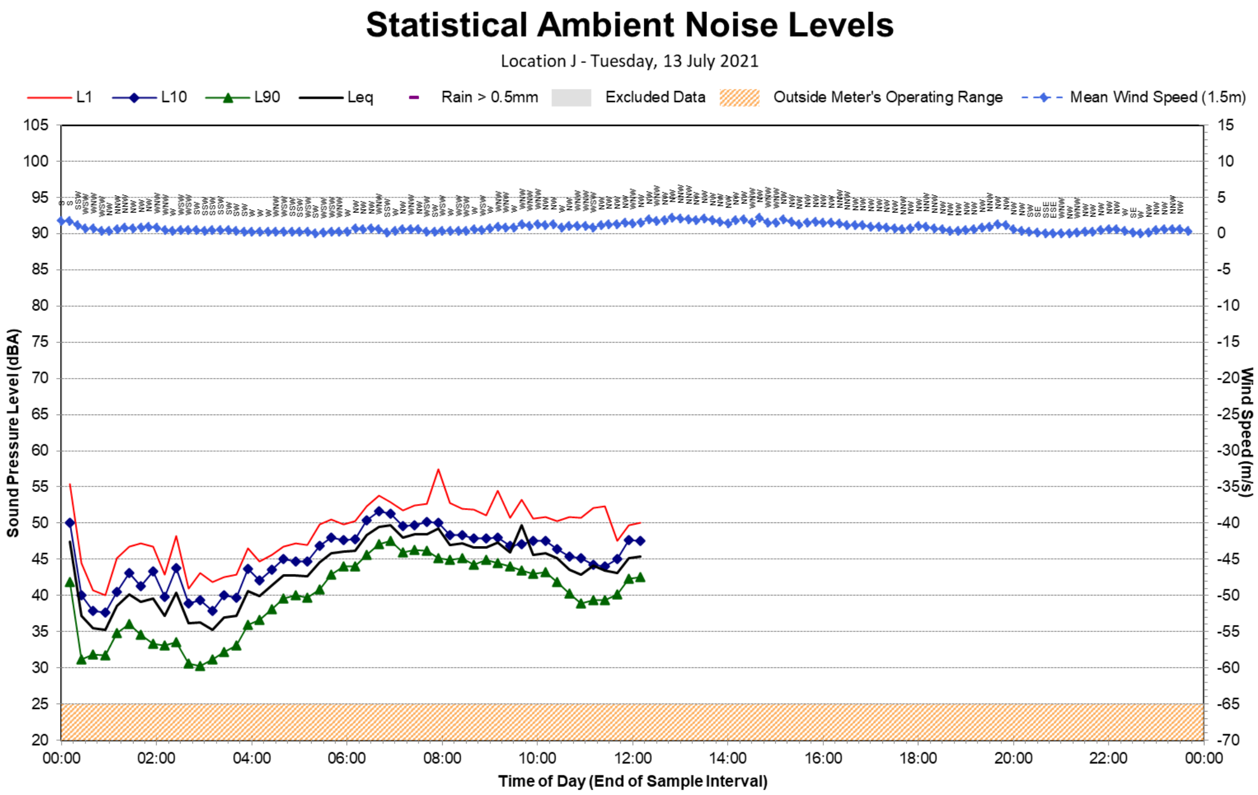

Statistical Ambient Noise Levels
Location J - Saturday, 10 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
Location J - Sunday, 11 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
Location J - Monday, 12 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location J - Tuesday, 13 July 2021
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Outside Meter's Operating Range
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

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