WESTLINK STAGE 2

Noise and Vibration Impact Assessment

Prepared for:

ESR Developments (Australia) Pty Ltd
Level 24, 88 Phillip St,
Sydney NSW 2000

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PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
Tenancy 202 Submarine School, Sub Base Platypus, 120 High Street
North Sydney NSW 2060 Australia
T: +61 2 9427 8100
E: sydney@slrconsulting.com www.slrconsulting.com

BASIS OF REPORT

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

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.30893.00100-R02-v5.0	1 April 2025	Adam Sirianni	Steven Luzuriaga	Steven Luzuriaga
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610.30893.00100-R02-v3.0	08 August 2024	Jordan McMahon	Steven Luzuriaga	Steven Luzuriaga
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610.30893.00100-R02-v1.0	26 October 2022	Steven Luzuriaga Joshua Ridgway	Antony Williams	Antony Williams

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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by ESR Developments (Australia) Pty Ltd (ESR) to undertake a noise impact assessment in support of a State Significant Development (SSD) application (SSD 46983729) for Westlink Stage 2, which is a proposed warehousing and distribution development at 1030-1048 and 1050-1064 Mamre Road, and 59-62 & 63 Abbotts Road, Kemps Creek (the proposal). The site is located within the Mamre Road Precinct (MRP).

SLR is suitably qualified and endorsed by the Planning Secretary to produce SSD noise impact assessments. SLR is a member of the Australian Acoustical Society (AAS) and a member firm of the Association of Australasian Acoustical Consultants (AAAC).

This report summarises the assessment of the potential construction and operational noise impacts associated with the proposal.

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

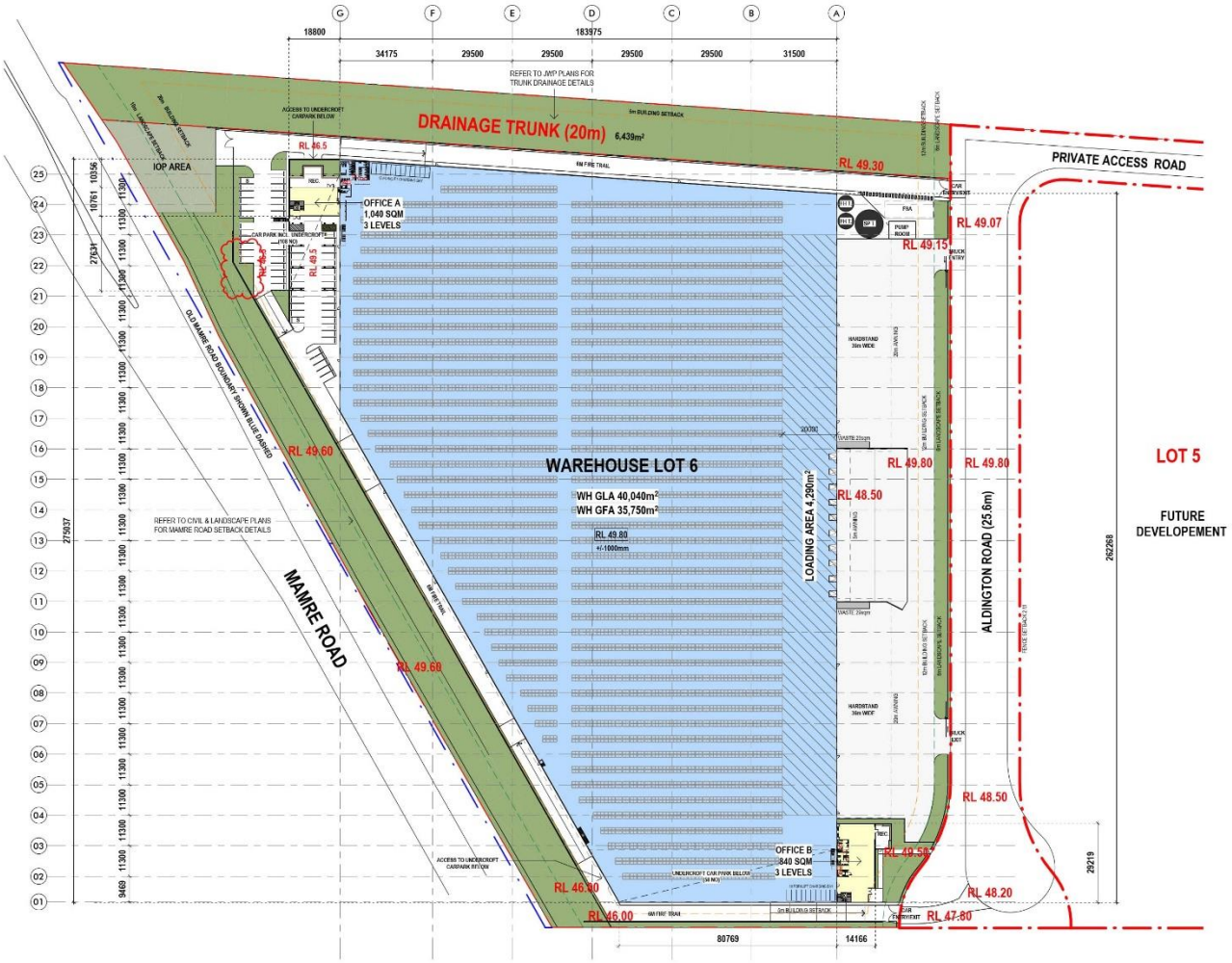
1.1 Proposal Description

The proposal comprises the following:

- Site preparatory works, including:
  - Demolition and clearing of all existing built form structures and vegetation
  - Bulk earthworks of the broader site (area of approximately 370,000m^2) including 'cut and fill' to create flat development platforms for the proposed buildings, and topsoiling, grassing and site stabilisation works
- Subdivision of the broader site into six individual lots with two being residual lots for future development
- Construction of a new industrial estate at the site comprising a total gross floor area of approximately 41,910 m^2, including:
  - One new industrial warehousing buildings comprising a total of 40,810 m^2 of warehousing floorspace and ancillary office floor space
  - Ancillary offices comprising a total 1,100 m^2 of floor space
  - At grade and under croft car parking
- Construction of a new internal road layout including connectivity to the internal access road and car parking areas
- Associated site servicing works and ancillary facilities, including an OSD detention basin located on one allotment
- Associated site landscaping and signage
- 24-hour operation of the new industrial warehousing building with heavy vehicle movements on and off site.

The proposed Stage 2 design is shown in **Figure 1**. This assessment has been prepared to assess Stage 2 only.

Figure 1 Stage 2 Development



The Secretary's Environmental Assessment Requirements (SEARs) for SSD 46983729 were issued by the Department of Planning and Environment (DPE) in August 2022. The requirements relevant to noise and vibration are shown in **Table 1**.

Table 1 Secretary's Environmental Assessment Requirements – SSD 46983729

Noise and Vibration	Where Addressed
SEARs –August 2022	
Provide a noise and vibration assessment prepared in accordance with the relevant EPA guidelines. The assessment must detail construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that would be implemented.	Existing Noise Environment and Sensitive Receivers: **Section 2** Assessment Criteria: **Section 3** Assessment Methodology: **Section4** Assessment of Impacts: **Section 5** Mitigation and Management Measures: **Section 6**

1.2 Mamre Road Precinct Development Control Plan

The Mamre Road Precinct (MRP) Development Control Plan (DCP) also applies to the proposal. The requirements of the MRP DCP relevant to noise and vibration are shown in **Table 2**. The MRP Structure Plan is shown in **Appendix C**.

Table 2 Mamre Road Precinct Development Control Plan Requirements

Noise and Vibration	Where Addressed
2.2.3 Biodiversity Conservation and Management	
16) Where noise adjacent to natural areas is likely to impact wildlife, the proponent must manage the timing of noise producing activities, including installing appropriate noise treatment barriers along major roads and other attenuation measures.	Noise from the development is not expected to impact on wildlife.
2.11 Aviation Safeguarding	
3) Development is constructed in accordance with Australian Standards AS2021 – Acoustics Noise Intrusion – Building Siting and Construction.	The site is located inside the Western Sydney Airport ANEC25 contour for Long-term (Year 2063) operations. Based on the highest predicted impact of Lmax 72dBA, no further treatment to the Warehouse or Office building envelopes would be required to comply with AS2021:2015 internal assessment requirements. (refer *Westlink Industrial Estate – Environmental Impact Statement, Appendix L*).

Noise and Vibration	Where Addressed
4.3 Amenity – 4.3.1 Noise and Vibration	
1) Any machinery or activity considered to produce noise emissions from a premise shall be adequately sound-proofed so that noise emissions are in accordance with the provisions of the Protection of the Environment Operations Act 1997.	**Sections 5, 6**
2) Noise should be assessed in accordance with Noise Policy for Industry (EPA, 2017) and NSW Road Noise Policy (Department of Environment, Climate Change and Water, 2011).	**Sections 3, 4, 5**
3) An Acoustic Report by a qualified acoustical engineer must be submitted where proposed development, including traffic generated by that development, will create noise and/or vibration impacts, either during construction or operation, that impacts on adjoining developments or nearby rural-residential areas. The Acoustic Report should outline the proposed noise amelioration strategies and management methods.	This report **Sections 1, 2, 3, 4, 5, 6**
4) An Acoustic Report shall be prepared for developments within 500m of rural-residential areas and other sensitive receivers, including educational establishments.	This report **Section 2**
5) Acoustic Reports for individual developments must assess cumulative noise impacts, including likely future noise emissions from the development and operation of the Precinct. The consultant should liaise with the relevant consent authority to determine acceptable amenity goals for individual industrial developments and background noise levels.	**Section 3.3** and **Appendix C**
6) The use of mechanical plant and equipment may be restricted in areas close to sensitive receivers, such as adjoining rural-residential development and educational establishments.	**Sections 4, 5, 6**
7) Building design is to incorporate noise amelioration features. Roof elements are to control potential breakout noise, having regard to surrounding topography.	**Section 4, 5, 6**
8) Boundary fences are to incorporate noise amelioration features and control breakout noise having regard to developments adjoining rural-residential areas.	**Section 6**
9) Development shall comply with the relevant Australian Standards for noise and vibration.	**Sections 3.2, 4.1, 5.2, 7.1**
10) A qualified acoustical consultant is to certify any acoustic design measures have been satisfactorily incorporated into the development at construction certificate stage and validate the criteria at occupation certificate stage.	Will be undertaken following approval at construction certificate stage and occupation certificate stage

1.3 EIS Submission Comments

Comments on the exhibited EIS were received from the Department of Planning, Housing and Infrastructure (DPHI) on 3 April 2024. The comments related to the Noise and Vibration Impact Assessment are shown in **Table 3**.

Table 3 DPHI Comments

Comment	Response / where Addressed
Clarify how cumulative noise from development across the precinct was considered with regard to section 3.3.1.3 of the Noise and Vibration Impact Assessment (NVIA) and the identified development sites in Appendix C, noting that section 2.4.2 of the NPfI refers to 'additional premises' and that most of the identified sites are not just one building but comprise multiple premises. Clarify what industrial noise sources were considered as part of the assessment of cumulative noise and the influence of future development on surrounding industrial land, including the impact from changes to ground absorption due to hard surfaces replacing undeveloped land.	The Noise Policy for Industry (NPfI) states that it aims to limit continuing increases in cumulative industrial noise through the application of amenity noise levels, which are applicable to all industrial noise sources in an area. The NPfI accounts for potential cumulative impacts by lowering the criteria for each individual development to ensure that the combined noise level from all industrial noise sources remains below the recommended amenity noise levels, where feasible and reasonable. As such, the potential cumulative impacts from the proposal and other potential sources of industrial noise in the area are accounted for in the proposal-specific Project Noise Trigger Levels (PNTL) (see **Section 3.3.1**). The noise model for the proposal has been updated to be consistent with more recent noise assessments within the MRP. Updates include the use of the ISO 9613-2 algorithm for noise prediction, modelling indicative adjacent warehouse buildings and modelling hard ground to represent the hard surfaces replacing undeveloped land (see methodology in **Section 4.2** and assessment in **Section 5.3**).
Provide an assessment of cumulative construction noise with regard to concurrent construction activity occurring on other parts of the Westlink estate and other sites within the MRP.	The potential for cumulative construction noise is considered in **Section 6.1**.
Clarify whether the NVIA included consideration of heavy vehicles travelling along the private access road between Abbotts and Aldington Road, which has a gradient in some parts of 8%.	Vehicles are proposed to access Westlink Stage 2 directly from Aldington Road, which is planned to be extended through the Westlink Industrial Estate as a public road. However, the timing of the Aldington Road extension is not known at the time of this assessment and Westlink Stage 2 would likely operate for a period prior to the road connection opening. In the interim, vehicles accessing Westlink Stage 2 would use a private east to west access road. The assessment has been updated to consider this scenario for the operational noise at receivers within the MRP (see methodology in **Section 4.2** and assessment in **Section 5.3**).
Include consideration of mitigation measures that could further reduce predicted noise at the identified receivers outside of the MRP.	A detailed assessment of all potential feasible and reasonable mitigation measures that could be applied to the development to minimise the impacts has been completed and is summarised in **Section 7.2**.

Comment	Response / where Addressed
As the development seeks to establish future development pads across the remainder of the site, consideration should be given as to whether future development on these lots will able to achieve compliance with the noise criteria for the precinct and be able to be managed as part of the cumulative noise generated with the other parts of the Westlink Industrial Estate.	The establishment of future development pads across the remainder of the Westlink estate will be covered by separate approval applications. **Figure 1** has been updated to only show Westlink Stage 2.

2 Existing Noise Environment and Sensitive Receivers

2.1 Nearest Receivers

Sensitive receivers in the area surrounding the development have been identified and Noise Catchment Areas (NCAs) have been defined. These are summarised in **Table 4** and shown in **Figure 2**. The sensitive receivers are divided into those within the MRP and those outside the MRP.

The MRP was rezoned on 11 June 2020 to create additional industrial land for Western Sydney to meet projected demand. This included rezoning all existing receivers within the MRP to industrial. The rezoning delivered around 850 hectares of industrial land that can be readily serviced and developed, is integrated with the existing Western Sydney Employment Area (WSEA) and in close proximity to the Aerotropolis. The strategic intent is for the MRP to become a warehousing industrial hub providing around 17,000 new jobs in Western Sydney.

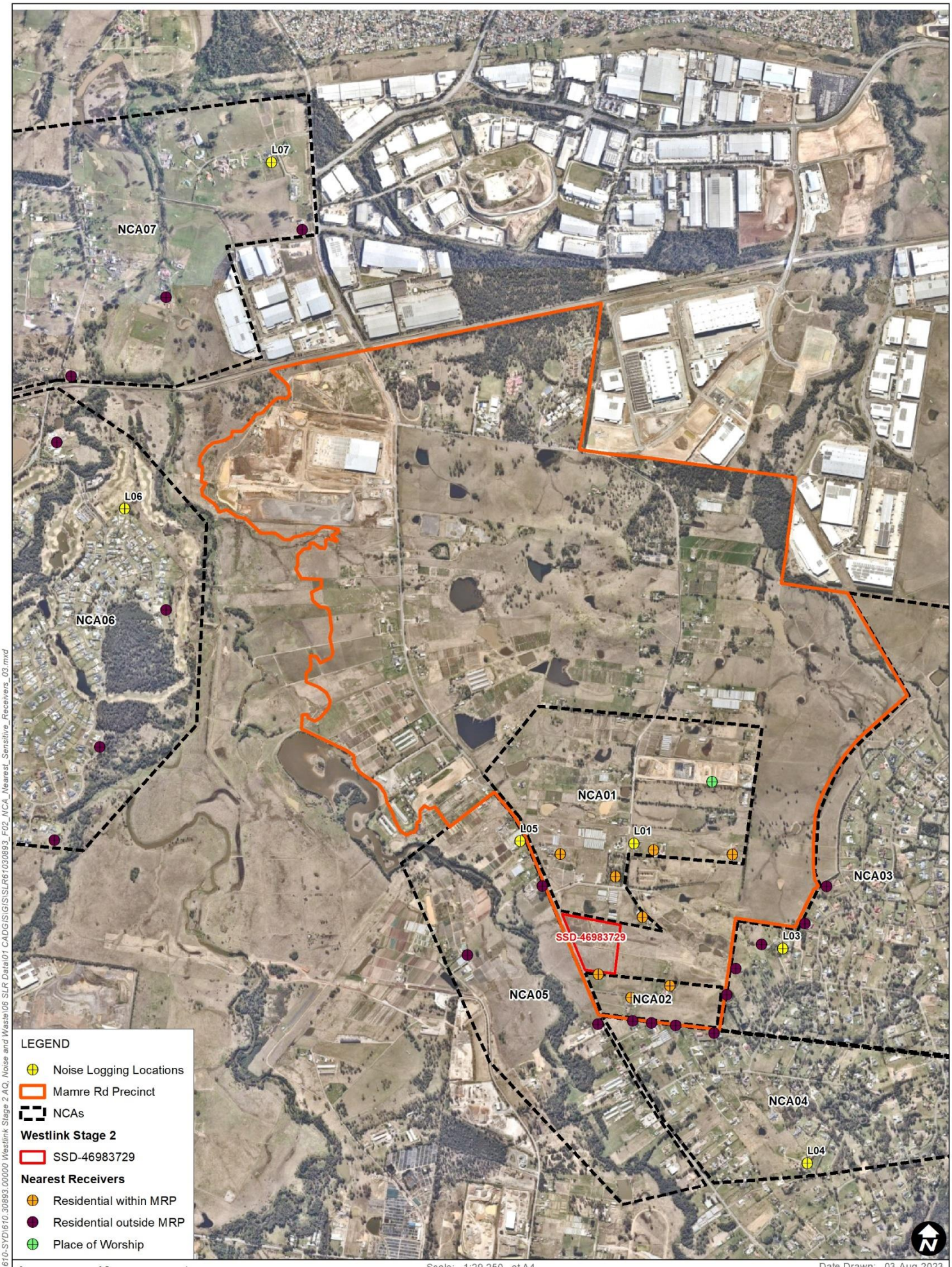
Various SSDAs have been submitted (or are in the process of being submitted) for much of the land within the MRP. It is understood that ultimately, all existing receivers within the MRP will be redeveloped into future industrial land uses.

Table 4 NCAs and Sensitive Receivers

Location	NCA	Direction	Receiver Type	Closest Distance (m)
Within MRP (now zoned industrial)	NCA01	North	Residential	150 m
	NCA01-PW	Northeast	Place of Worship (BAPS Shri Swaminarayan Mandir)	950 m
	NCA02	South	Residential	50 m
Outside MRP	NCA03	East	Residential	350 m
	NCA04	South	Residential	300 m
	NCA05[1]	West	Residential	250 m
	NCA06	Northwest	Residential	3000 m
	NCA07	North	Residential	4500 m

Note 1: Some receivers in NCA05 are located within the Western Sydney Aerotropolis precinct.

It is noted that there are other residential receivers within the MRP further to the east of NCA03 and south of NCA04. These have not been included in the assessment as they are more distant than the receivers identified for assessment in NCA03 and NCA04.



Scale: 1:29,250 at A4
Coordinate System: GDA2020 MGA Zone 56

Date Drawn: 03-Aug-2023
Project Number: 610.30893

Data Source:
Nearmap Imagery Sep 2022

SLR

NCA'S AND NEAREST SENSITIVE RECEIVERS

FIGURE 2

H:\Projects-SLR\610-SrvSYD\610-SYD\610.30893.00000 Westlink Stage 2 AQ, Noise and Waste\06 SLR Data\01 CADG\SIG\SLR610.30893_F02_NCA_Nearest_Sensitive_Receivers_03.mxd

2.2 Existing Noise Survey and Monitoring Locations

The existing noise environment in the area is typically dominated by road traffic noise from Mamre Road, with rural ambient noise becoming dominant at distances further back from existing roads. Industrial noise from existing premises also influences the noise environment at receivers close to those premises.

A combination of previously measured existing noise levels and noise monitoring undertaken for this proposal has been used. The measured noise levels have been used to determine the existing noise environment and to set the criteria used to assess the potential impacts from the proposal.

The monitoring equipment was positioned to measure existing noise levels that are representative of receivers potentially most affected by the proposal, within constraints such as accessibility, security and landowner permission.

The noise monitoring equipment continuously measured existing noise levels in 15-minute periods during the daytime, evening and night-time. All equipment carried current National Association of Testing Authorities (NATA) or manufacturer calibration certificates and equipment calibration was confirmed before and after each measurement.

The measured data has been processed to exclude noise from extraneous events and periods affected by adverse weather conditions, such as strong wind or rain (measured at Horsley Park Equestrian Centre AWS), to establish representative existing noise levels in each NCA.

The noise monitoring locations are shown in **Figure 2** and the results are summarised in **Table 5**. Details of each monitoring location together with graphs of the measured daily noise levels are provided in **Appendix B**.

A morning shoulder period has been used for this assessment, in accordance with the NPfI:

> *"where early morning (5 am to 7 am) operations are proposed, it may be unreasonable to expect such operations to be assessed against the night-time project noise trigger levels – especially if existing background noise levels are steadily rising in these early morning hours."*

Heavy vehicle operations of the proposal commence at 6 am, and the existing noise environment is dominated by road traffic noise with steadily rising noise levels in these early morning 5 am to 7 am period.

