Erskine Park Resource Management Facility Staged SSD

Stage 1 Waste Transfer Station

Construction and Operation Noise Assessment

Report Number 610.14324-R1

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Transpacific Cleanaway Pty Ltd

50 Quarry Road, Erskine Park, NSW 2759

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Stage 1 Waste Transfer Station

Construction and Operation Noise Assessment

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1 INTRODUCTION

This Construction and Operational Noise Assessment has been prepared by SLR Consulting Australia (SLR) on behalf of Transpacific Cleanaway Pty Limited (Cleanaway) to accompany an EIS and application for State Significant Development (SSD 7075) to the NSW Department of Planning and Environment (DP&E), seeking Development Approval under Part 4, Division 4.1 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The application relates to the Erskine Park Waste Transfer Station (herein referred to as the Development), located approximately 11 kilometres south-east of Penrith in western Sydney, New South Wales (NSW), as shown on **Figure 1**.

Cleanaway own and operate the Erskine Park Landfill which is located adjacent to the proposed Development site. The Erskine Park Landfill was opened in 1994 and involves rehabilitation of a former quarry through non-putrescible waste disposal. The landfill currently accepts commercial and industrial waste, general solid waste, low level contaminated soils, construction and demolition waste, and clean fill.

The landfill at Erskine Park currently represents Cleanaway's major post-collections facility in NSW. Based on current input rates it is anticipated that the landfill has approximately two years of commercial operations remaining. Cleanaway is therefore seeking approval for ongoing use of a portion of the site as a putrescible Waste Transfer Station to meet growing market demand. This will also assist in maintaining an operating presence on the site to facilitate active care and maintenance of the existing landfill in its post-closure management phase. The proposed Development will include ancillary facilities including a weighbridge, administrative offices, and parking. It will operate 24 hours per day, seven days per week.

This report identifies the potential construction, operational and traffic noise impacts associated with the Development on the community.

A summary of the acoustic terminology used in this report is presented in **Appendix A**.

1.1 Development Description

Cleanaway are seeking development consent under Part 4 of the EP&A Act for the construction and operation of a 300,000 tonnes per annum (tpa) putrescible Waste Transfer Station and associated infrastructure. The key aspects of the Development are:

- General site clearance and earthworks to establish suitable grades for construction;
- A steel framed and clad waste transfer station building with associated two storey offices, amenities and lower level transfer vehicle load-out area;
- Fast acting roller shutter doors which will be normally closed;
- Transfer station working floor with concrete and asphalt peripheral roads;
- An active ventilation system and air treatment system with controlled discharge as part of the overall approach to air emissions and odour management;
- Associated infrastructure including all hardstand areas, car parks, weighbridges, and sealed roads; and
- Ancillaries including perimeter security fencing, security gates, rain water harvesting, fire suppression system, signage, landscaping, drainage and services.

The Development site is located approximately 11 kilometres south-east of Penrith in western Sydney, NSW. It is addressed to 50 Quarry Road, Erskine Park NSW, and is identified as Lot 1 in Deposited Plan (DP) 1140063 in the Penrith Local Government Area (LGA). The title comprises approximately 3 hectares. As shown the site is west of and adjacent to the existing Erskine Park Landfill that is located adjacent to the site (Lot 4, DP 1094504). Current site infrastructure includes buildings, car parks, sheds, laydown areas, a weighbridge, and sealed roads. Some vegetation is also located around the site.

Once operational, the Development will primarily comprise a putrescible Waste transfer facility with a nominal daily volume of approximately 1,040 tonnes of putrescible waste per day (design capacity 300,000 tonnes per annum (tpa)). However, initially 90,000 tpa will be received at the site. All received waste will then be transported off-site to an appropriately licensed waste management facility.

Waste delivery vehicles will enter the site, weighing on the incoming weighbridge located adjacent to the office building. Delivery vehicles will then proceed to the eastern side of the building where they will align with one of the five roller shutter door entrances on the eastern elevation. The vehicles will reverse through one of the rapid acting roller shutter doors, discharge their waste and then drive out of the building, down a ramp and proceed to the south of the transfer station towards the outgoing weighbridge, exiting the site onto Quarry Road. The majority of the material received is expected to be waste from commercial and residential waste collection trucks, stationary compactor (packer) hooklift loads and side-loader collections (e.g. 240L mobile garbage bin collections from commercial and residential premises).

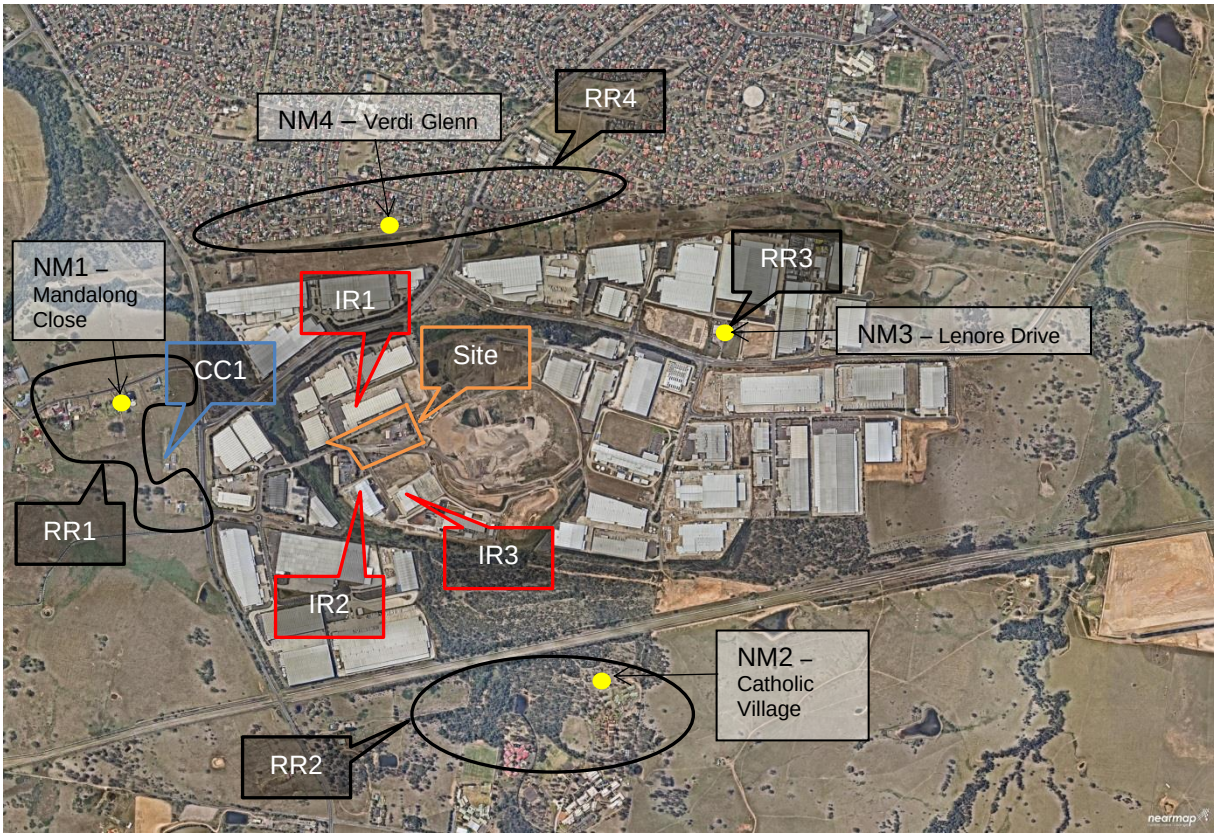
Waste offloaded on the tipping floor will be consolidated and transferred into transfer vehicles by a front loader which will push the material through a push pit for top-loading. Waste deemed suitable for recycling will be sorted by a floor sorting process, with mobile plant only (ie mobile material handler.). The excavator will also be used to redistribute waste material in the loaded vehicles and to provide some compaction by packing waste down within the load out truck with the excavator work tool attachment. The design has allowed for the future addition of waste compaction units to achieve greater compaction of waste before being loaded in to the waste transfer trucks.

Sorted and processed waste will then be transported off-site to a licensed land fill facility with 150km of the site.

The nearest potentially affected existing residences are located (refer to **Figure 1**):

- To the west, approximately 850 m from the proposed Erskine Park Transfer Station site (referred to as Noise Catchment RR1);
- To the south, approximately 1.3 km from the proposed Erskine Park Transfer Station site (referred to as Noise Catchment RR2) - this location corresponds to a retirement village;
- To the east, approximately 1.3 km from the proposed Erskine Park Transfer Station site (referred to as Isolated Residence RR3) - This refers to an isolated residence located in the Erskine Business Park;
- To the north, approximately 850 m from the proposed Eskine Park Transfer Station site (referred to as Noise Catchment RR4).

Figure 1 Site Location and Sensitive Receivers



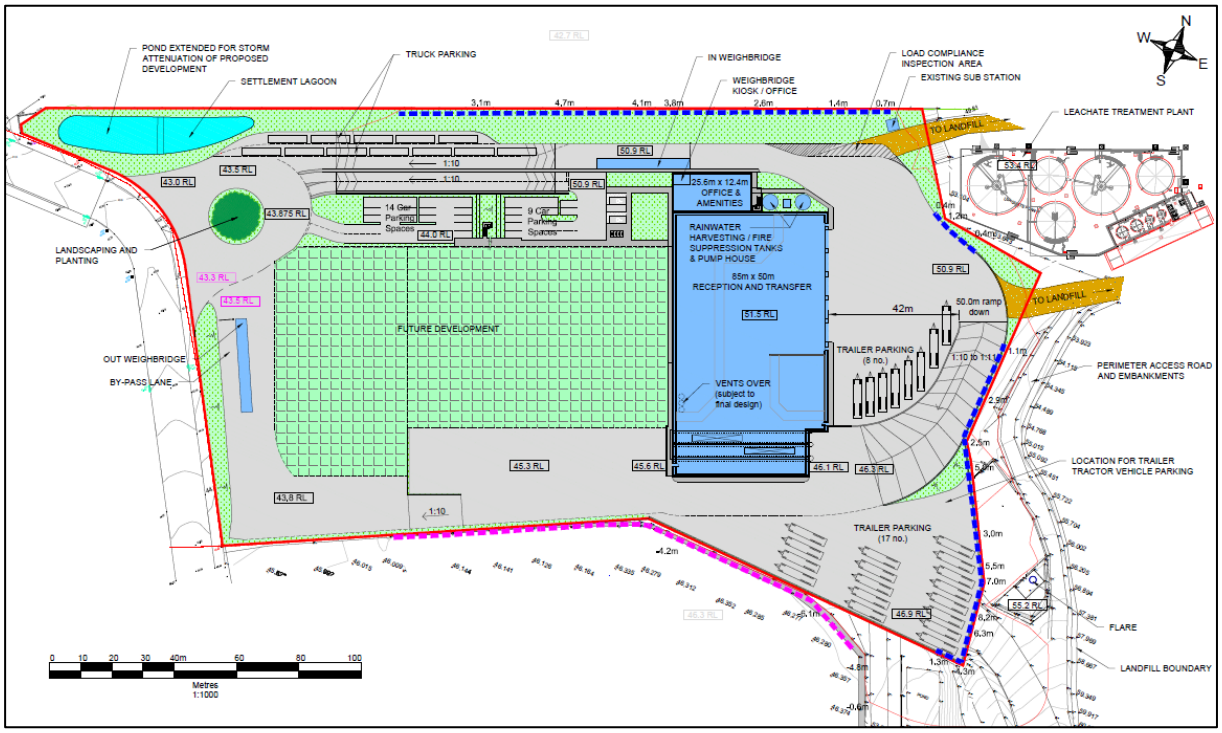
A child care centre under construction (CC1) is located approximately 670 m to the west of the closest boundary of the proposed Development site.

The nearest potentially affected industrial premises are located:

- To the north, approximately 30 m to the north of the closest boundary of the Erskine Park Transfer Station Site (IR1);
- To the southwest, approximately 50 m of the closest boundary of the Erskine Park Transfer Station Site (IR2);
- To the south, approximately 115 m of the closest boundary of the Erskine Park Transfer Station Site (IR3).

The proposed Development layout is shown in **Figure 2**.

Figure 2 Proposed Erskine Park Transfer Station Site Layout



1.2 Purpose of this document

The purpose of this Construction and Operational Noise Assessment is to specifically meet the Secretary's Environmental Assessment Requirements (SEARs) for the Development which relate to noise (refer **Section 1.3**), as well as the recommendations of other consulted agencies and relevant stakeholders.

1.3 Secretary's Environmental Assessment Requirements

A Project Briefing Paper and request for SEARs relating to the form and content of the EIS required to accompany the development application for the Development was submitted to the NSW DP&E in May 2015. The SEARs were subsequently issued by the DP&E on 30 June 2015. **Table 1** presents the acoustic requirements and key issues to be addressed in the EIS in accordance with the SEARs, and identifies where each requirement is addressed in this document or the EIS.

Table 1 Acoustic Requirements

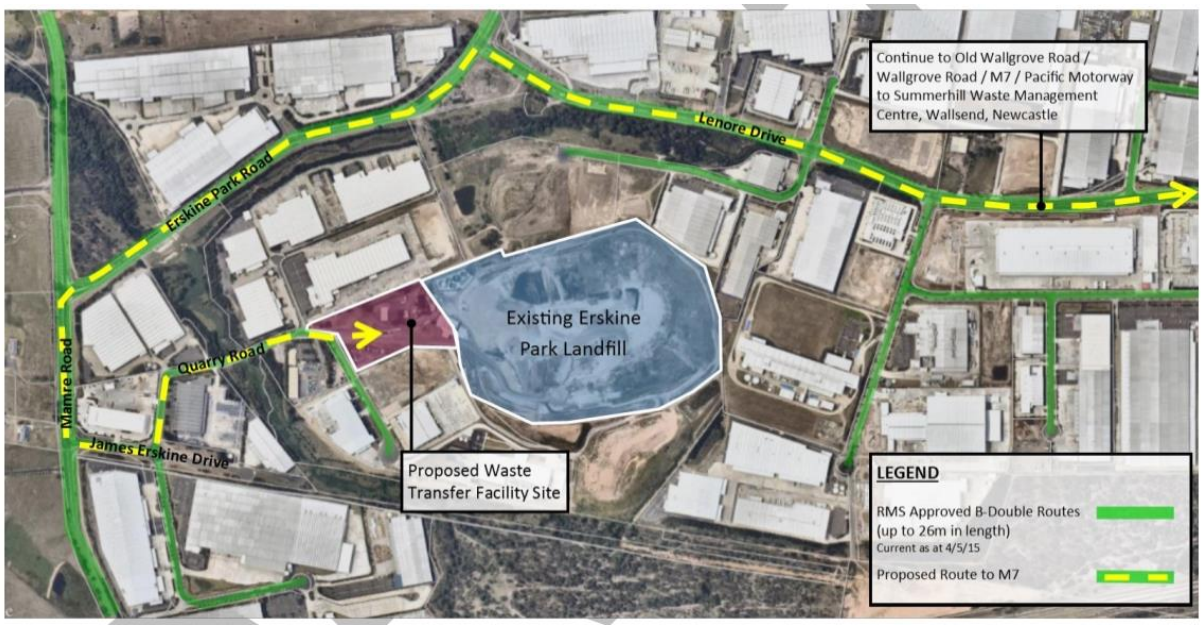
SEARs	Relevant Section
A description of all potential noise sources, including construction, operational and transport sources;	1.1, 1.3.1,
A qualitative assessment of construction, operational and transportation noise and vibration impacts from the development, including cumulative impacts, on surrounding land and sensitive receptors under relevant Environment Protection Authority guidelines;	2, 3, 4,5,6,7
Details of noise mitigation measures; and	not required
Details of the proposed management and monitoring measures.	The assessment shows compliance hence noise management and monitoring measures are not proposed

1.3.1 Transportation

Outbound waste will travel via the RMS approved B-double routes using Quarry Road, James Erskine Drive, Mamre Road, Erskine Park Road, Lenore Drive, Old Wallgrove Road and Wallgrove Road to access the M7. Remaining traffic (inbound waste and staff-generated traffic) is assumed to be distributed across the proposed Erskine Park Transfer Station adjacent roads (Refer to Traffic Impact Assessment Traffix, August 2015)

Haul roads are presented in **Figure 3**.

Figure 3 Haul roads



The proposed number of staff working at the facility is up to 10 (excluding the occasional person for specific issues such as maintenance) with staff generally working from 7 am to 5 pm.

The daily number of trucks entering and exiting the proposed Erskine Park Transfer Station is shown in **Table 2**. These volumes represent vehicles, therefore one movement and one exit movement would be generated by each vehicle in the table below.

Table 2 Daily Number of Trucks (Maximum Operating Capacity)

Time Slot	Refuse Collection Trucks - Inbound Waste	Waste Collection Trucks - Outbound Waste	Total Number of Trucks
12.00 am to 1.00 am	0	0	0
1.00 am to 2.00 am	0	0	0
2.00 am to 3.00 am	0	0	0
3.00 am to 4.00 am	0	0	0
4.00 am to 5.00 am	5	5	10
5.00 am to 6.00 am	21	1	22
6.00 am to 7.00 am	13	3	16
7.00 am to 8.00 am	8	2	10
8.00 am to 9.00 am	3	1	4
9.00 am to 10.00 am	28	0	28
10.00 am to 11.00 am	19	5	24
11.00 am to 12.00 pm	14	2	16
12.00 pm to 1.00 pm	33	2	35
1.00 pm to 2.00 pm	19	6	25
2.00 pm to 3.00 pm	21	2	23
3.00 pm to 4.00 pm	10	0	10
4.00 pm to 5.00 pm	6	0	6
5.00 pm to 6.00 pm	0	0	0
6.00 pm to 7.00 pm	0	0	0
7.00 pm to 8.00 pm	0	0	0
8.00 pm to 9.00 pm	0	0	0
9.00 pm to 10.00 pm	0	0	0
10.00 pm to 11.00 pm	0	0	0
11.00 pm to 12.00 am	0	0	0
Total Number of Trucks during daytime period (7.00 am to 6.00 pm)	161	20	181
Total Number of Trucks during evening period (6.00 pm to 10.00 pm)	0	0	0
Total Number of Trucks during night-time period (10.00 pm to 7.00 am)	39	9	48

1.3.2 Hours of operations

The Development will be capable of operating 24 hours a day, seven days a week (subject to approval); however, the majority of truck movements to and from the site will be between 7 am and 5 pm and within approved operating hours.

2 EXISTING ACOUSTICAL ENVIRONMENT

2.1 Noise Monitoring Locations

Environmental noise monitoring was conducted at the potentially most affected (representative) noise-sensitive locations, NM1, NM2, NM3 and NM4 (refer to Figure 1) in order to:

- Characterise the existing noise environment in the vicinity of the Proposed Erskine Park Transfer Station; and
- To establish the noise levels upon which to base the construction and operation noise emission objectives.

2.2 Instrumentation and Measurement Parameters

All acoustic instrumentation employed throughout the monitoring programme complies with the requirements of AS IEC 61672.1-2004 "*Electroacoustics - Sound Level Meters - Part 1: Specifications"* and carried appropriate and current NATA (or manufacturer) calibration certificates. Descriptions of the instrumentation, designated type and serial numbers are presented in **Table 3**.

Table 3 Acoustic Instrumentation

Location	Description	Type or Class	Serial Number
All	Brüel & Kjær 2250 Sound Level Meter[1]	Type 1	3004710
NM1 - Mandalong Close	ARL 316 Environmental Noise Logger[1]	Type 1	16-301-473
NM2 - Catholic Village	ARL 316 Environmental Noise Logger[1]	Type 1	16-207-050
NM3 - Lenore Drive	ARL 316 Environmental Noise Logger[1]	Type 1	16-203-524
NM4 - Verdi Glenn	ARL 316 Environmental Noise Logger[1]	Type 1	16-203-525

Note: Equipment fitted with a microphone windshield

All instrumentation was programmed to continuously record statistical noise level indices in 15 minute intervals, which included the L_{Amax}, L_{A1}, L_{A10}, L_{A50}, L_{A90} and the L_{Aeq}.

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

2.3 Unattended Noise Monitoring

Unattended background noise monitoring was conducted between Friday 24 April 2015 and Tuesday 5 May 2015 at the four sensitive locations listed in **Table 3** and shown on **Figure 1.**

Continuous weather data was obtained from the nearby Horsley Park weather station, in order to identify periods of adverse weather during the unattended noise logging survey. The Horsley Park Weather Station was selected as it is a station providing detailed meteorological data that falls within the guideline offset distance and topographical basin as nominated in the NSW Department of Environment Climate and Water (now the NSW Environment Protection Authority (EPA)) Industrial Noise Policy (INP). Data corresponding to periods of high winds and/or rain were excluded from the background noise analysis. The removal of the weather affected noise data did not significantly affect the resulting background noise levels.

The results of the unattended noise surveys are presented in tabular form in **Table 4** and graphically in **Appendix B**. The statistical descriptors shown on the graphs are described in **Appendix A**.

The noise data were processed in accordance with the procedures documented in the EPA's INP.

Table 4 presents the Rating Background Levels (RBLs) or background (L_{A90}) noise levels for the noise monitoring locations.

Table 4 Summary of Existing $L_{A90(15minute)}$ Rating Background Levels (RBLs) and Existing $L_{Aeq(period)}$ Ambient Noise Levels - dBA re 20 µPa

Location	$L_{A90(15minute)}$ Rating Background Level (RBL)			$L_{Aeq(period)}$ Existing Ambient Noise Level		
	Daytime 0700-1800 Hours	Evening 1800-2200 Hours	Night-time 2200-0700 Hours	Daytime 0700-1800 Hours	Evening 1800-2200 Hours	Night-time 2200-0700 Hours
NM1 - Mandalong Close	44	45	39	54	54	53
NM2 - Catholic Village	35	38	36	49	43	44
NM3 - Lenore Drive	46	48	44	57	54	53
NM4 - Verdi Glenn	43	41	39	51	53	48

2.4 Operator-Attended Noise Monitoring

Operator-attended (15 minute) noise surveys were conducted at each of the locations listed in **Table 4**, on Friday 24 April 2015, in order to determine the character of the existing background noise levels. The results of the background noise surveys are presented in **Table 5** together with a description of the noise sources and the prevailing weather conditions at the time of measurement.

Table 5 Operator-attended Background Noise Survey Results

Location Start Time Conditions	Measurement Description	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission and Typical Maximum Levels (LAmax)
		LAeq	LA1	LA10	LA50	LA90	
NM1 - Mandalong Close 24/04/2015 1118 hours Temperature at 10m: 20.8^{0}C Humidity: 72% Wind At 10m : 1.7 m/s N No Rain	Ambient	50	58	52	48	46	Trucks turning onto Mamre Road 52-57 Engine braking onto Mamre Road 56-62 Cars on Mamre Road 45-50 Truck accelerating on Mamre 51 Engine braking on Mamre 51-55 Plane 50-56
		Ambient noise dominated by traffic on Mamre Road					
NM2 - Catholic Village 24/04/2015 1155 hours Temperature at 10m: 22.3^{0}C Humidity: 70% Wind At 10m : 0.6 m/s NNE No Rain	Ambient	45	50	47	44	42	Birds 41 Resident 47 Erskine Business Park hum 43-44 Banging 46-54 Plane 48-52 Trucks in Erskine Business Park 47
		Ambient noise influenced by Erskine Business Park activities					
NM3 - Lenore Drive 24/04/2015 1312 hours Temperature at 10m: 24.4^{0}C Humidity: 59% Wind At 10m : 1.9 m/s N No Rain	Ambient	54	62	57	51	47	Traffic on Lenore Drive 47-62 Welding 50 Birds 57-67 Distant Traffic 44 Wiper sniper 51-59 Bikes 66-67
NM4 - Verdi Glenn 24/04/2015 1404 hours Temperature at 10m: 25.2^{0}C Humidity: 47% Wind At 10m : 1.7 m/s NNW No Rain	Ambient	48	55	48	44	42	Dog 62-75 Traffic 44-50 Birds 46-52 Erskine Business Park hum 37 Insects continuous 31-35 Plane 47

The attended noise monitoring confirmed that the measured ambient noise levels were dominated by traffic noise and Erskine Business Park activities.

3 CONSTRUCTION NOISE IMPACT ASSESSMENT PROCEDURE

3.1 Construction Noise Guidelines

When dealing with noise from construction works, the NSW EPA recognises that higher levels of noise are likely to be tolerated by people in view of the relatively short duration of the works. As a result, the EPA has published guidelines in its "*Interim Construction Noise Guideline*", 2009 (ICNG or Guideline) for the management of construction works noise.

The Guideline recommends the following approaches to mitigating adverse noise impacts from construction sites.

3.2 Hours of Construction

The EPA's Guideline recommend confining permissible work times as outlined in **Table 6**.

Table 6 Preferred Hours of Construction

Day	Preferred Construction Hours
Monday to Friday	7.00 am to 6.00 pm
Saturdays	8.00 am to 1.00 pm
Sundays or Public Holidays	No construction

3.3 Construction Noise Assessment Method

The EPA's Guideline recognises that people are usually annoyed more by noise from longer-term works than by the same type of works occurring for only a few days. For this reason the Guideline identifies two methods of assessing noise from construction:

- The quantitative assessment method which applies to long-term duration work; and
- The qualitative assessment method which applies to short-term duration work.

3.3.1 Quantitative Assessment Method

The EPA's Guideline recommends that the $L_{Aeq(15minute)}$ noise levels arising from a construction project, measured within the curtilage of an occupied noise-sensitive premises (ie at boundary or within 30 m of the residence, whichever is the lesser) should not exceed the levels indicated in **Table 7**. These Noise Management Levels (NMLs) are generally consistent with community reaction to construction noise. The EPA's Guideline also recognises other kinds of noise sensitive receivers and provides recommended construction NMLs for them. Those specific receivers and their recommended noise levels are presented in **Table 8**.

Table 7 Recommended EPA General NMLs for Construction Works

Period of Noise Exposure	$L_{Aeq(15minute)}$ Construction NML
Recommended Standard Hours	Noise affected[1] RBL[2] + 10 dBA
	Highly noise affected[3] 75 dBA
Outside Recommended Standard Hours	Noise affected[1] RBL + 5 dBA

Note 1: The noise affected level represents the point above which there may be some community reaction to noise.
Note 2: Refer to **Table 4** and **Appendix A**.
Note 3: The highly noise affected level represents the point above which there may be strong community reaction to noise.

Table 8 Noise at Sensitive Land Uses (other than Residences)

Land use	$L_{Aeq(15minute)}$ Construction NML
Classrooms at schools and other educational institutions	Internal noise level 45 dBA
Hospital wards and operating theatres	Internal noise level 45 dBA
Places of worship	Internal noise level 45 dBA
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dBA
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dBA
Community centres	Depends on the intended use of the centre
Industrial premises	External noise level 75 dBA

The EPA's Guideline recommends using the following quantitative assessment when the noise affected level is not met.

Mitigation

Recommended Standard Hours - Noise affected RBL + 10 dBA

- Where the predicted or measured $L_{Aeq(15minutes)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices in order to meet the noise affected level.
- The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

Recommended Standard Hours - Highly Noise affected RBL 75 dBA

- Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours during which the very noisy activities can occur, taking into account:
  - Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences).
  - If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

3.3.2 Qualitative Assessment Method

The qualitative method for assessing construction noise is a simplified way to identify the cause of potential noise impacts. It avoids the need to perform complex predictions by using a checklist approach to assessing and managing noise.

The following checklist for work practice can be used:

- Community notification;
- Operate plant in a quiet and efficient manner;
- Involve workers in minimising noise; and
- Handle complaints.

The quantitative assessment method is considered the appropriate method for the Development as the construction works are expected to take approximately 12 -15 months.

3.4 Development Specific Construction NMLs

The assessment of the impact from on-site construction works is conducted according to the EPA's Interim Construction Noise Guideline. The Development construction works are expected to take up to 15 months. Accordingly, the quantitative assessment method described in **Section 3.3.1** is to be followed.

It is anticipated that the Development construction works will be undertaken during Recommended Standard Hours. The EPA's Guideline $L_{Aeq(15minute)}$ construction NMLs are presented in **Table 9**.

Table 9 Recommended EPA NMLs for Construction Works

Location	Noise Management Levels ($L_{Aeq(15min)}$)
	Recommended Standard Hours1
RR1 2	54
RR2 3	45
RR3 4	56
RR4 5	53
CC1 6	65
IR1	75
IR2	75
IR3	75

Note 1: EPA's standard construction hours: 7.00 am to 6.00 pm Monday to Friday, 7.00 am to 1.00 pm (if inaudible at residential premises) otherwise 8.00 am to 1.00 pm on Saturdays and no work on Sundays or Public Holidays.

Note 2: Based on measured background at NM1 - Mandalong Close.

Note 3: Based on measured background at NM2 - Catholic Village.

Note 4: Based on measured background at NM3 - Lenore Drive.

Note 5: Based on measured background at NM3 - Verdi Glenn.

Note 6: Based on the 45 dBA internal noise level and an external to internal noise reduction (fixed non-openable windows) of 20 dBA).

4 OPERATIONAL NOISE IMPACT ASSESSMENT PROCEDURE

4.1 Environmental Noise Control - General Objectives

Noise objectives for the assessment of industrial/commercial facilities at residential receivers are detailed in the INP, as administered by the EPA. The policy is normally applied at the residential property boundary.

The INP's objectives are:

- To establish noise criteria that would protect the community from excessive noise;
- To preserve the amenity for specific land uses;
- To use the criteria for deriving project specific land uses; and
- To promote uniform methods to estimate and measure noise impacts including a procedure for evaluating meteorological effects.

Implementation is achieved by ensuring that:

- Noise from any single source does not intrude greatly above the prevailing background noise level. This is known as the intrusive noise criterion; and
- The background noise level does not exceed the level appropriate for the particular locality and land use. This is known as the amenity criterion.

In order to satisfy the above two requirements, an intrusive and an amenity noise criterion is determined of which the lower is usually adopted as the project specific noise level.

4.1.1 Assessing Intrusiveness

For assessing intrusiveness, the background noise generally needs to be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5 dBA above the measured (or default) Rating Background Level (RBL).

4.1.2 Assessing Amenity

The amenity assessment is based on noise criteria specific to the land use and associated activities. The amenity criteria are shown is **Table 10** and relate only to industrial-type noise and do not include road, rail or community noise. If present, the existing noise level from industry is generally measured. If it approaches the criterion value, then noise levels from new industries need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion. The cumulative effect of noise from industrial sources also needs to be considered in assessing the impact. The correction to be applied to the source to account for existing levels of industrial noise is shown in **Table 11**.

Table 10 Amenity Criteria - Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50 dBA	55 dBA
		Evening	45 dBA	50 dBA
		Night	40 dBA	45 dBA
	Suburban	Day	55 dBA	60 dBA
		Evening	45 dBA	50 dBA
		Night	40 dBA	45 dBA
	Urban	Day	60 dBA	65 dBA
		Evening	50 dBA	55 dBA
		Night	45 dBA	50 dBA
	Urban/Industrial Interface - for existing situations only	Day	65 dBA	70 dBA
		Evening	55 dBA	60 dBA
		Night	50 dBA	55 dBA
School classrooms - internal	All	Noisiest 1-hour period when in use	35 dBA	40 dBA
Active recreation area (eg School playground, golf course)	All	When in use	55 dBA	60 dBA
Commercial premises	All	When in use	65 dBA	70 dBA
Industrial premises	All	When in use	70 dBA	75 dBA

Notes: For Monday to Saturday, Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00pm; Night-time 10.00 pm - 7.00 am.

On Sundays and Public Holidays, Daytime 8.00 am hours - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.

Table 11 Modification to Acceptable Noise Level (ANL)[1] to Account for Existing Level of Industrial Noise

Total existing L_{Aeq} noise level from industrial sources, dB(A)	Maximum L_{Aeq} noise level for noise from new sources alone, dB(A)
≥ Acceptable noise level plus 2	If existing noise level is likely to decrease in future: acceptable noise level minus 10 If existing noise level is unlikely to decrease in future: existing level minus 10
Acceptable noise level plus 1	Acceptable noise level minus 8
Acceptable noise level	Acceptable noise level minus 8
Acceptable noise level minus 1	Acceptable noise level minus 6
Acceptable noise level minus 2	Acceptable noise level minus 4
Acceptable noise level minus 3	Acceptable noise level minus 3
Acceptable noise level minus 4	Acceptable noise level minus 2
Acceptable noise level minus 5	Acceptable noise level minus 2
Acceptable noise level minus 6	Acceptable noise level minus 1
< Acceptable noise level minus 6	Acceptable noise level

Note 1: ANL = recommended acceptable L_{Aeq} noise level for the specific receiver, area and time of day from **Table 10**.

4.1.3 INP Assessment of Prevailing Weather Conditions

Wind

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

When the source to receiver wind component is at speeds of up to 3 m/s for 30% or more of the time in any seasonal period (ie daytime, evening or night-time), then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

The NSW INP Section 5.3, Wind Effects, states that:

> *"Wind effects need to be assessed where wind is a feature of the area. Wind is considered to be a feature where source to receiver wind speeds (at 10 m height) of 3 m/s or below occur for 30 percent of the time or more in any assessment period in any season."*

An assessment of existing wind conditions has been prepared from the meteorological data recorded by the Bureau of Meteorology at the Horsley Park weather station for the period May 2012 to May 2015. This weather station is located approximately 7.5 km from the proposed Development and the recorded weather conditions are considered representative of those in the vicinity of the proposed Development. The dominant seasonal wind speeds and wind directions are presented in **Appendix C.**

Any prevailing winds of speed less than (or equal to) 3 m/s with a frequency of occurrence greater than (or equal to) 30%, and considered to be a feature of the project site in accordance with the INP, are presented in **Table 12**.

Table 12 Project Site Prevailing Wind Conditions in Accordance with the INP

Season	Winds ±45° ≤3m/s with Frequency of Occurrence ≥30%		
	Daytime	**Evening**	**Night-Time**
Summer	Nil	Nil	Nil
Autumn	Nil	Nil	**32.9% SW, 32.3% WSW**
Winter	Nil	**29.8% SW, 29.6% WSW**	**34.0% WSW, 31.6% W, 30.6% SW**
Spring	Nil	Nil	Nil

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions occur predominantly at night during the winter months. For a temperature inversion to be a significant characteristic of the area it needs to occur for 30% or more of the total night-time during winter or about two nights per week. The NSW INP states that temperature inversions need only be considered for the night-time noise assessment period ie 10.00 pm to 7.00 am.

Temperature Inversion

The NSW INP Section 5.2, Temperature Inversions, states:

> *"Assessment of impacts is confined to the night noise assessment period (10:00 pm to 7:00 am), as this is the time likely to have the greatest impact - that is, when temperature inversions usually occur and disturbance to sleep is possible."*
>
> *"Where inversion conditions are predicted for at least 30% (or approximately two nights per week) of total night-time in winter, then inversion effects are considered to be significant and should be taken into account in the noise assessment."*

In the absence of measured data, the INP nominates default inversion parameters for non-arid areas where the average rainfall is greater than 500 mm namely:

> *"3°C/100 m temperature inversion for all receivers, plus a 2 m/s source-to-receiver component drainage-flow wind speed for those receivers where applicable."*

An assessment of atmospheric stability has been prepared from the meteorological data set at Horsley Park and the evening and night-time frequency of occurrences of atmospheric stability classes for the period May 2012 to May 2015 are presented in **Table 13** together with the estimated Environmental Lapse Rates (ELR).

Table 13 Prevailing Atmospheric Stability Frequency - Evening and Night-time - May 2012 to May 2015

Stability Class	Frequency of Occurrence				Estimated ELR °C/100 m	Qualitative Description
	Summer	**Autumn**	**Winter**	**Spring**		
A	0.0%	0.0%	0.0%	0.0%	<-1.9	Lapse
B	0.0%	0.0%	0.0%	0.0%	-1.9 to -1.7	Lapse
C	0.0%	0.0%	0.0%	0.0%	-1.7 to -1.5	Lapse
D	50.6%	42.4%	44.3%	45.5%	-1.5 to -0.5	Neutral
E	9.3%	11.5%	12.0%	9.5%	-0.5 to 1.5	Weak Inversion
F	8.7%	11.2%	14.2%	10.7%	1.5 to 4	Moderate Inversion
G	31.4%	34.9%	29.5%	34.4%	>4.0	Strong Inversion
F + G	40.1%	46.1%	43.7%	45.1%	>1.5	Moderate to Strong Inversion

Note 1: ELR (Environmental Lapse Rate).

In accordance with the INP, as the frequency of occurrence of moderate to strong (ie 1.5 to >4.0˚C/100 m) winter temperature inversions are greater than 30% during the combined evening and night-time period, temperature inversion requires assessment.

4.1.4 Modifying Factors

Modifying factors are to be applied to the predicted noise levels if the source noise, at the receiver, is low frequency, tonal or intermittent in nature. No modifying factors need to be applied in the subject assessment.

4.1.5 Sleep Disturbance

The EPA's most recent policy considers sleep disturbance as the emergence of the $L_{A1(1minute)}$ level above the $L_{A90(15minute)}$ level at the time. Appropriate screening criteria for sleep disturbance are determined to be an $L_{A1(1minute)}$ level 15 dBA above the Rating Background Level (RBL) for the night-time period (10.00 pm to 7.00 am).

When the criterion is not met, a more detailed analysis may be required which should cover the maximum noise level or $L_{A1(1minute)}$, the extent that the maximum noise level exceeds the background level and the number of times this occurs during the night-time period. Some guidance on possible impacts is contained in the review of research results in the appendices to the NSW Environmental Criteria for Road Traffic Noise (ECRTN).

Other factors that may be important in assessing the extent of impacts on sleep include:

- How often high noise events will occur;
- Time of day (normally between 10.00 pm and 7.00 pm); and
- Whether there are times of the day when there is a clear change in the noise environment (such as during early morning shoulder periods).

It is noteworthy that there are no specific criteria for sleep disturbance nominated in the INP, in the INP Application Notes, the ECRTN, or in the ICNG. This is consistent with the statement in the ECRTN that "*at the current level of understanding, it is not possible to establish absolute noise level criteria that would correlate to an acceptable level of sleep disturbance".*

A substantial portion of the ECRTN is a review of international sleep disturbance research, indicating that:

- A maximum internal noise levels below 50-55 dBA are unlikely to cause awakening reactions; and
- One or two noise events per night with maximum internal noise levels 65-70 dBA are not likely to significantly affect health and wellbeing.

4.2 Development Specific Operational Noise Goals

The Development operational noise emission criteria have been set with reference to the INP, as outlined in **Section 4.1**.

The resulting operational intrusive and amenity noise emission criteria are given in **Table 14**.

Table 14 INP Project Specific Noise Assessment Criteria (dBA re 20 µPa)

Location	Project Specific Assessment Criteria					
	Intrusive $L_{Aeq(15minute)}$			Amenity $L_{Aeq(Period)}$		
	Day	Evening	Night	Day	Evening	Night
RR1	49[1]	50[1]	44[1]	58[6]	44[6]	43[6]
RR2	40[2]	43[2]	41[2]	60[6]	50[6]	39[6]
RR3	51[3]	53[3]	49[3]	57[6]	44[6]	43[6]
RR4	48[4]	46[4]	44[4]	59[6]	43[6]	38[6]
CC1 [5]	60	-	-	-	-	-
IR1	-	-	-	70	70	70
IR2	-	-	-	70	70	70
IR3	-	-	-	70	70	70

Note 1: Based on measured background at NM1 - Mandalong Close

Note 2: Based on measured background at NM2 - Catholic Village

Note 3: Based on measured background at NM3 - Lenore Drive

Note 4: Based on measured background at NM3 - Verdi Glenn

Note 5: The INP and Australian Standard AS/NZS 2107:2000 'Acoustics - Recommended design sound levels and reverberation times for building interiors' do not provide guideline values for internal noise levels in childcare centres. The Association of Australian Acoustical Consultants has a Technical Guideline - Child Care Centre Noise Assessment and this recommends an internal level of 40 dBA for playing and sleeping areas. The intrusive criterion is based on the 40 dBA internal noise level and an external to internal noise reduction (fixed non-openable windows) of 20 dBA).

Note 6: The amenity criteria are based on an Urban noise amenity area corrected to account for existing industrial levels. (As a conservative approach, it was assumed that the ambient L_{Aeq} measured were dominated by the Erskine Business Park activities).

The overall noise criterion for noise emissions from the site is generally the lower of the intrusive and amenity criteria. Note that the intrusive criterion is applicable over any 15 minute period whereas the amenity level is applicable over the whole daytime, evening or night-time period, as appropriate.

5 ROAD TRANSPORTATION NOISE ASSESSMENT PROCEDURE

Whilst operating on the project site, the assessment procedure for vehicle noise is as previously outlined in **Section 4**. That is, road vehicle noise contributions are included in the overall predicted operational noise emissions. On public roads, different noise assessment criteria apply to the vehicles, which would be regarded as "traffic", rather than as part of the proposed Development operations noise sources.

For traffic operating on public roads, the NSW Government's *Road Noise Policy* (RNP) (DECCW, 2011) is appropriate for assessing potential road traffic noise impacts.

The RNP identifies strategies that address the issue of road traffic noise from:

- Existing roads;
- New road projects;
- Road redevelopment projects; and
- New traffic-generating developments.

The RNP noise criteria aim to protect amenity inside and immediately around permanent residences, schools, hospitals and other sensitive land uses, rather than at all points in a given locality, which would not be practical or possible. Although it is not mandatory to achieve the noise assessment criteria in the RNP, project proponents need to provide justification if it is not considered feasible or reasonable to achieve them.

The guideline recognises that there are generally more opportunities to minimise noise impacts from new roads and road corridors, especially those in greenfield locations, through judicious road design and land use planning. The scope to reduce noise impacts from existing roads and corridors is more limited.

Mamre Road, Erskine Park Road and Lenore Drive are approved heavy vehicles routes for up to 26 m B-Double vehicles as stated in the traffic report. Those roads convey traffic to the M4 Western Motorway and Westlink M7.

Based on the above, the relevant assessment criteria for the proposed Erskine Park Transfer Station traffic are presented in **Table 15** and **Table 16** for Residential Land Uses and other non-residential land uses respectively.

Table 15 Road Traffic Noise Criteria for Residential Land Uses

Road Category	Land Use	Assessment Criteria	
		Day 7.00 am - 10.00 pm (dBA)	Night 10.00 pm - 7.00 am (dBA)
Freeway/Arteria/Sub-Arterial Roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hour)}$ 60 dBA (external)	$L_{Aeq(9hour)}$ 55 dBA (external)

Table 16 Road Traffic Noise Assessment Criteria for Non-Residential Land Uses Affected by Proposed Road Projects and Traffic Generating Developments

Existing Sensitive Land Use	Assessment Criteria		Additional Considerations
	Day 7.00 am - 10.00 pm (dBA)	Night 10.00 pm - 7.00 am (dBA)	
8. Childcare facilities	Sleeping rooms LAeq(1hour) 35 (Internal) Indoor Play Areas (LAeq(1hour) 40 (Internal Outdoor Play Areas LAeq(1hour) 55 (External)	-	Multi-purpose spaces, e.g. shared indoor play/sleeping rooms should meet the lower of the respective criteria. Measurements for sleeping rooms should be taken during designated sleeping times for the facility, or if these are not known, during the highest hourly traffic noise level during the opening hours of the facility.

Note that where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria. A secondary objective is to protect against excessive decreases in amenity as the result of a project by applying the relative increase criteria.

The RNP describes a minor impact to be an increase of up to 2 dB, which is considered to be a barely perceptible change to the average person. A 2 dB increase can be achieved when the project related percentage increase in existing light and heavy vehicle movements is less than 60%.

6 CONSTRUCTION AND OPERATIONAL NOISE ASSESSMENT

6.1 Prediction of Noise Emissions - General Discussion

In order to determine the acoustical impact of the Development during construction and operations on the surrounding community, a computer model was developed which incorporates the significant noise sources and the intervening terrain to the closest potentially affected receivers.

The computer model was prepared using the SoundPLAN V7.1 Industrial Module, a commercial software system developed by Braunstein and Berndt GmbH in Germany. The software allows the use of various internationally recognised noise prediction algorithms. The CONCAWE algorithm, suitable for the assessment of large industrial plants, has been selected for this assessment as it also enables meteorological influences to be assessed.

The noise modelling takes into account source sound level emissions and locations, screening effects, receiver locations, meteorological effects, ground topography and noise attenuation due to spherical spreading and atmospheric absorption.

Noise predictions were calculated at all sensitive receivers described in **Section 1.1**.

6.2 Prediction of Noise Emissions - Construction

6.2.1 Construction Scenarios

In order to assess the potential noise impacts during demolition and construction works, a number of scenarios comprising typical plant and equipment frequently used on similar sites have been developed based on our understanding of the project. These scenarios are considered to be representative of the noisiest demolition and construction activities that will happen on site and are summarised in **Table 17**.

Table 17 Construction Scenarios and Corresponding Equipment

Scenario	Description	Equipment	Number of unit
Sc 1	Demolition of existing buildings	Dump truck	1
		30t excavator	1
		FEL	1
		Grader	1
Sc 2	Site preparation - Earthworks	30t excavator	1
		Excavator breaker	1
		Dump truck	1
		Dozer	2
		Water cart	1
		Vibratory Roller	1
		Grader	1
Sc 3	Transfer Station Building Construction	Delivery truck	1
		Dump truck	1
		Crane	2
		Concrete pump	1
		Concrete truck	2
		Backhoe	2
		30t excavator	2

Scenario	Description	Equipment	Number of unit
Sc 4	Services, water, sewer, electricity, stormwater installation	30t excavator	2
		Backhoe	2
		Delivery truck	1
		Dump truck	1
		Compactors	2
Sc 5	External paving	Delivery truck	1
		Concrete pump	1
		Concrete truck	2

6.2.2 Demolition and Construction Equipment Sound Power Levels

Typical maximum Sound Power Levels (SWLs) of construction plant are shown in **Table 18**. Those SWLs are maximum noise emission levels of plant that will or may be used on this project in typical operation.

Table 18 Construction Plant and Equipment Sound Power Levels (SWLs)

Plant Item	SWL (Maximum L_{Aeq} 15 min) dBA	Duty Factor (minutes operating per 15 minute period)
Backhoe	101	15
Compactor	108	15
Concrete Pump	106	15
Concrete Truck	106	15
Crane	104	15
Delivery truck	105	5
Dozer D8	110	15
Dump Truck (25 t)	108	15
Excavator - breaker	121	7.5
Excavator - 30 t	104	15
FEL	112	15
Grader	108	15
Vibratory Roller (10-12 tonne) [1]	109	15
Water cart	98	15

Note 1: The SWLs include a 5 dB penalty to account for the impulsive nature of the source.

In accordance with the ICNG, activities identified as being particularly annoying attract a 5 dBA "annoyance penalty". Activities and associated plant operations which contain potential tonal, impulsive, intermittent and/or low frequency noise characteristics would typically be identified as being annoying. The SLR database of SWLs for construction equipment accounts for this "annoyance penalty".

The duty factor represents the likely amount of time that a particular piece of equipment would be operating in any 15 minute period. This takes account of the fact that in a 15 minute period all the equipment will not be used simultaneously.

It should be noted that the sound power levels given for each item of mobile equipment do not include noise emissions which emanate from reversing alarms. In the event that reversing alarm noise is considered to be a source of disturbance, the alarm noise level should be checked against the appropriate regulatory and health and safety requirements and the necessary mitigating action taken in order to achieve an acceptable noise reduction without compromising safety standards.

6.2.3 Noise Impact Assessment - Construction

Predicted noise levels for all scenarios listed in **Table 17** are presented in **Table 19** together with the relevant $L_{Aeq(15minute)}$ construction noise management levels (NMLs) for each noise assessment location. A daytime $L_{Aeq(15minute)}$ noise contour diagram for the 'worst-case' construction scenario (Scenario 2) is presented in **Appendix D1**.

Table 19 Predicted Daytime Construction Noise Levels - dBA re 20 µPa

Noise Assessment Location	Predicted $L_{Aeq(15minute)}$ Noise Level					Recommended Standard Hours NML
	Sc 1	Sc 2	Sc 3	Sc 4	Sc 5	
RR1	34	40	35	34	31	54
RR2	31	37	33	32	28	45
RR3	29	32	29	28	24	56
RR4	35	40	36	35	31	53
CC1	35	41	35	34	31	65
IR1	59	66	59	58	55	75
IR2	48	62	49	48	48	75
IR3	53	57	55	54	47	75

Discussion

Noise emissions from construction activities during daytime recommended Standard Hours are predicted to meet the $L_{Aeq(15minute)}$ NMLs at all receivers.

6.3 Prediction of Noise Emissions - Operations

6.3.1 Meteorological Parameters

The noise modelling meteorological parameters presented in **Table 20** are based on the meteorological conditions presented in **Section 4.1.3**.

Table 20 Operational Noise Modelling Meteorological Parameters

Season	Period	Air Temp	Relative Humidity	Wind Velocity	Temperature Gradient
Non-adverse Annual	Daytime	20°C	58%	0m/s	0°C/100m
Non-Adverse Annual	Evening	17°C	68%	0m/s	0°C/100m
Adverse Winter SW Wind	Evening	12°C	70%	3m/s SW	0°C/100m
Adverse Winter WSW Wind	Evening	12°C	70%	3m/s WSW	0°C/100m
Non-Adverse Annual	Night-time	14°C	81%	0m/s	0°C/100m
Adverse Winter WSW Wind	Night-time	9°C	80%	3m/s WSW	0°C/100m
Adverse Winter W Wind	Night-time	9°C	80%	3m/s W	0°C/100m
Adverse Winter SW Wind	Night-time	9°C	80%	3m/s SW	0°C/100m
Adverse Winter Temperature Inversion	Night-time	9°C	80%	0m/s	3°C/100m[1]

Note 1: Using INP default inversion parameter for non-arid areas

6.3.2 Hours of operation

The Development will be capable of operating 24 hours a day, seven days a week (subject to approval); however, the majority of truck movements to and from the site will be between 7.00 am and 5.00 pm and within approved operating hours.

6.3.3 Equipment Operating

The noise sources at the Erskine Park Transfer Station are as listed in **Table 21**.

Table 21 Operational Plant

Location	Equipment	Number of units
Transfer Station Building	Wheel Loader	1
Top of Transfer Station Building	Fan Outlet Model TS4S750A15M with Silencer	3

On site transports trucks

In accordance with the INP, trucks and cars travelling on the site access road are included in site noise emissions.

Trucks have been modelled travelling from the site entrance to the proposed Erskine Park Transfer Station site as well as light vehicles travelling to the car park. It is anticipated that the proposed Erskine Park Transfer Station site will have up to 10 employees. It has been assumed that 100% of the employees will arrive or leave site with their own car.

6.3.4 Equipment Sound Power Levels

The sound power levels (SWLs) listed in **Table 22**, have been adopted for this study.

Table 22 Equipment Plant and Associated Sound Power Levels

Equipment	L_{Aeq} SWL (per unit)	L_{Amax} SWL (per unit)
CAT972 Wheel Loader	112 dBA	120 dBA
CAT318D Material Handler	104 dBA	110 dBA
Fan Outlet Model TS4S750A15M	105 dBA	-
Fan Outlet Model TS4S750A15M with Silencer	94 dBA	-
SSI Compactor and Power Unit	112 dBA	112 dBA
On site car	98 dBA	101 dBA
On site refuse collection truck	108 dBA	113 dBA
On site transfer truck	111 dBA	116 dBA
Truck reversing alarm[1]	110 dBA	110 dBA
Brakes	-	120 dBA

Note 1: Typical truck reversing alarm is 105 dBA - 115 dBA and for the purpose of this assessment is assumed to be 110 dBA. It has also been assumed that reversing alarms used on site will have a broadband spectrum and will not be tonal.

6.3.5 Operational Scenarios Modelled

Based on **Table 2**, the following worse case operational scenarios were modelled with reference to **Table 20**:

- Erskine Park Transfer Operations - Daytime - Non-Adverse Annual
- Erskine Park Transfer Operations - Night-time - Non-Adverse Annual
- Erskine Park Transfer Operations - Night-time - Adverse Winter SW Wind
- Erskine Park Transfer Operations - Night-time - Adverse Winter WSW Wind
- Erskine Park Transfer Operations - Night-time - Adverse Winter Temperature Inversion

The operational scenario modelled for this assessment comprised the concurrent operations presented in **Table 23**. The assessment against the intrusiveness criteria was based on the worst case traffic scenarios presented in **Table 2** ie 12.00 pm - 1.00 pm period during the day and the 5.00 am - 6.00 am period at night. The assessment againdst the amenity criteria is based on the total number of truck movements over the day and night time periods as presented in **Table 2**.