Table 5 Summary of Unattended Noise Monitoring Results

ID	NCA	Address	Measured Noise Levels (dBA)[1]							
			Background Noise (RBL)				Average Noise (L_{Aeq})			
			Day	Evening	Night	Morning Shoulder	Day	Evening	Night	Morning Shoulder
L01[2]	NCA01, NCA02	286 Aldington Rd, Kemps Creek	34	34	33	*34*[5]	47	48	46	*47*[5]
L03	NCA03	62 Mount Vernon Rd, Mount Vernon	36	36	33	39	50	44	43	45
L04	NCA04	26 Cressy Rd, Mount Vernon	42	40	35	44	53	48	47	51
L05	NCA05	981 Mamre Rd, Kemps Creek	48	46	34	50	61	59	57	60

ID	NCA	Address	Measured Noise Levels (dBA)[1]							
			Background Noise (RBL)				Average Noise (L_{Aeq})			
			Day	Evening	Night	Morning Shoulder	Day	Evening	Night	Morning Shoulder
L06[3]	NCA06	1 Medinah Avenue, Luddenham	37	36	33	*37*[5]	49	45	45	*49*[5]
L07[4]	NCA07	25-31 Mandalong Cl, Orchard Hills	41	42	35	*41*[5]	53	52	50	*53*[5]

Note 1: The assessment periods are the daytime which is 7 am to 6 pm Monday to Saturday and 8 am to 6 pm on Sundays and public holidays, the evening which is 6 pm to 10 pm, and the night-time which is 10 pm to 7 am on Monday to Saturday and 10 pm to 8 am on Sunday and public holidays. See the NSW EPA *Noise Policy for Industry*.

Note 2: Measured data from L01 taken from *RWDI report 2101343 Version B, dated February 2021*

Note 3: Measured data from L06 taken from *ARUP report SYD05-06-07_Y-R-0000 Revision 3, dated July 2021*

Note 4: Measured data from L07 taken from *SLR report 610.30064-R02-v1.0-20210719, dated July 2021.*

Note 5: Measured 'Morning Shoulder' values not specified in source report for this location. Daytime measured values have been used.

2.3 Attended Noise Measurements

Short-term attended noise monitoring was also completed at each monitoring location. The attended measurements allow the contributions of the various noise sources at each location to be determined. Detailed observations from the attended measurements are provided in **Appendix B**.

The attended measurements were generally found to be consistent with the results of the unattended noise monitoring and show that existing noise levels are typically dominated by road traffic noise from the surrounding road network.

3 Assessment Criteria

3.1 Construction Noise Criteria

3.1.1 Interim Construction Noise Guideline

The NSW *Interim Construction Noise Guideline* (ICNG) is used to assess and manage impacts from construction noise on residences and other sensitive land uses in NSW.

The ICNG contains procedures for determining project specific Noise Management Levels (NMLs) for sensitive receivers based on the existing background noise in the area. The 'worst-case' noise levels from construction of a proposal are predicted and then compared to the NMLs in a 15-minute assessment period to determine the likely impact of the proposal.

The NMLs are not mandatory limits, however, where construction noise levels are predicted or measured to be above the NMLs, feasible and reasonable work practices to minimise noise emissions are to be investigated.

3.1.1.1 Residential Receivers

The ICNG approach for determining NMLs at residential receivers is shown in **Table 6**.

Table 6 ICNG NMLs for Residential Receivers

Time of Day	NML $L_{Aeq(15minute)}$	How to Apply
Standard Construction Hours Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	Noise affected RBL[1] + 10 dB	• The noise affected level represents the point above which there may be some community reaction to noise • Where the predicted or measured $L_{Aeq(15minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices 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.

	Highly Noise Affected 75 dBA	• The Highly Noise Affected (HNA) level represents the point above which there may be strong community reaction to noise
		• Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that 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.

Outside Standard Construction Hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours • The proponent should apply all feasible and reasonable work practices to meet the noise affected level • Where all feasible and reasonable practises have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1: The RBL is the Rating Background Level and the ICNG refers to the calculation procedures in the NSW *Industrial Noise Policy* (INP). The INP has been superseded by the NSW EPA *Noise Policy for Industry* (NPfI).

3.1.1.2 'Other Sensitive' Land Uses

The ICNG NMLs for 'other sensitive' non-residential land uses are shown in **Table 7**.

Table 7 Construction NMLs at 'Other Sensitive' Land Uses

Land Use	Noise Management Level $L_{Aeq(15minute)}$ (dBA) (applied when the property is in use)	
	Internal	External
ICNG 'Other Sensitive' Receivers		
Classrooms at schools and other educational institutions	45	55[1]
Places of worship	45	55[1]
Non-ICNG 'Other Sensitive' Receivers		
n/a	n/a	n/a

Note 1: It is assumed that these receivers have windows partially open for ventilation which results in internal noise levels being around 10 dB lower than the external noise level.

3.1.1.3 NML Summary

The construction NMLs are summarised in **Table 8**.

Table 8 Construction Noise Management Levels

NCA	Receiver Type	Monitoring Location	Measured RBL[1] – dBA			NML ($L_{Aeq(15minute)}$ – dBA)				Sleep Disturbance Screening Level[2] (L_{Amax} dBA)
						Standard Construction Hours (RBL+10dB)	Out of Hours (RBL+5dB)			
			Day	Eve.	Night	Day	Day	Eve.	Night	Night
NCA01	Residential	L01	35[4]	34	33	45	40	39	38	52
NCA02	Residential	L01	35[4]	34	33	45	40	39	38	52
NCA03	Residential	L03	36	36	33	46	41	41	38	52
NCA04	Residential	L04	42	40	35	52	47	45	40	52
NCA05	Residential	L05	48	46	34	58	53	51	39	52
NCA06	Residential	L06	37	36	33	47	42	41	38	52
NCA07	Residential	L07	41	41[5]	35	51	46	46	40	52
All	Place of Worship	n/a				External noise level 55 dBA when in use[3]				n/a

Note 1: RBL = Rating Background Level.

Note 2: Sleep disturbance screening level is RBL+15 dB or 52 dBA, whichever is higher.

Note 3: The criterion is specified as an internal noise level for this receiver category. As the noise model predicts external noise levels, it has been conservatively assumed that these receiver types have openable windows and external noise levels are therefore 10 dB higher than the corresponding internal level, which is generally considered representative of windows being partially open for ventilation.

Note 4: The NPfI minimum RBL value has been used due to the measured RBL being below the NPfI minimum value.

Note 5: The evening RBL has been reduced to match the daytime RBL due to the measured evening RBL being higher than the daytime, as outlined in the NPfI.

3.2 Construction Vibration Guidelines

The effects of vibration from construction works can be divided into three categories:

- Those in which the occupants of buildings are disturbed (human comfort)
- Those where building contents may be affected (building contents)
- Those where the integrity of the building may be compromised (structural or cosmetic damage).

3.2.1 Human Comfort Vibration

People can sometimes perceive vibration impacts when vibration generating construction works are located close to occupied buildings.

Vibration from construction works tends to be intermittent in nature and the EPA's *Assessing Vibration: a technical guideline* (2006) provides criteria for intermittent vibration based on the Vibration Dose Value (VDV). The 'preferred' and 'maximum' VDVs for human comfort impacts are shown in **Table 9**.

Table 9 Vibration Dose Values for Intermittent Vibration

Building Type	Assessment Period	Vibration Dose Value[1] ($m/s^{1.75}$)	
		Preferred	Maximum
Critical Working Areas (eg operating theatres or laboratories)	Day or night-time	0.10	0.20
Residential	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

Note 1: The VDV accumulates vibration energy over the daytime and night-time assessment periods, and is dependent on the level of vibration as well as the duration.

3.2.2 Effects on Building Contents

People perceive vibration at levels well below those likely to cause damage to building contents. For most receivers, the human comfort vibration criteria are the most stringent and it is generally not necessary to set separate criteria for vibration effects on typical building contents.

Exceptions to this can occur when vibration sensitive equipment, such as electron microscopes, are located in buildings near to construction works. No such items of equipment have been identified in the proposal area.

3.2.3 Structural and Cosmetic Damage Vibration

If vibration from construction works is sufficiently high it can cause damage to structural elements of affected buildings. The levels of vibration required to cause cosmetic damage tend to be at least an order of magnitude (10 times) higher than those at which people can perceive vibration.

Examples of damage that can occur includes cracks or loosening of drywall surfaces, cracks in supporting columns and loosening of joints. Structural damage vibration limits are contained in British Standard BS 7385 and German Standard DIN 4150.

BS 7385

British Standard BS 7385 recommends vibration limits for transient vibration judged to give a minimal risk of vibration induced damage to affected buildings. The limits for residential and industrial buildings are shown in **Table 10**.

Table 10 BS 7385 Transient Vibration Values for Minimal Risk of Damage

Group	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures. Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Note 1: Where the dynamic loading caused by continuous vibration may give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values may need to be reduced by up to 50%.

For heritage buildings, the standard states that *"a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive"*.

DIN 4150

German Standard DIN 4150 also provides guideline vibration limits for different buildings. Damage is not expected to occur where the values are complied with and the values are generally recognised to be conservative. The DIN 4150 values for buildings and structures are shown in **Table 11**.

Table 11 DIN 4150 Guideline Values for Short-term Vibration on Structures

Group	Type of Structure	Guideline Values Vibration Velocity (mm/s)				
		Foundation, All Directions at a Frequency of			Topmost Floor, Horizontal	Floor Slabs, Vertical
		1 to 10 Hz	10 to 50 Hz	50 to 100 Hz	All frequencies	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40	20
2	Residential buildings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15	20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified as Group 1 or 2 **and** are of great intrinsic value (eg heritage listed buildings)	3	3 to 8	8 to 10	8	20[1]

Note 1: It may be necessary to lower the relevant guideline value markedly to prevent minor damage.

3.2.4 Minimum Working Distances for Vibration Intensive Works

Minimum working distances for typical vibration intensive construction equipment are provided in the Roads and Maritime (now Transport for NSW) *Construction Noise and Vibration Guideline* (CNVG) and are shown in **Table 12**. The minimum working distances are for both cosmetic damage (from BS 7385 and DIN 4150) and human comfort (from the NSW EPA Vibration Guideline). They are based on empirical data which suggests that where works are further from receivers than the quoted minimum distances then impacts are not considered likely.

Table 12 Recommended Minimum Working Distances from Vibration Intensive Equipment

Plant Item	Rating/Description	Minimum Distance		
		Cosmetic Damage		Human Response (NSW EPA Guideline)
		Residential and Light Commercial (BS 7385)	Heritage Items (DIN 4150, Group 3)	
Vibratory Roller	<50 kN (1–2 tonne)	5 m	11 m	15 m to 20 m
	<100 kN (2–4 tonne)	6 m	13 m	20 m
	<200 kN (4–6 tonne)	12 m	25 m	40 m
	<300 kN (7–13 tonne)	15 m	31 m	100 m
	>300 kN (13–18 tonne)	20 m	40 m	100 m
	>300 kN (>18 tonne)	25 m	50 m	100 m
Small Hydraulic Hammer	300 kg (5 to 12 t excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	900 kg (12 to 18 t excavator)	7 m	15 m	23 m
Large Hydraulic Hammer	1,600 kg (18 to 34 t excavator)	22 m	44 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	5 m to 40 m	20 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	5 m	4 m
Jackhammer	Hand held	1 m (nominal)	3 m	2 m

The minimum working distances are indicative and will vary depending on the particular item of equipment and local geotechnical conditions. The distances apply to cosmetic damage of typical buildings under typical geotechnical conditions.

3.3 Operational Noise Criteria

3.3.1 Noise Policy for Industry

The NSW *Noise Policy for Industry* (NPfI) was released in 2017 and sets out the requirements for the assessment and management of operational noise from industry in NSW.

3.3.1.1 Industrial Noise Trigger Levels

The NPfI defines how to determine 'trigger levels' for noise emissions from industrial developments. Where a development is likely to exceed the trigger levels at existing noise sensitive receivers, feasible and reasonable noise management measures are required to be considered to reduce the impacts.

There are two types of trigger levels – one to account for 'intrusive' noise impacts and one to protect the 'amenity' of particular land uses:

- The **intrusiveness** of an industrial noise source is generally considered acceptable if the L_{Aeq} noise level of the source, measured over a period of 15-minutes, does not exceed the representative background noise level by more than 5 dB. Intrusive noise levels are only applied to residential receivers. For other receiver types, only the amenity levels apply.
- To limit continual increases in noise levels from the use of the intrusiveness level alone, the ambient noise level within an area from all industrial sources should remain below the recommended **amenity** levels specified in the NPfI for that particular land use.

Intrusive and amenity noise levels are not used directly as regulatory limits. They are used to assess the potential impact of noise, assess feasible and reasonable mitigation options and subsequently determine achievable noise requirements.

3.3.1.2 Sleep Disturbance

The potential for sleep disturbance from maximum noise level events during the night-time period from the development is required to be considered.

The NPfI defines the sleep disturbance screening level as 52 dBA L_{AFmax} or the prevailing background level plus 15 dB, whichever is greater.

A detailed maximum noise level event assessment should be completed where the sleep disturbance screening level is exceeded. The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the RBL, and the number of times this happens during the night-time period.

The NPfI refers to the *Road Noise Policy* (RNP) for additional information regarding sleep disturbance. enHealth Council studies are referenced which indicate that for short-term or transient noise events, for good sleep over eight hours the indoor L_{AFmax} sound pressure level should ideally not exceed around 45 dBA more than 10 or 15 times per night.

The RNP goes on to conclude that from the research on sleep disturbance to date:

- Maximum internal noise levels below 50 dBA to 55 dBA are unlikely to awaken people from sleep
- One or two events per night with maximum internal noise levels of 65-70 dBA are not likely to affect health and wellbeing significantly.

3.3.1.3 Project Noise Trigger Levels

Project Noise Trigger Levels (PNTLs) were determined based on the intrusiveness and amenity criteria, in accordance with the *Noise Policy for Industry* (NPfI). All surrounding receivers have been assumed to be rural.

Amenity criteria for each NCA have been determined using the approach to cumulative noise impacts detailed in Section 2.4.2 of the NPfI *"Amenity noise levels in areas near an existing or proposed cluster of industry"*. This approach sets appropriate amenity criteria for individual developments based on the total number of developments contributing to industrial noise levels in a particular NCA. The potentially contributing industrial sites for each NCA are shown in **Appendix C**.

The intention of this approach is to ensure that the total cumulative industrial noise levels from the MRP (and any existing industrial sites, where appropriate) remain compliant with the overall amenity goals. A summary of the PNTLs is provided in **Table 13**.

Table 13 Operational Project Noise Trigger Levels

NCA	Receiver Type	Monitoring Location	Period	Recommended Amenity Noise Level $L_{Aeq(period)}$ (dBA)	Measured Noise Level (dBA)		Number of Contributing Developments[2]	Project Noise Trigger Levels $L_{Aeq(15minute)}$ (dBA)		Sleep Disturbance Screening Level[6] (L_{Amax} dBA)
					RBL[1]	L_{Aeq} (period)		Intrus-iveness	Amenity [3,4]	
NCA01	Residential	L01	Day	50	35[5]	47	11	**40**	43	n/a
			Evening	45	34	48		39	**38**	n/a
			Night	40	33	46		38	**33**	52
			Morning Shoulder	50[9]	*34*[7]	*47*[7]		**39**	43	52
NCA01 -PW	Place of Worship[8]	n/a	When in use	50	n/a	n/a	11	n/a	**43**	n/a
NCA02	Residential	L01	Day	50	35[5]	47	10	**40**	43	n/a
			Evening	45	34	48		39	**38**	n/a
			Night	40	33	46		38	**33**	52
			Morning Shoulder	50[9]	*34*[7]	*47*[7]		**39**	43	52
NCA03	Residential	L03	Day	50	36	50	11	**41**	43	n/a
			Evening	45	36	44		41	**38**	n/a
			Night	40	33	43		38	**33**	52
			Morning Shoulder	50[9]	39	45		44	**43**	54
NCA04	Residential	L04	Day	50	42	53	11	47	**43**	n/a
			Evening	45	40	48		45	**38**	n/a
			Night	40	35	47		40	**33**	52
			Morning Shoulder	50[9]	44	51		49	**43**	59

NCA	Receiver Type	Monitoring Location	Period	Recommended Amenity Noise Level $L_{Aeq(period)}$ (dBA)	Measured Noise Level (dBA)		Number of Contributing Developments[2]	Project Noise Trigger Levels $L_{Aeq(15minute)}$ (dBA)		Sleep Disturbance Screening Level[6] (L_{Amax} dBA)
					RBL[1]	L_{Aeq} (period)		Intrusiveness	Amenity[3,4]	
NCA05	Residential	L05	Day	50	48	61	11	53	**43**	n/a
			Evening	45	46	59		51	**38**	n/a
			Night	40	34	57		39	**33**	52
			Morning Shoulder	50[9]	50	60		55	**43**	65
NCA06	Residential	L06	Day	50	37	49	9	**42**	43	n/a
			Evening	45	36	45		41	**38**	n/a
			Night	40	33	45		38	**33**	52
			Morning Shoulder	50	*37*[7]	*49*[7]		**42**	43	52
NCA07	Residential	L07	Day	50	41	53	7	46	**45**	n/a
			Evening	45	41[10]	52		46	**40**	n/a
			Night	40	35	50		40	**35**	52
			Morning Shoulder	50	*41*[7]	*53*[7]		46	**45**	56

Note 1: RBL = Rating Background Level.

Note 2: Number of existing and proposed industrial developments potentially contributing to the industrial noise levels in this NCA (refer to **Appendix C**).

Note 3: The recommended amenity noise levels have been reduced based on the NPfI formula for clusters of industry, using the recommended amenity noise level. This addresses the potential cumulative impacts from the development and any existing/future projects.

Note 4: The project amenity noise levels have been converted to a 15-minute level by adding 3 dB, as outlined in the NPfI.

Note 5: The NPfI minimum RBL value has been used due to the measured RBL being below the NPfI minimum value.

Note 6: Sleep disturbance screening level is RBL+15 dB or 52 dBA, whichever is higher.

Note 7: Measured 'Morning Shoulder' values not specified in source report for this location. Daytime measured values have been used.

Note 8: The criterion is specified as an internal noise level for this receiver category. As the noise model predicts external noise levels, it has been conservatively assumed that all 'places of worship' have openable windows and external noise levels are therefore 10 dB higher than the corresponding internal level, which is generally considered representative of windows being partially open for ventilation.

Note 9: The project amenity noise level for the morning shoulder period is the same as the project amenity noise level for the corresponding day period.

Note 10: The evening RBL has been reduced to match the daytime RBL due to the measured evening RBL being higher than the daytime, as outlined in the NPfI.

3.3.2 Corrections for Annoying Noise Characteristics

Sources of industrial noise can cause greater annoyance where they contain certain characteristics, such as tonality, intermittency or dominant low-frequency content. The NPfI specifies the following modifying factor corrections, shown in **Table 14**, which are to be applied where annoying characteristics are present. The corrections are to be added to the noise level at the receiver before comparison with the Project Noise Trigger Levels.

Table 14 NPfI Modifying Factor Corrections

Factor	Assessment/Measurement	When to Apply	Correction[1]
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by the levels defined in the NPfI.	5 dB[2]
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements	Measure/assess source contribution C and A weighted Leq,t levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and the level to which the thresholds defined in the NPfI are exceeded.	2 or 5 dB[2]
Intermittent noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level	The source noise heard at the receiver varies by more than 5 dB and the intermittent nature of the noise is clearly audible. The NPfI further defines intermittent noise as noise where the level suddenly drops/increases several times during the assessment period, with a noticeable change in source noise level of at least 5 dB, for example, equipment cycling on and off. The intermittent correction does not apply to short-term events that emerge above the general industrial noise level and is therefore not applicable to industrial or commercial sites that have vehicle or plant movements at night, including audible reversing alarms. The intermittency correction is not intended to be applied to changes in noise level due to meteorology.	5 dB[3]
Maximum adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated.	Maximum correction of 10 dB[2] (excluding duration correction)

Note 1: Corrections to be added to the measured or predicted levels.

Note 2: Where a source emits tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

Note 3: Adjustment to be applied to night-time only.

Details of the modifying factor corrections applied in the assessment are provided in **Section 4.2**.

3.3.3 Traffic on Surrounding Roads

The potential impacts from proposal related traffic on the surrounding public roads are assessed using the NSW EPA *Road Noise Policy* (RNP).

An initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2.0 dB. Where this is considered likely, further assessment is required using the RNP criteria shown in **Table 15**.

Table 15 RNP/NCG Criteria for Assessing Traffic on Public Roads

Road Category	Type of Project/Land Use	Assessment Criteria (dBA)	
		Daytime (7 am – 10 pm)	**Night-time (10 pm – 7 am)**
Freeway/ arterial/ 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 (external)	$L_{Aeq(9hour)}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hour)}$ 55 (external)	$L_{Aeq(1hour)}$ 50 (external)

4 Assessment Methodology

4.1 Construction Noise and Vibration Assessment Methodology

A noise model of the study area has been used to predict noise levels from the proposed construction work to all surrounding receivers. The model uses ISO 9613 algorithms in SoundPLAN software.

Local terrain, receiver buildings and structures were digitised in the noise model to develop a three-dimensional representation of the construction sites and surrounding areas.

4.1.1 Construction Activities

Representative scenarios have been developed to assess the likely impacts from the various construction phases of the proposal. These scenarios are shown in **Table 16**.

The assessment uses 'realistic worst-case' scenarios to determine the impacts from the noisiest 15-minute period that are likely to occur for each work scenario, as required by the ICNG. The impacts represent construction noise levels without mitigation applied.

The sound power levels for the construction equipment used in each scenario is presented in **Appendix D.**

Table 16 Construction Equipment

Scenario ID	Works Activity	Equipment
W.01	Vegetation clearing	Chainsaw, chipper, dozer, dump truck, excavator, front end loader, water truck
W.02	Earthworks	Dozer, dump truck, excavator, front end loader, grader, vibratory roller, water truck
W.03	Excavation of hard rock	Dozer, dump truck, rockbreaker, excavator, front end loader, water truck
W.04	Construction of roads	Bitumen spray truck, line marking plant, paving machine, vibratory roller
W.05	Construction of pads and hardstands	Concrete pump, concrete truck/agitator, concrete vibrator
W.06	Construction of structures	Elevated working platform, flatbed truck, hand tools, mobile crane

4.1.2 Hours of Construction

Construction activities for the proposal would only be undertaken during the following standard daytime construction hours:

- 7:00 am to 6:00 pm, Mondays to Fridays
- 8:00 am to 1:00 pm on Saturdays
- At no time on Sundays or Public Holidays.