Table 23 Operational Scenarios and Equipment Operating

Criteria	Operational Scenarios	Period of Day/Weather	Equipment operating	On Site traffic
Intrusive[0]	1	Daytime Non-Adverse Annual	Transfer station building with loader and material handler operating inside, 3x fans fitted with silencer, compactor operational in tunnel	Up to 33 refuse collection trucks entering and leaving site / 1 hour corresponding to up to 8 refuse collection trucks entering and leaving site / 15 minutes[1] Up to 2 transfer truck entering and leaving site / 1 hour corresponding to up to 1 transfer truck entering and leaving site / 15 minutes[1]
	2	Night-time Non-Adverse Annual	Transfer station building with loader and material handler operating inside, 3x fans fitted with silencer	Up to 21 refuse collection trucks entering and leaving site / 1 hour corresponding to up to 5 refuse collection trucks entering and leaving site / 15 minutes[2] Up to 1 transfer truck entering and leaving site / 1 hour corresponding to up to 1 transfer truck entering and leaving site / 15 minutes[2]
	3	Night-time Adverse Summer SSW Wind		
	4	Night-time Adverse Winter WSW Wind		
	5	Night-time Adverse Winter Temperature Inversion		
Amenity[0]	6	Daytime Non-Adverse Annual	Transfer station building with loader and material handler operating inside, 3x fans fitted with silencer, compactor operational in tunnel	Up to 161 refuse collection trucks entering and leaving site / 11 hour[3] Up to 20 transfer truck entering and leaving site / 11 hour[3] Up to 10 cars entering and leaving site / 11 hour
	7	Night-time Non-Adverse Annual	Transfer station building with loader and material handler operating inside, 3x fans fitted with silencer	Up to 39 refuse collection trucks entering and leaving site / 9 hour[3] Up to 9 transfer truck entering and leaving site / 9 hour[3] Up to 10 cars entering and leaving site / 9 hour[3]
	8	Night-time Adverse Summer SSW Wind		
	9	Night-time Adverse Winter WSW Wind		
	10	Night-time Adverse Winter Temperature Inversion		

Note 0: The intrusive criterion is applicable over any 15 minute period whereas the amenity level is applicable over the whole daytime, evening or night-time period, as appropriate.

Note 1: Refer to **Table 2**, Hours ending at 1.00 pm.

Note 2: Refer to **Table 2**, Hours ending at 6.00 am.

Note 3: Refer to **Table 2**

Within the noise model, operations consisted of all plant items operating concurrently in order to simulate the overall maximum potential noise emission.

6.3.6 Noise Impact Assessment - Operations

Predicted noise level contributions from the 'worst case' proposed operations of the Erskine Park Transfer Station together with the respective criteria at the assessment locations are presented in **Table 24** and **Table 25.** Predicted $LA_1(_{1minute})$ noise level contributions to assess sleep disturbance are presented in **Table 26** together with the respective criteria at the residential locations.

Table 24 Predicted INTRUSIVE Erskine Park Transfer Station Operations $L_{Aeq(15minute)}$ Noise Levels - dBA re 20 µPa

Receivers	Predicted INTRUSIVE $L_{Aeq(15minute)}$ Noise Level					INTRUSIVE $L_{Aeq(15minute)}$ Noise Criteria	
	Sc 1 Daytime Non-Adverse Annual	Sc 2 Night-time Non-Adverse Annual	Sc 3 Night-time Adverse Winter SW Wind	Sc 4 Night-time Adverse Winter WSW Wind	Sc 5 Night-time Adverse Winter Temp. Inversion	Daytime	Night-time
NM1	35	34	28	28	38	49	44
NM2	30	29	26	31	34	40	41
NM3	29	28	33	33	33	51	49
NM4	37	36	41	40	40	48	44
CC1[1]	35	34	29	28	38	60	NA
IR1[1]	62	60	61	60	61	NA	NA
IR2[1]	54	53	51	51	55	NA	NA
IR3[1]	53	52	51	52	53	NA	NA

Table 25 Predicted AMENITY Erskine Park Transfer Station Operations $L_{Aeq(period)}$ Noise Levels - dBA re 20 µPa

Receivers	Predicted AMENITY $L_{Aeq(15minute)}$ Noise Level					AMENITY $L_{Aeq(Period)}$ Noise Criteria	
	Sc 6 Daytime Non-Adverse Annual	Sc 7 Night-time Non-Adverse Annual	Sc 8 Night-time Adverse Winter SW Wind	Sc 9 Night-time Adverse Winter WSW Wind	Sc 10 Night-time Adverse Winter Temp. Inversion	Daytime (11 Hours)	Night-time (9 Hours)
NM1	33	31	26	25	34	58	43
NM2	29	26	24	28	31	60	39
NM3	28	26	31	31	30	57	43
NM4	36	33	38	37	37	59	38
CC1[1]	33	31	26	26	35	NA	NA
IR1[1]	60	57	57	57	58	70	70
IR2[1]	53	51	49	49	52	70	70
IR3[1]	52	50	50	50	51	70	70

Table 26 Predicted Erskine Park Transfer Station Operations $L_{A1(1minute)}$ - Sleep Disturbance - dBA re 20 µPa

Receivers	Predicted $L_{A1(1minute)}$ Noise Level				$L_{A1(1minute)}$ Sleep Disturbance Criteria
	Night-time Non-Adverse Annual	Night-time Adverse Summer SSW Wind	Night-time Adverse Winter WSW Wind	Night-time Adverse Winter Temperature Inversion	Night-time
NM1	42	36	35	46	54
NM2	38	31	35	43	51
NM3	32	37	37	36	59
NM4	42	47	46	46	54
CC1[1]	N/A	N/A	N/A	N/A	N/A
IR1[1]	N/A	N/A	N/A	N/A	N/A
IR2[1]	N/A	N/A	N/A	N/A	N/A
IR3[1]	N/A	N/A	N/A	N/A	N/A

Note 1: N/A - Sleep disturbance apply to residences only.

Discussion

Review of **Table 24** and **Table 25** indicates that the operational noise emissions from the proposed Erskine Park Transfer Station are predicted to be below or to meet the intrusive and amenity noise criteria at all of the noise assessment locations. Compliance is predicted for daytime, evening and night-time. $L_{Aeq(15minute)}$ noise contour diagrams for the daytime scenario and night-time worst case scenario (Adverse Winter Temperature Inversion) are presented in **Appendix D2** and **Appendix D3** respectively.

In relation to the potential for sleep disturbance, the EPA's INP Application Notes, as presented in **Section 4.1.5**, suggests that the $L_{A1(1minute)}$ noise level from any specific noise (ideally) should not exceed the L_{A90} background noise level by more than 15 dBA.

A review of noise events from the proposed Erskine Park Transfer Station operations (**Table 26**) shows that the $L_{A1(1minute)}$ noise levels comply with the EPA's sleep disturbance screening criterion.

It is noted whilst the sleep disturbance screening criteria is clearly met the reversing alarms might be audible. In the event that reversing alarm noise is considered to be a source of disturbance, the alarm noise level should be checked against the appropriate regulatory and health and safety requirements and the necessary mitigating action taken to achieve an acceptable noise reduction without compromising safety standards.

7 ROAD TRAFFIC NOISE ASSESSMENT

7.1 Prediction of Noise Emissions - General Discussion

In order to assess the potential impact of traffic noise at the sensitive receivers from the Development, noise level calculations were carried out using the UK Department of Transport, *"Calculation of Road Traffic Noise"* (CORTN 1988) algorithms. The modelling allows for traffic volume and mix, type of road surface, vehicle speed and ground absorption. The algorithm output of CORTN has been modified to calculate the relevant L_{Aeq} road traffic noise emission descriptors, as required.

The calculated noise levels are determined by taking into account overall traffic volumes, vehicle speed, percentage of heavy vehicles and the distance between roadway and the receiver and includes a 2.5 dBA facade reflection.

7.2 Traffic Noise Assessment

Traffic movements on Mamre Road, Erskine Park Road, Lenore Drive and traffic movements generated by the proposed Erskine Park Transfer Station have been sourced or estimated from Traffix.

7.2.1 Traffic Noise Assessment for Residential Land Uses

The estimated existing and additional traffic movements and the corresponding predicted noise level increase on Mamre Road, Erskine Park Road and Lenore Drive are presented in **Table 27** on an average daily basis.

Table 27 Estimated Average Daily Traffic Movements

Road	Time Period	Existing traffic (number of vehicles per period)			Additional Traffic generated by the Proposed Erskine Park Transfer Station (number of vehicles per period)			Total Cumulative Traffic (number of vehicles per period)			Predicted Noise Level Increase (dBA)
		Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	
Mamre Road [3] (North of Erskine Park Road)	Day (7.00 am to 10.00 pm)	10,734[1]	380[1]	11,114[1]	10[1]	181[1]	191[1]	10,744	561	11,305	0.4
	Night (10.00 pm to 7.00 am)	1,681[1]	60[1]	1,741[1]	10[1]	48[1]	58[1]	1,691	108	1,799	0.6
Mamre Road [3] (South of Erskine Park Road)	Day (7.00 am to 10.00 pm)	14,081[1]	893[1]	14,974[1]	10[1]	181[1]	191[1]	14,091	1,074	15,165	0.2
	Night (10.00 pm to 7.00 am)	2,206[1]	140[1]	2,346[1]	10[1]	48[1]	58[1]	2,216	188	2,404	0.4
Erskine Park Road [3] (East of Mamre Road)	Day (7.00 am to 10.00 pm)	8,002[1]	691[1]	8,693[1]	10[1]	181[1]	191[1]	8,012	872	8,884	0.4
	Night (10.00 pm to 7.00 am)	1,254[1]	108[1]	1,362[1]	10[1]	48[1]	58[1]	1,264	156	1,420	0.7
Lenore Drive [2, 3]	Day (7.00 am to 10.00 pm)	0	691	691	0	181	181	0	872	872	1.0
	Night (10.00 pm to 7.00 am)	0	108	108	0	48	48	0	156	156	1.6

Note 1: Source Traffic information provided by Traffix (Based on measured volumes and interpolation from measured volumes at relevant intersections and Traffic Report). It is also assumed that 100% of the employees will arrive or leave site with their own car.

Note 2: It is assumed as a worst case scenario that all trucks travelling on Erskine Road would travel on Lenore Drive.

Note 3: Posted speed on Mamre Road and Lenore Drive is 80 km/h, posted speed on Erskine Park Road is 70 km/h.

7.2.2 Traffic Noise Assessment for Non- Residential Land Uses (Childcare Centre)

The estimated existing and additional traffic movements and corresponding predicted noise level increase on Mamre Road are presented in **Table 28** on a peak hourly basis.

Table 28 Estimated Peak Hourly Traffic Movements - Mamre Road (South of Erskine Park Road)

Peak Period	Existing traffic (number of vehicles per period)			Additional Traffic generated by the Proposed Erskine Park Transfer Station (number of vehicles per period)			Total Cumulative Traffic (number of vehicles per period)			Predicted Noise Level Increase (dBA)
	Light	Heavy	Total	Light	Heavy	Total	Light	Heavy	Total	
Mamre Road's AM Peak [2] 7.00 am - 8.00 am	1,764[1]	139[1]	1,903[1]	10[1]	10[1]	10[1]	1,774	149	1,923	0.1
Mamre Road's PM Peak [2] 4.00 pm - 5.00 pm	1,505[1]	56[1]	1,561[1]	10[1]	6[1]	16[1]	1,515	62	1,577	0.1
Proposed Facility's daytime Peak 12.00 am - 1.00 pm	683[1]	43[1]	726[1]	0[1]	35[1]	35[1]	683	78	761	0.9

Note 1: Source Traffic information provided by Traffix (Based on measured volumes and interpolation from measured volumes at relevant intersections and Traffic Report).

Note 2: Posted speed on Mamre Road is 80 km/h.

7.2.3 Discussion

Predicted increase in noise levels in **Table 27** for residences located near Mamre Road, Erskine Park Road and Lenore Drive comply with the 2 dBA allowance criterion.

Predicted increase in noise levels in **Table 28** for the childcare centre located on Mamre Road comply with the 2 dBA allowance criterion. It is noted that the childcare is located approximately 100 m away from the road and predicted daytime noise levels with and without the proposed facility are 55.7 dBA and 56.6 dBA respectively. A standard building construction with no special acoustic treatment measures to the facade would typically attenuate noise by 20 dBA with the windows closed. 4 mm monolithic glass (Category 1 acoustic treatment of the DoP's *"Development Near Rail and Busy Roads – Interim Guideline"*) would typically attenuate noise by 24 dBA with the windows closed. Predicted LAeq(1hour) Internal Noise levels without the facility with a standard building construction are in the order of 36 dBA (1 dBA above the criteria). It is therefore anticipated that the childcare was built to account for the existing traffic.

8 CONCLUSION

Cleanaway are proposing to build and operate an enclosed Waste Transfer Station at 50 Quarry Road, Erskine Park, NSW. SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Cleanaway to undertake a noise assessment for the construction and operation (including traffic noise) of the proposed Erskine Park Transfer Station, for inclusion in their Environmental Assessment (EA).

The nature of the building, being an enclosed building incorporating concrete push walls and rapid acting roller shutter doors, contributes to the containment of noise within the building.

The results of the study are summarised in the following points:

- Ambient noise surveys were conducted and design criteria for construction and operational noise developed in accordance with the NSW INCG and the NSW EPA's Industrial Noise Policy. Goals were set for nearby residents and also set for the nearby childcare centre and industrial receivers.

- Noise emissions from construction activities during daytime recommended Standard Hours are predicted to meet the $L_{Aeq(15minute)}$ criteria at all receivers.
- Noise emissions from the operational activities from the proposed Erskine Park Transfer Station are predicted to be below or to meet the intrusive and amenity noise criteria at all of the noise assessment locations. Compliance is predicted for daytime, evening and night-time.
- Predicted $L_{A1(1minute)}$ noise levels comply with the EPA's sleep disturbance screening criterion.
- Changes to traffic noise levels as a result of the project are predicted to comply with the EPAs Road Noise Policy.

Appendix A

ACOUSTIC TERMINOLOGY

1. Sound Level or Noise Level

The terms "sound" and "noise" are almost interchangeable, except that in common usage "noise" is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is 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.

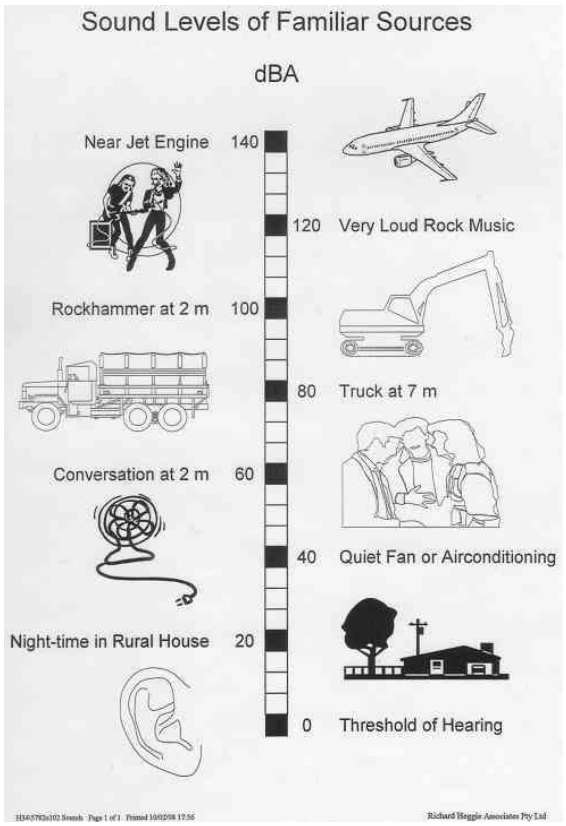
The symbols SPL, L or L_P are commonly used to represent Sound Pressure Level. The symbol L_A represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2 x 10^{-5} Pa.

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 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

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



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

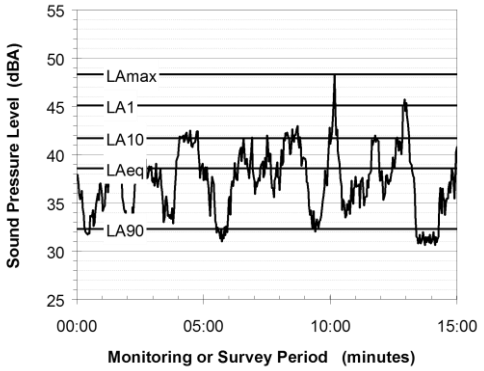
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or L_W, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure may be likened to 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 L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} 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:

L_{Amax} The maximum noise level during the 15 minute interval

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

L_{A10} The noise level exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

L_{A90} 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.

L_{Aeq} 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.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the "repeatable minimum" L_{A90} noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or "average" levels representative of the other descriptors (L_{Aeq}, L_{A10}, etc).

5. Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than "broad band" noise.

6. Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7. Frequency Analysis

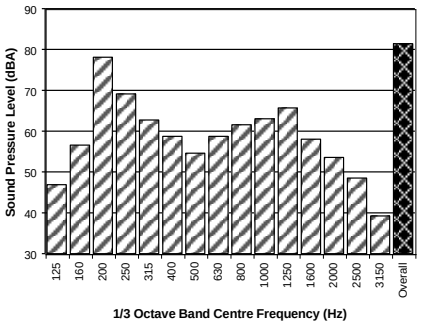
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

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 (3 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.



8. 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. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) 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/V_o), where V_o is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used by some organizations.

9. 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.

10. Over-Pressure

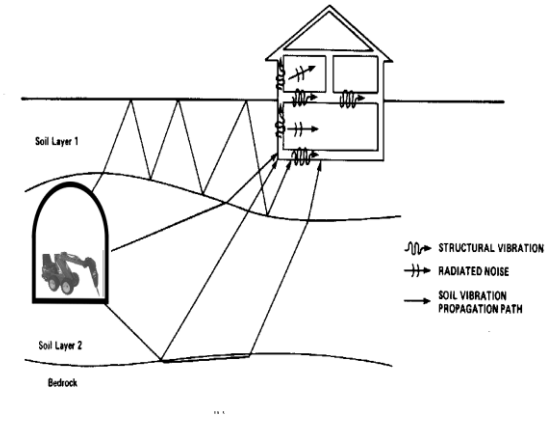
The term "over-pressure" is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11. 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).

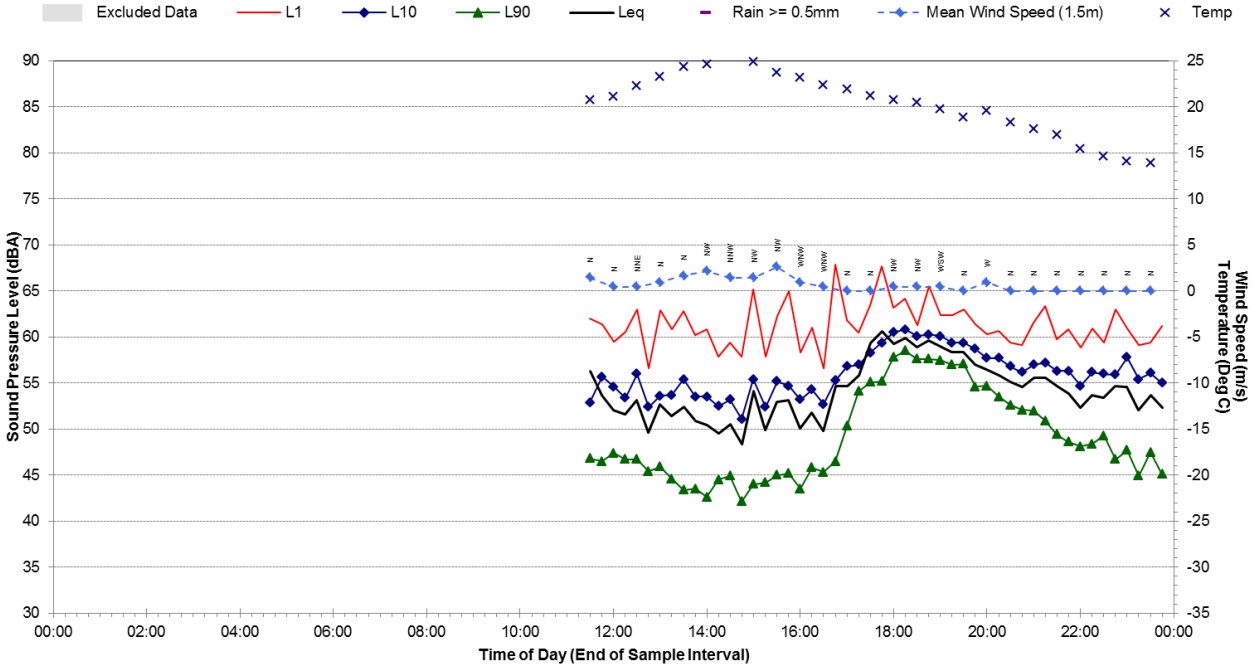
The following figure presents the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



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.

Statistical Ambient Noise Levels

NM1 - Mandalong Close - Friday, 24 April 2015



Statistical Ambient Noise Levels

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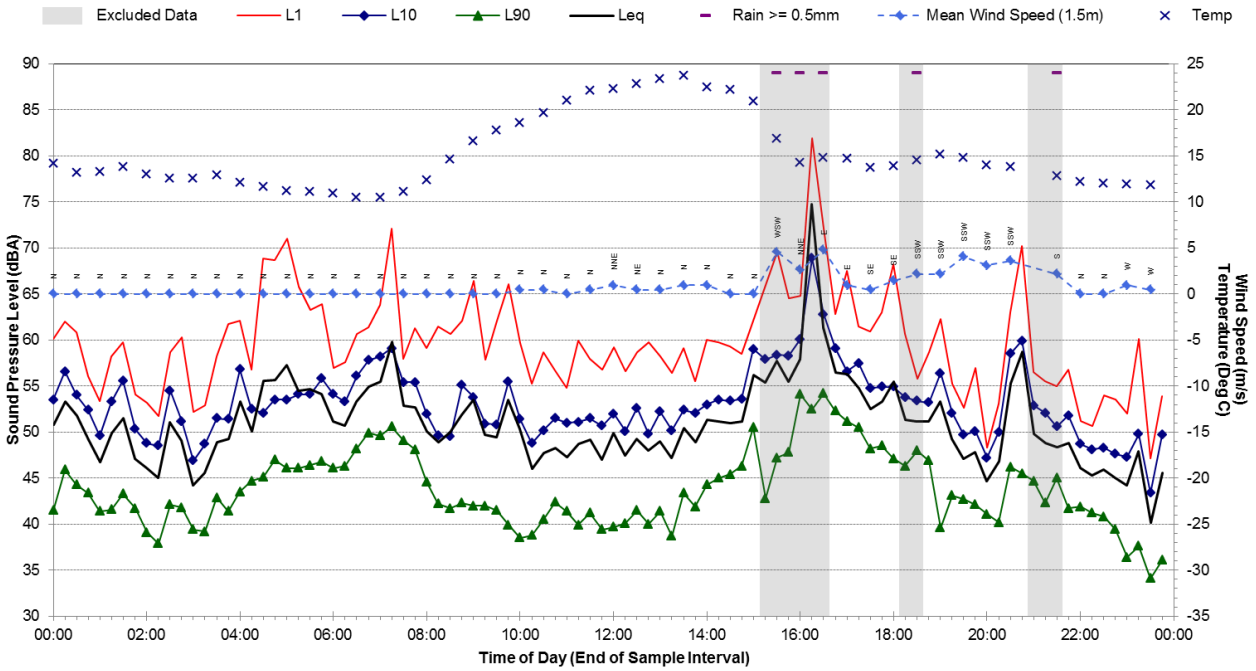

Statistical Ambient Noise Levels

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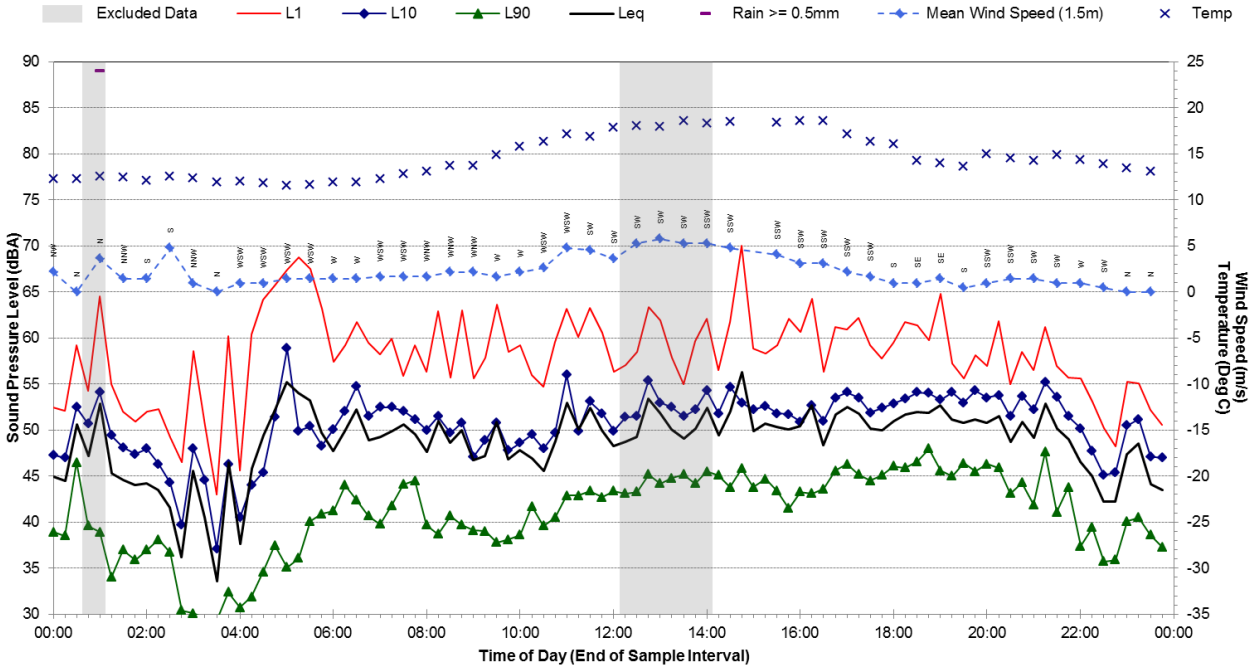