4.2 Operational Noise Assessment Methodology

Representative operational information for the future tenants of Westlink Stage 2 has been provided by the project team. This information has been used to develop representative worst-case noise modelling scenarios that reflect the highest noise emissions that the development would likely emit. The modelling assumptions are considered conservative and represent a realistic worst-case scenario, meaning contingency/risk factors or a sensitivity analysis are not required and have not been included in the assessment.

The potential operational noise levels from the proposal have been predicted to the surrounding receivers using the ISO 9613-2 algorithm in SoundPLAN V8.2, implemented in accordance with ISO 17534.

ISO 9613-2 is an industry standard algorithm that is considered suitable for use in the prediction of noise from industrial sources where intervening objects provide acoustic shielding, such as at the subject site and surrounding area.

The ISO 9613-2 algorithm predicts continuous A-weighted sound pressure levels under noise-enhancing meteorological conditions favourable to downwind propagation, or equivalently, propagation under a well-developed, moderate, ground-based temperature inversion, such as commonly occurs on clear calm nights.

Downwind propagation conditions include wind from source to receiver, with wind speeds of around 1 to 5 m/s, measured at a height of 3 to 11 m above the ground. These propagation conditions are considered consistent with the noise-enhancing weather conditions specified in *Fact Sheet D: Accounting for noise-enhancing weather conditions* of the NPfI.

ISO 9613-2 has been used extensively on industrial projects in Australia over several decades and has been accepted previously by NSW DPE (now DPHI) in numerous environmental noise assessments.

The model includes ground topography, ground type (ground absorption modelled at 0.75 in rural areas and 0.0 elsewhere), buildings and representative worst-case noise sources from the proposal.

The potential impacts have been determined by comparing the predicted worst-case noise levels to the NPfI PNTLs in a 15-minute assessment period.

Where proposed industrial estates within the MRP are located between the development site and the receivers outside of the MRP, indicative warehouse buildings have been modelled to account for screening provided by these future estates, as shown in **Appendix E**. Future warehouse buildings are based on an indicative layout of the MRP which considered the MRP Development Control Plan built form controls, including proposed road corridors and other easements, and existing ground levels. Buildings footprints in line with and south of Westlink have been provided by ESR. The indicative layout of buildings north of Westlink are based on Figure 1 of Renzo Tonin Report TN328-02F02 DNVR (r6) 'Aspect Industrial Estate Stage 2 Warehouse 9 Design Noise Verification Report,' issued 17 July 2023. All future buildings are indicative and subject to change in their respective development applications. The indicative warehouse buildings have not been included in the assessment of residential receivers within the MRP.

Vehicles are proposed to access Westlink Stage 2 directly from Aldington Road, which is planned to be extended through the Westlink Industrial Estate as a public road by the Penrith City Council. However, the timing of the Aldington Road extension is not known at the time of this assessment and Westlink Stage 2 would likely operate for a period prior to the road connection opening. In the interim, vehicles accessing Westlink Stage 2 would use a private east to west access road (see **Figure 3**). All off-site vehicle movements are assessed separately (see **Section 4.2.4** and **Section 5.3.3**).

Operational noise has been assessed based on the following two scenarios for receivers within and outside of the MRP, respectively.

- **Receivers within the MRP:**
  Westlink Stage 2 vehicles on private access road and on-site. No future indicative MRP buildings and soft ground (0.75) outside of the proposal.

- **Receivers outside of the MRP:**
  Westlink Stage 2 vehicles on-site only. Future indicative buildings and hard ground (0.0) are included for the MRP.

4.2.1 Operational Noise Sources

The development comprises of a warehouse building with associated ancillary offices, heavy vehicle access and hardstands, and light vehicle access and carparking. Vehicles would access the site from the main estate road connecting to Abbotts Road. Heavy vehicle deliveries would park in the hardstand loading areas or recessed loading docks while they are loaded/unloaded, before exiting the site. Light vehicle carparking is provided at the warehouse which would generally be used by staff.

Internal noise sources would generally be minimal and associated with typical logistical, distribution, warehousing and office space activities. There would be no use of manufacturing equipment within the warehouse.

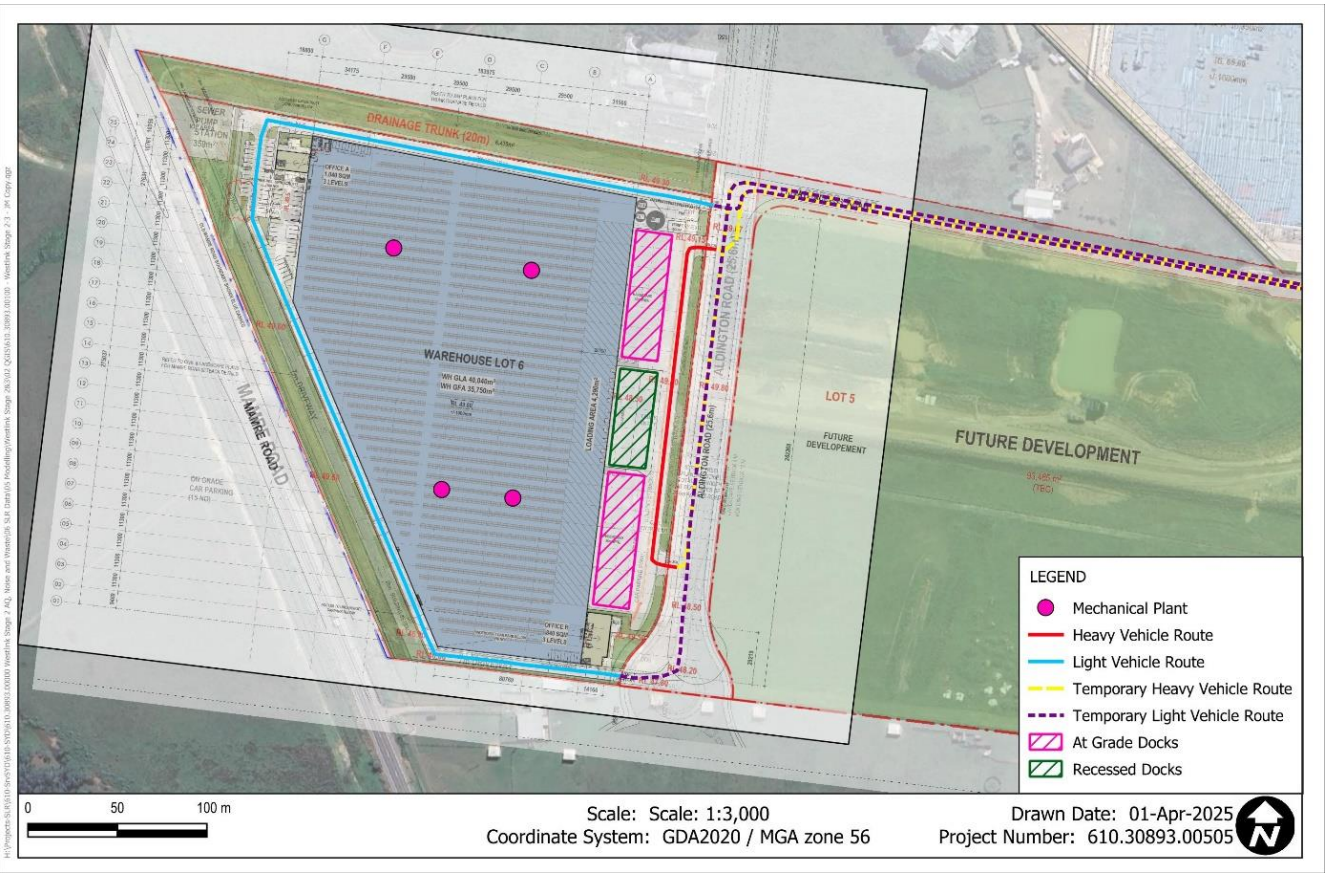
Roof mounted mechanical plant would be provided for each warehouse. The development would operate 24 hours a day.

The main sources of operational noise at the development are expected to include:

- On-site light and heavy vehicle movements
- Loading dock activities in hardstands
- Mechanical plant
- Off-site vehicle movements.

The location of all modelled noise sources is shown in **Figure 3**.

Figure 3 Noise Source Locations



A summary of the expected noise sources and worst-case assessment scenarios associated with the operation of the development is provided below.

On-Site Traffic

On-site vehicles have been modelled using the data in **Table 17**. The volumes are representative of the worst-case 15-minute period for the daytime, evening and night-time, based on hourly vehicle volumes provided by the project team. The volumes conservatively assume that light and heavy vehicles concurrently access the various warehouse tenancies during the worst-case 15-minute assessment period. In reality, vehicle access to the warehouse would be unlikely to occur concurrently, particularly during the night-time.

Heavy vehicles accessing the estate are anticipated to be around 30% rigid trucks, 40% semi-trailer trucks and 30% B-double trucks. For the purpose of modelling all heavy vehicles have conservatively assumed to be 'heavy trucks', with the assumed sound power level being representative of all trucks with three or more axles.

Table 17 Vehicle Traffic Data – Worst-case 15-Minute Period

Vehicle Type	Location	Sound Power Level (dBA)	Vehicle Speed (km/h)	Number of Vehicles in Worst-case 15-minute Period[1]			
				Daytime (7am to 6pm)	Evening (6pm to 10pm)	Night-time (10pm to 5am)	Morning Shoulder (5am to 7am)
Heavy trucks	Hardstands	108[2]	10	2	1	1	2
	Access Roads		25				
Rigid Trucks	Hardstands	97[3]	10	3	1	1	2
	Access Roads		25				
Light vehicles	Carparks and access	90[4]	20	13	3	3	13

Note 1: Total vehicles, includes both inbound and outbound vehicles. Volumes are rounded up to whole numbers for display purposes.

Note 2: Sound power level for 'heavy trucks' based on 106 dBA for trucks at slow speed for 80% of the time and 111 dBA for trucks accelerating for 20% of the time and is representative of trucks with three or more axles. Sound power level taken from the Federal Highway Administration's Traffic Noise Model and is representative of trucks with three or more axles.

Note 3: Sound power level for medium trucks based on measurement data. Based on 95 dBA for trucks at slow speed for 80% of the time and 100 dBA for trucks accelerating for 20% of the time.

Note 4: Sound power level for light vehicles based on measurement data.

Hardstands and Loading Docks

Details of the hardstand and loading dock noise sources are shown in **Table 18**. The various sources have been modelled in the hardstands (see **Figure 3**) based on the corresponding number of heavy vehicle movements in the worst-case 15-minute period (see **Table 17**).

Table 18 Typical Loading Dock Noise Sources

Noise Source	Sound Power Level (dBA)[1]	Typical Duration of Use in Worst-case 15-minute Period
Truck reversing alarm	107[2,3]	30 seconds
Forklift reversing alarm	102[2,3]	90 seconds
Truck air brakes	118	1 second
Roller door	94	15 seconds
Electric forklift	83	900 seconds

Note 1: SWLs based on measurement data, where appropriate.

Note 2: SWL based on recommendation to use broadband reversing alarms, see **Section 7.2**.

Note 3: SWL includes a -3 dB reduction due to alarms being discrete events.

Internal Activities

The future tenants of the warehouse would likely be associated with typical warehousing and distribution uses. Internal noise-generating activities at the warehouse are expected to generally be minimal. A sound power level of 75 dBA has been applied at openings in the facades of the warehouse to cover potential break-out noise from general internal activities, based on observations of loading activities at similar warehouse facilities. Warehouse roller shutter doors are assumed to be open during loading dock activities.

The facade and roof construction of the warehouse would be metal sheeting (Colourbond or similar). The proposed warehouse construction is expected to be sufficient to minimise noise breakout through the facade and roof to a level that results in negligible to external noise emissions.

Mechanical Plant

At this early stage of the development the specific mechanical plant requirements for the warehouse have not been determined. Reasonable assumptions have been made that the warehouse has fixed mechanical plant on the roof (see **Figure 3**) with an indicative cumulative SWL of 90 dBA.

4.2.2 Corrections for Annoying Noise Characteristics

The potential annoying noise characteristics and modifying factor corrections relevant to the project are:

- **Tonality** – the only source identified with potential tonal characteristics is reversing alarms. However, when considering broadband reversing alarms have been recommended as a noise mitigation measure (see **Section 7.2**), it is unlikely that this noise source would result in tonal noise impacts and no corrections have been applied.
- **Low frequency noise** – previous measurements of sources similar to those operating at the development indicate that no sources are expected to result in low frequency noise impacts.
- **Intermittent noise** – the NPfI defines intermittent noise as noise heard at the receiver where the level suddenly drops or increases several times during the assessment period, with a noticeable change of at least 5 dB, for example, where equipment cycles on and off. The intermittent correction does not apply to short-term events that emerge above the general industrial noise level and is therefore not applicable to industrial or commercial sites that have vehicle or plant movements at night, including audible reversing alarms. No sources have been identified with potential intermittent characteristics.

4.2.3 Noise Sources with Potential for Sleep Disturbance

As the development is proposed to operate 24-hours a day, noise emissions during the night-time require assessment for potential sleep disturbance at the nearest residential receivers. The details of typical activities with the potential to cause sleep disturbance are shown in **Table 19**.

Table 19 Sleep Disturbance Noise Events – L_{Amax} Sound Power Levels

Noise Source	Sound Power Level L_{Amax} (dBA)
Truck airbrakes in hardstands (recessed and at-grade docks)	118
Truck reversing alarm in hardstands (recessed and at-grade docks)	110
Forklift reversing alarm in hardstands (at-grade docks)	105
Roller doors	94
Accelerating trucks on estate roads, on-lot truck access and hardstands	111
Light vehicle movements on estate roads, carparks and light-vehicle access	100

4.2.4 Off-site Road Traffic

Traffic associated with the development would enter and exit from Abbotts Road. Traffic would travel west to Mamre Road, then north or south along Mamre Road. The potential noise impacts from additional traffic have been assessed based on traffic data shown in **Table 20**.

Table 20 Traffic Volumes

Road	Existing Traffic volumes (2018)[1]				Development Related Traffic Volumes			
	Daytime (7am to 10pm)		Night-time (10pm to 7am)		Daytime (7am to 10pm)		Night-time (10pm to 7am)	
	Light	Heavy[2]	Light	Heavy[2]	Light	Heavy	Light	Heavy
Mamre Road (north of Bakers Lane) weekday average	16,088	1,788	3,561	396	225	163	34	44
Mamre Road (north of Bakers Lane) seven-day average	13,665	1,518	2,961	329				

Note 1: Existing traffic volumes adopted from the *Summit at Kemps Creek SSD-30628110 Noise Impact Assessment* (SLR, 2022).

Note 2: Heavy Vehicle volumes assumed to be 10% of the total existing traffic volumes.

4.2.5 Weather Conditions

Fact Sheet D of the NPfI requires noise assessments to consider the potential effects of noise-enhancing weather conditions, such as wind from the source to the receiver and/or temperature inversions.

The nearest sensitive receivers are within 200 m of the proposal site and the effects of weather on noise levels are expected to be minimal. Notwithstanding, the noise prediction modelling uses ISO 9613-2 algorithms which include noise-enhancing weather conditions including downwind propagation, or equivalently, propagation under a well-developed moderate ground-based temperature inversion.

As such, the assessment has conservatively applied noise-enhancing weather conditions for all periods as per Option 1 of Fact Sheet D of the NPfI.

5 Assessment of Impacts

5.1 Construction Noise Predictions

The predicted construction noise levels at the most-affected sensitive receivers surrounding the site are shown in **Table 21** and the exceedances of the NMLs are shown in **Table 22**. An explanation of acoustic terminology and sound pressure levels is provided in **Appendix A**.

The predictions represent a realistic worst-case scenario where the equipment in each scenario is working concurrently at the nearest location to each receiver. It is expected that noise levels would frequently be lower than the worst-case levels presented.

Table 21 Predicted Construction Noise Levels at Nearest Receivers

NCA	Type	NML (Day)	Predicted Noise Level – $L_{Aeq(15minute)}$ (dBA)					
			W.01 Vegetation clearing	W.02 Earthworks	W.03 Hard rock excavation	W.04 Roads	W.05 Hardstands	W.06 Structures
NCA01	Residential	45	69	64	66	54	46	43
NCA01-PW	Place of Worship	55	49	44	46	35	28	25
NCA02	Residential	45	73	68	70	63	44	41
NCA03	Residential	46	70	65	67	43	32	29
NCA04	Residential	52	56	51	53	45	38	35
NCA05	Residential	58	56	51	53	43	42	39
NCA06	Residential	47	28	23	25	17	<20	<20
NCA07	Residential	51	21	<20	<20	<20	<20	<20

Note 1: Worst-case predicted noise levels are representative of the 'noisiest' construction periods during concurrent operation of equipment in the closest location to the most-affected receivers in each NCA.

Table 22 Predicted Exceedance at Nearest Receivers

NCA	Type	NML (Day)	Exceedance (dB)					
			W.01 Vegetation clearing	W.02 Earthworks	W.03 Hard rock excavation	W.04 Roads	W.05 Hardstands	W.06 Structures
NCA01	Residential	45	24	19	21	6	-	-
NCA01-PW	Place of Worship	55	-	-	-	-	-	-
NCA02	Residential	45	28	23	25	18	-	-
NCA03	Residential	46	24	19	21	-	-	-
NCA04	Residential	52	3	-	-	-	-	-
NCA05	Residential	58	-	-	-	-	-	-
NCA06	Residential	47	-	-	-	-	-	-
NCA07	Residential	51	-	-	-	-	-	-
Legend (NML exceedances)		= Minor to marginal (1 to 10 dB exceedance)		= Moderate (11 to 20 dB exceedance)			= High (>20 dB exceedance)	

The above worst-case predictions show the following:

- Noise levels during construction are expected to exceed the NMLs at the nearest receivers during certain stages of the work.
- The highest exceedances are seen during work which uses noise intensive equipment, such as wood chippers or rockbreakers. Exceedances of around 20 to 25 dB are predicted when these items of equipment are being used in areas of the site near to receivers in NCA01, NCA02 and NCA03, during activities such as 'vegetation clearing' or 'excavation of hard rock'. Noise intensive equipment is likely to only be required for relatively short durations.
- Noise levels during less noisy activities or in NCAs that are further from the site are predicted to result in lower impacts or be compliant with the goals.
- No receivers are predicted to be highly noise affected (ie ≥75 dBA) during any of the construction work.
- It is noted that all work is expected to be completed during standard daytime construction hours.

The presented worst-case impacts would only be expected to occur when noisy work is being completed close to the most-affected receivers. When work is in other areas of the site, or when less noise intensive equipment is being used, the noise levels and impacts are expected to reduce accordingly.

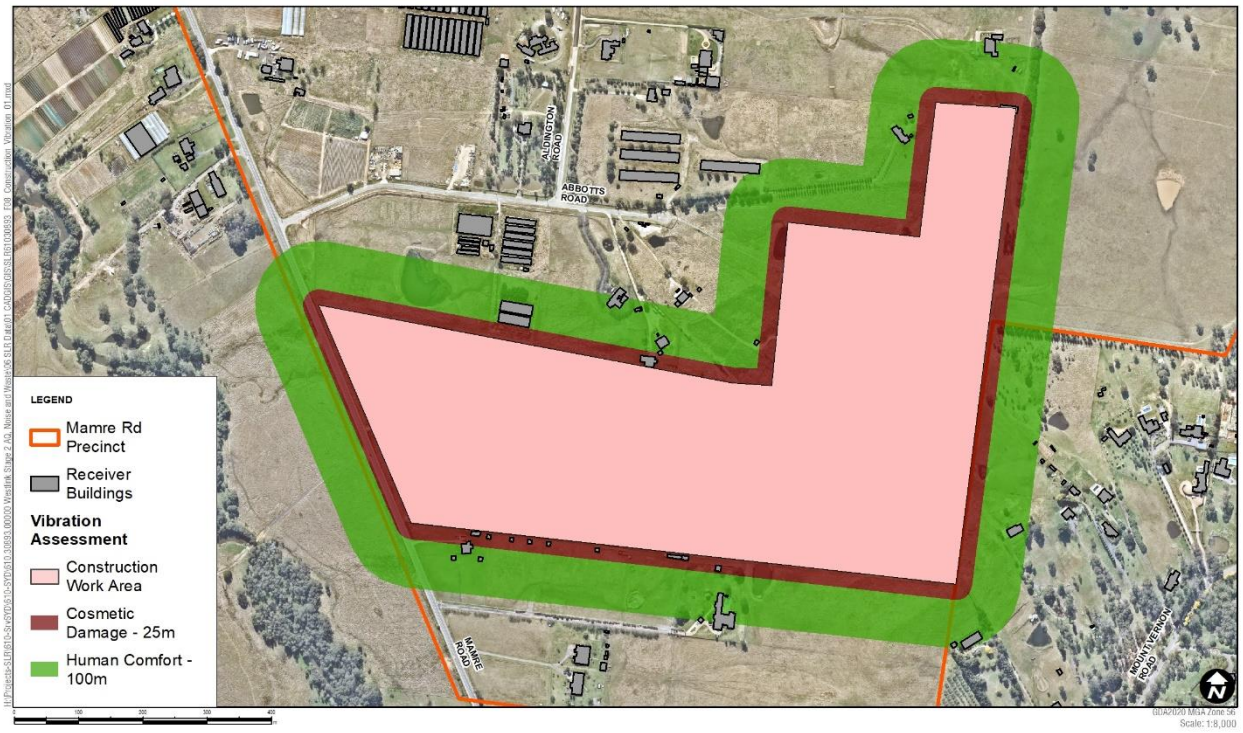
Feasible and reasonable construction noise mitigation measures should be applied where exceedances of the NMLs are predicted. Construction noise mitigation and management measures are discussed in **Section 7.1**.

5.2 Construction Vibration

The major potential sources of vibration from the proposed construction activities would likely be during 'earthworks' and 'construction of roads' when vibratory rollers are being used, and 'excavation of hard rock' when rockbreakers are being used.