Statistical Ambient Noise Levels

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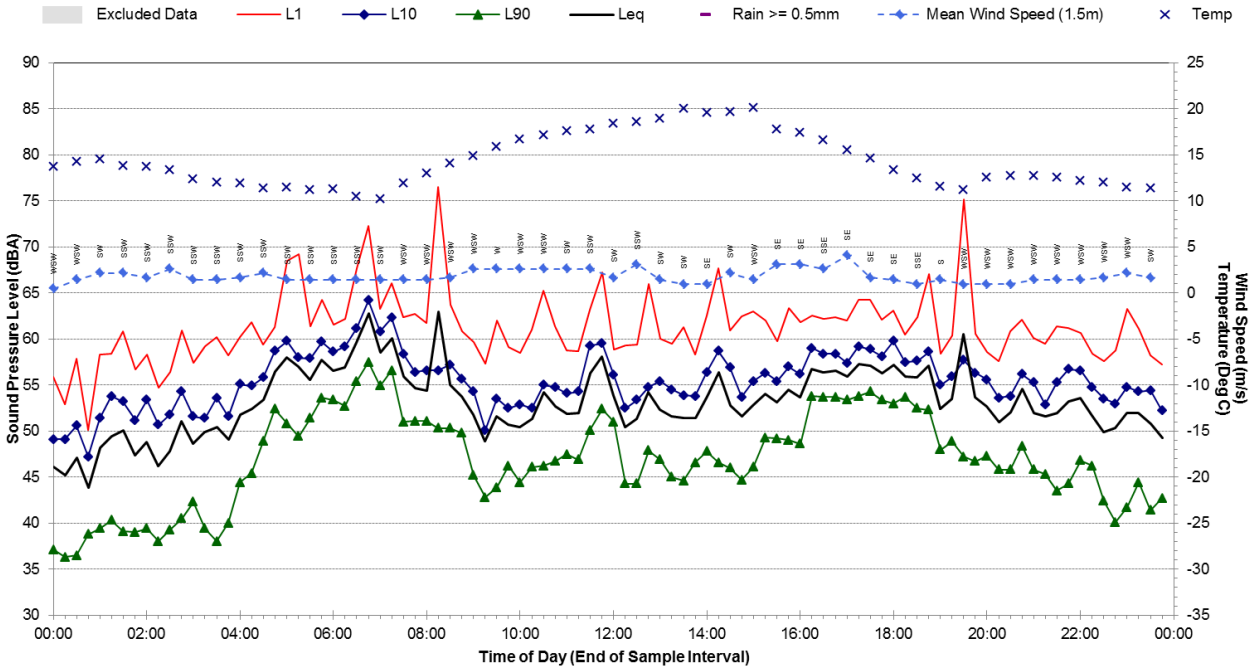

Statistical Ambient Noise Levels

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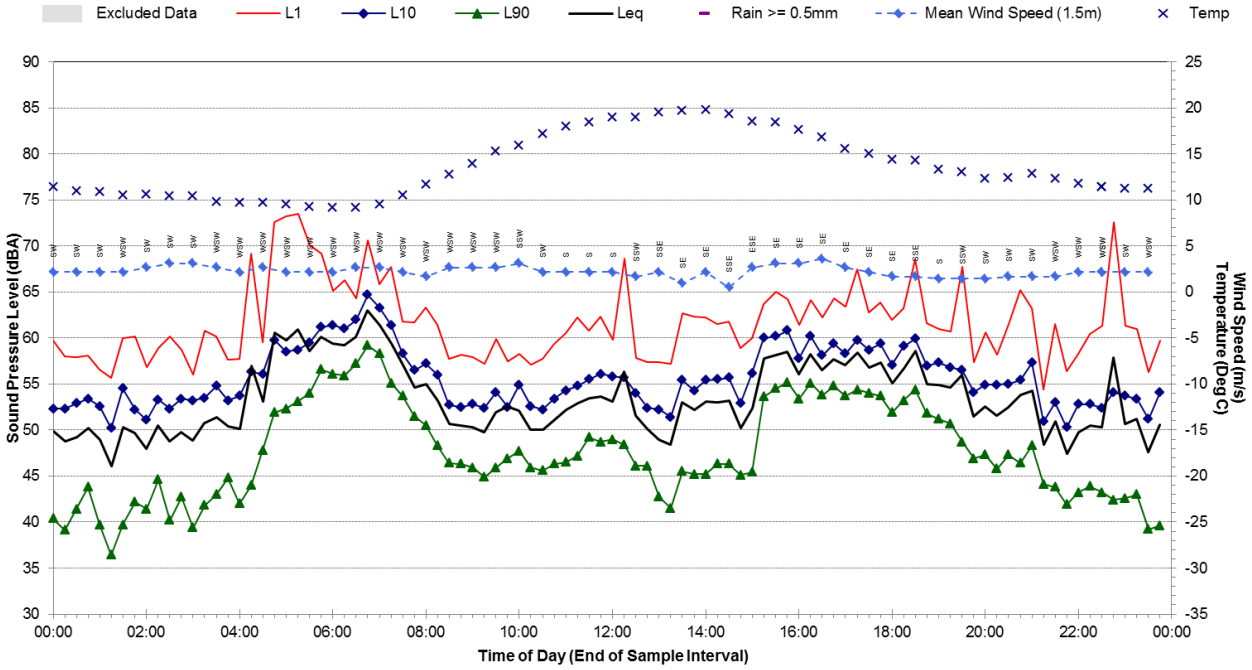

Statistical Ambient Noise Levels

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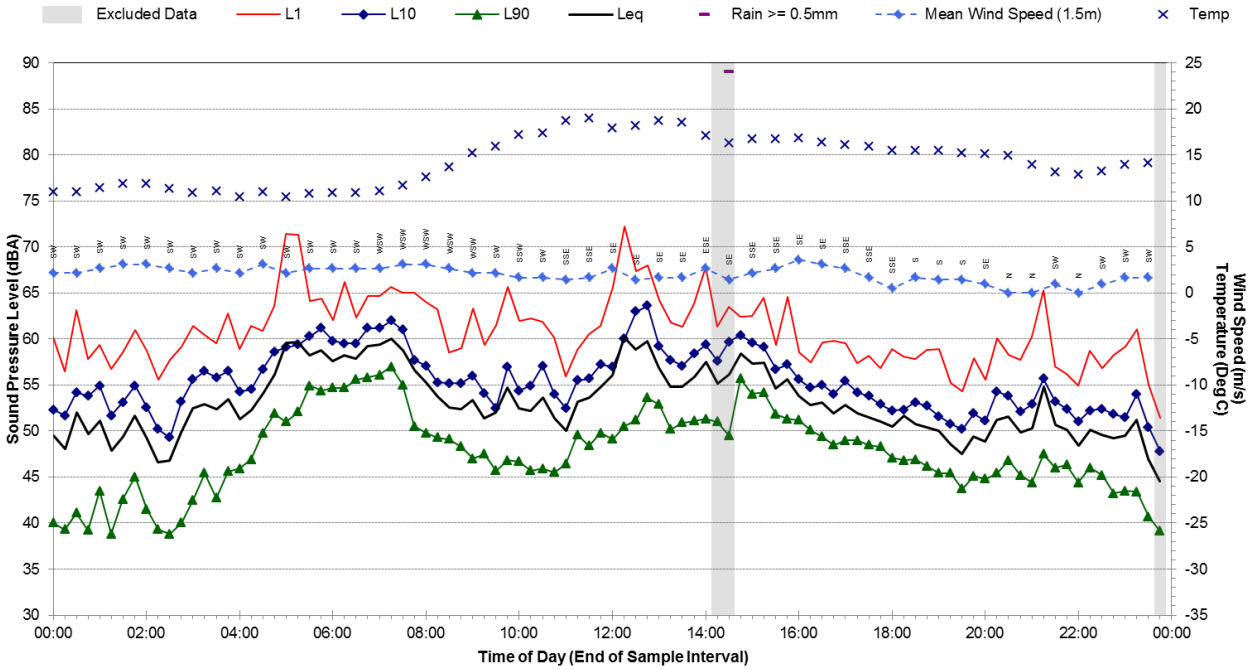

Statistical Ambient Noise Levels

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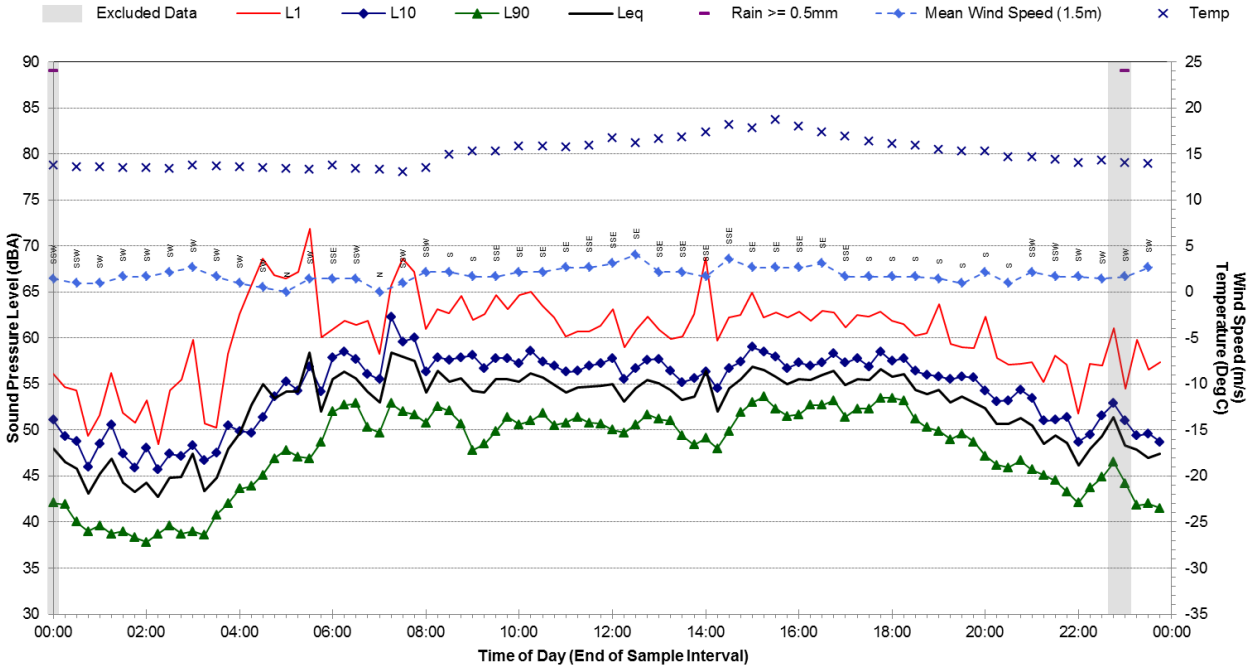

Statistical Ambient Noise Levels

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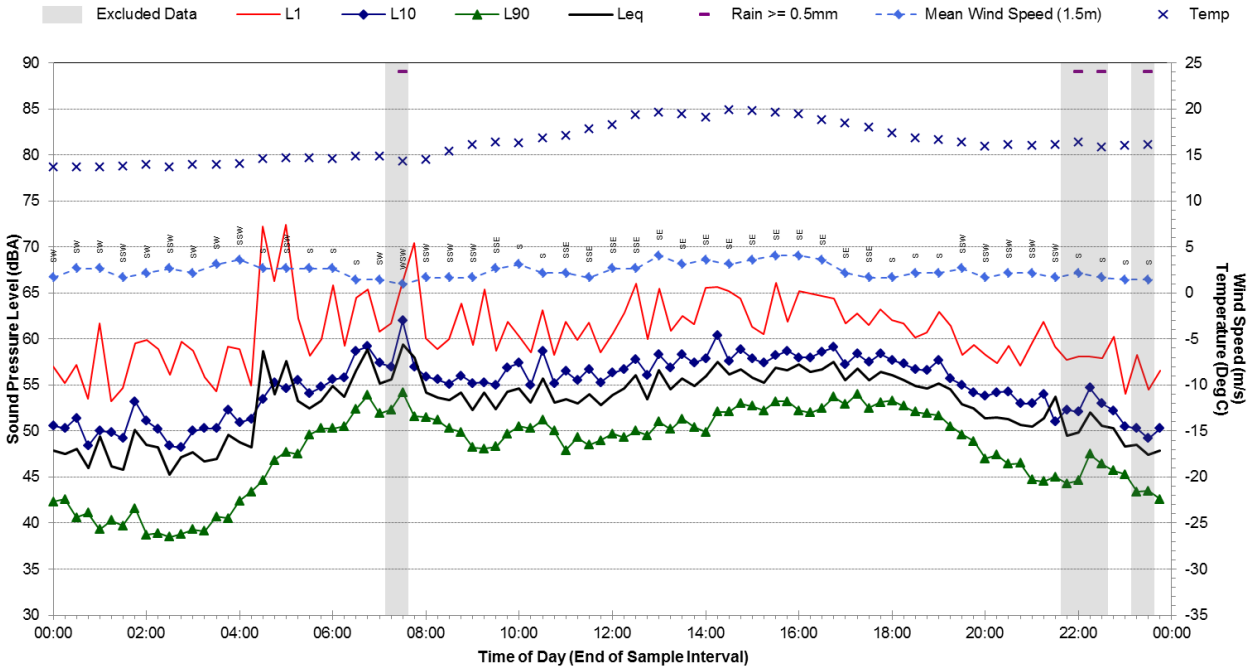

Statistical Ambient Noise Levels

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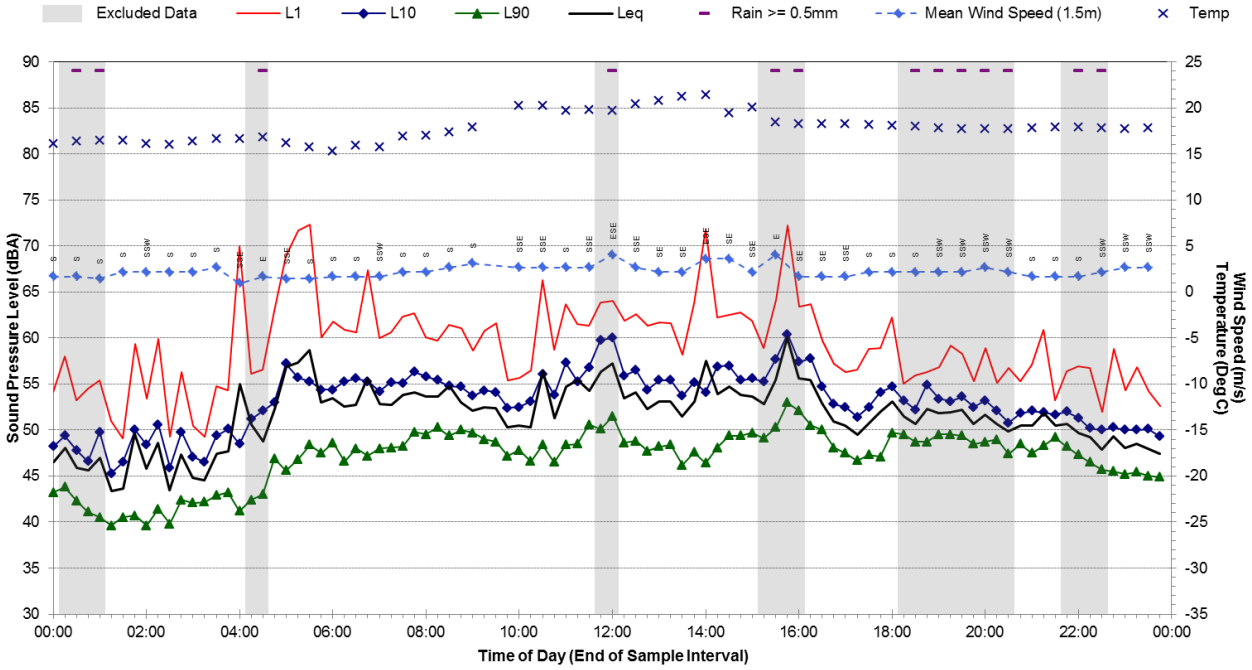

Statistical Ambient Noise Levels

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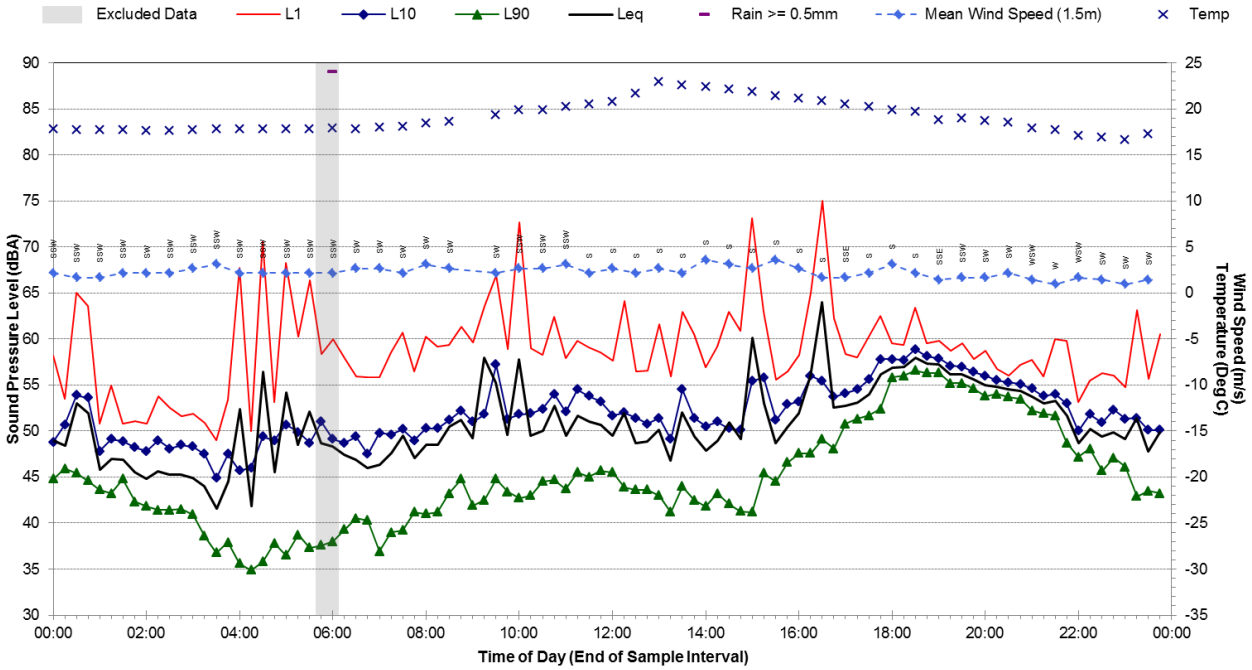

Statistical Ambient Noise Levels

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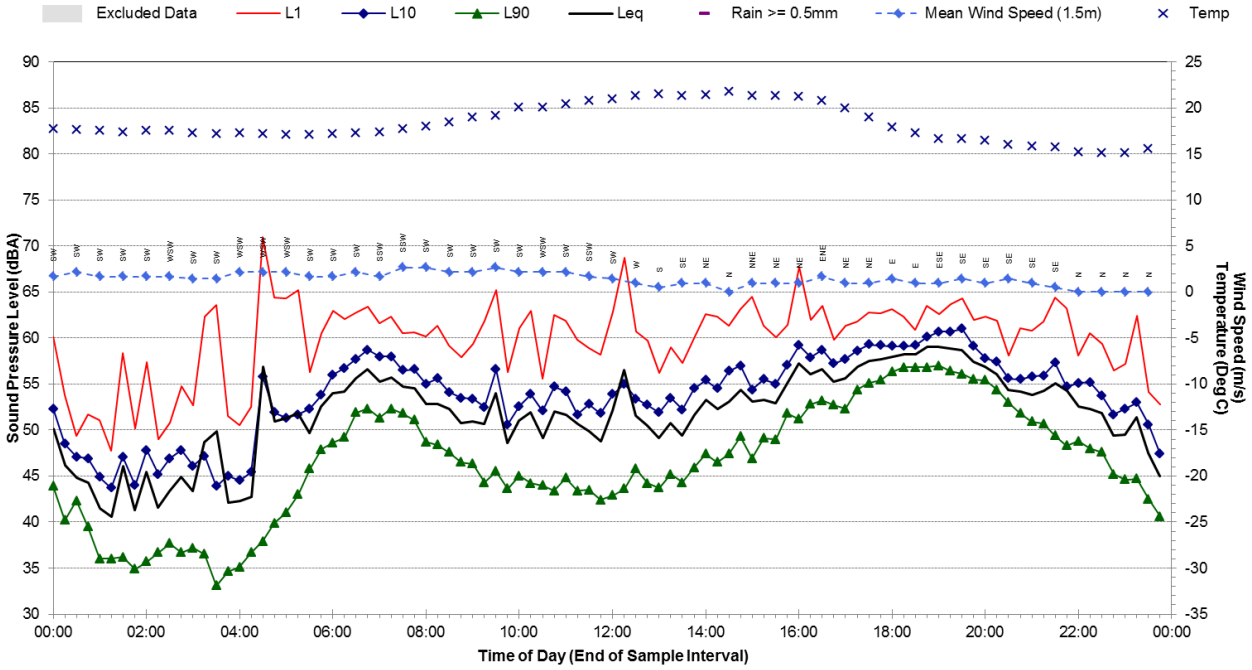

Statistical Ambient Noise Levels

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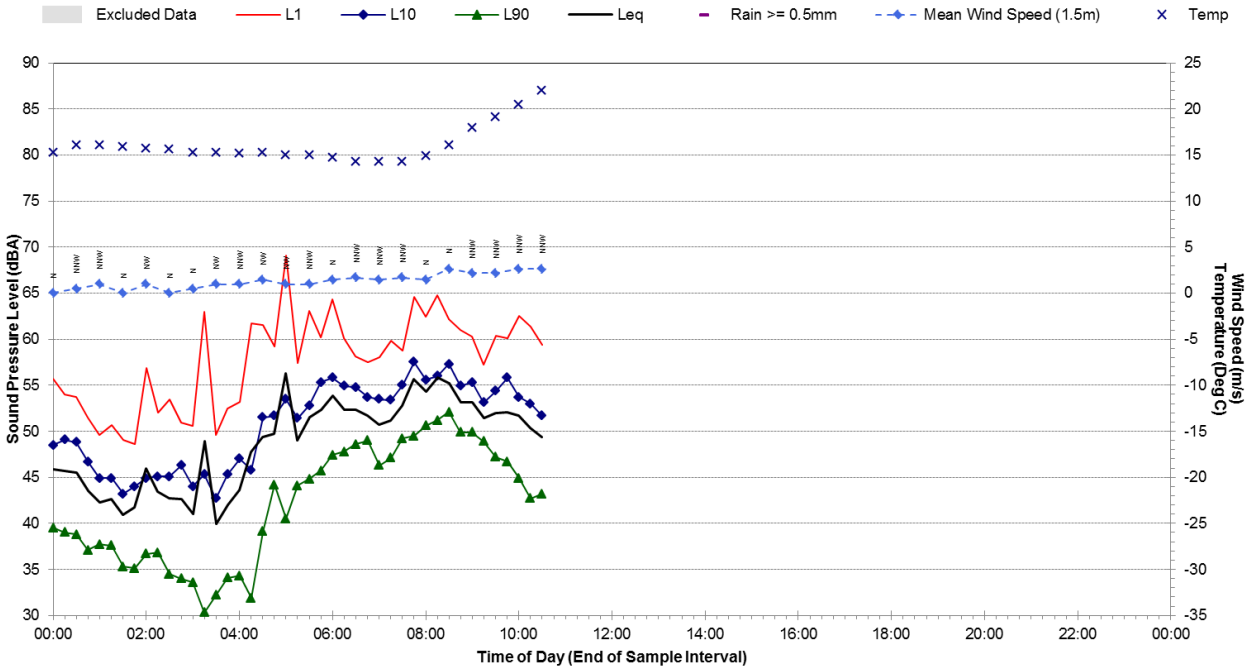

Statistical Ambient Noise Levels

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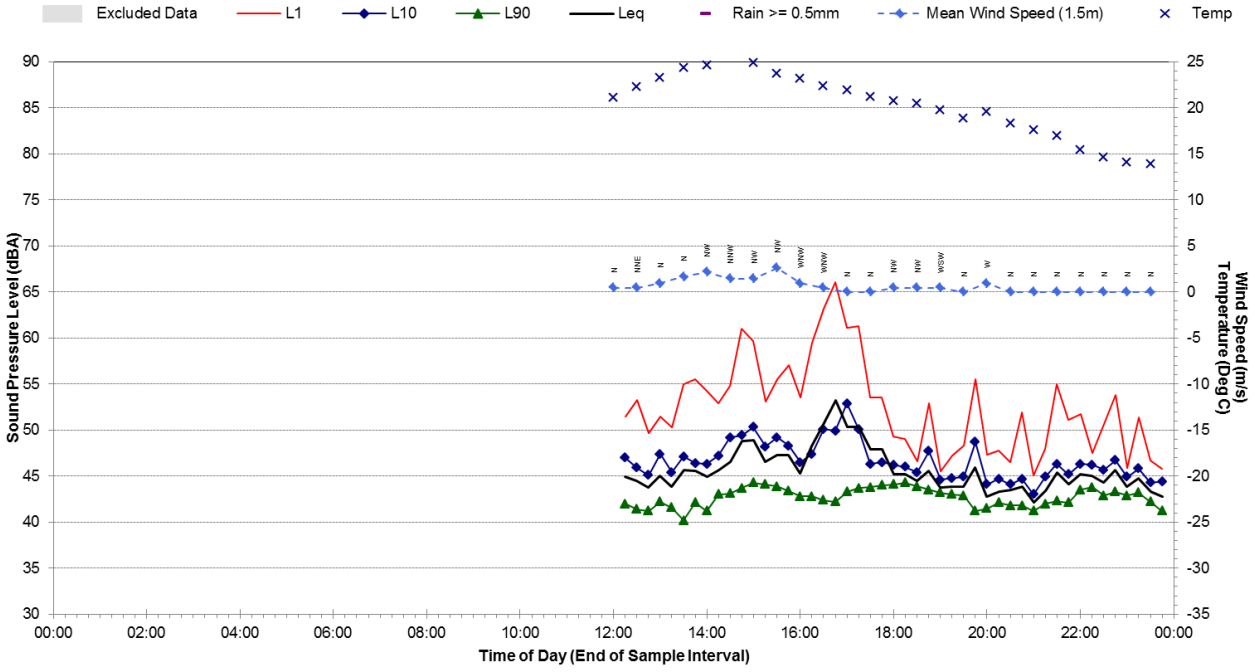