Vibration offset distances have been determined from the CNVG minimum working distances for cosmetic damage and human comfort (see **Table 12**) and the assessment is summarised in **Figure 4**.

Figure 4 Construction Vibration Minimum Working Distances



Cosmetic Damage Assessment

The above figure shows that the nearest sensitive receiver buildings may potentially be within the cosmetic damage minimum working distance for vibration intensive equipment. Where this does occur, this would only be when vibration intensive equipment is being used at the site boundary, near to adjacent sensitive receivers. Work in other more distant areas of the site would be outside the minimum working distances.

Offset distances from specific vibration intensive plant to the nearest receivers should be confirmed before commencing vibration intensive works during construction.

Human Comfort Vibration Assessment

The above figure shows that two residences in NCA01, one residence in NCA02, and two residences in NCA03 are likely within the human comfort minimum working distance and occupants of these buildings may be able to perceive vibration impacts at times when vibratory rollers or rockbreakers are in use nearby. Where impacts are perceptible, they would likely only be apparent for relatively short durations when vibration intensive equipment is in use.

Feasible and reasonable construction vibration mitigation measures should be applied where vibration intensive works are required within the minimum working distances. Construction vibration mitigation and management measures are discussed in **Section 7.1**.

5.3 Operational Noise Assessment

5.3.1 Predicted Operational Noise Levels

The Stage 2 development includes operation of Warehouse 2 in the western area of the site (see **Figure 1**). A summary of the worst-case noise assessment for Stage 2 at the receivers surrounding the development is shown in **Table 23**. Noise contours of the operational noise levels are shown for the future scenario with indicative adjacent warehouses, hard ground within the MRP and site access via Aldington Road in **Appendix E.**

A detailed assessment of all potential feasible and reasonable mitigation measures that could be applied to the development to minimise the impacts has been completed and is summarised in **Section 7.2**. The following predictions include the recommended mitigation measures, where appropriate.

Table 23 Operational Noise Assessment – Stage 2 Development

NCA	Receiver Type	Assessment Period	$L_{Aeq(15\ minutes)}$ Noise Level (dBA)			Compliance
			Noise Criteria	Predicted	Exceedance	
Receivers within MRP (zoned industrial)						
NCA01	Residential	Daytime	40	51	11	**No**
		Evening	38	45	7	**No**
		Night-time	33	46	13	**No**
		Morning Shoulder	39	50	11	**No**
NCA01-PW	Place of Worship	When in use	43	24	-	Yes
NCA02	Residential	Daytime	40	44	4	**No**
		Evening	38	38	-	Yes
		Night-time	33	39	6	**No**
		Morning Shoulder	39	43	4	**No**

NCA	Receiver Type	Assessment Period	$L_{Aeq(15\ minutes)}$ Noise Level (dBA)			Compliance
			Noise Criteria	Predicted	Exceedance	
Receivers outside MRP						
NCA03	Residential	Daytime	41	22	-	Yes
		Evening	38	<20	-	Yes
		Night-time	33	<20	-	Yes
		Morning Shoulder	43	22	-	Yes
NCA04	Residential	Daytime	43	25	-	Yes
		Evening	38	21	-	Yes
		Night-time	33	21	-	Yes
		Morning Shoulder	43	24	-	Yes
NCA05	Residential	Daytime	43	31	-	Yes
		Evening	38	26	-	Yes
		Night-time	33	26	-	Yes
		Morning Shoulder	43	31	-	Yes
NCA06	Residential	Daytime	42	<20	-	Yes
		Evening	38	<20	-	Yes
		Night-time	33	<20	-	Yes
		Morning Shoulder	42	<20	-	Yes
NCA07	Residential	Daytime	45	<20	-	Yes
		Evening	40	<20	-	Yes
		Night-time	35	<20	-	Yes
		Morning Shoulder	45	<20	-	Yes

The above assessment indicates that noise from the operation of the Stage 2 development is predicted to exceed the Project Noise Trigger Levels at the nearest receivers in NCA01 and NCA02 within the MRP.

Receivers within the Mamre Road Precinct

Exceedances of the relevant noise criteria are predicted at the nearest receivers within the MRP which are zoned industrial.

- **NCA01** – Exceedances of up to 13 dB are predicted at the nearest residential receiver in NCA01 which is directly north of the of the private access road that would be used before Aldington Road is connected to Westlink Stage 2.
- **NCA01-PW** – Compliance with the relevant noise criteria is predicted at the place of worship.
- **NCA02** – Exceedances of up to 6 dB are predicted at the nearest residential receiver in NCA02 which is directly south of the site.

Receivers outside the Mamre Road Precinct

- Compliance with the relevant noise criteria is predicted at all sensitive receivers outside the MRP (in NCA03, NCA04, NCA05, NCA06 and NCA07) during all assessment periods.

Further discussion regarding the feasible and reasonable mitigation that can be applied to the proposal is provided in **Section 7.2**.

5.3.2 Sleep Disturbance

The predicted maximum noise levels at the nearest residential receivers during the night-time and morning shoulder periods are shown in **Table 24**.

Table 24 Sleep Disturbance Assessment – Residential Receivers

NCA	Source	Maximum Noise Level L_{Amax} (dBA)				Below Screening Level
		Sleep Dist. Screening Level	Predicted Night-time	Predicted Morning Shoulder	Highest Exceedance	
Receivers within MRP (zoned industrial)						
NCA01	Airbrake	52	64	64	12	**No**
	Truck reversing		53	53	1	**No**
	Forklift reversing		51	51	-	Yes
	Roller door		43	43	-	Yes
	Trucks		67	67	15	**No**
	Cars		56	56	4	**No**
NCA02	Airbrake	52	62	62	10	**No**
	Truck reversing		51	51	-	Yes
	Forklift reversing		49	49	-	Yes
	Roller door		30	30	-	Yes
	Trucks		55	55	3	**No**
	Cars		56	56	4	**No**
Receivers outside MRP						
NCA03	All	52[2] / 54[3]	40	40	-	Yes
NCA04	All	52[2] / 59[3]	41	41	-	Yes
NCA05	All	52[2] / 65[3]	44	44	-	Yes
NCA06	All	52[2] / 52[3]	<20	<20	-	Yes
NCA07	All	52[2] / 56[3]	<20	<20	-	Yes

Note 1: The predicted L_{Amax} noise levels are shown for the most-affected receiver in each NCA.

Note 2: Night-time sleep disturbance screening level.

Note 3: Morning shoulder sleep disturbance screening level.

The above assessment indicates that maximum noise levels from the operation of the development are predicted to exceed the sleep disturbance screening level at some of the nearest receivers within the MRP.

Receivers within the Mamre Road Precinct

Exceedances of the sleep disturbance screening level are predicted at a small number of the nearest receivers within the MRP which are zoned industrial. The exceedances at the nearest receivers in NCA01 to the north and NCA02 to the south are due to truck reversing and airbrakes in the hardstand area and truck and car acceleration on the and internal access road temporary private access road.

Receivers outside the Mamre Road Precinct

Compliance with the sleep disturbance screening level is predicted at all residential receivers outside the MRP (in NCA03, NCA04, NCA05, NCA06 and NCA07) during all the assessed scenarios and weather conditions.

The NPfI requires a detailed maximum noise level assessment to be completed where night-time noise levels exceed the sleep disturbance screening level.

5.3.2.1 Detailed Maximum Noise Level Assessment

The detailed maximum noise levels assessment is summarised in **Table 25**. Noise from truck reversing and airbrakes and truck acceleration are predicted to exceed the sleep disturbance screening level at a small number of the nearest receivers within the MRP in NCA01 and NCA02.

Table 25 Detailed Maximum Noise Level Assessment

NCA / Receivers	Maximum Noise Level L_{Amax} (dBA)					Comments
	External Sleep Disturbance Goals (dBA)		Development Related Maximum Noise Events		Existing Maximum Noise Levels[3]	
	Awakening Response[1]	Good Sleep[2]	Predicted (dBA)	Frequency of Occurrence		
NCA01 – nearest residence in MRP	65	Around 55 (should not occur more than 10 to 15 times per night)	56-67	>15 events	Typical: 50-60 dBA Occasional: >60 dBA	**Awakening Response:** Maximum noise levels from trucks accelerating and truck airbrakes are predicted to be above 65 dBA and may cause an 'awakening response'. Maximum noise levels from cars are predicted to be below 65 dBA. **Good Sleep:** Trucks accelerating on the access route are predicted to exceed 55 dBA at the nearest residence in NCA01. Maximum noise events may adversely affect 'good sleep' in NCA01 (ie they could occur more than 10-15 times per night). Trucks reversing alarms and cars are not predicted to exceed 55 dBA at the nearest residence in NCA01 and are unlikely to affect 'good sleep'.

NCA / Receivers	Maximum Noise Level L_{Amax} (dBA)					Comments
	External Sleep Disturbance Goals (dBA)		Development Related Maximum Noise Events		Existing Maximum Noise Levels[3]	
	Awakening Response[1]	Good Sleep[2]	Predicted (dBA)	Frequency of Occurrence		
NCA02 – nearest residences in MRP	65	Around 55 (should not occur more than 10 to 15 times per night)	55-62	>15 events	Typical: 50-60 dBA Occasional: >60 dBA	**Awakening Response:** Maximum noise levels are predicted to be below 65 dBA. **Good Sleep:** Cars are predicted to exceed 55 dBA at the nearest residence in NCA02. These maximum noise level events are only predicted when cars use the outer driveway closest to NCA02. Maximum noise events may adversely affect 'good sleep' in NCA02 (ie they could occur more than 10-15 times per night).

Note 1: Based on RNP guidance that maximum internal noise levels below 50 dBA to 55 dBA are unlikely to awaken people from sleep. This equates to an external noise level of 65 dBA when assuming a conservative 10 dB loss for open windows.

Note 2: Based on RNP guidance (from enHealth studies) that for a good sleep over eight hours the indoor L_{Amax} sound pressure level should not exceed around 45 dBA more than 10 to 15 times per night. This equates to an external noise level of around 55 dBA when assuming a conservative 10 dB loss for open windows.

Note 3: Existing maximum noise levels have been adopted from the noise monitoring data at L04 (a similar offset distance from Mamre Rd).

The above indicates that the predicted sleep disturbance screening level exceedances at the nearest residences in NCA01 and NCA02 may result in internal noise levels that have the potential to cause sleep disturbance.

All affected residences within the MRP in NCA01 and NCA02 have been rezoned to IN1 Industrial and it is understood they will be redeveloped into future industrial land uses. As such, there is no requirement to consider any operational mitigation or management measures with regard to sleep disturbance for these receivers. Notwithstanding, feasible and reasonable mitigation measures have been investigated for the development with the aim of reducing noise levels to the goals. A detailed investigation of feasible and reasonable mitigation is provided in **Section 7.2**.

5.3.3 Off-site Traffic Assessment

Traffic associated with the development would enter and exit from Abbotts Road. Traffic would travel west to Mamre Road, then north or south along Mamre Road. Development related heavy vehicles are anticipated to be via a range of vehicle types, with current expectations being around 30% rigid trucks, 40% semi-trailer trucks and 30% B-double trucks.

The potential noise impacts from additional traffic on Mamre Road are expected to be negligible (ie <2.0 dB) given the small number of vehicles accessing the Stage 2 development relative to the high existing volumes on this route (refer **Table 20**). Increases of less than 2.0 dB represent a minor impact that is considered barely perceptible to the average person.

It is expected that traffic noise levels in the MRP would increase as the precinct is progressively developed and the various estates become operational. Impacts from increased traffic noise are likely to occur at certain receivers within the MRP as the precinct is developed. These impacts should, however, be considered as temporary as all potentially affected receivers within the MRP have been rezoned to IN1 Industrial and will be redeveloped into future industrial land uses.

6 Cumulative Impacts

Cumulative impacts can be caused by the compounding effects of multiple projects in an area, and by the accumulation of effects from past, current and future activities as they arise.

6.1 Construction Noise

Cumulative construction noise impacts can occur where multiple work activities are being completed near to a particular receiver at the same time. There is potential for cumulative construction impacts from multiple construction activities being completed in different areas of the MRP.

Since the construction scenarios required for various developments within the MRP would generally require similar items of equipment, concurrent construction work being completed near to a particular area could theoretically increase the worst-case noise levels in this report by around 3 dB (ie a logarithmic adding of two sources of noise at the same level) particularly at nearby receivers within the MRP.

The likelihood of worst-case noise levels being generated by two different work activities at the same time is, however, considered low and rather than increase construction noise levels, the impact of concurrent work would generally be a limited to a potential increase in the duration, and annoyance, of noise impacts on the affected receivers.

In practice, construction noise levels in any one location would vary and would be frequently much lower than the worst-case scenario assessed due to construction staging moving work around within the study area and, in many cases, only a few items of equipment being used at any one time.

ESR will take feasible and reasonable steps to consult and coordinate with other construction projects when they become aware of them and if they have the potential to impact the same receivers concurrently, to minimise cumulative impacts of noise and vibration and maximise respite for affected sensitive receivers.

6.2 Operational Noise

The *Noise Policy for Industry* states that it aims to limit continuing increases in cumulative industrial noise through the application of amenity noise levels, which are applicable to all industrial noise sources in an area.

The policy accounts for potential cumulative impacts by lowering the criteria for each individual development to ensure that the ambient noise level within an area from all industrial noise sources combined remains below the recommended amenity noise levels, where feasible and reasonable. As such (as discussed in **Section 3.3.1**), the potential cumulative impacts from the proposal and other potential sources of industrial noise in the area are accounted for in the proposal-specific PNTLs and, therefore, do not require further consideration.

7 Mitigation and Management Measures

7.1 Construction Impacts

The impacts during construction of the project are predicted to be typical of major construction works near to sensitive receivers. No works outside of standard construction hours are currently proposed.

The use of standard mitigation measures to minimise the impacts is considered sufficient to control the majority of the impacts. Examples of measures which could be applied to the work are provided in the Roads and Maritime (now Transport for NSW) *Construction Noise and Vibration Guideline* (see **Appendix F**).

A Construction Noise and Vibration Management Plan (CNVMP) would be prepared before any work begins. This would identify all potentially impacted receivers, assess the potential noise and vibration impacts from the project and provide details regarding how the impacts would be minimised through the use of all feasible and reasonable mitigation measures. The CNVMP would also contain procedures for handling complaints, should they occur, and detail any compliance monitoring requirements.

7.2 Operational Noise Impacts

Where operational noise impacts from the site are predicted to exceed the relevant noise criteria, feasible and reasonable operational noise mitigation and management measures should be considered, with the aim of reducing noise emissions to the relevant criteria.

The typical hierarchy for mitigation and management of industrial noise sources is as follows:

- Reducing noise emissions at the source (ie noise source control)
- Reducing noise in transmission to the receiver (ie noise path control)
- Reducing noise at the receiver (ie at-receiver control).

A detailed assessment of all potential feasible and reasonable mitigation measures that could be applied to the development to minimise the impacts has been completed and is summarised in **Table 26**.

Table 26 Operational Noise Mitigation Options

Ref.	Mitigation Option	Noise Impact/Benefit	Reasonable and Feasible to Apply
Source Control			
S1	Optimised site layout to minimise noise emissions from the site	Where possible, the site layout has been designed so that the warehouse building screens the noisier areas of the development (ie hardstands and truck routes) from the nearest receivers.	Yes – applied during design of the concept masterplan
S2	Limit vehicle movements	A reduction in concurrent vehicle movements across the site by staggering delivery/pickup times and/or employee shift change times could reduce noise emissions. In practice, this would occur naturally across the estate due to operational requirements of the different tenants.	No – vehicle volumes used in this assessment are likely needed to meet tenant's requirements. Placing restrictions on allowable vehicle movements across the different tenancies is unlikely to be feasible and reasonable.

Ref.	Mitigation Option	Noise Impact/Benefit	Reasonable and Feasible to Apply
S3	Hardstand/external equipment use	Minimising the concurrent use of forklifts or other mobile plant outside the warehouse and/or limiting their use to the less sensitive day and evening periods. In practice, this would occur naturally across the estate due to operational requirements of the different tenants.	No – placing restrictions on allowable external use of forklifts and equipment across the different tenancies is unlikely to be feasible and reasonable.
S4	Quieter mobile plant and equipment	Use of quieter mobile plant and equipment options, such as electric forklifts instead of gas forklifts.	Yes – the development proposes to use quieter equipment such as electric forklifts instead of gas forklifts.
S5	Use broadband and/or ambient sensing alarms on trucks and forklifts where they are required to reverse during the night-time.	Reduce potential for annoying noise emissions during the night-time from forklifts and trucks.	Yes – use broadband and/or ambient sensing alarms on forklifts and trucks where they are required to reverse during the night-time.
S6	Appropriate specification and location of mechanical plant during detailed design.	If noise impacts from mechanical plant are identified during detailed design, quieter plant could be selected, or the plant could be relocated to a location screened from view of the nearest receivers, where appropriate.	Impacts from mechanical plant were not identified during this assessment. Noise impacts from mechanical plant would be investigated further during detailed design or construction certificate stages when specific plant requirements are identified.
S7	Appropriate design of warehouses during detailed design.	Appropriate warehouse materials to minimise noise break-out from internal activities would be selected during detailed design. Where it is identified that noisier equipment is required to be used within the warehouse buildings than currently assumed (eg manufacturing equipment instead of standard warehousing and distribution equipment), facade and roof construction can use materials that provide a greater acoustic benefit.	Potentially – noise impacts from internal equipment would be investigated further during construction certificate stages if tenant requires manufacturing plant or other noisy equipment.
S8	Roller doors kept closed when loading/unloading is not occurring to minimise noise breakout.	Use of roller doors to minimise internal noise breakout.	Yes – roller doors should be kept closed when not in use for loading/unloading trucks.

Ref.	Mitigation Option	Noise Impact/Benefit	Reasonable and Feasible to Apply
S9	Appropriate design of site layout to minimise the need for trucks to stop or brake outside of loading docks with line of sight to residential receivers.	Minimise noise emissions, particularly from truck airbrakes.	Yes – applied during design of the concept masterplan
S10	Production of an Operational Noise Management Plan.	This would detail the measures that could be used by the various tenants to minimise general noise emissions from the site. Reference can be made to the Best Management Practice (BMP) and Best Available Technology Economically Available (BATEA) measures listed in the NPfI (see **Appendix G**).	Yes
Path Control			
P1	Noise barriers	Construction of noise barriers along boundary fence locations or other strategic locations could be used to reduce noise levels where plant or equipment are in line of sight of the nearest receivers.	The potential noise impacts are limited to receivers within the MRP and have been rezoned to industrial. These are expected to be developed into employment land uses, meaning permanent noise barriers to mitigate these receivers are unlikely to be reasonable.
Receiver Control			
R1	At-property treatments	The NPfI notes that noise mitigation at a residence may be required to be considered where the residual impact exceeds the PNTLs by ≥3 dB. At-property treatments typically include mechanical ventilation to allow windows to be closed as a noise mitigation measure, together with upgraded facade elements such as windows, doors and acoustic seals.	Noise levels are predicted to comply with the noise goals at all receivers outside the MRP. While exceedances are predicted at certain receivers within the MRP, these receivers are considered temporary as they have all been rezoned and will be redeveloped into future industrial land uses over time. At-property treatment may not be considered reasonable given the temporary nature of the impacted receivers.
Verification Monitoring			
V1	Noise monitoring	Verify post-construction operational noise levels are in-line with predictions and the mitigation is working as intended.	Yes

It is noted that several assumptions have been made regarding the likely future sources of noise. The noise predictions in this report should be regarded as indicative for planning purposes and are required to be confirmed at a later stage when detailed information is available.

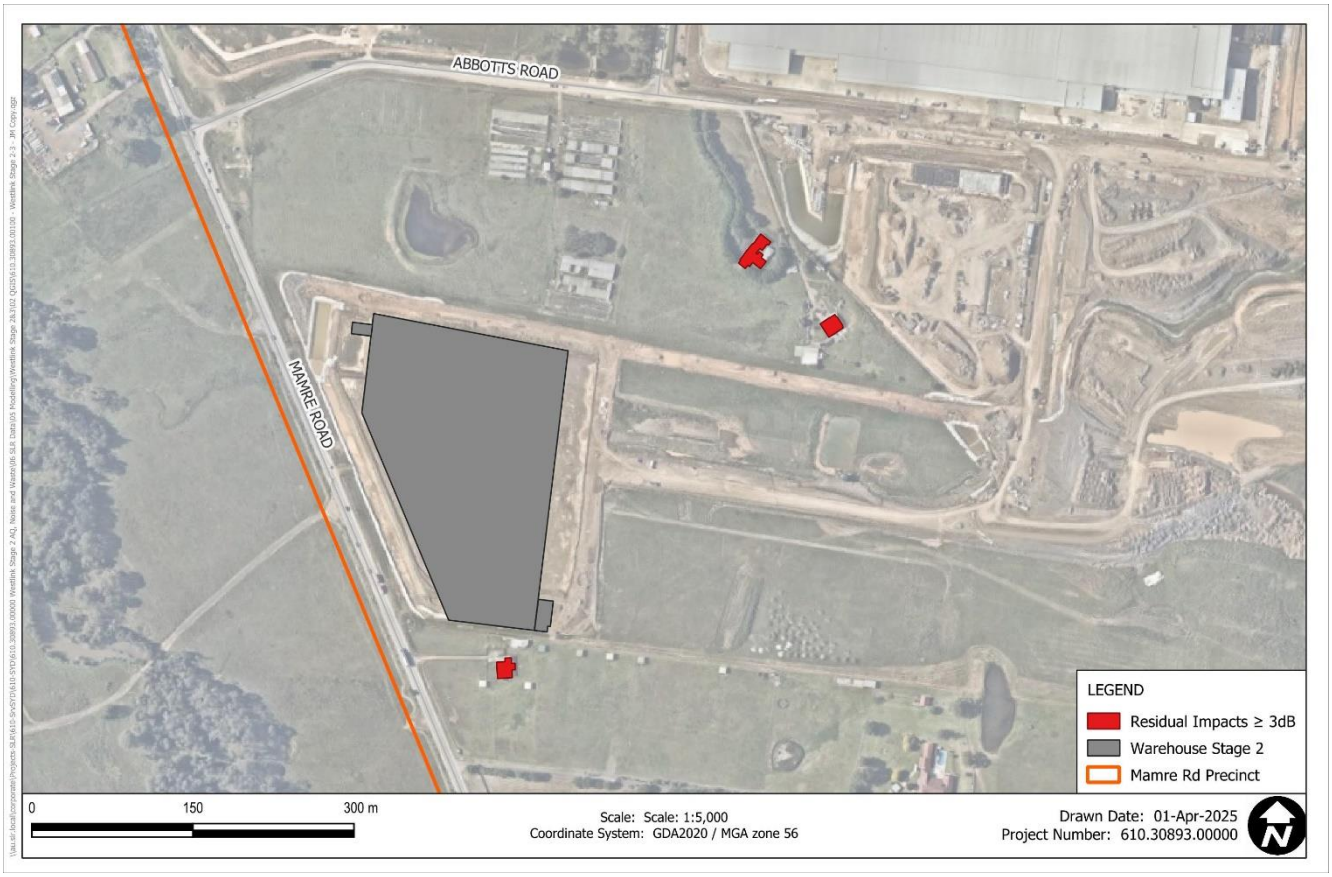
Compliance with the noise goals is predicted at all receivers outside the MRP. Residual impacts have been identified at certain receivers located within the MRP, however, these have all been rezoned to industrial. Various SSDAs have been submitted (or are in the process of being submitted) for much of the land within the MRP. It is understood that ultimately, all existing receivers within the MRP will be redeveloped into future industrial land uses. Consideration of the zoning and future uses of the receivers within the MRP with residual impacts should be taken into account when determining whether mitigation and management measures for temporary impacts at these receivers are feasible and reasonable.