Statistical Ambient Noise Levels

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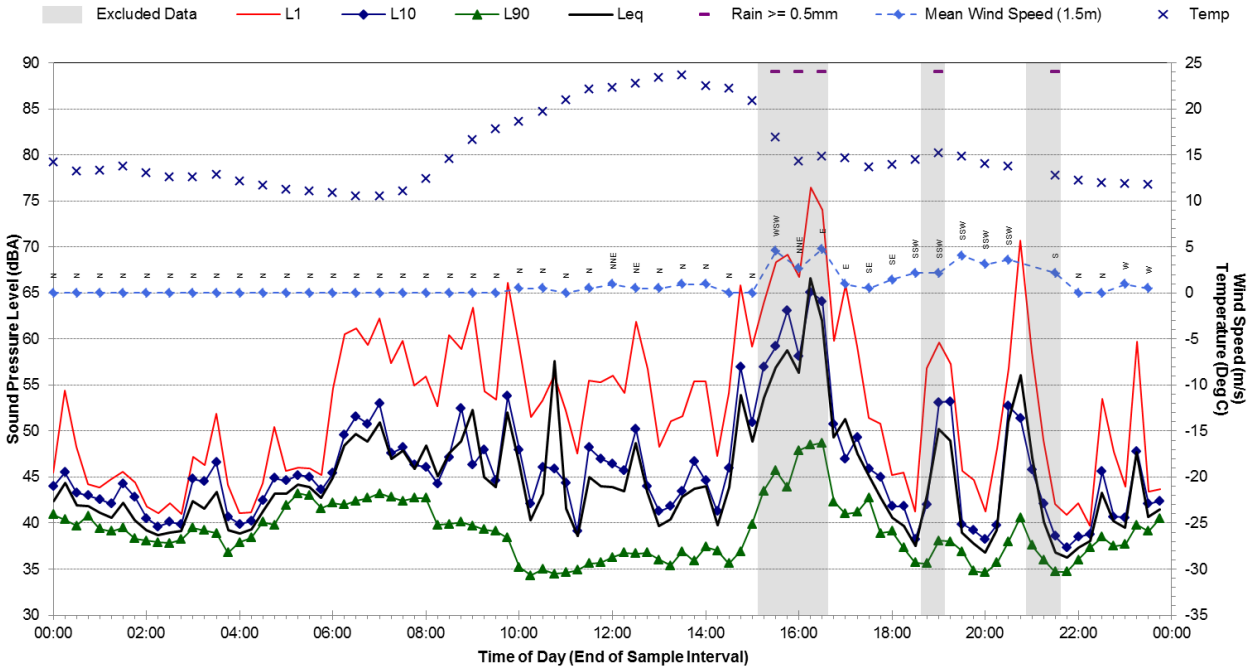

Statistical Ambient Noise Levels

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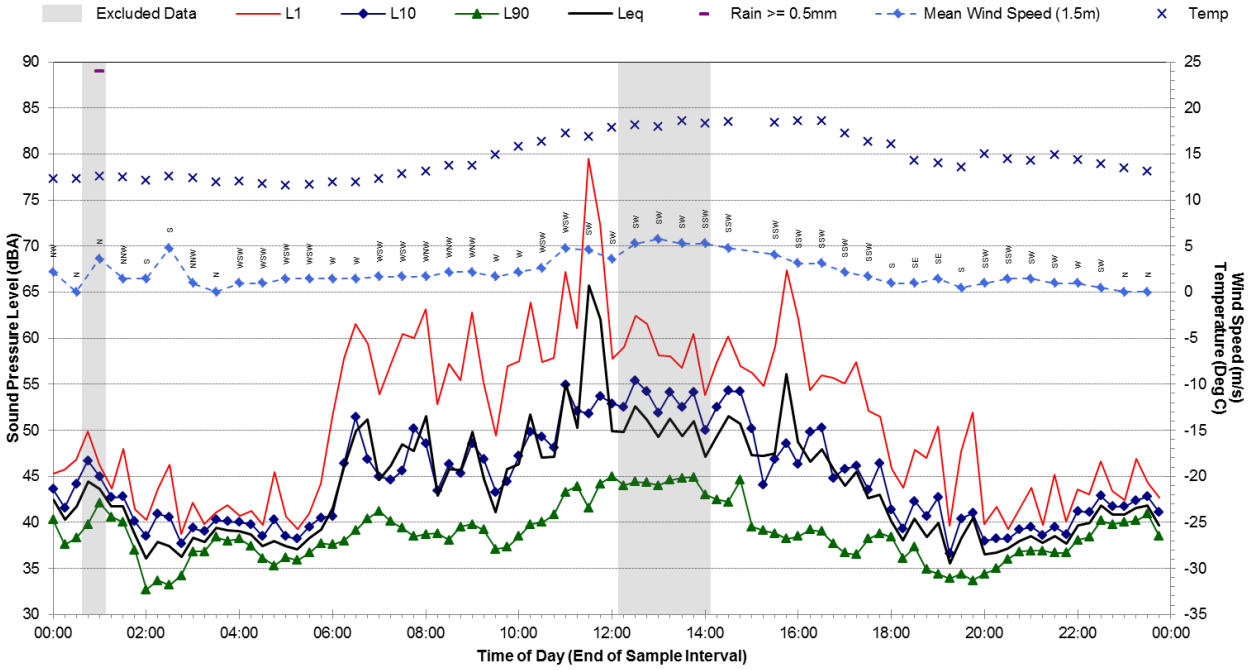

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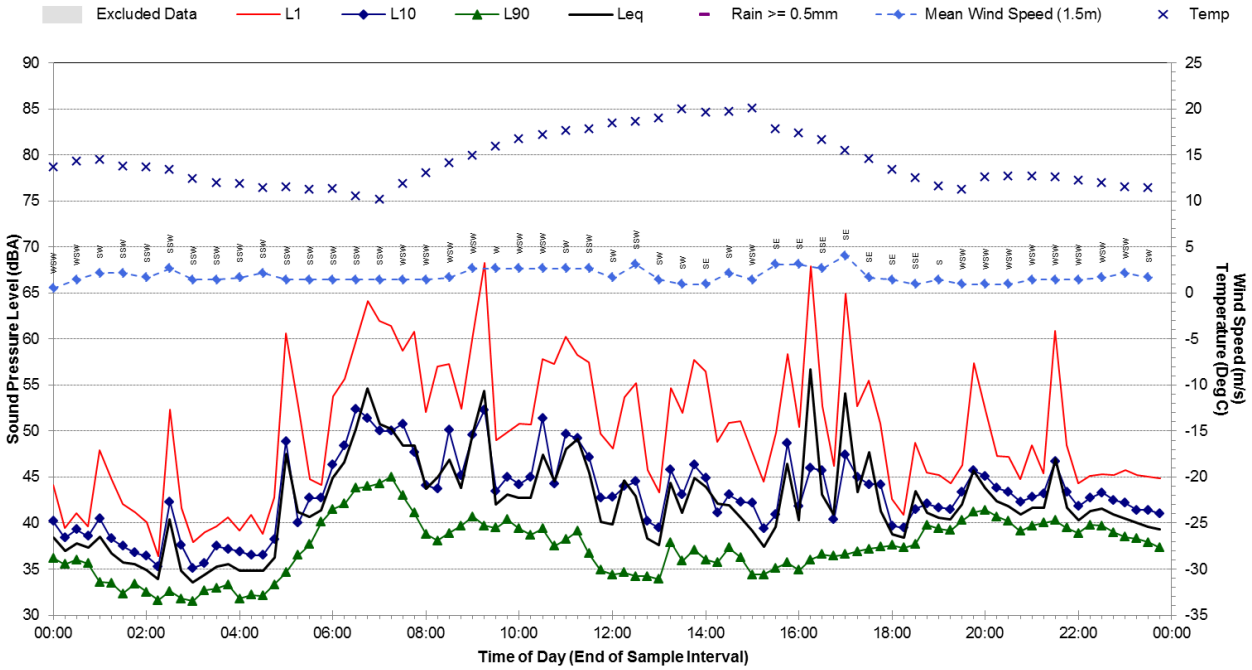

Statistical Ambient Noise Levels

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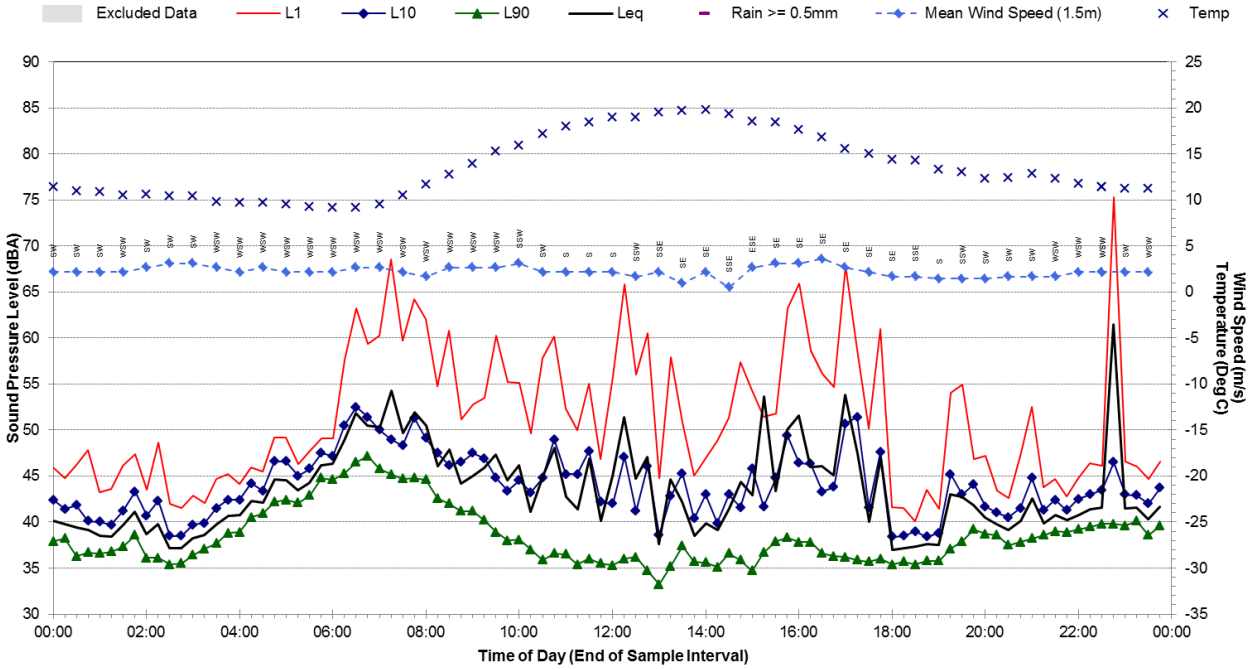

Statistical Ambient Noise Levels

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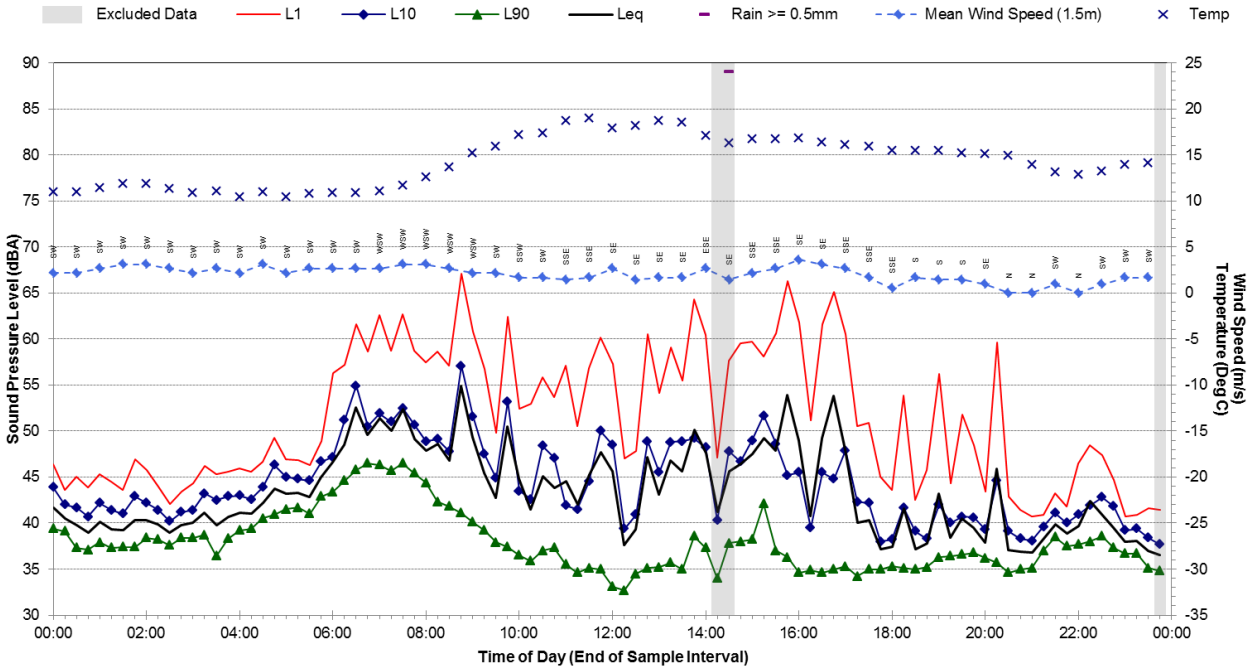

Statistical Ambient Noise Levels

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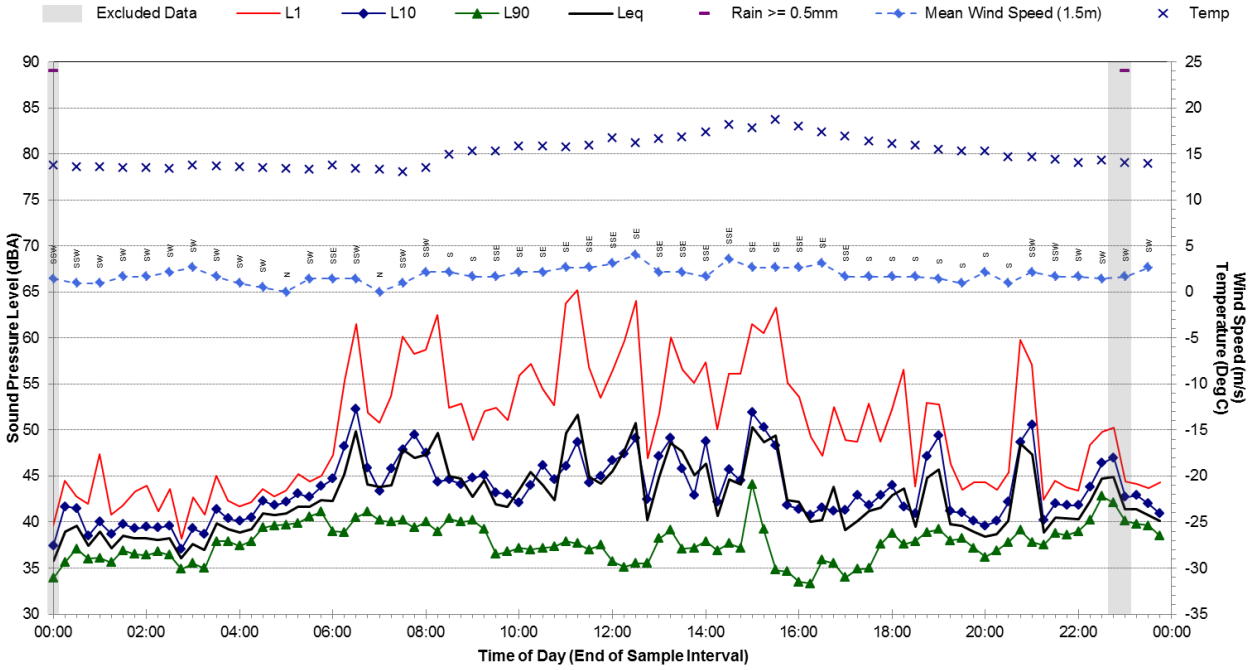

Statistical Ambient Noise Levels

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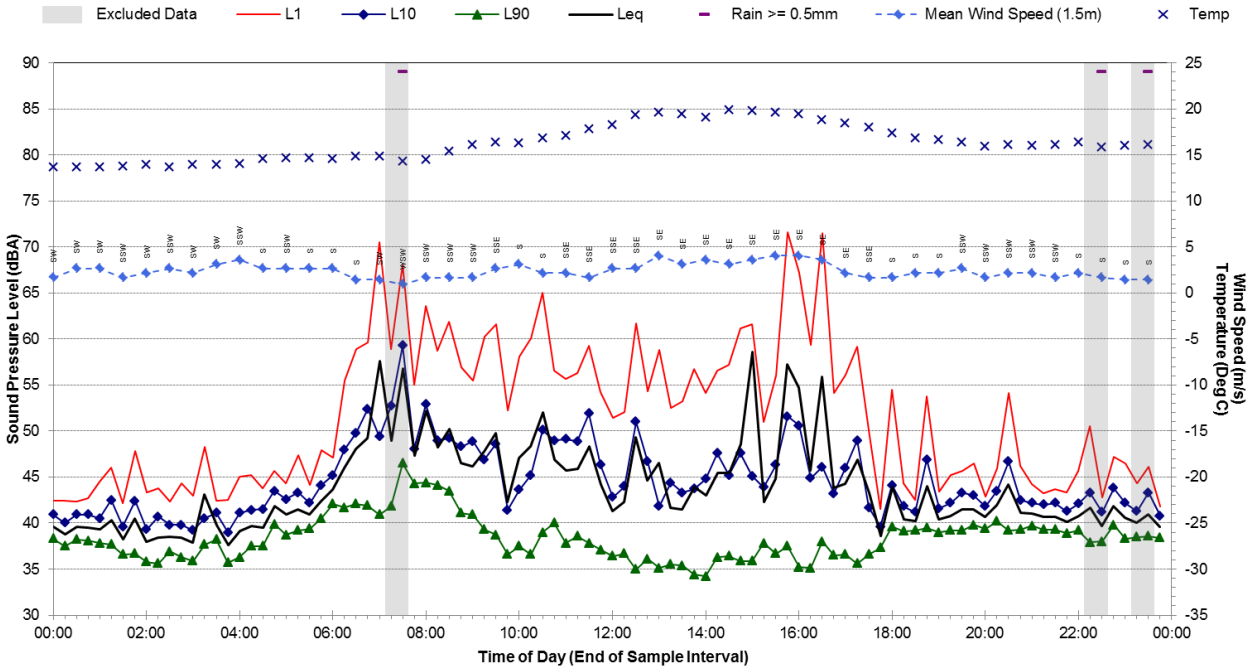

Statistical Ambient Noise Levels

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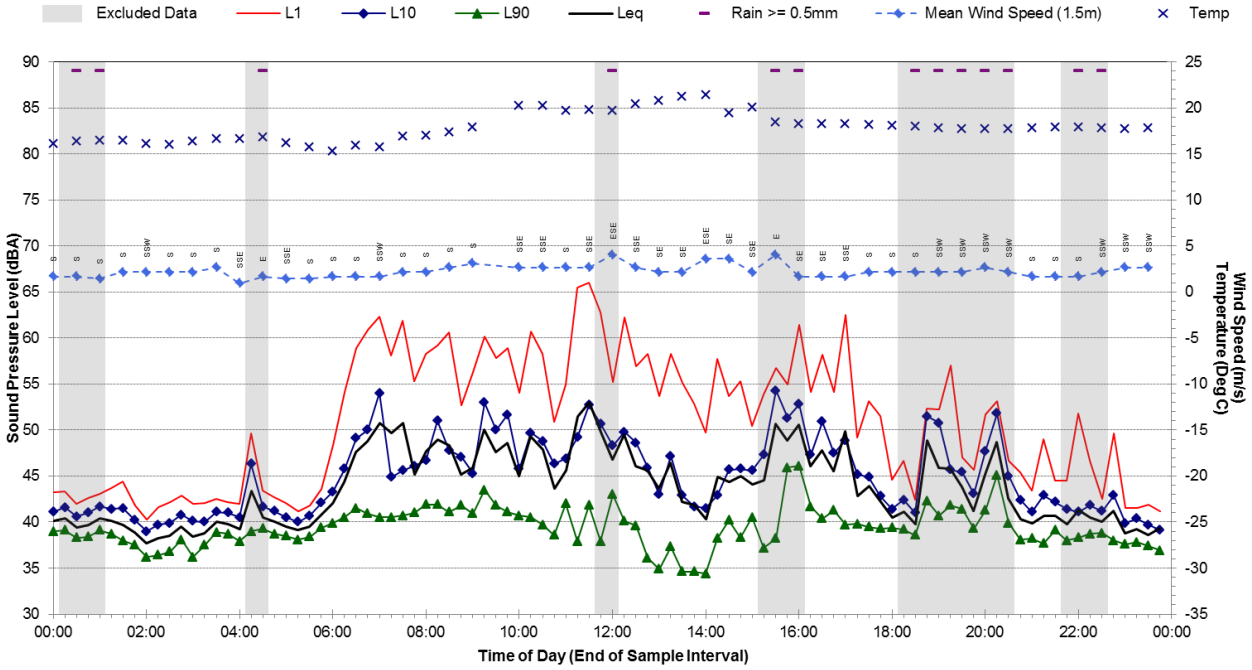

Statistical Ambient Noise Levels

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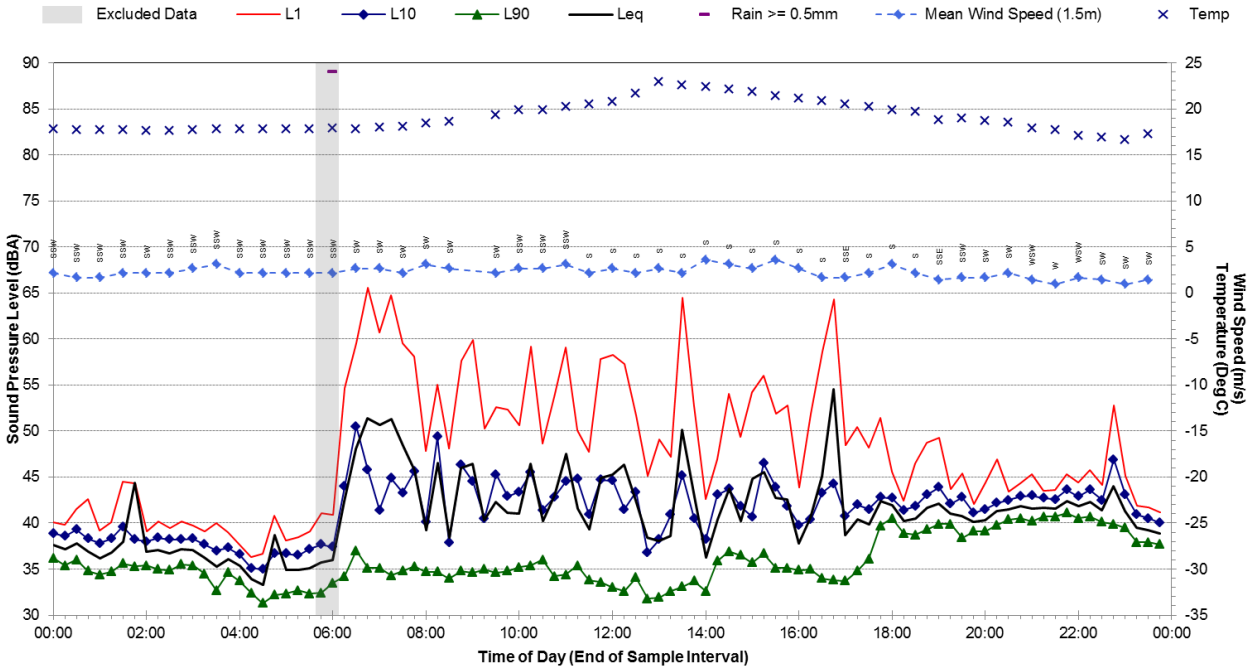

Statistical Ambient Noise Levels

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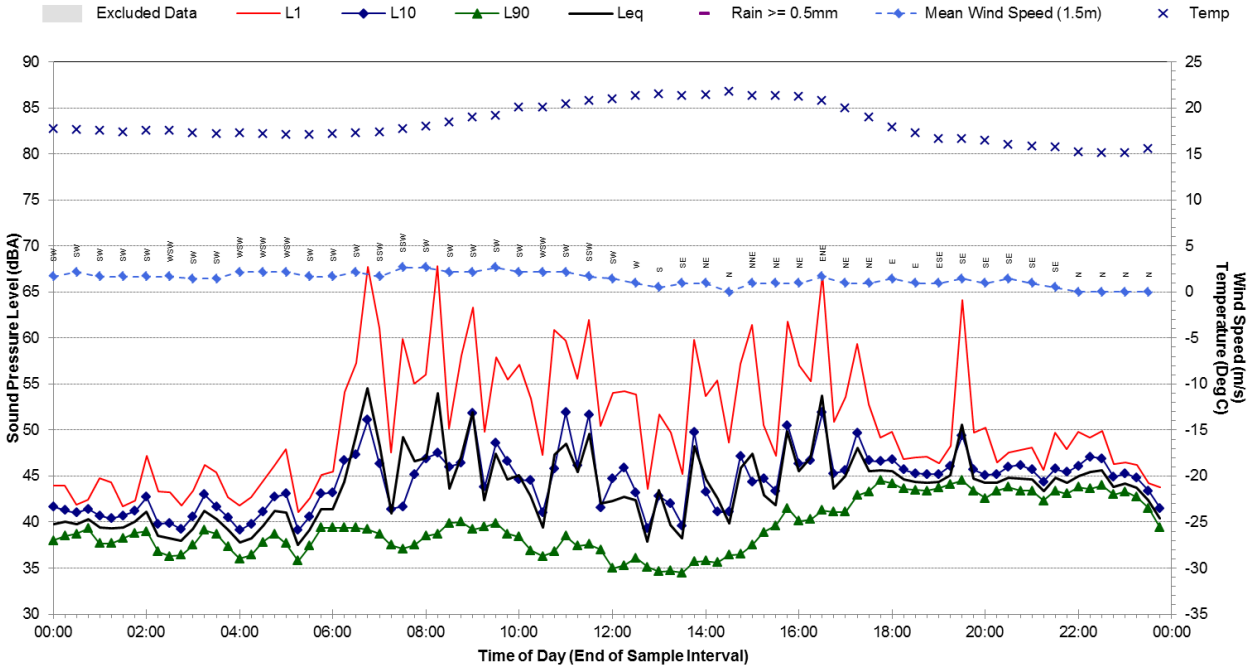