7.2.1 Residual Impacts

The NPfI defines residual noise impacts as exceedances of the Project Noise Trigger Levels which remain after all source and pathway feasible and reasonable mitigation measures have been considered. Residual noise impacts that exceed the Project Noise Trigger Levels by ≤2 dB are considered negligible and would not be discernible by most people. Exceedances of ≥3 dB are considered potentially significant and may require further consideration.

The predicted residual impacts from the development are limited to receivers within the MRP immediately north and south of the site, as shown in **Figure 5**. Note that some of the predicted residual impacts are due to the temporary vehicle access via the private east to west access road.

Figure 5 Residual Exceedances of PNTLs



8 Conclusion

SLR has been engaged to assess the potential construction and operational noise emissions from the proposed Westlink Stage 2 development at 1030-1048 and 1050-1064 Mamre Road, and 59-62 & 63 Abbotts Road, Kemps Creek. Stage 2 of the development is the subject of this assessment and includes site preparation, earthworks and infrastructure works across the site, along with the construction and operation of a warehouse in the western area of the site which would be in use 24/7.

The potential impacts from the proposal have been assessed against the noise and vibration specific Secretary's Environmental Assessment Requirements and Mamre Road Precinct Development Control Plan.

Construction noise levels are expected to exceed the noise management levels at the nearest receivers during some works. Moderate to high exceedances are predicted at the nearest receivers during vegetation clearing, earthworks and excavation. Minor to moderate exceedances are predicted at the nearest receivers during other works, however, this would only be expected to occur when noisy work is being completed close to the site boundary nearest to these receivers. Construction activities for the proposal would only be undertaken during standard daytime construction hours.

Vibration intensive equipment has the potential to result in human comfort impacts when operated within the minimum working distances of the nearest receivers. There is also potential for the nearest sensitive receiver buildings to be within the cosmetic damage minimum working distance for vibration intensive equipment. Offset distances from specific vibration intensive plant to the nearest receivers should be confirmed before commencing vibration intensive works during construction.

Standard mitigation and management measures have been recommended to address the potential construction impacts. A Construction Noise and Vibration Management Plan (CNVMP) should also prepared before any work begins.

Operational noise levels are predicted to exceed the relevant noise criteria at the nearest receivers within the Mamre Road Precinct. Compliance is predicted at all receivers outside the Mamre Road Precinct.

A range of feasible and reasonable operational noise mitigation and management measures have been evaluated to control the operational noise impacts from the development.

Based on the predicted levels and indicative mitigation measures, the proposal is considered appropriate from an acoustic standpoint.

Appendix A

Acoustic Terminology

1. Sound Level or Noise Level

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

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

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

2. 'A' Weighted Sound Pressure Level

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

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

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

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

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

3. Sound Power Level

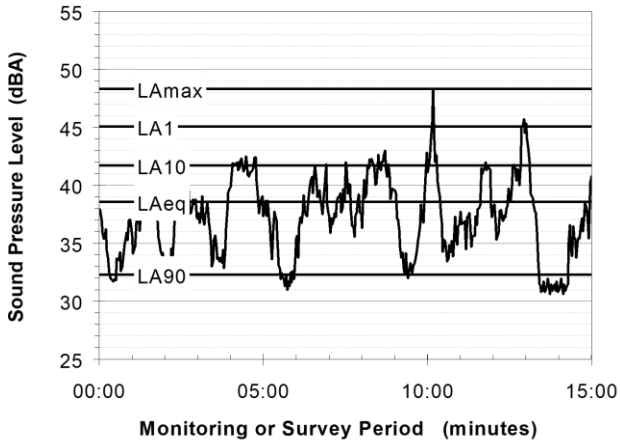
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

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

4. Statistical Noise Levels

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

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



Of particular relevance, are:

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

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

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

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

LAmax The A-weighted maximum sound pressure level of an event measured with a sound level meter.

5. Frequency Analysis

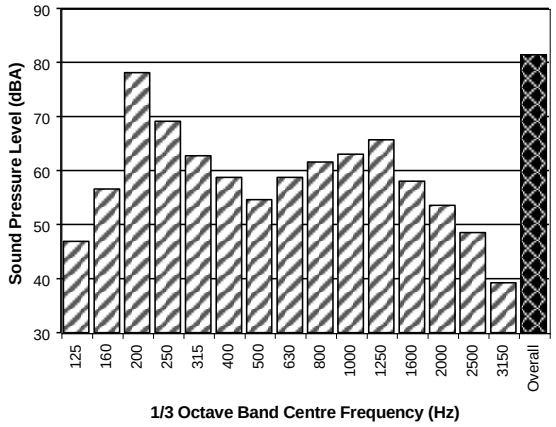
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

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

Frequency analysis can be in:

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

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



6. Annoying Noise (Special Audible Characteristics)

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

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

7. Vibration

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

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

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

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

8. Human Perception of Vibration

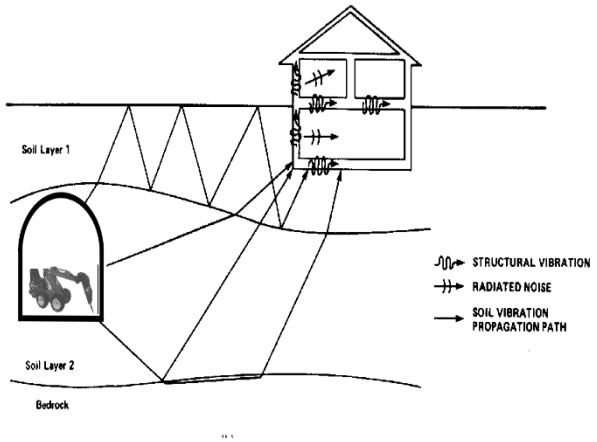
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience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

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

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

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

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



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

Appendix B

Noise Monitoring Data

Noise Monitoring Location	L03
Noise Monitoring Address	**62 Mount Vernon Road, Mount Vernon**

Logger Device Type: Svantek 957, Logger Serial No: 20644
Sound Level Meter: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3004635

Ambient noise monitor located in yard of large lot residential property at 62 Mount Vernon Road, Mount Vernon.

Attended noise measurements indicate the ambient noise environment at this location is dominated by steady road traffic on Mamre Road. Local fauna (birds) and pet dogs also contribute to the noise at this location.

Measured Attended Noise Levels (L_{Amax}):
17/16/2022: Road traffic on Mamre Rd: 45-55 dBA, birds: 37-58 dBA, dogs: 40-43 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – NPfI Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L_{10}	L_1
Daytime	36	50	49	57
Evening	36	44	43	48
Night-time	33	43	41	46
Morning Shoulder	39	45	46	49

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7 am-10 pm)	49	51
Night-time (10 pm-7 am)	45	44

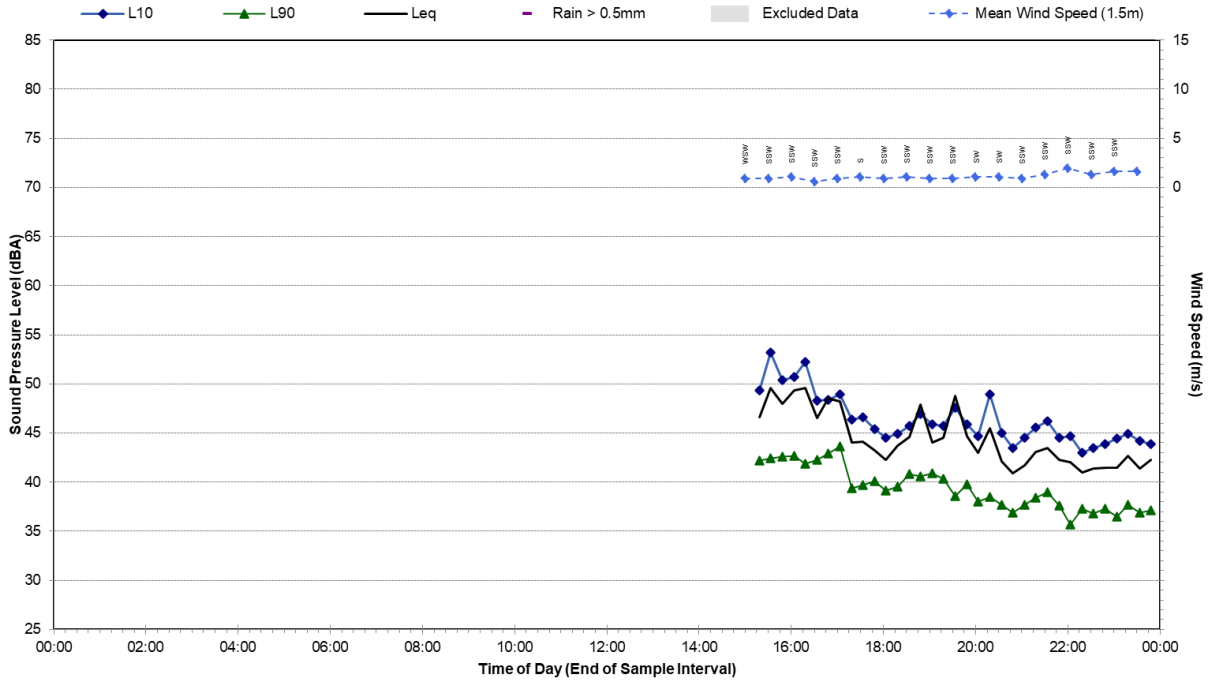
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
17/06/2022	14:57	41	45	58