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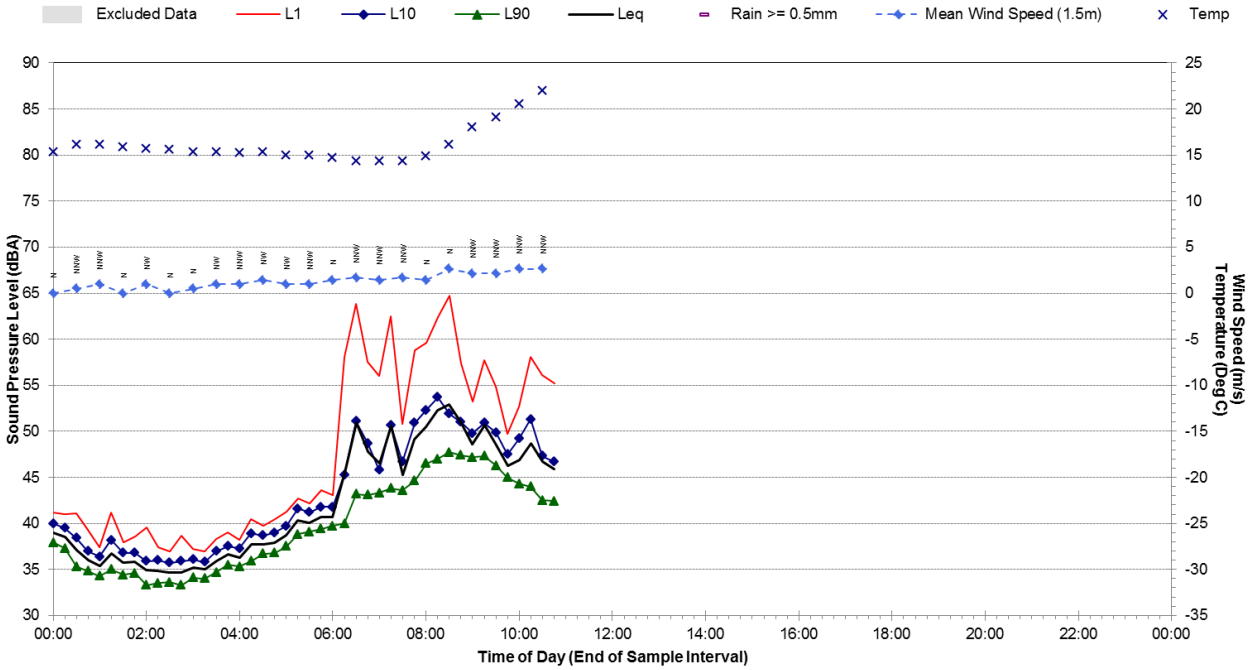
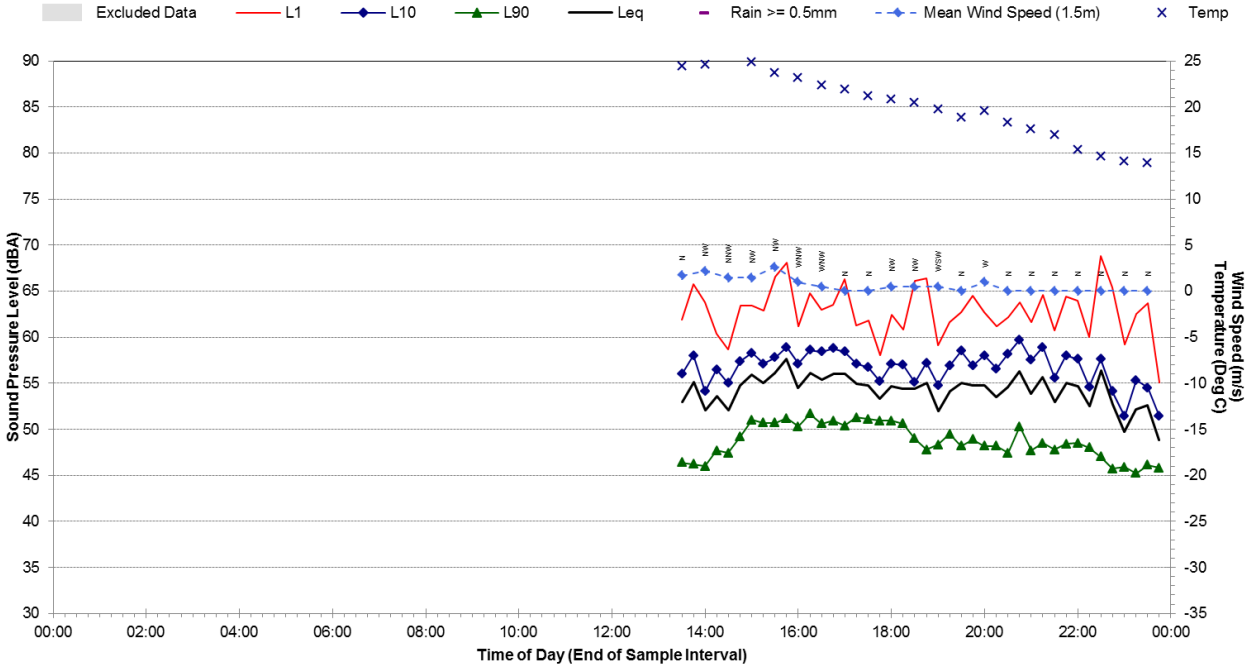


Statistical Ambient Noise Levels

NM3 - Lenore Drive - Friday, 24 April 2015



Statistical Ambient Noise Levels

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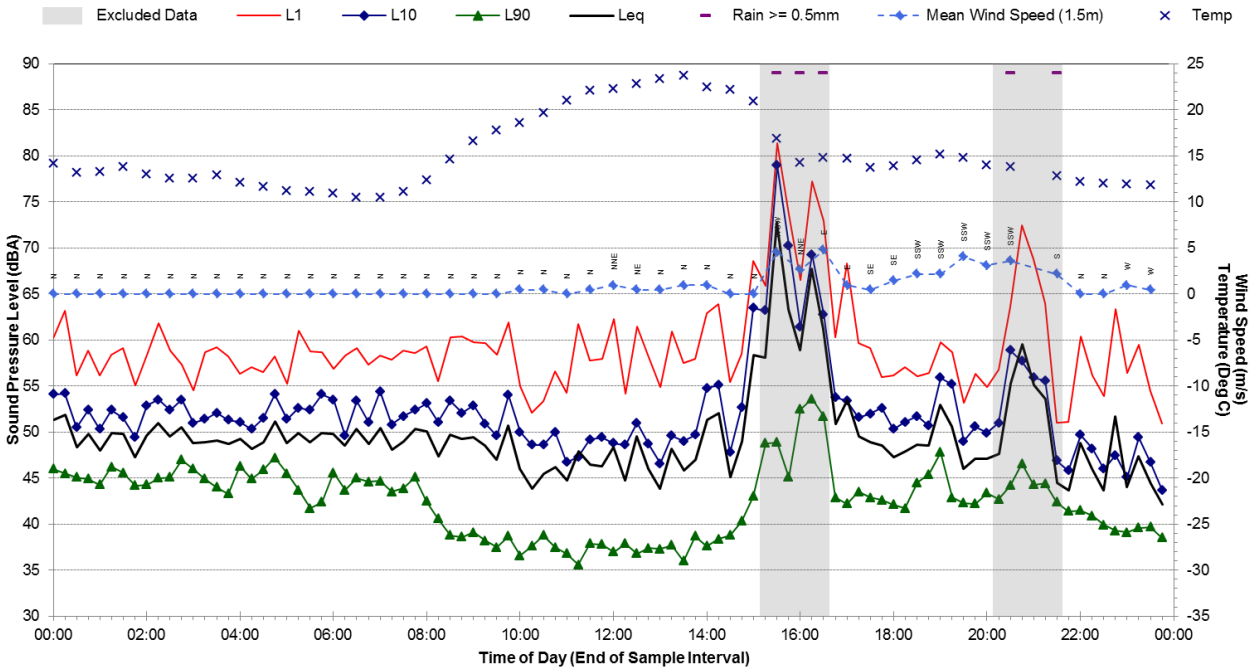

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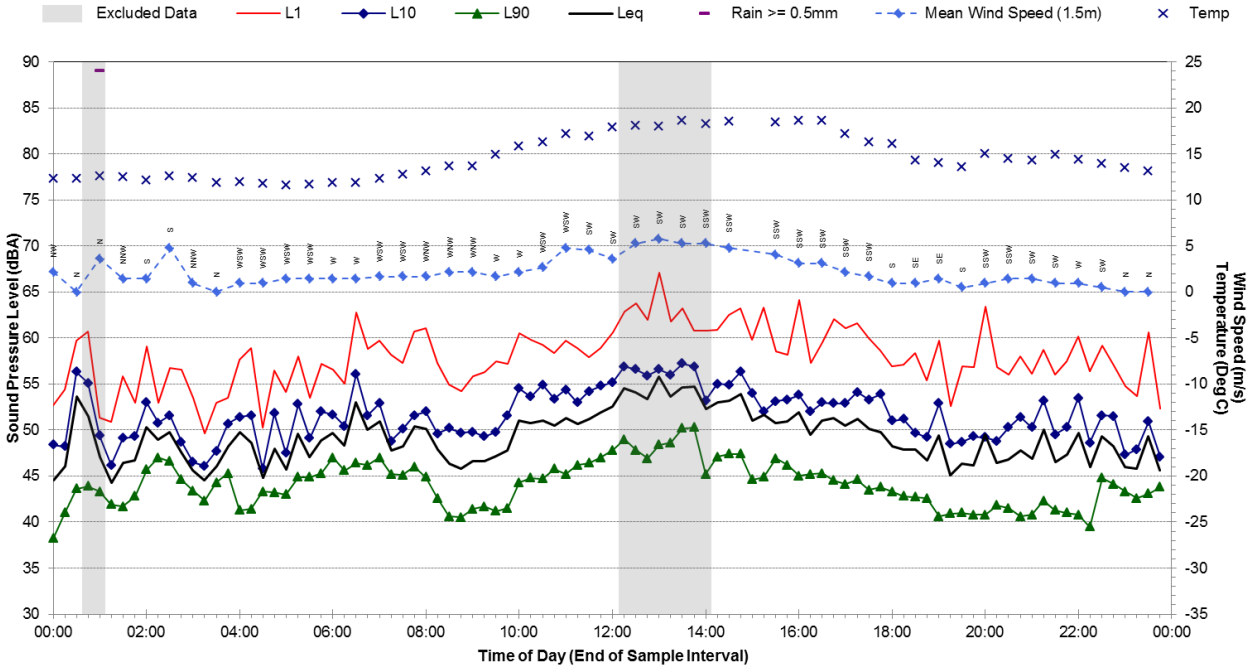

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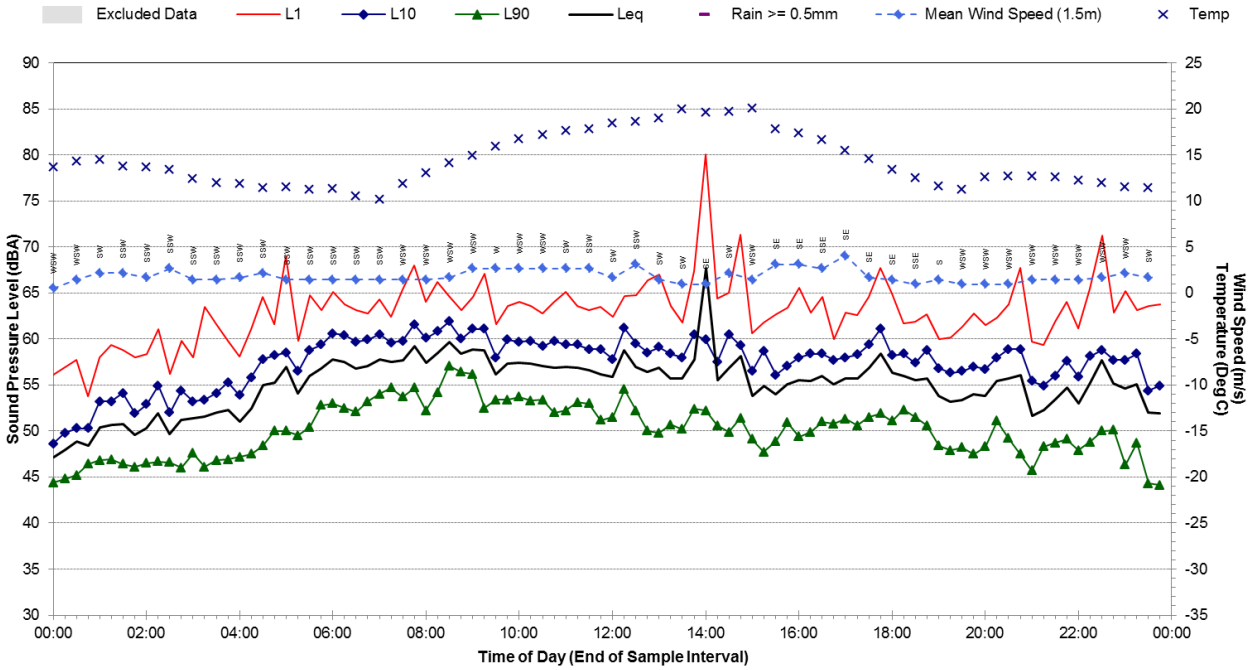
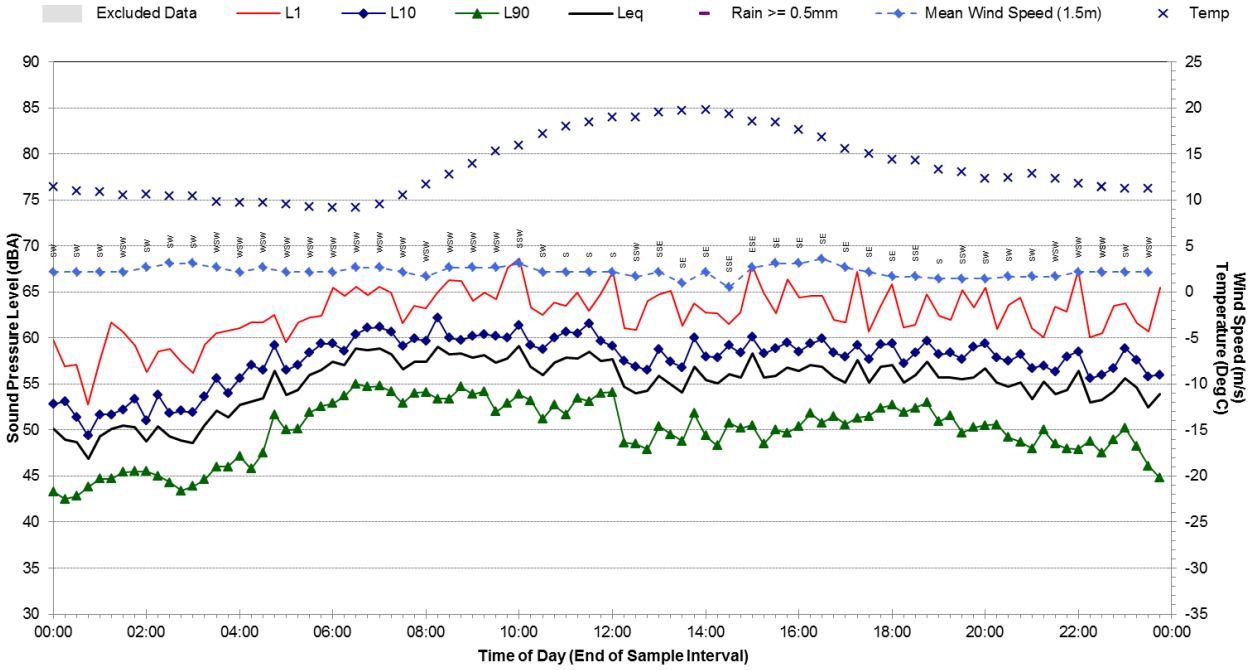