Photo of Noise Monitoring Location

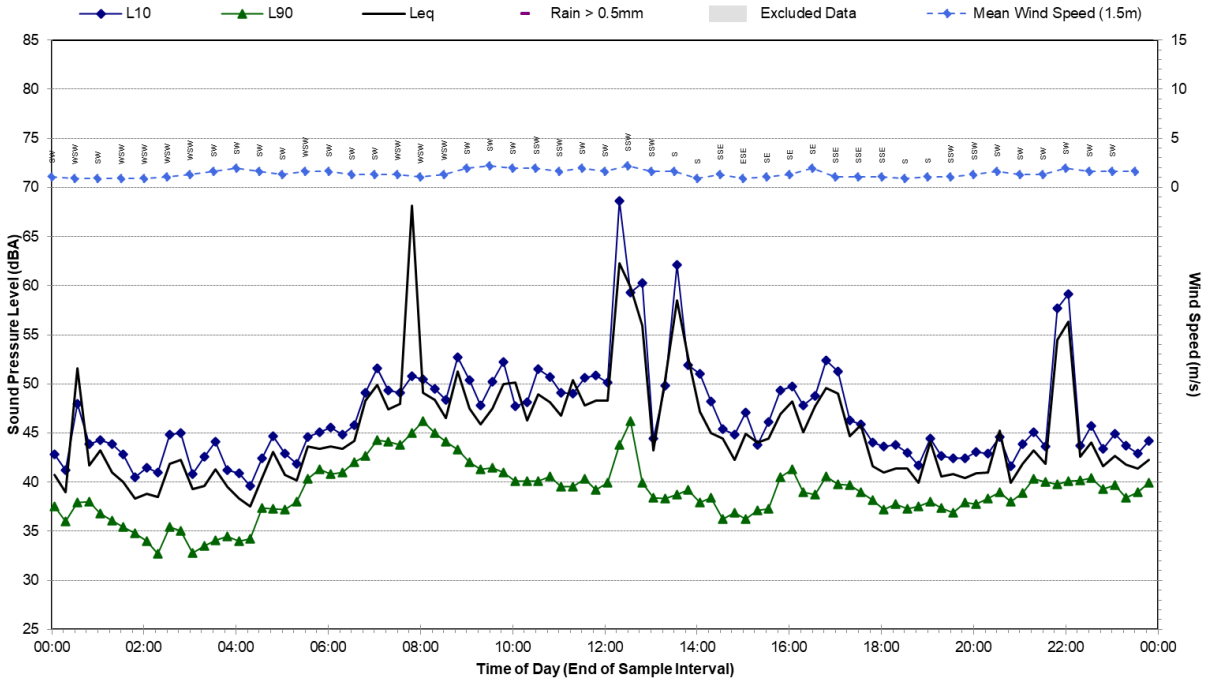
Statistical Ambient Noise Levels

L03 - Friday, 17 June 2022



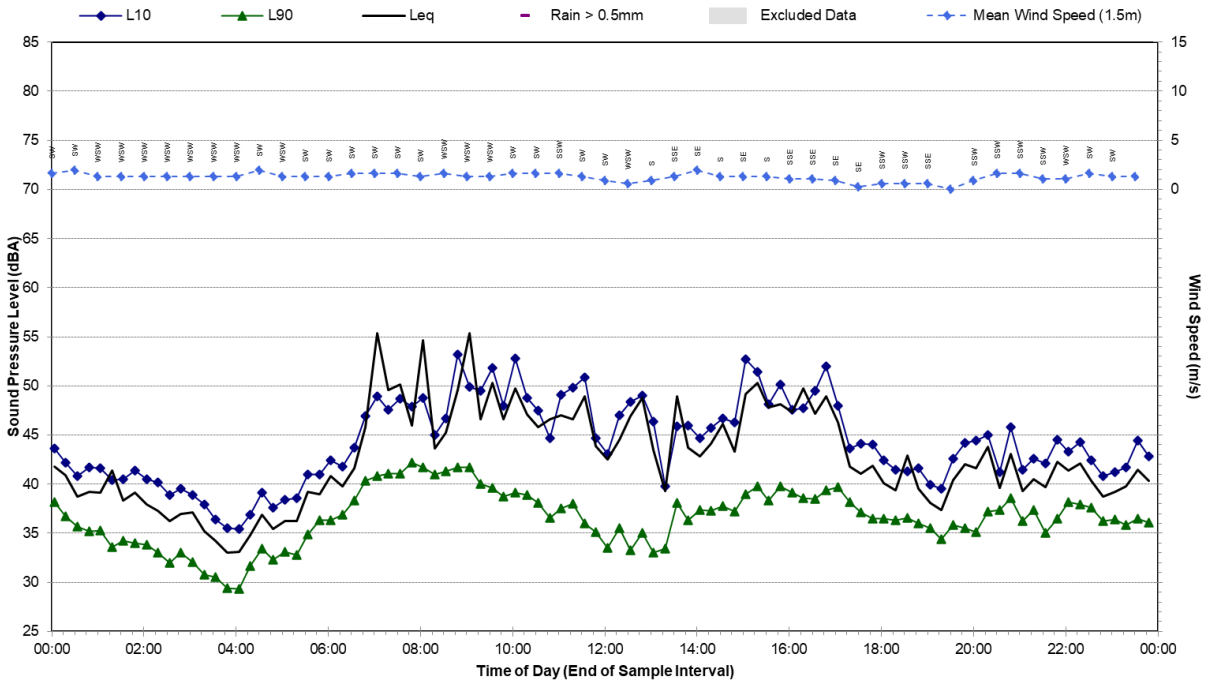
Statistical Ambient Noise Levels

L03 - Saturday, 18 June 2022



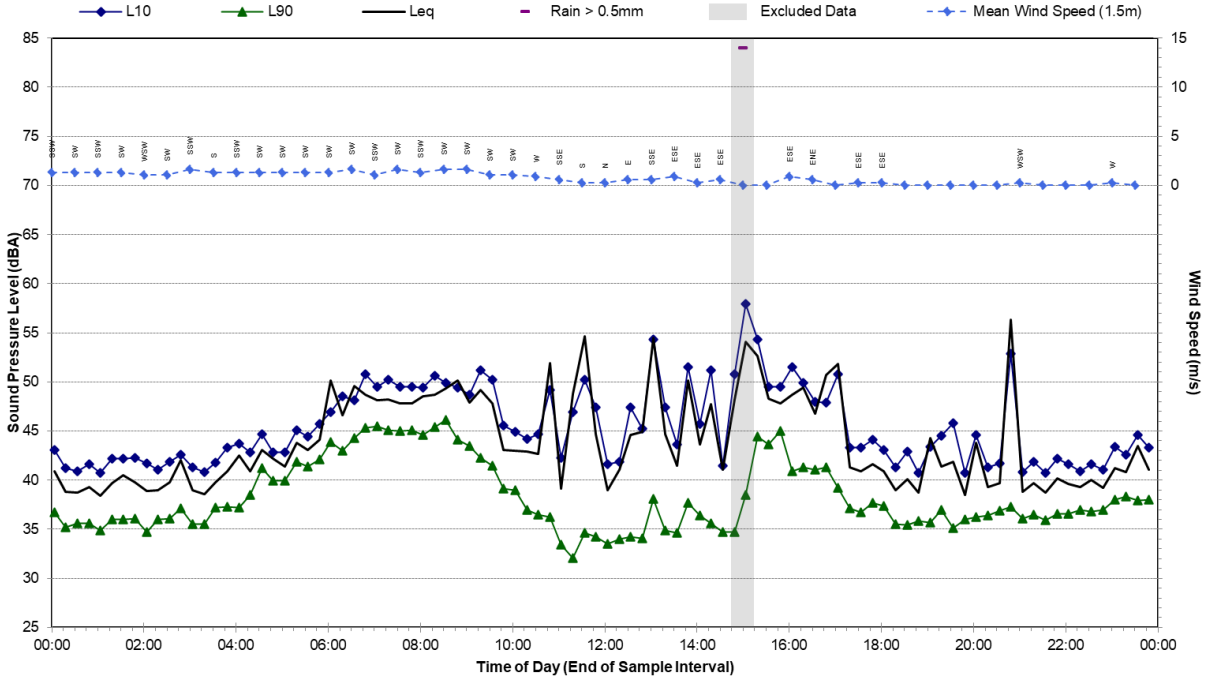
Statistical Ambient Noise Levels

L03 - Sunday, 19 June 2022



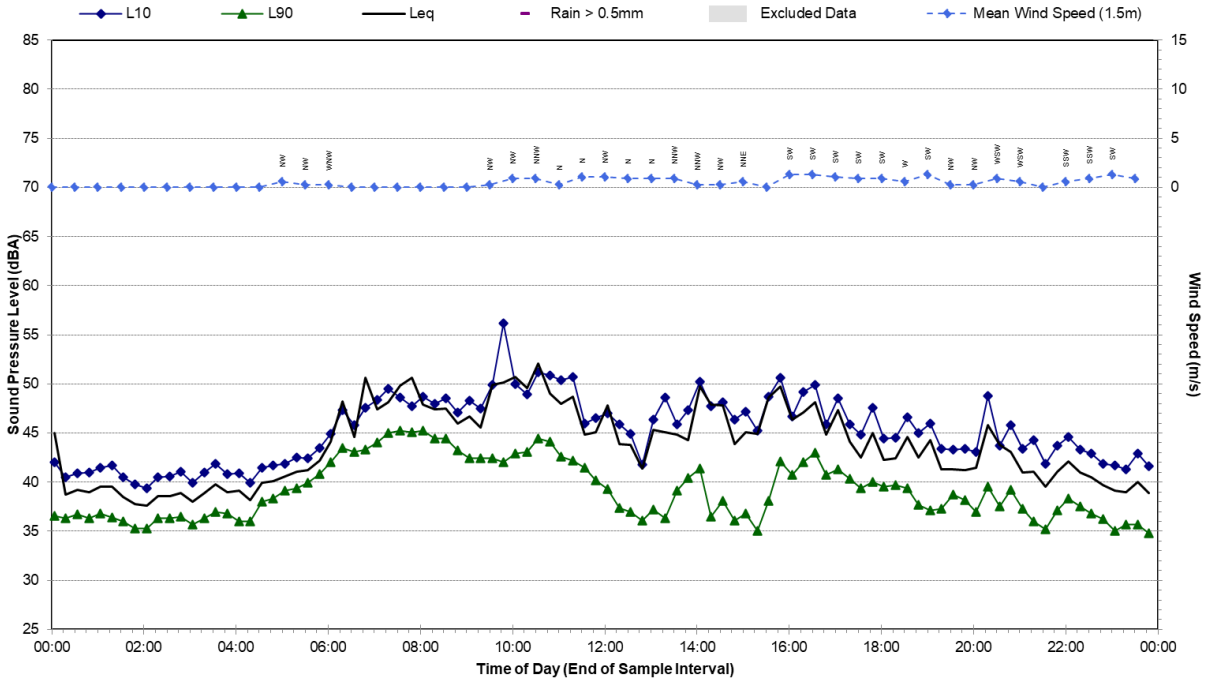
Statistical Ambient Noise Levels

L03 - Monday, 20 June 2022



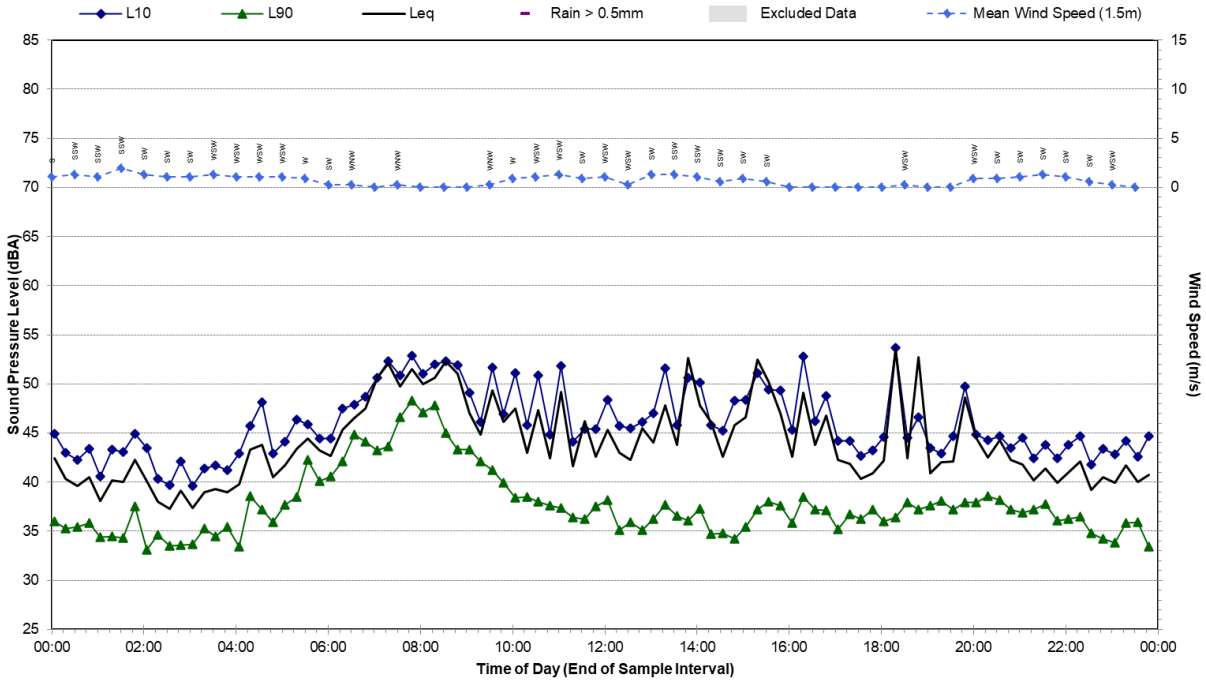
Statistical Ambient Noise Levels

L03 - Tuesday, 21 June 2022



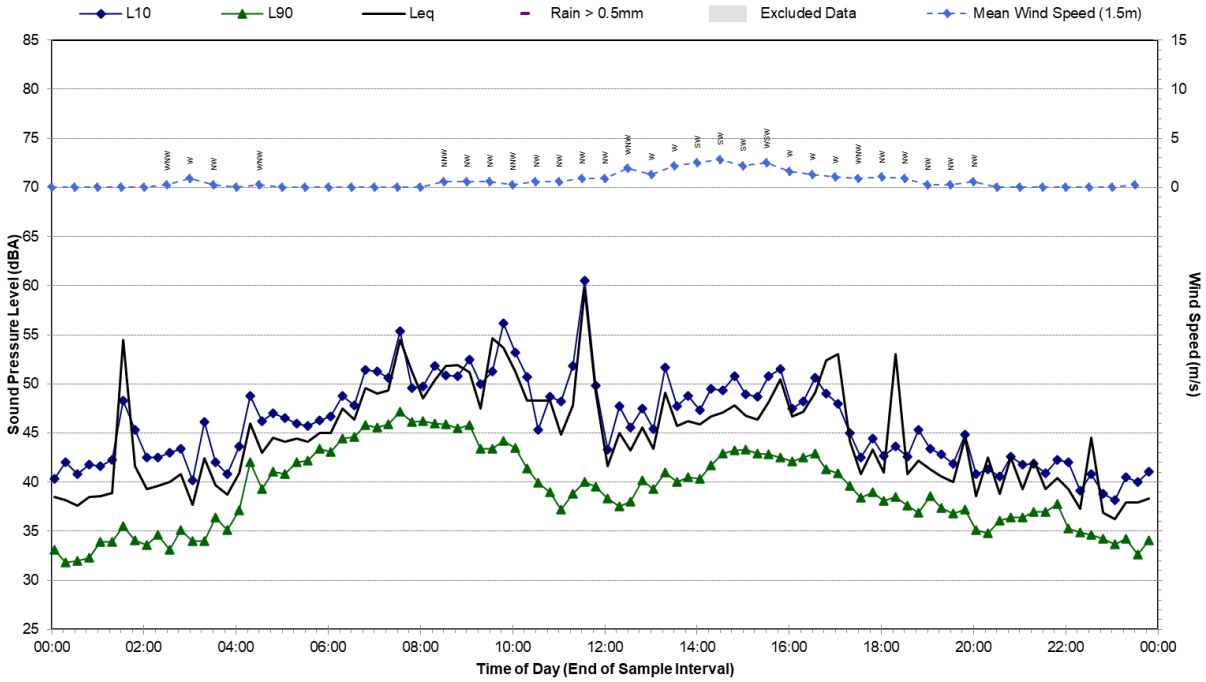
Statistical Ambient Noise Levels

L03 - Wednesday, 22 June 2022



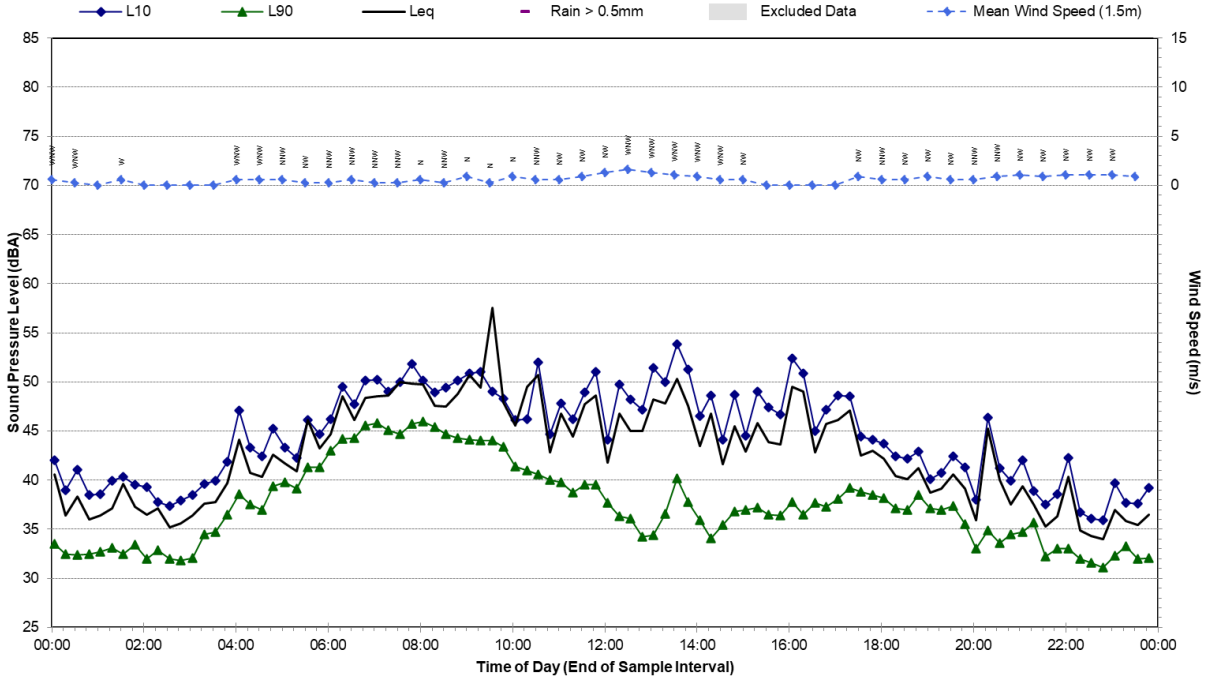
Statistical Ambient Noise Levels

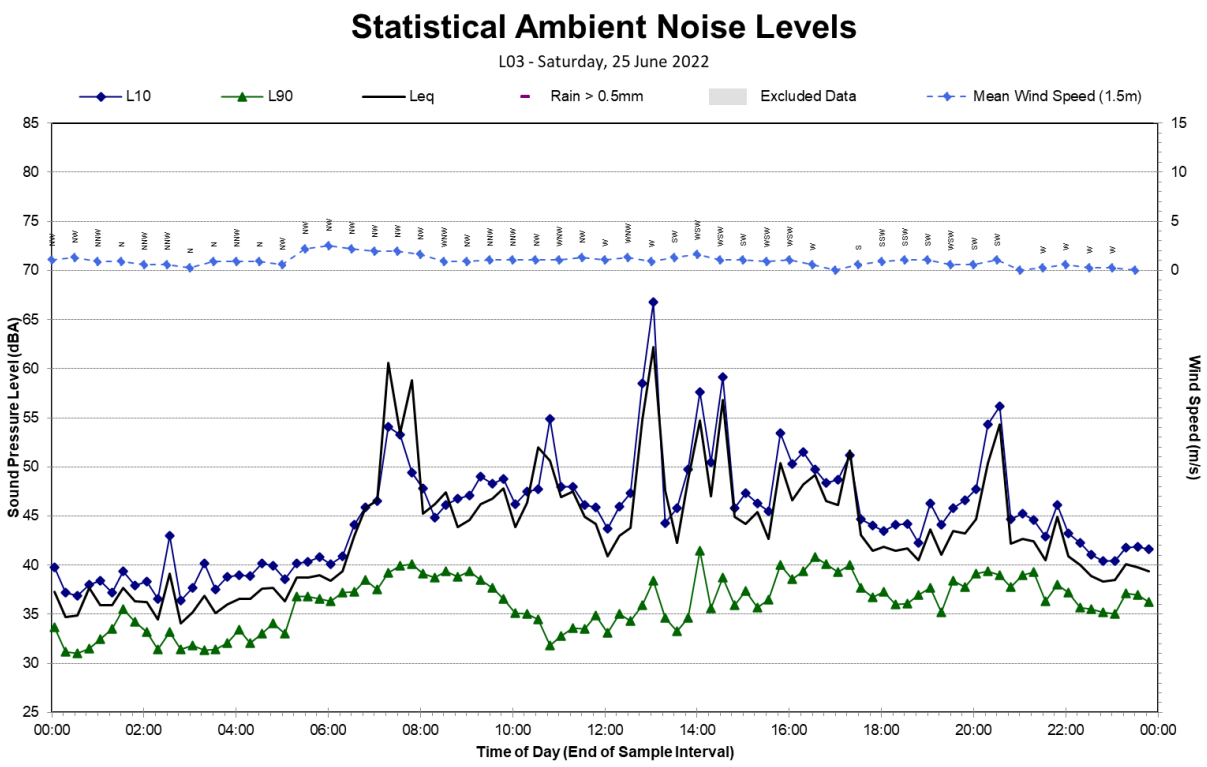
L03 - Thursday, 23 June 2022

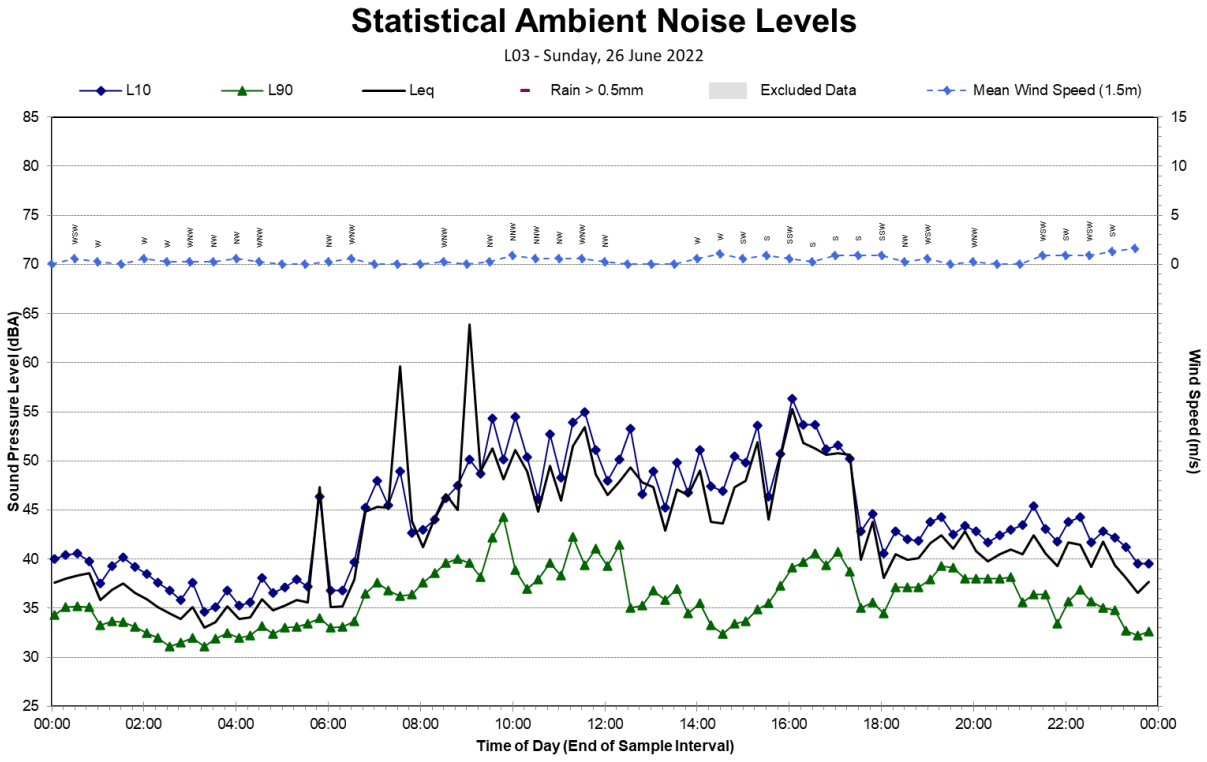


Statistical Ambient Noise Levels

L03 - Friday, 24 June 2022

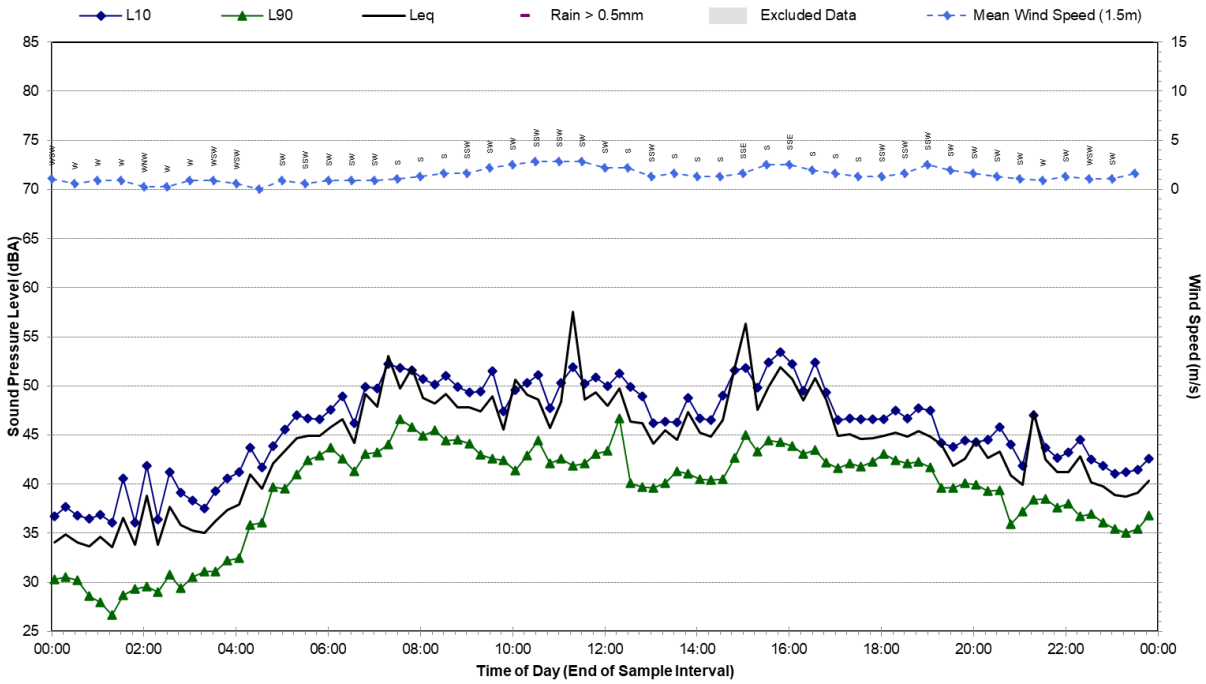



Statistical Ambient Noise Levels
L03 - Saturday, 25 June 2022
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - Sunday, 26 June 2022
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

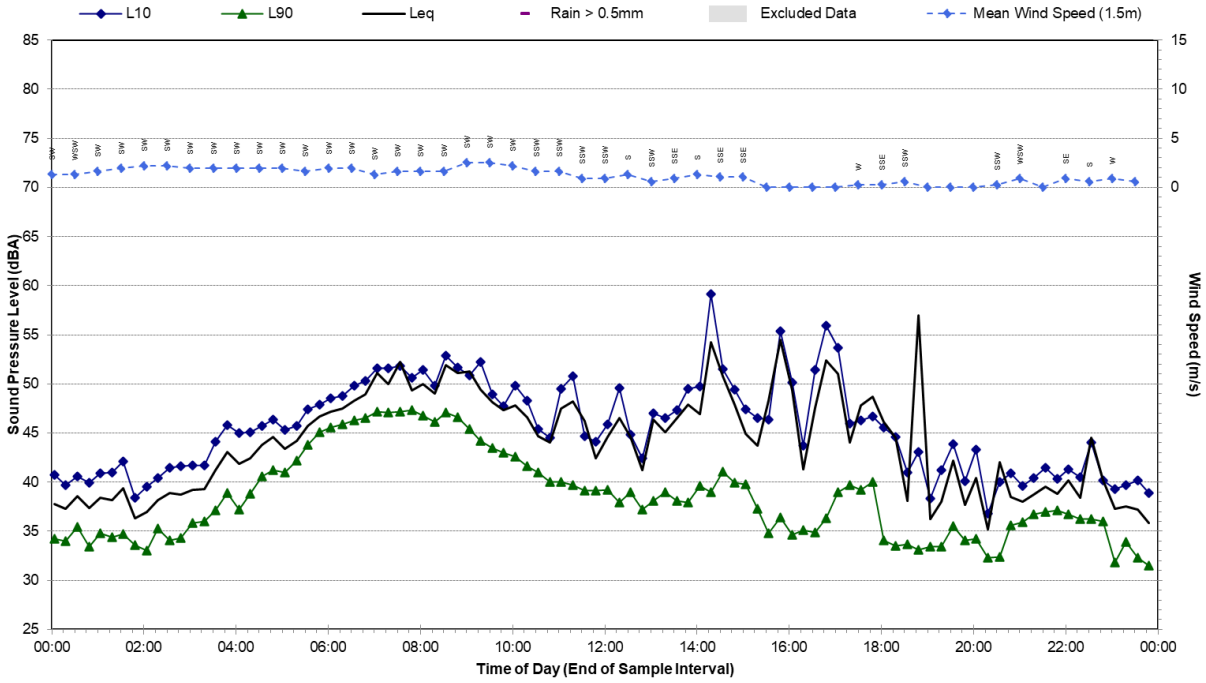
Statistical Ambient Noise Levels

L03 - Monday, 27 June 2022



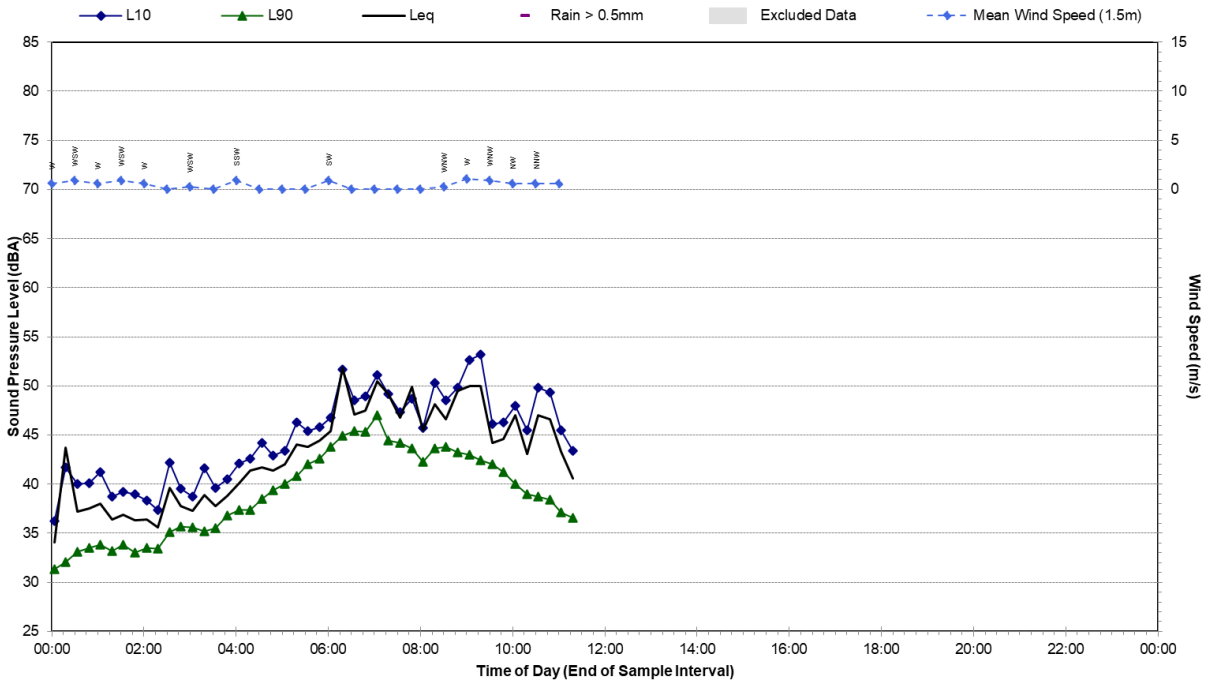
Statistical Ambient Noise Levels

L03 - Tuesday, 28 June 2022



Statistical Ambient Noise Levels

L03 - Wednesday, 29 June 2022



Noise Monitoring Location	L04	Map of Noise Monitoring Location
Noise Monitoring Address	**26 Cressy Road, Mount Vernon**	

Logger Device Type: Svantek 957, Logger Serial No: 20667
Sound Level Meter: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3004635

Ambient noise monitor located in vacant residential lot at 26 Cressy Road, Mount Vernon.

Attended noise measurements indicate the ambient noise environment at this location is dominated by steady road traffic on Mamre Road. Aeroplane flybys, local fauna (birds) and pet dogs also contribute to the noise at this location.

Measured Attended Noise Levels (LAmax):
17/16/2022: Road traffic on Mamre Rd: 51-54 dBA, birds: 49-64, dogs: 55-81, aeroplanes: 56-63

Ambient Noise Logging Results – NPfI Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	42	53	52	60
Evening	40	48	47	53
Night-time	35	47	45	50
Morning Shoulder	44	51	52	54

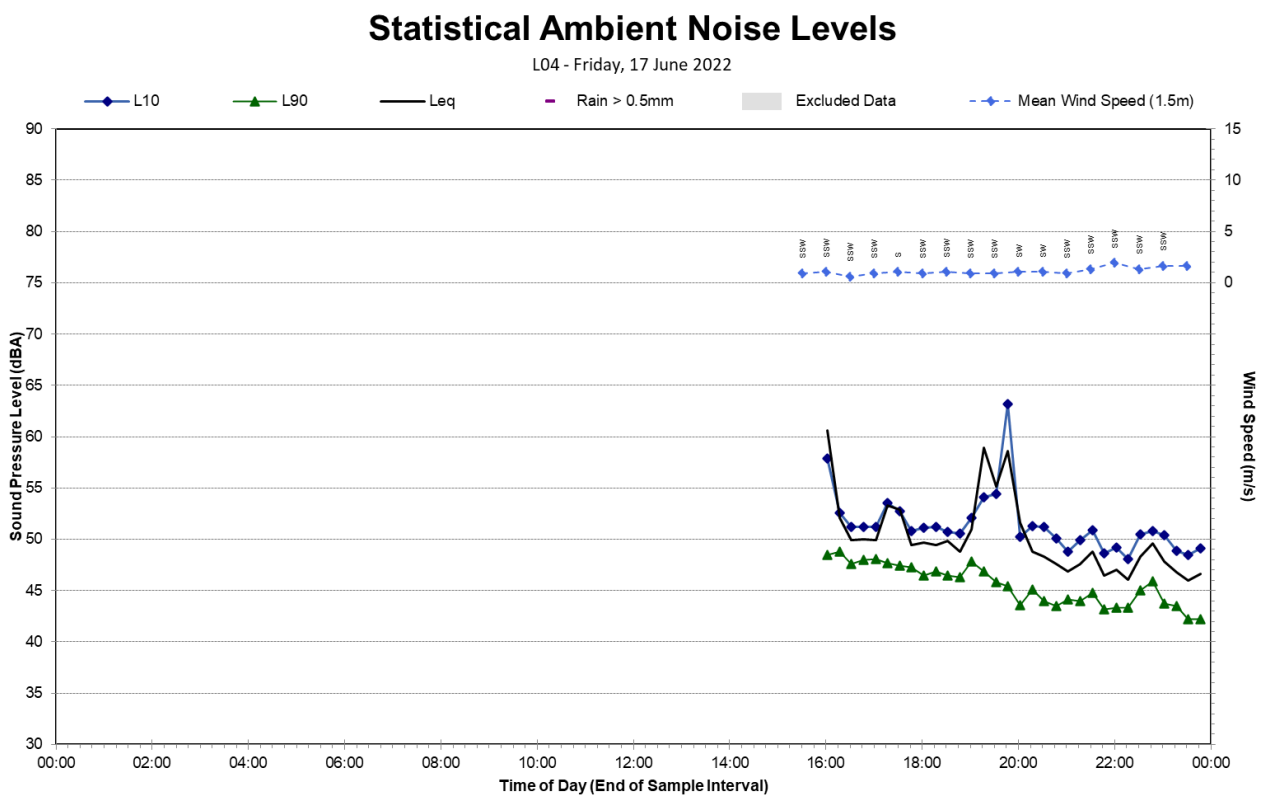
Ambient Noise Logging Results – RNP Defined Time Periods

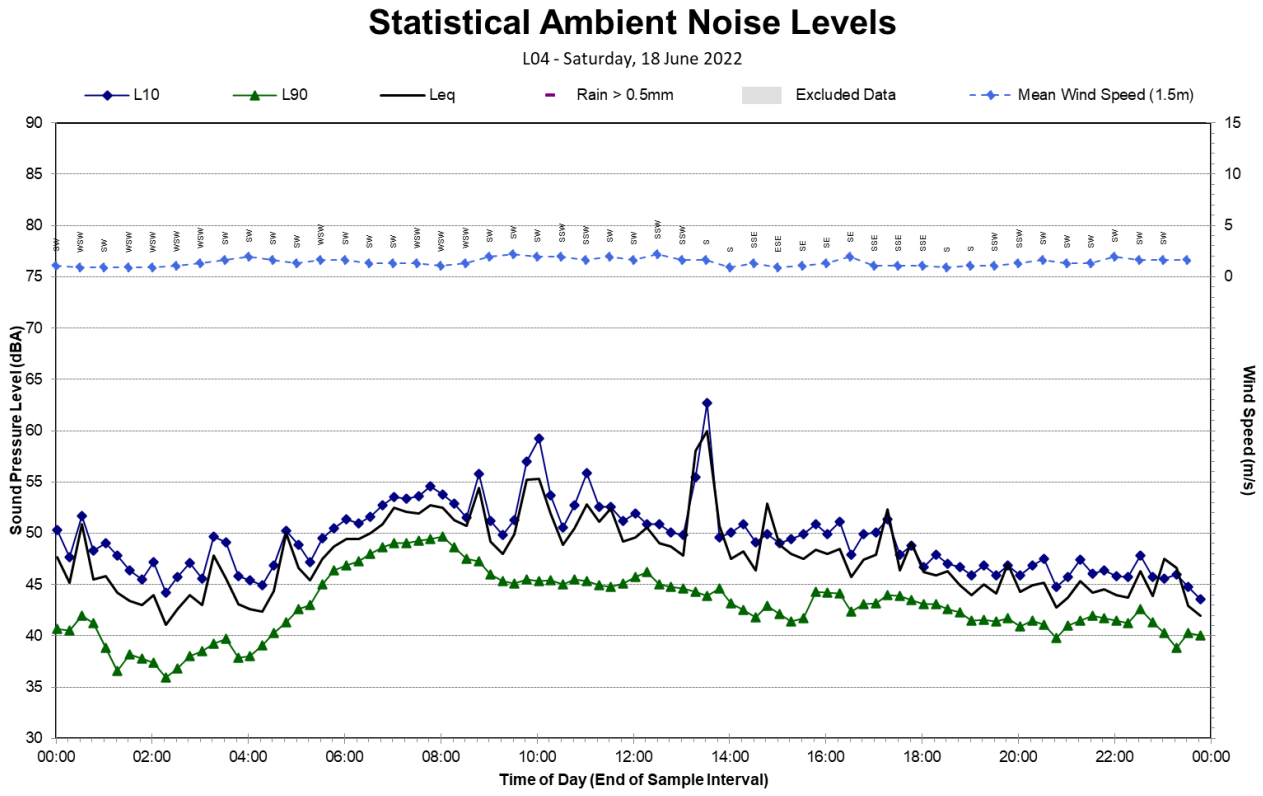
Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7 am-10 pm)	52	54
Night-time (10 pm-7 am)	47	49

Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
17/06/2022	15:41	49	63	81

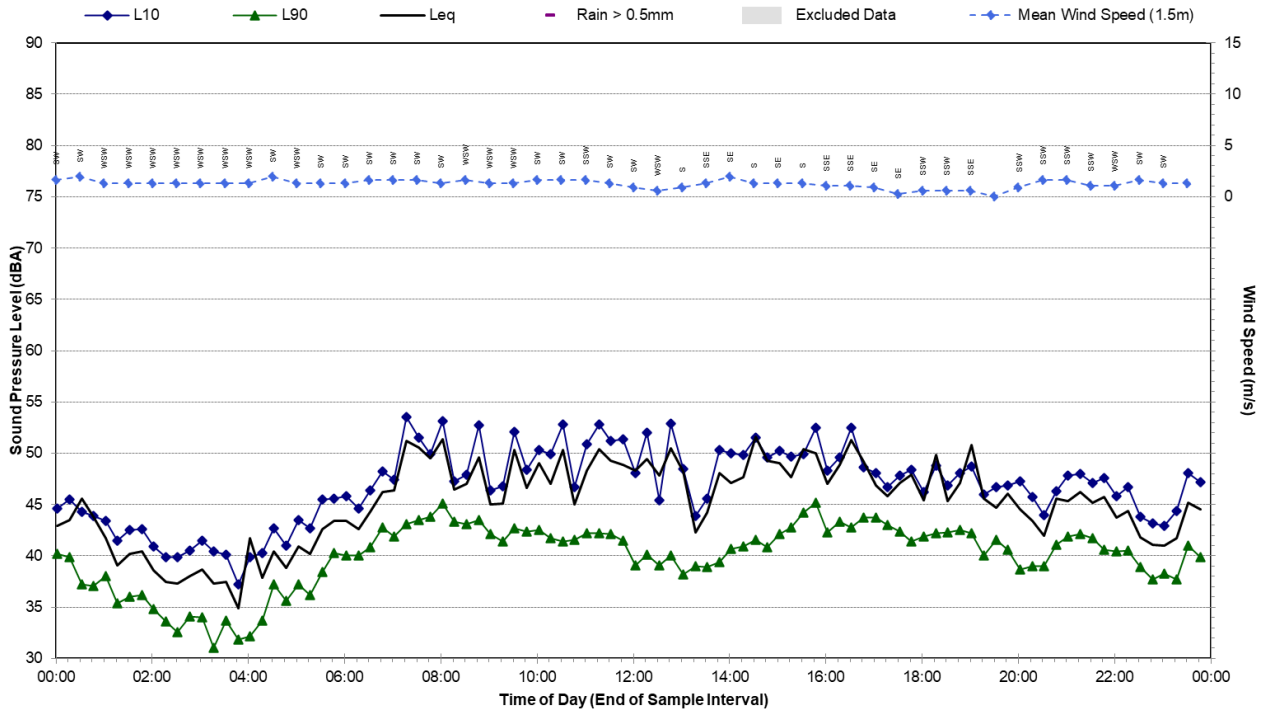
Photo of Noise Monitoring Location


Statistical Ambient Noise Levels
L04 - Friday, 17 June 2022
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L04 - Saturday, 18 June 2022
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