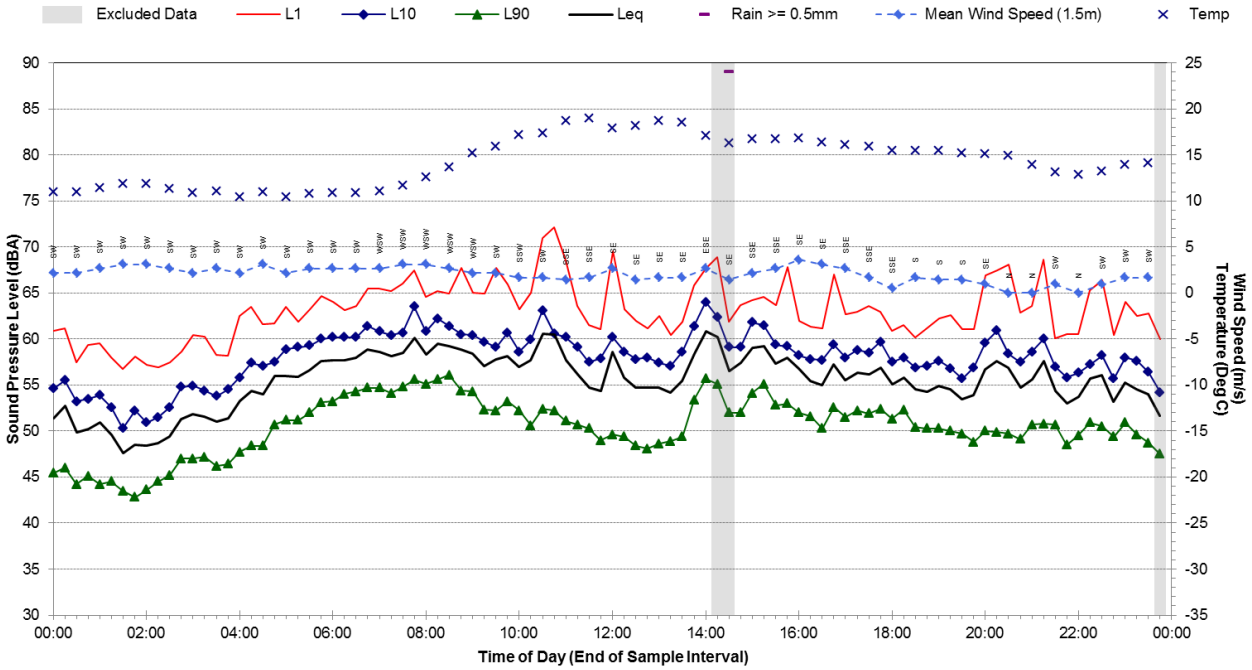
Statistical Ambient Noise Levels

NM3 - Lenore Drive - Tuesday, 28 April 2015



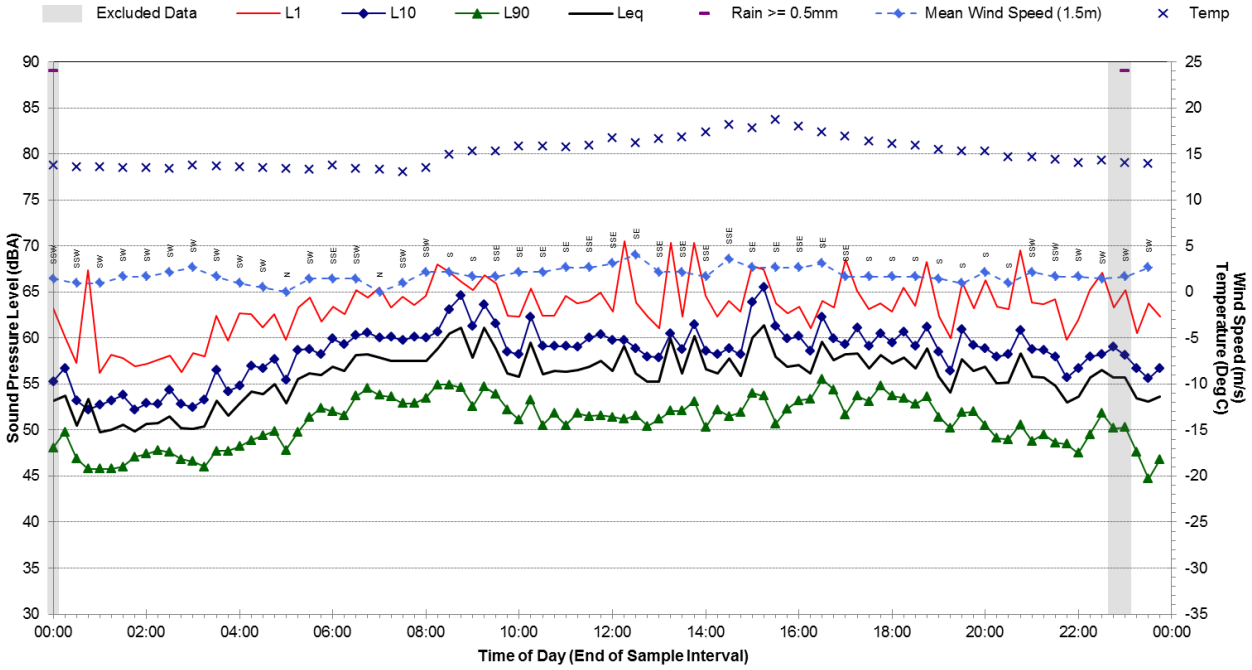
Statistical Ambient Noise Levels

NM3 - Lenore Drive - Wednesday, 29 April 2015



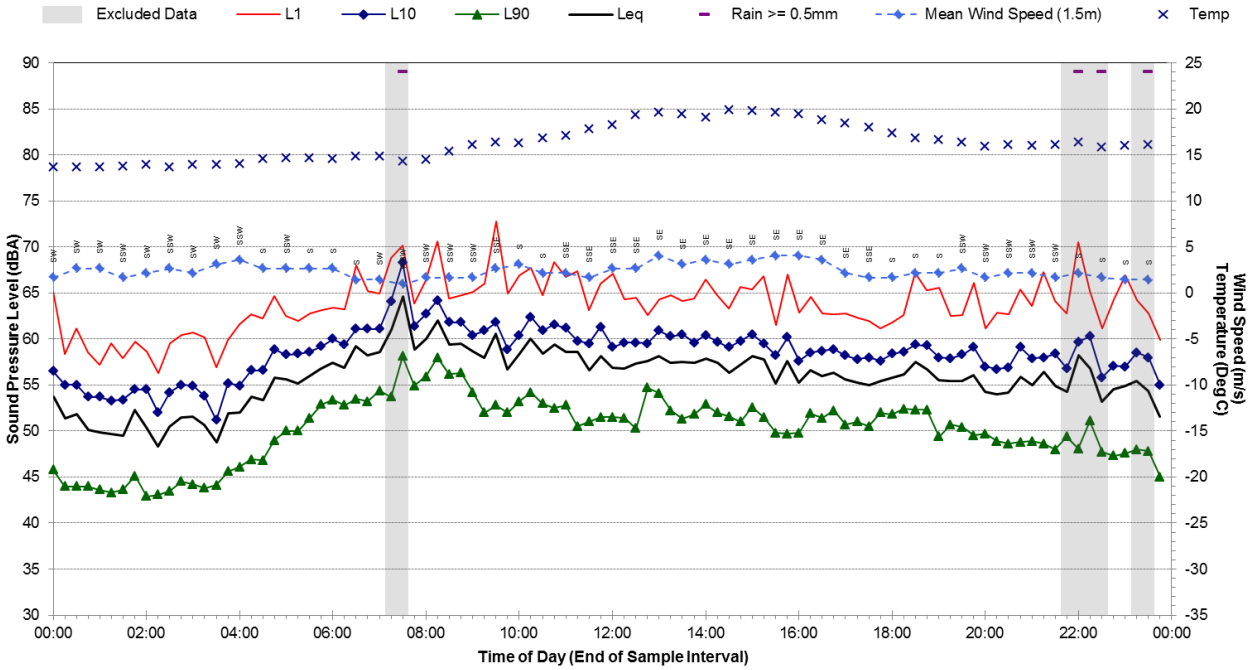
Statistical Ambient Noise Levels

NM3 - Lenore Drive - Thursday, 30 April 2015



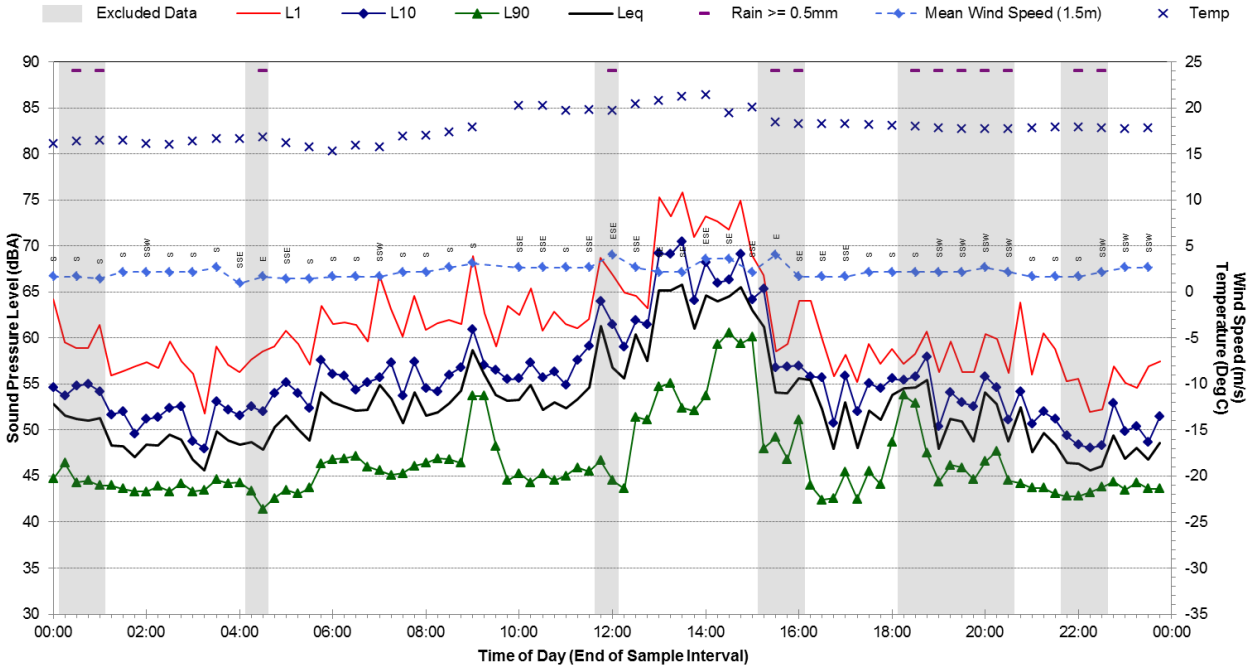
Statistical Ambient Noise Levels

NM3 - Lenore Drive - Friday, 1 May 2015



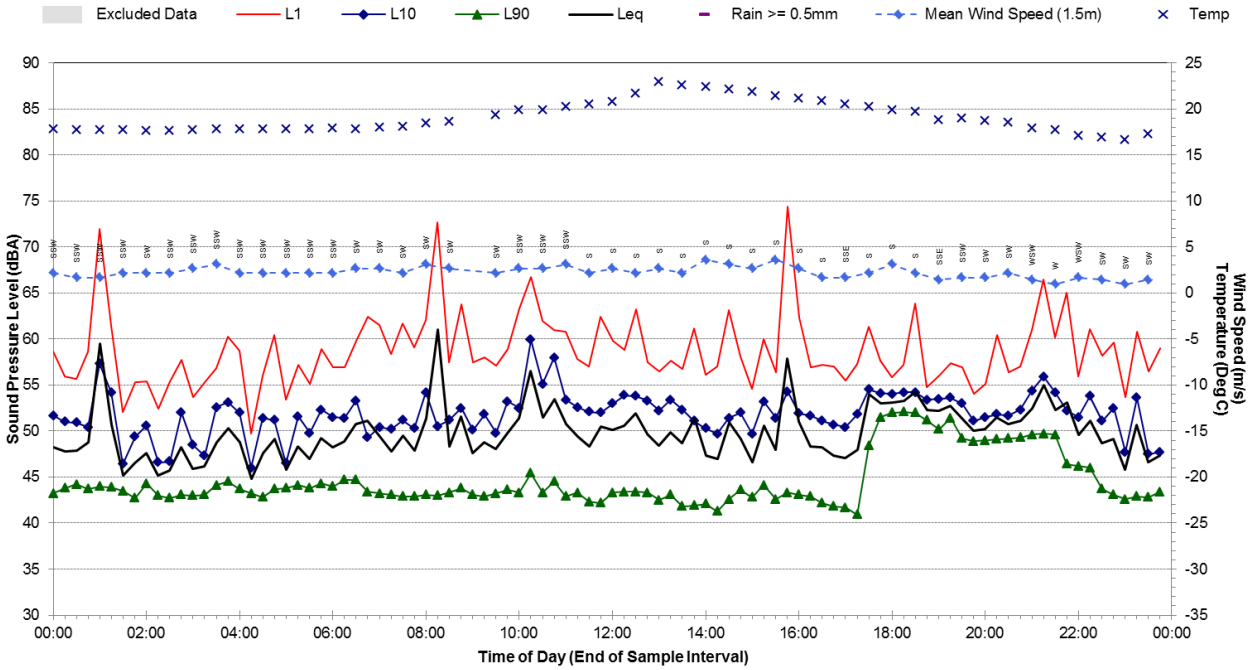
Statistical Ambient Noise Levels

NM3 - Lenore Drive - Saturday, 2 May 2015



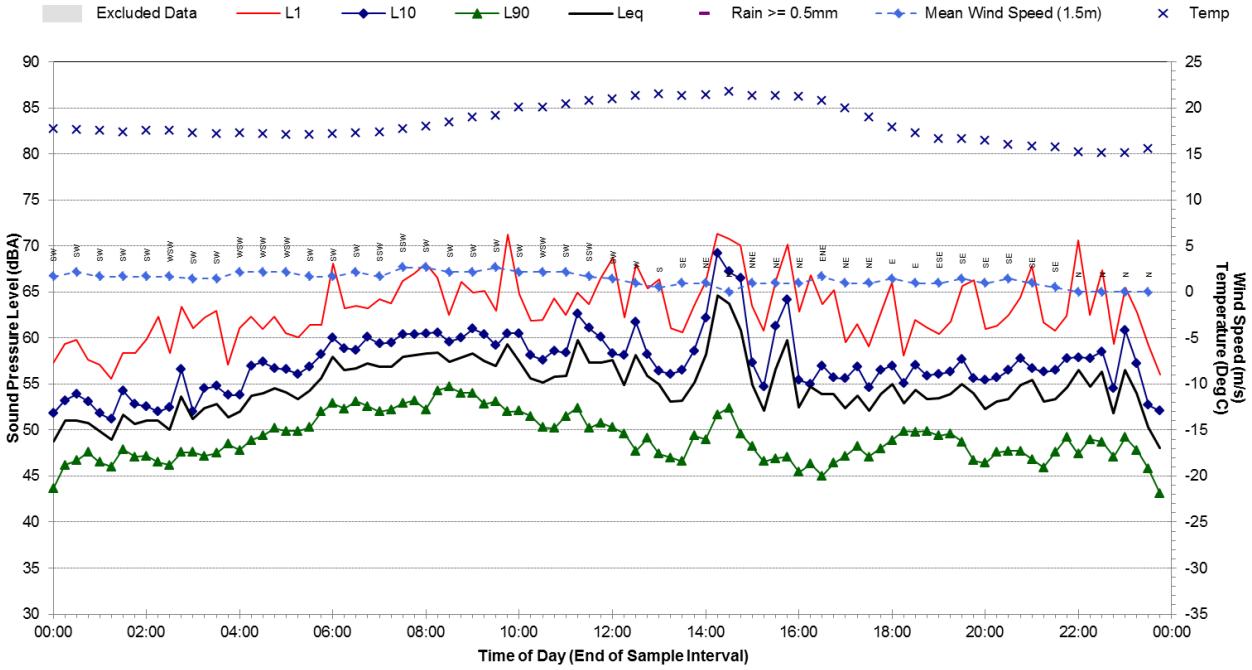
Statistical Ambient Noise Levels

NM3 - Lenore Drive - Sunday, 3 May 2015



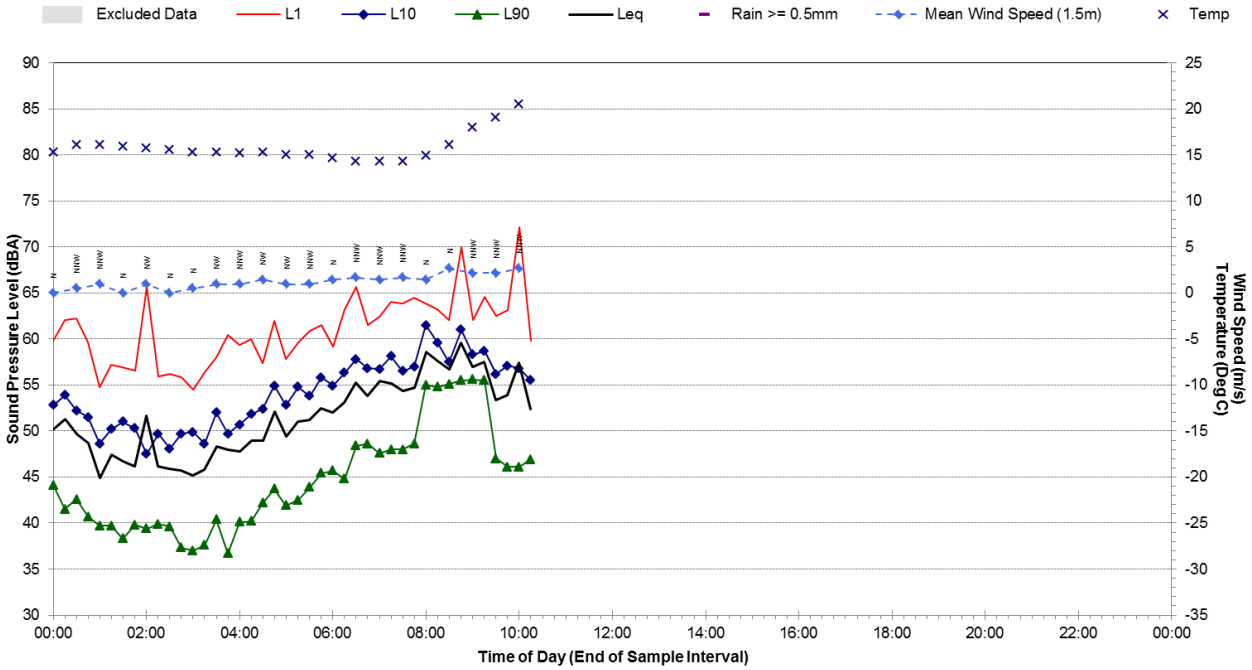
Statistical Ambient Noise Levels

NM3 - Lenore Drive - Monday, 4 May 2015



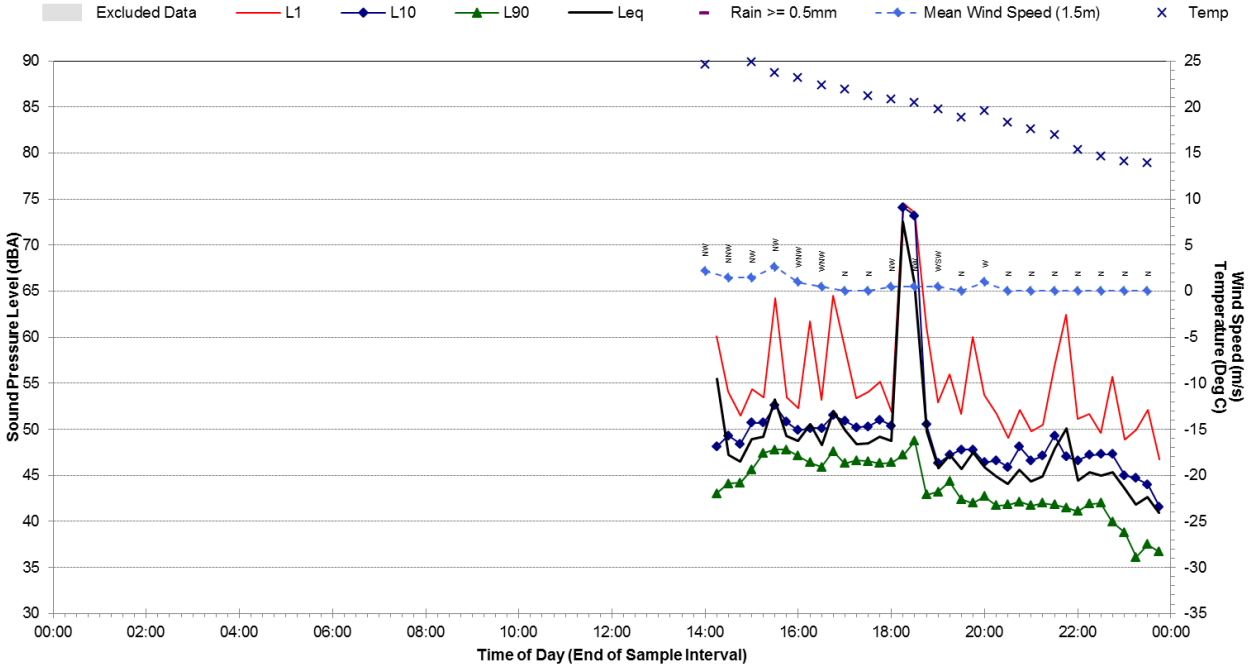
Statistical Ambient Noise Levels

NM3 - Lenore Drive - Tuesday, 5 May 2015



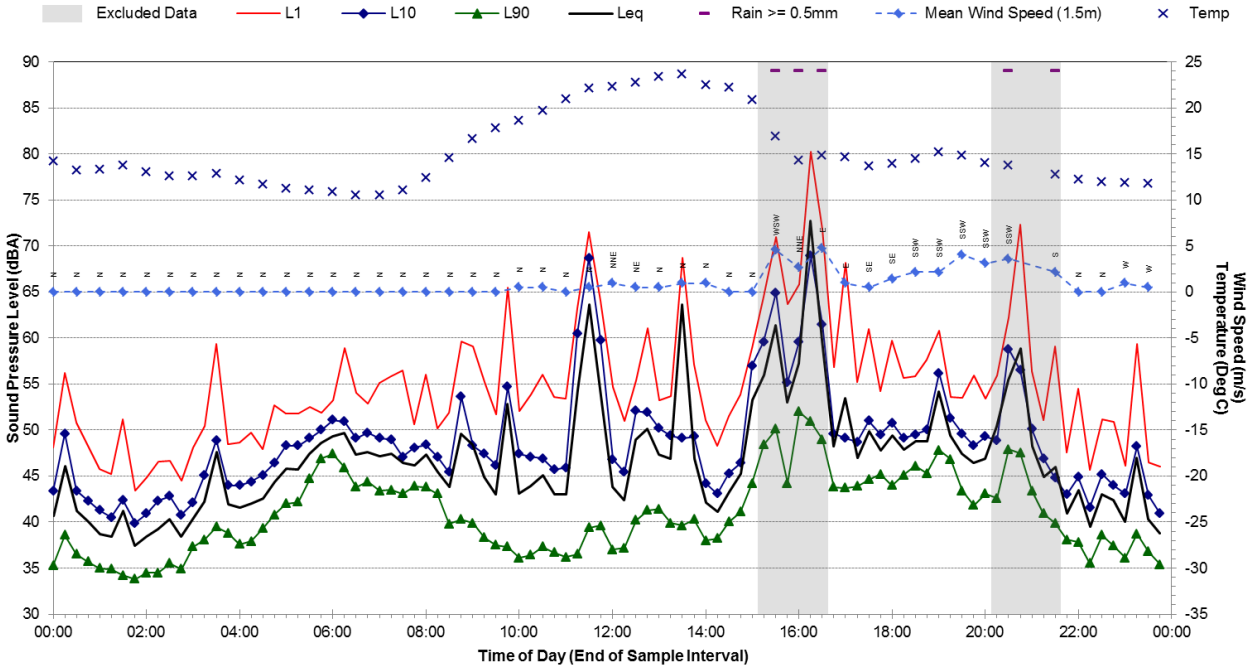
Statistical Ambient Noise Levels

NM4 - Verdi Glenn - Friday, 24 April 2015



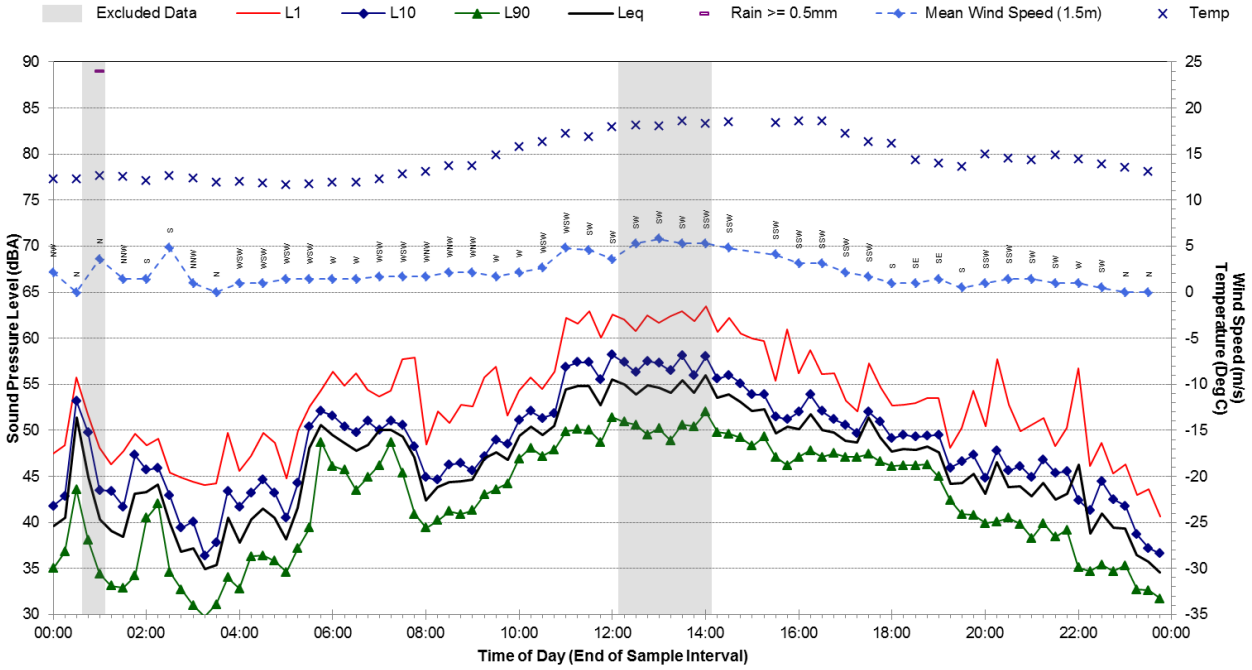
Statistical Ambient Noise Levels

NM4 - Verdi Glenn - Saturday, 25 April 2015



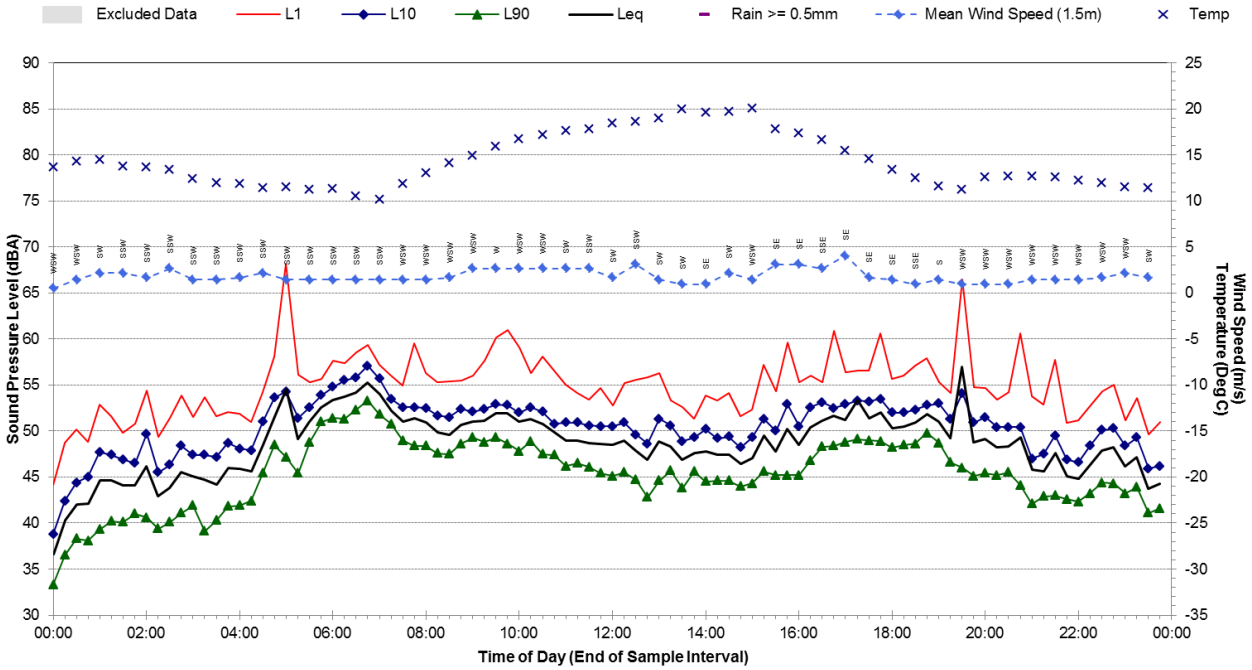
Statistical Ambient Noise Levels

NM4 - Verdi Glenn - Sunday, 26 April 2015



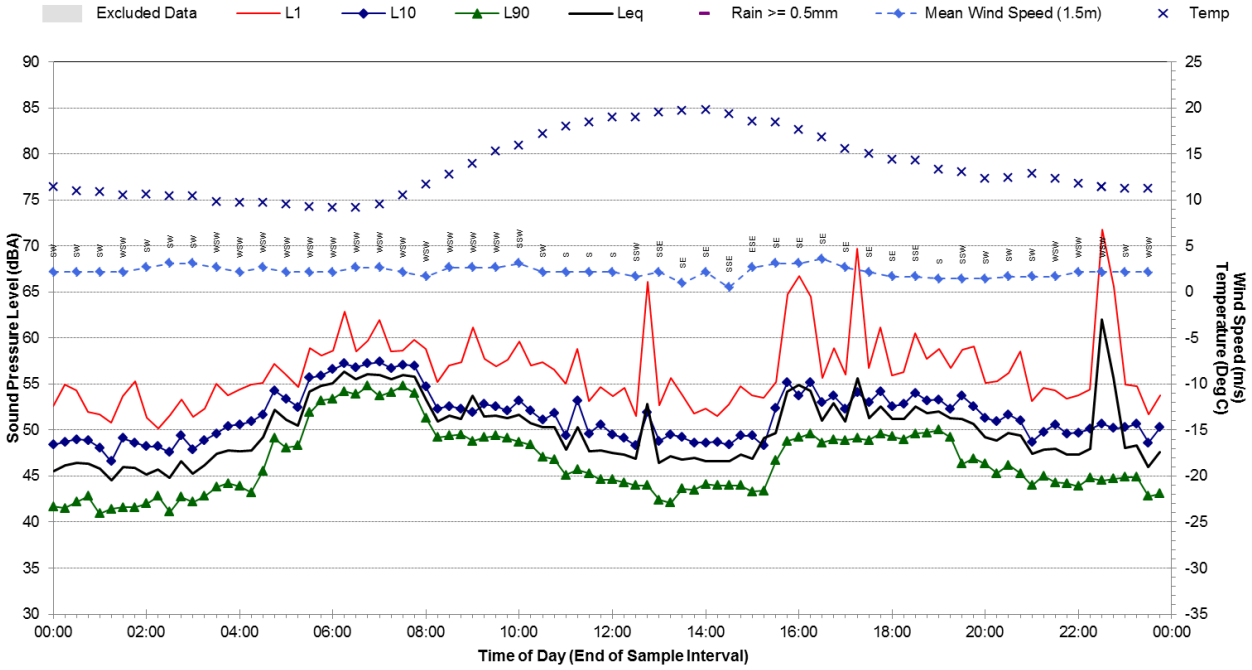
Statistical Ambient Noise Levels

NM4 - Verdi Glenn - Monday, 27 April 2015



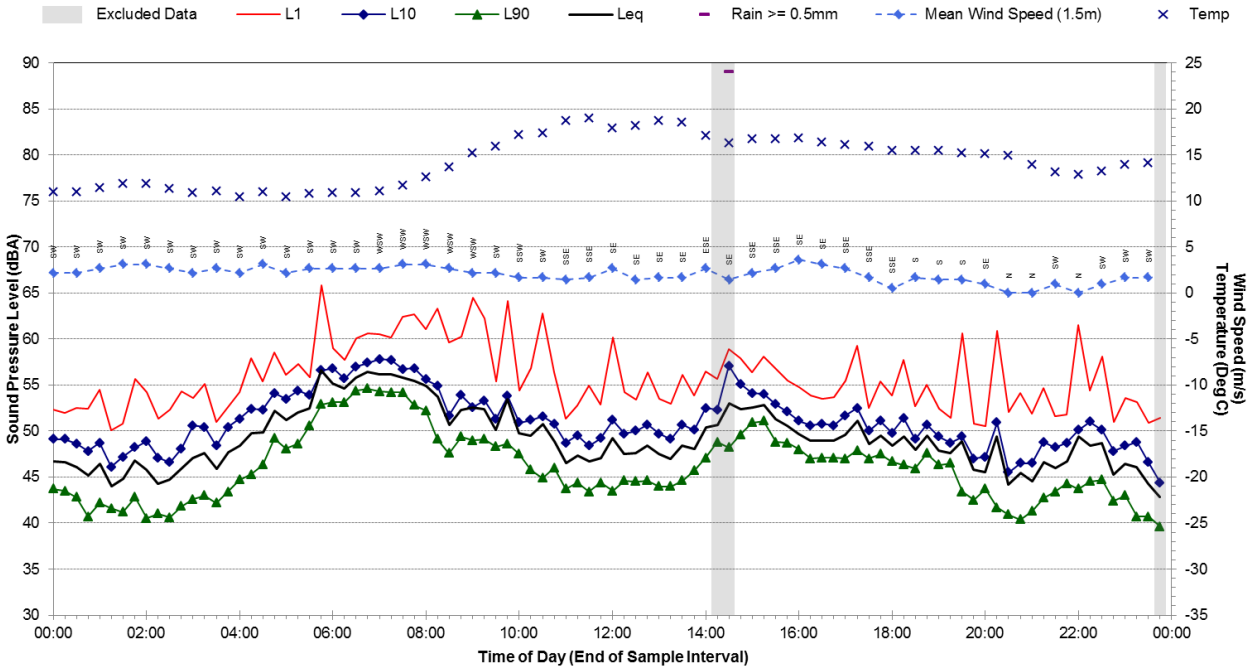
Statistical Ambient Noise Levels

NM4 - Verdi Glenn - Tuesday, 28 April 2015



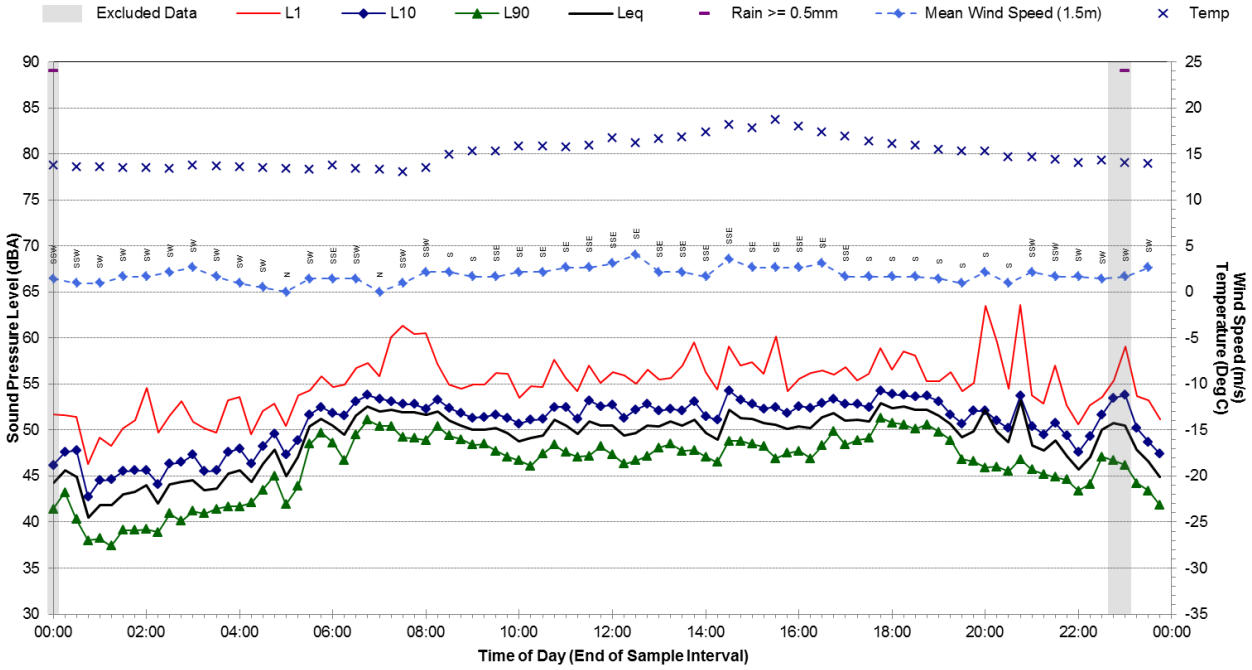
Statistical Ambient Noise Levels

NM4 - Verdi Glenn - Wednesday, 29 April 2015



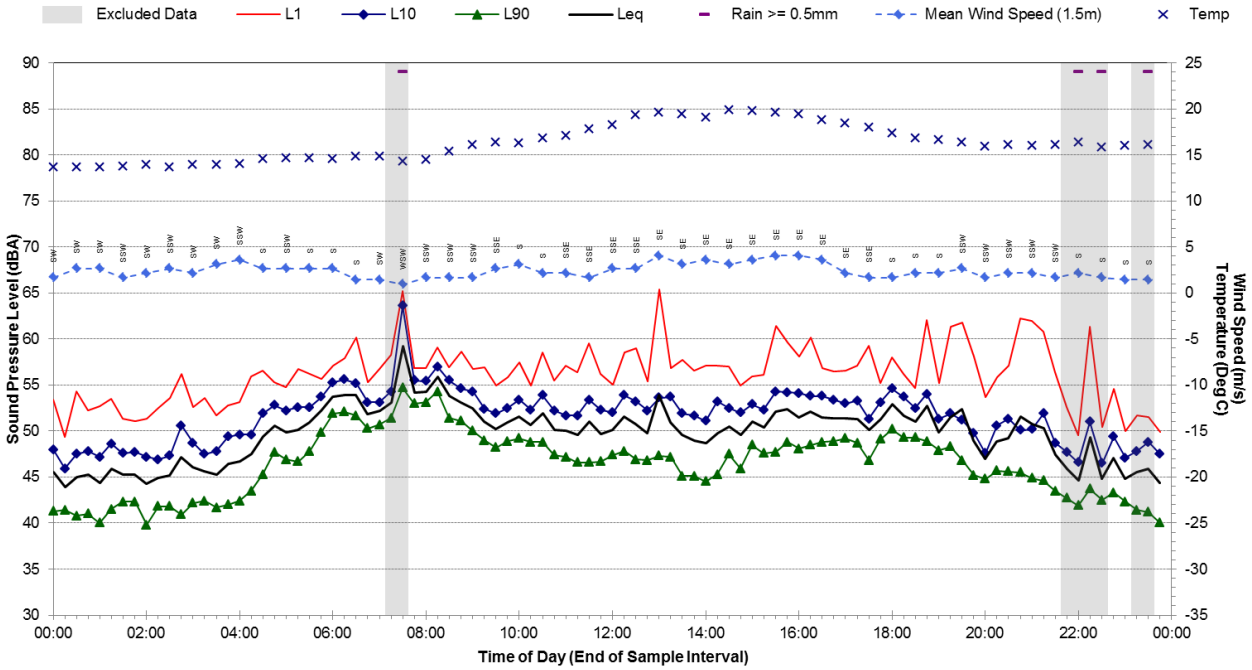
Statistical Ambient Noise Levels

NM4 - Verdi Glenn - Thursday, 30 April 2015



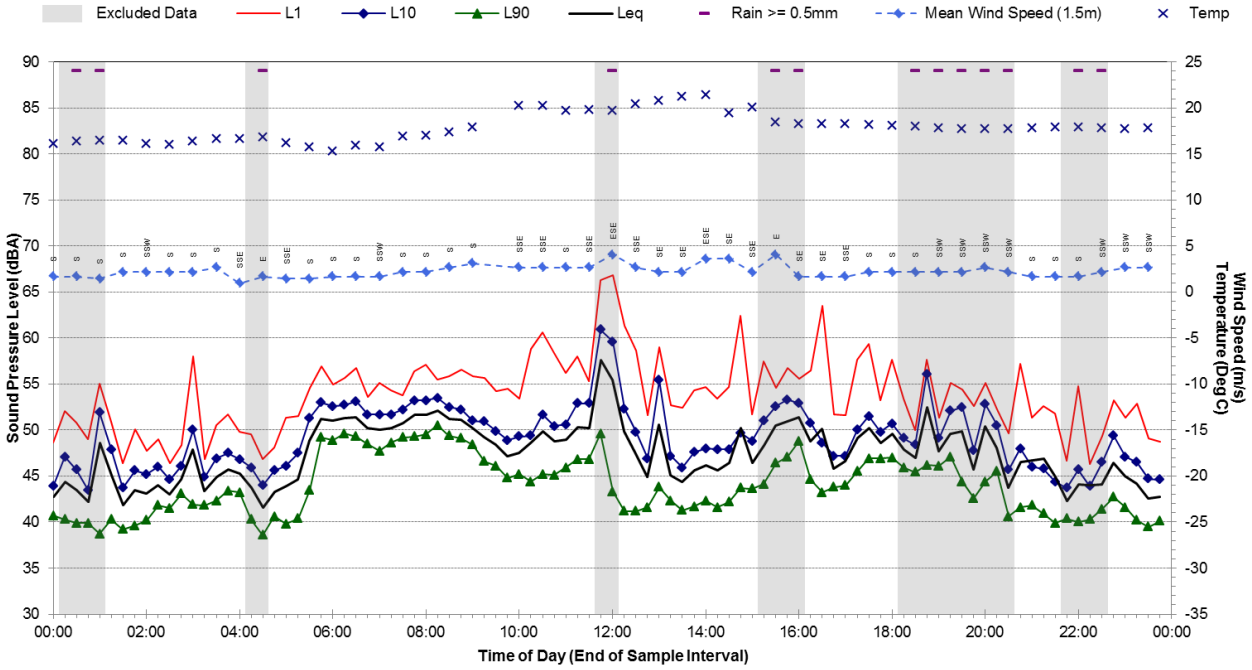
Statistical Ambient Noise Levels

NM4 - Verdi Glenn - Friday, 1 May 2015



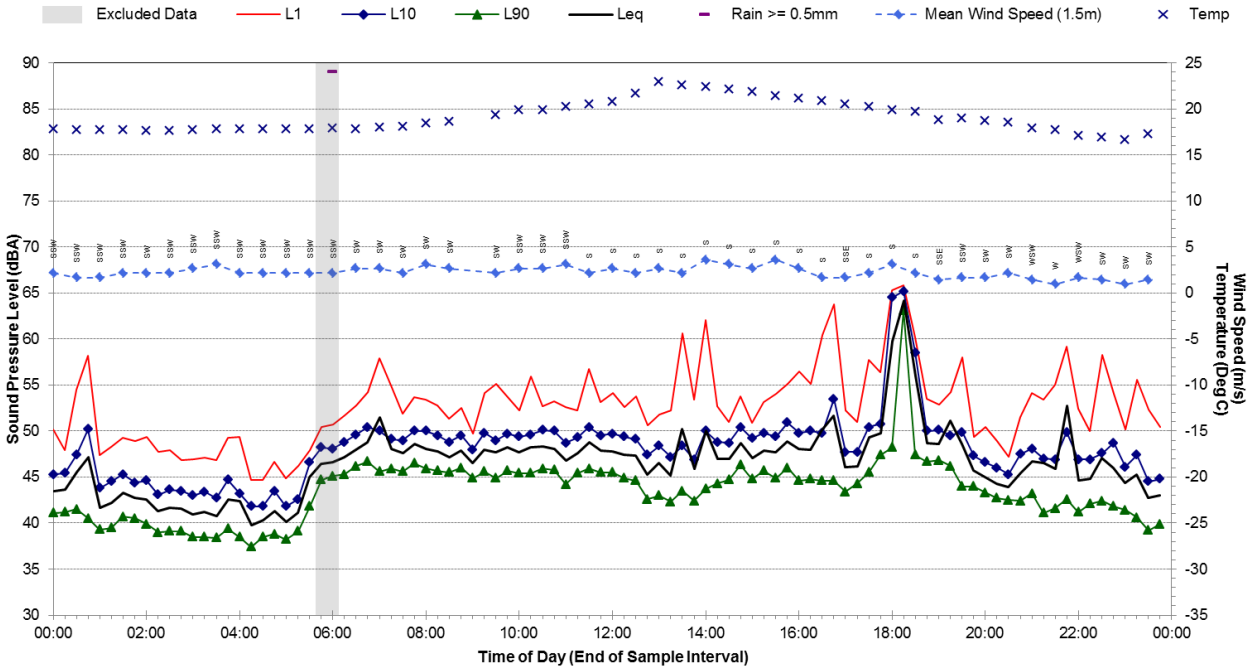
Statistical Ambient Noise Levels

NM4 - Verdi Glenn - Saturday, 2 May 2015



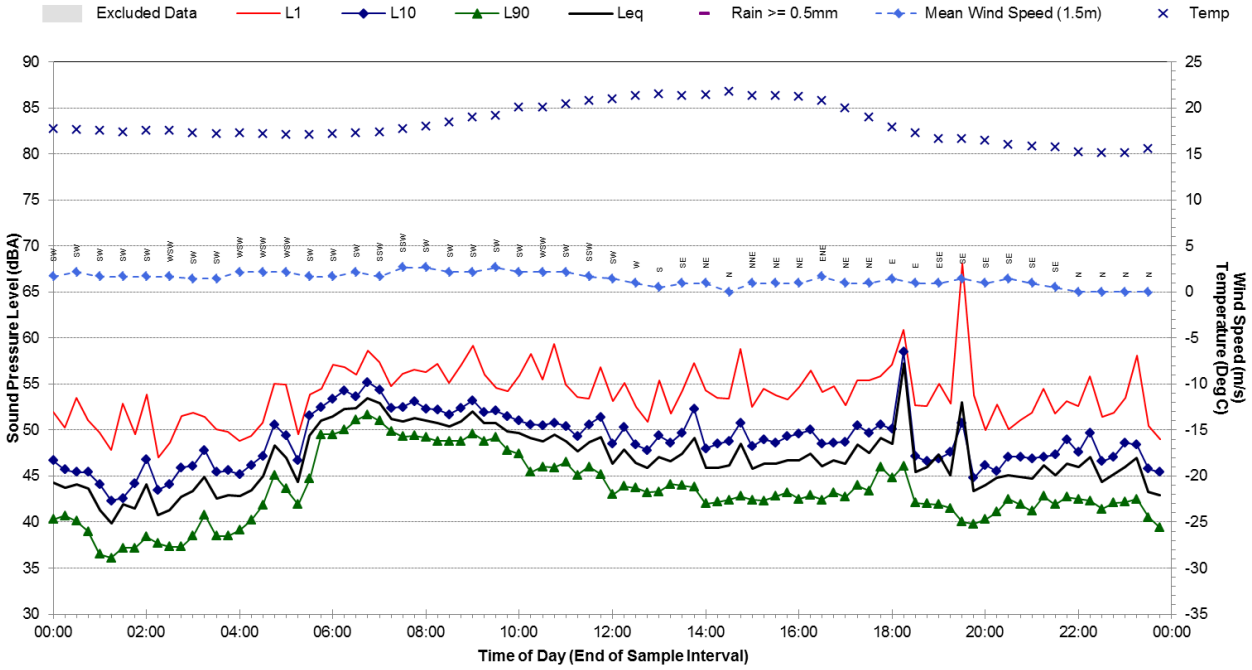
Statistical Ambient Noise Levels

NM4 - Verdi Glenn - Sunday, 3 May 2015



Statistical Ambient Noise Levels

NM4 - Verdi Glenn - Monday, 4 May 2015



Statistical Ambient Noise Levels

NM4 - Verdi Glenn - Tuesday, 5 May 2015

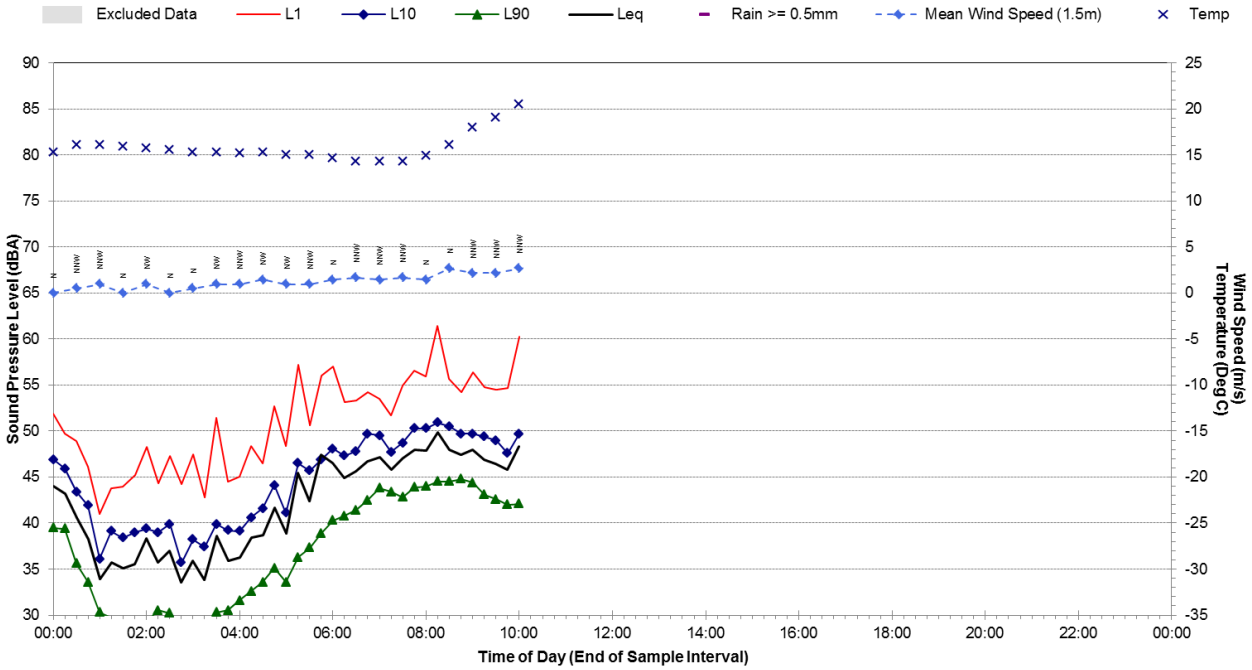


Table 1 Seasonal Frequency of occurrence Wind Speed Intervals - Daytime

Period	Calm (<0.5 m/s)	Wind Direction ±45°	Wind Speed		
			0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	6.4%	NNE	11.9%	8.2%	20.1%
Autumn	15.0%	NNW	14.4%	4.1%	18.6%
Winter	9.2%	NW	16.5%	4.9%	21.4%
Spring	5.4%	N	12.6%	6.1%	18.7%

Table 2 Seasonal Frequency of occurrence Wind Speed Intervals - Evening

Period	Calm (<0.5m/s)	Wind Direction ±45°	Wind Speed		
			0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	5.7%	E	11.3%	11.9%	23.1%
Autumn	24.7%	SW	14.7%	7.7%	22.5%
Winter	17.6%	SW, WSW	18.3%, 19.4%	11.5%, 10.2%	**29.8%, 29.6%**
Spring	14.5%	ESE	10.6%	8.5%	19.2%

Table 3 Seasonal Frequency of occurrence Wind Speed Intervals - Night-Time

Period	Calm (<0.5m/s)	Wind Direction ±45°	Wind Speed		
			0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	32.9%	SSW	19.4%	8.3%	27.8%
Autumn	35.9%	SW, WSW	19.0%, 19.7%	13.9%, 12.6%	**32.9%, 32.3%**
Winter	22.8%	WSW, W, SW	20.9%, 21.9%, 17.3%	13.1%, 9.7%, 13.2%	**34.0%, 31.6%, 30.6%**
Spring	36.5%	SW	18.5%	8.4%	26.9%

Table 4 Summary

Season	Winds ±45° ≤3m/s with Frequency of Occurrence ≥30%		
	Daytime	Evening	Night-Time
Summer	Nil	Nil	Nil
Autumn	Nil	Nil	**32.9% SW, 32.3% WSW**
Winter	Nil	**29.8% SW, 29.6% WSW**	**34.0% WSW, 31.6%W, 30.6% SW**
Spring	Nil	Nil	Nil

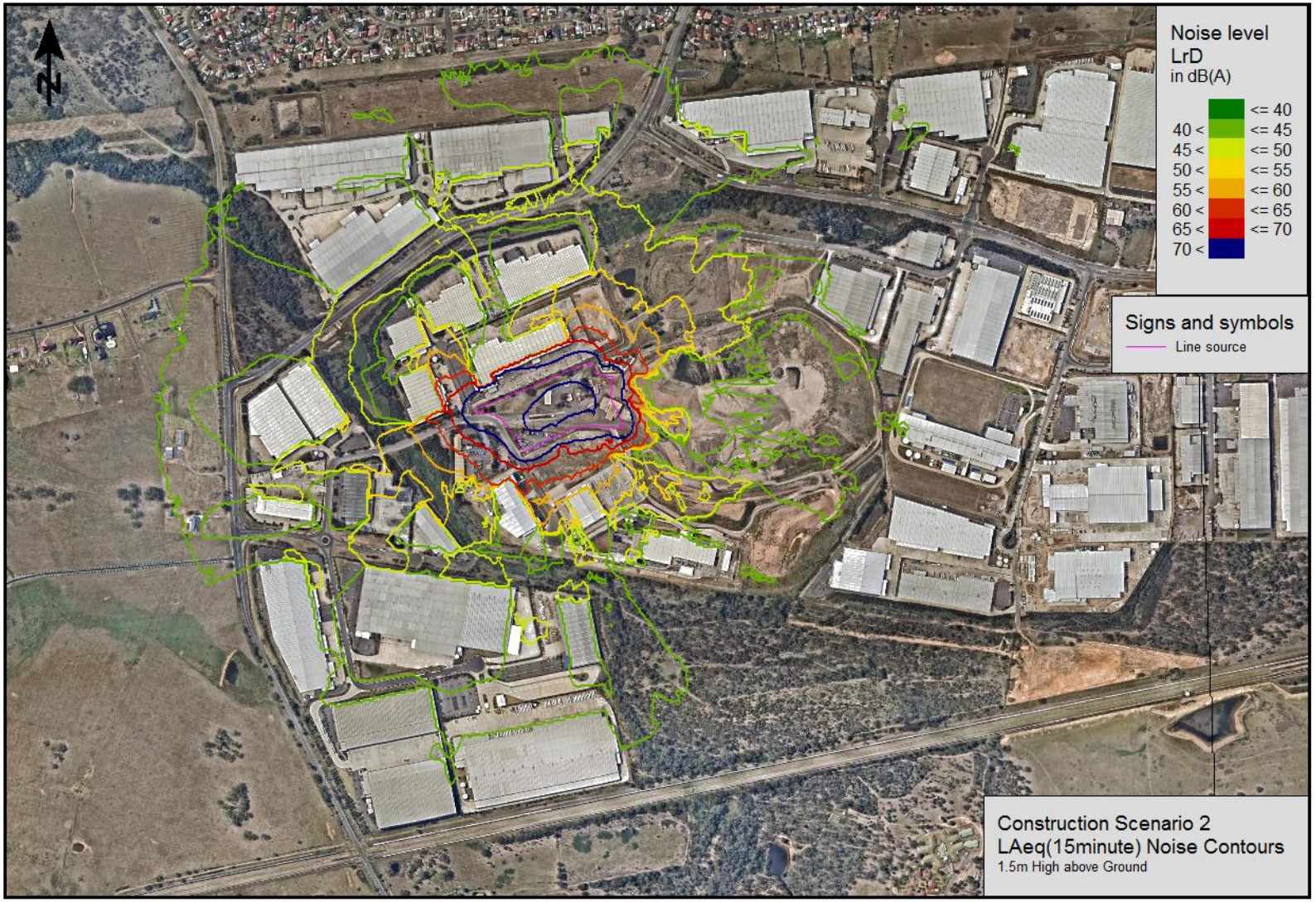
Table 5 Frequency of Occurrence of Atmospheric Stability Classes - Evening and Night-time

Stability Class	Frequency of Occurrence				Estimated ELR °C/100 m	Qualitative Description
	Summer	Autumn	Winter	Spring		
A	0.0%	0.0%	0.0%	0.0%	<-1.9	Lapse
B	0.0%	0.0%	0.0%	0.0%	-1.9 to -1.7	Lapse
C	0.0%	0.0%	0.0%	0.0%	-1.7 to -1.5	Lapse
D	50.6%	42.4%	44.3%	45.5%	-1.5 to -0.5	Neutral
E	9.3%	11.5%	12.0%	9.5%	-0.5 to 1.5	Weak inversion
F	8.7%	11.2%	14.2%	10.7%	1.5 to 4	Moderate inversion
G	31.4%	34.9%	29.5%	34.4%	>4.0	Strong inversion
F+G	40.1%	46.1%	43.7%	45.1%	>1.5	Moderate to strong inversion

Note: ELR (Environmental Lapse Rate).

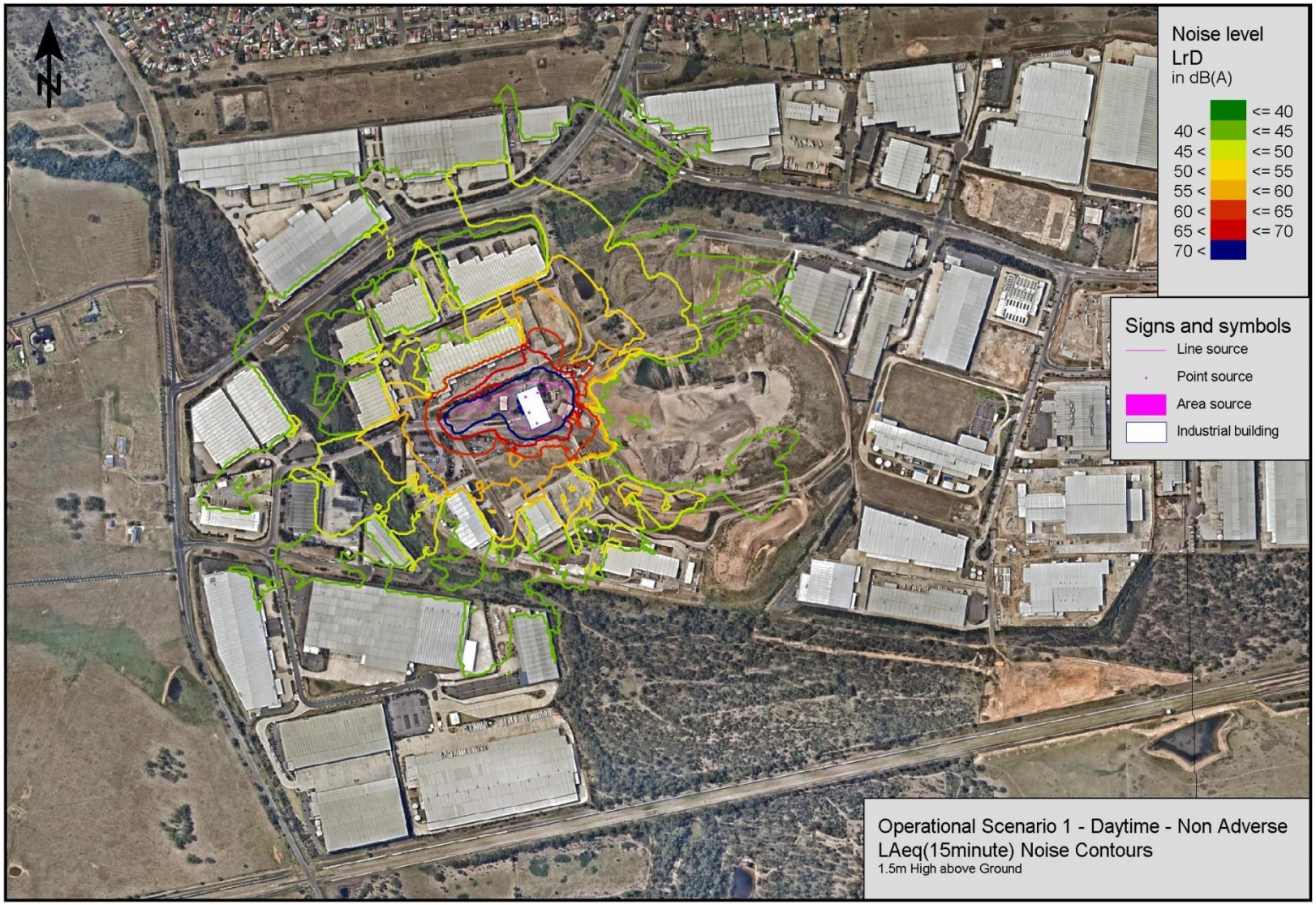
Appendix D1

NOISE CONTOURS - CONSTRUCTION SCENARIO - BUILDINGS CONSTRUCTION



Appendix D2

NOISE CONTOURS - OPERATIONAL INTRUSIVE SCENARIO - DAYTIME - NON ADVERSE



Appendix D3

NOISE CONTOURS - OPERATIONAL INTRUSIVE SCENARIO – NIGHT-TIME ADVERSE (WINTER TEMPERATURE INVERSION)