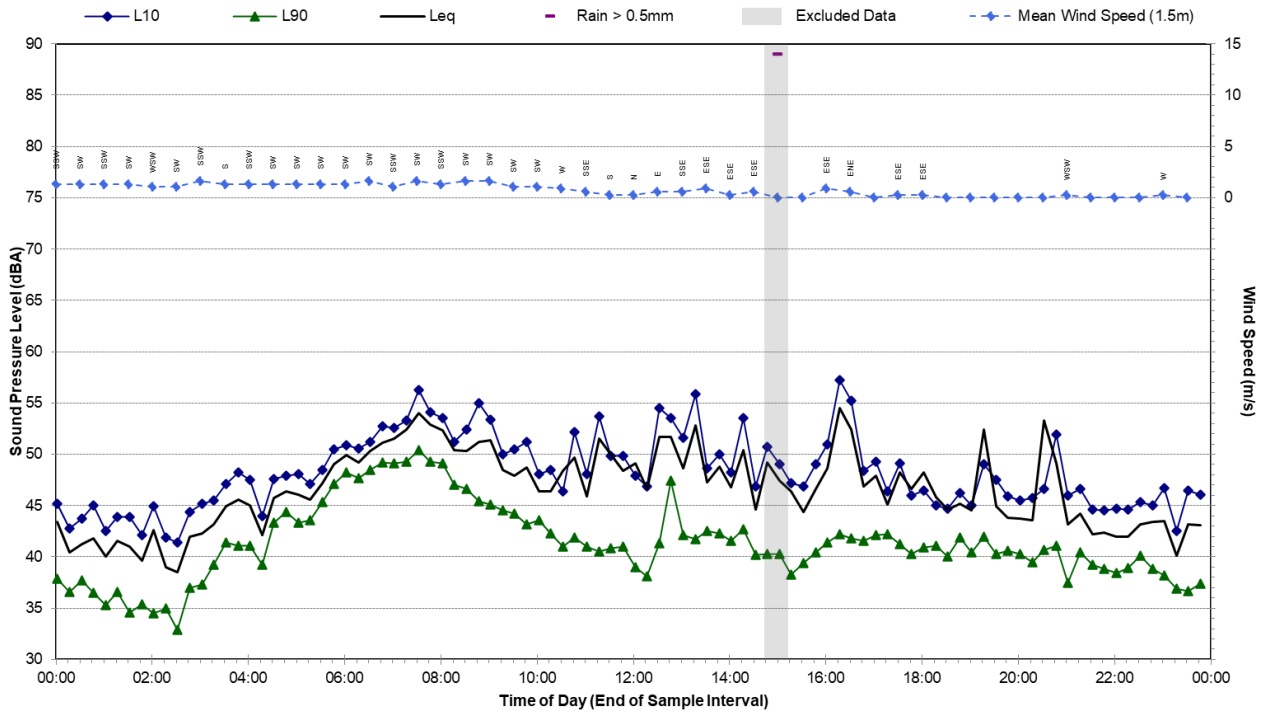
Statistical Ambient Noise Levels

L04 - Sunday, 19 June 2022



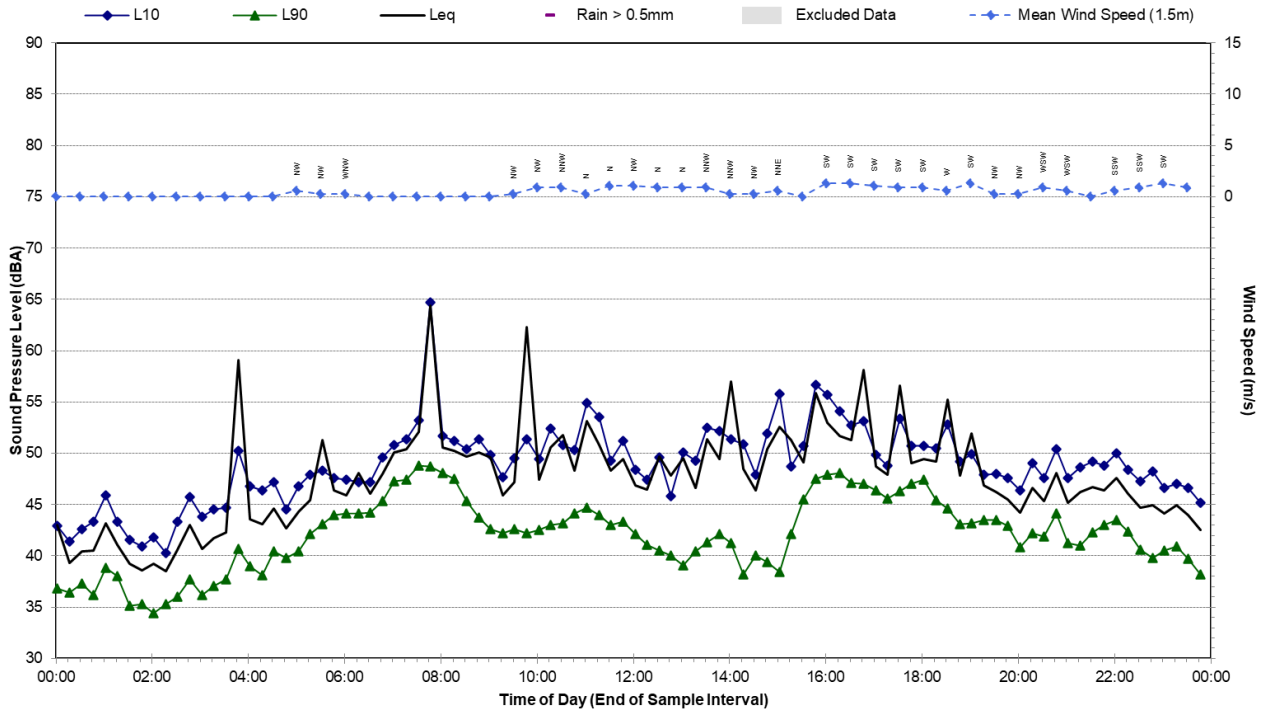
Statistical Ambient Noise Levels

L04 - Monday, 20 June 2022



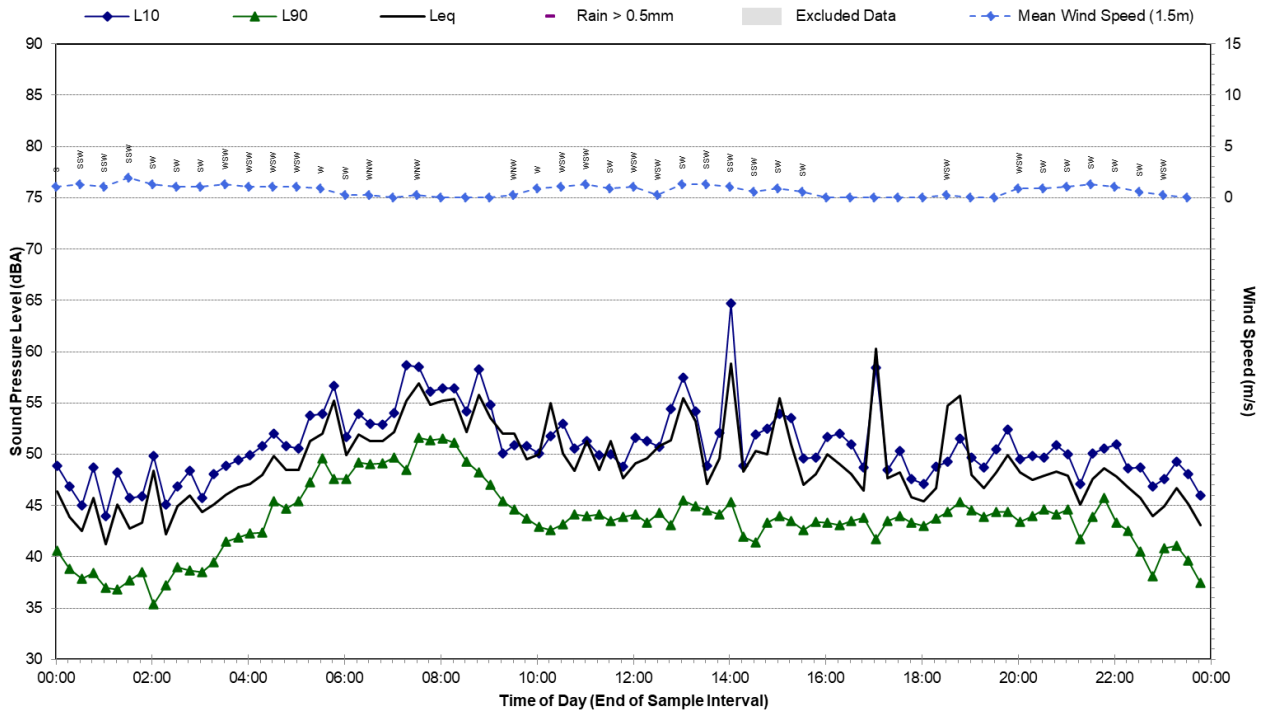
Statistical Ambient Noise Levels

L04 - Tuesday, 21 June 2022



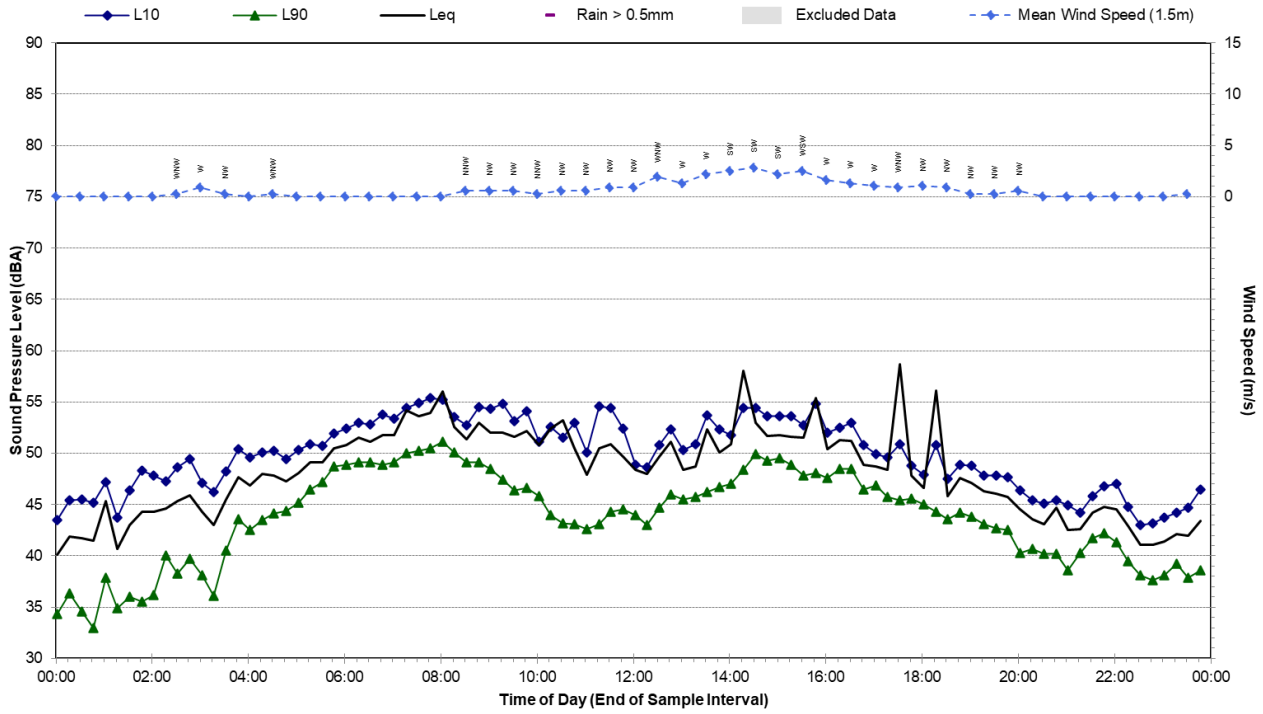
Statistical Ambient Noise Levels

L04 - Wednesday, 22 June 2022



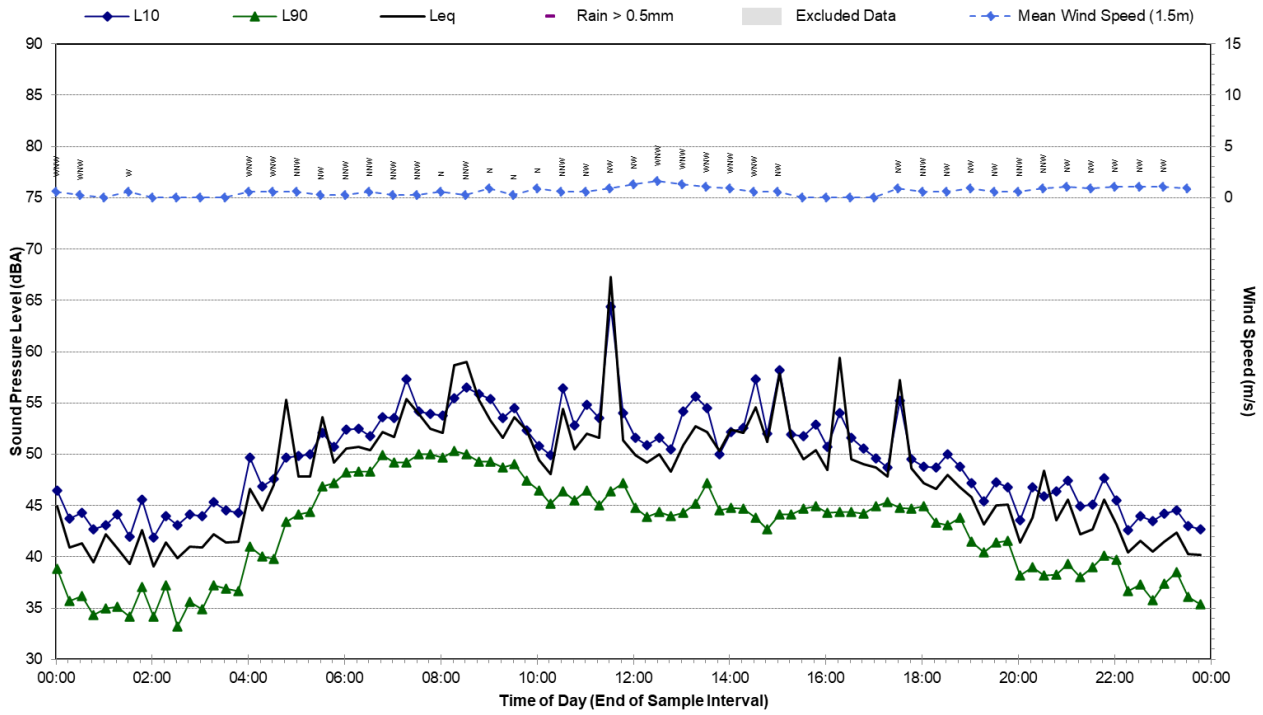
Statistical Ambient Noise Levels

L04 - Thursday, 23 June 2022



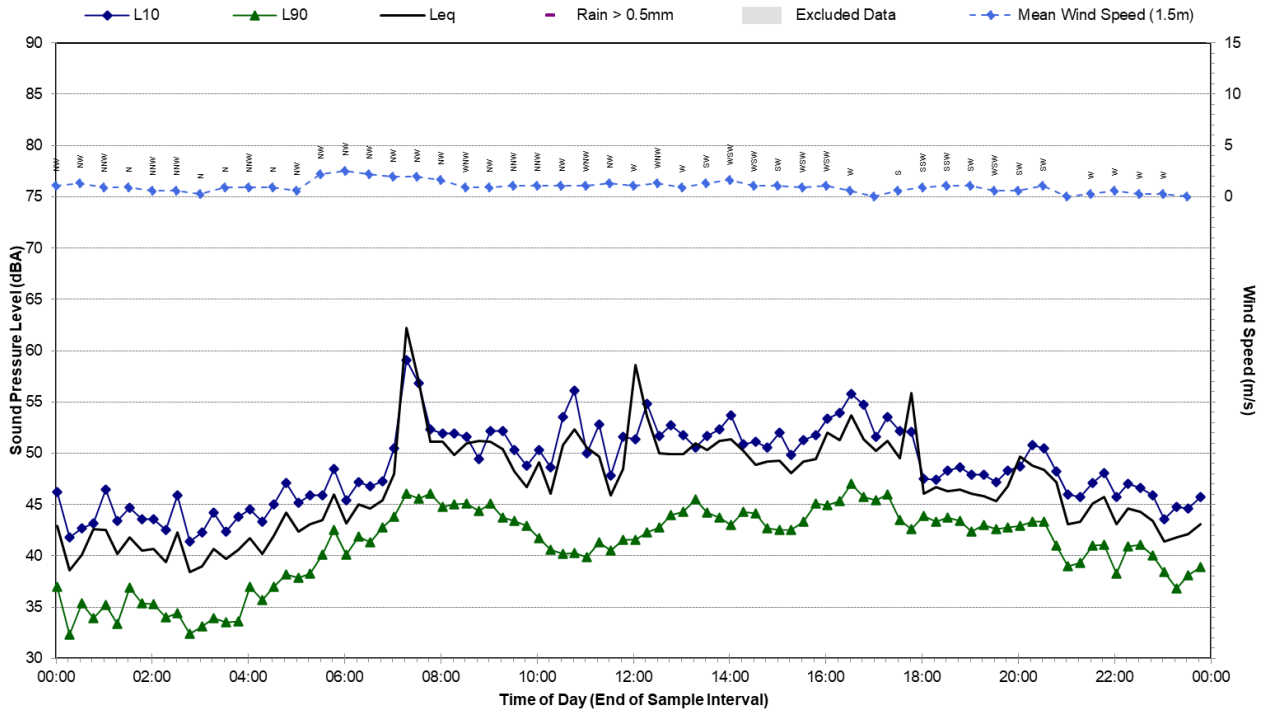
Statistical Ambient Noise Levels

L04 - Friday, 24 June 2022



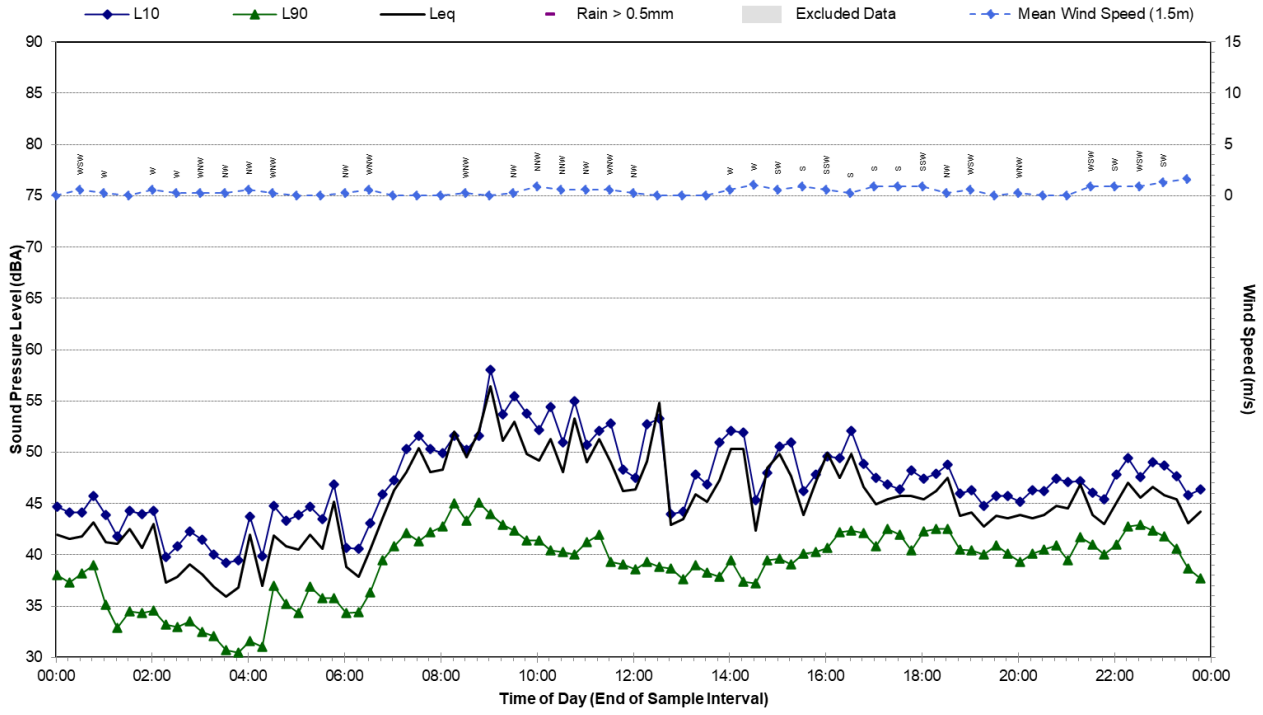
Statistical Ambient Noise Levels

L04 - Saturday, 25 June 2022



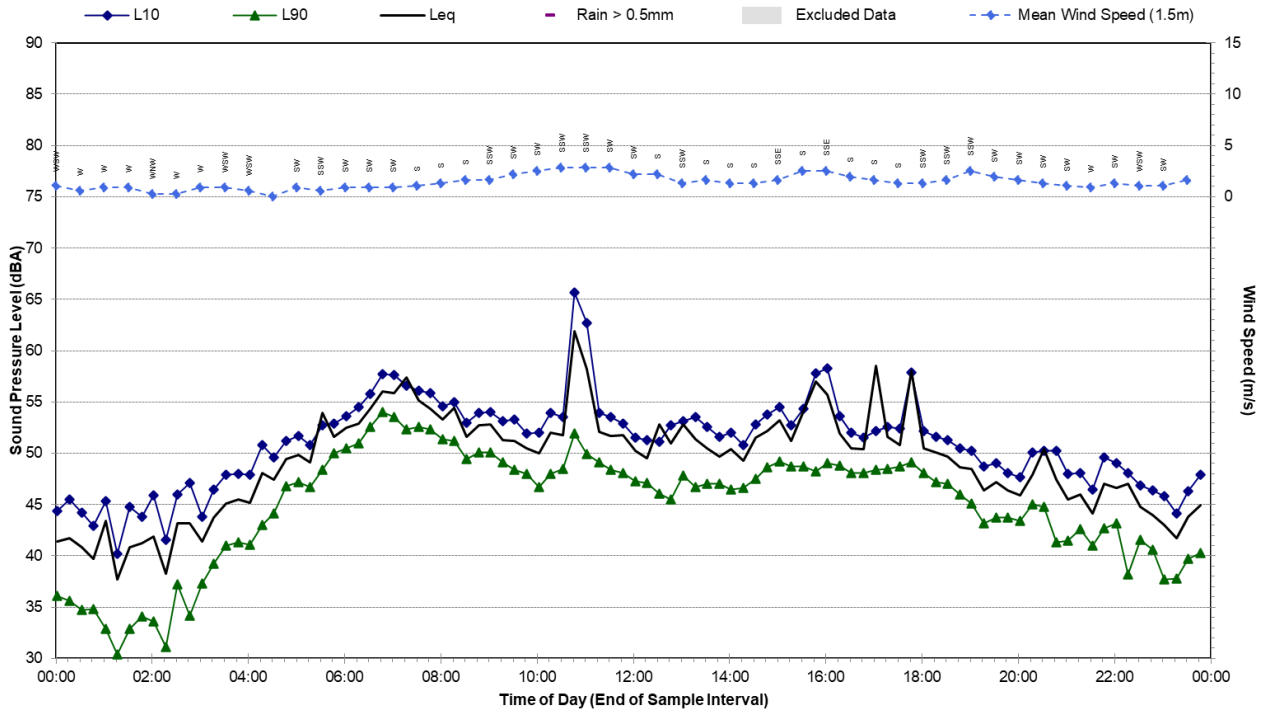
Statistical Ambient Noise Levels

L04 - Sunday, 26 June 2022



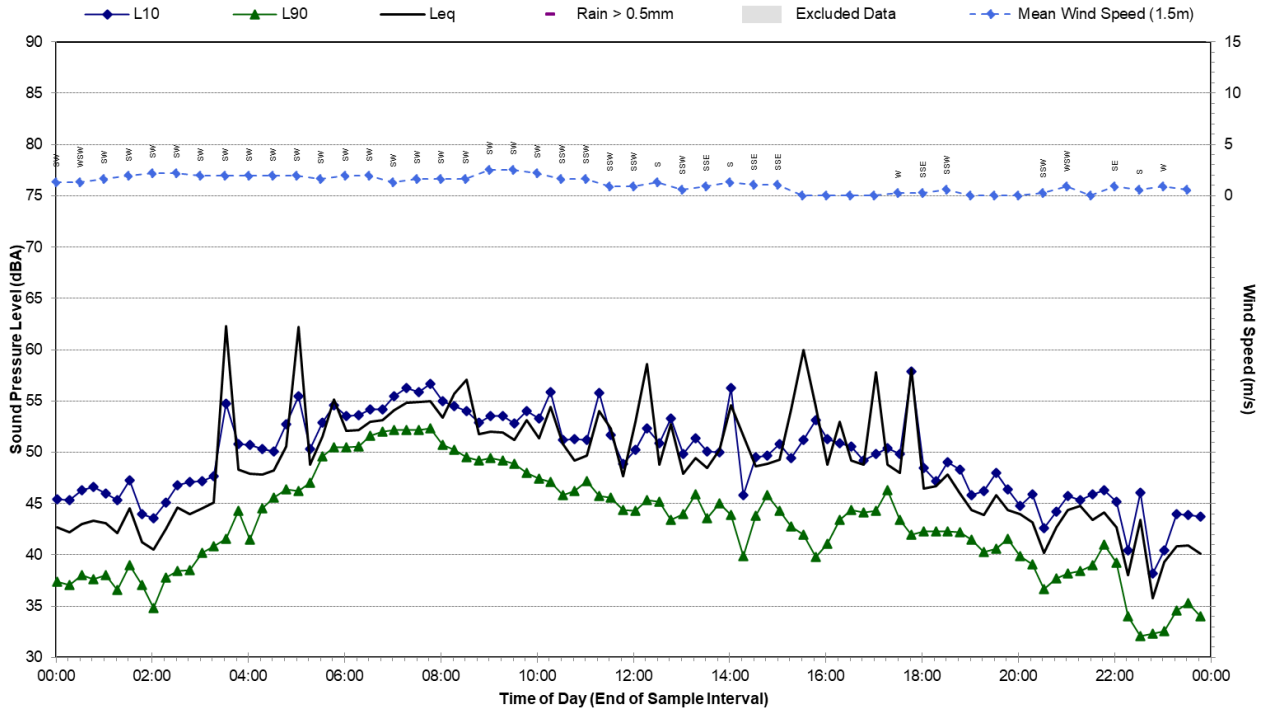
Statistical Ambient Noise Levels

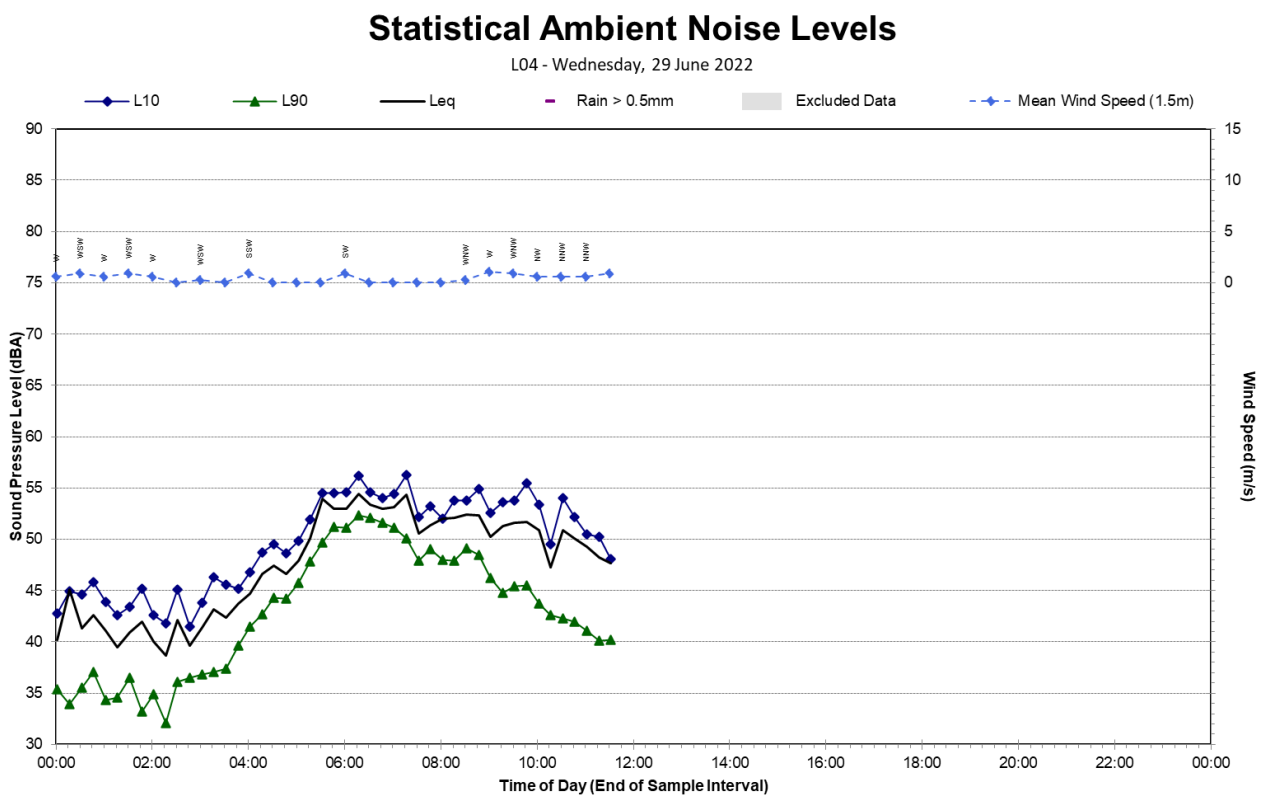
L04 - Monday, 27 June 2022



Statistical Ambient Noise Levels

L04 - Tuesday, 28 June 2022




Statistical Ambient Noise Levels
L04 - Wednesday, 29 June 2022
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

Noise Monitoring Location	L05
Noise Monitoring Address	**981 Mamre Road, Kemps Creek**

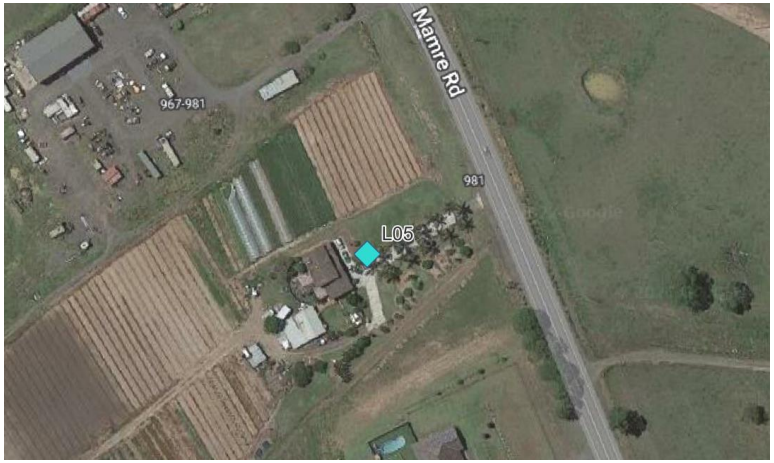
Logger Device Type: Svantek 957, Logger Serial No: 21884
Sound Level Meter: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3004635

Ambient noise monitor located in yard of rural residential property at 981 Mamre Road, Kemps Creek, with direct view of Mamre Road.

Attended noise measurements indicate the ambient noise environment at this location is dominated by steady-state road traffic on Mamre Road. Heavy vehicle passbys and local fauna (birds) also contribute to the noise at this location.

Measured Attended Noise Levels (LAmax):
17/06/22: Steady light vehicle traffic on Mamre Road: 51-61 dBA, heavy vehicles: 60-70 dBA

Map of Noise Monitoring Location



Ambient Noise Logging Results – NPfI Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	48	61	65	68
Evening	46	59	62	67
Night-time	34	57	59	65
Morning Shoulder	50	60	64	67

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7 am-10 pm)	61	62
Night-time (10 pm-7 am)	57	60

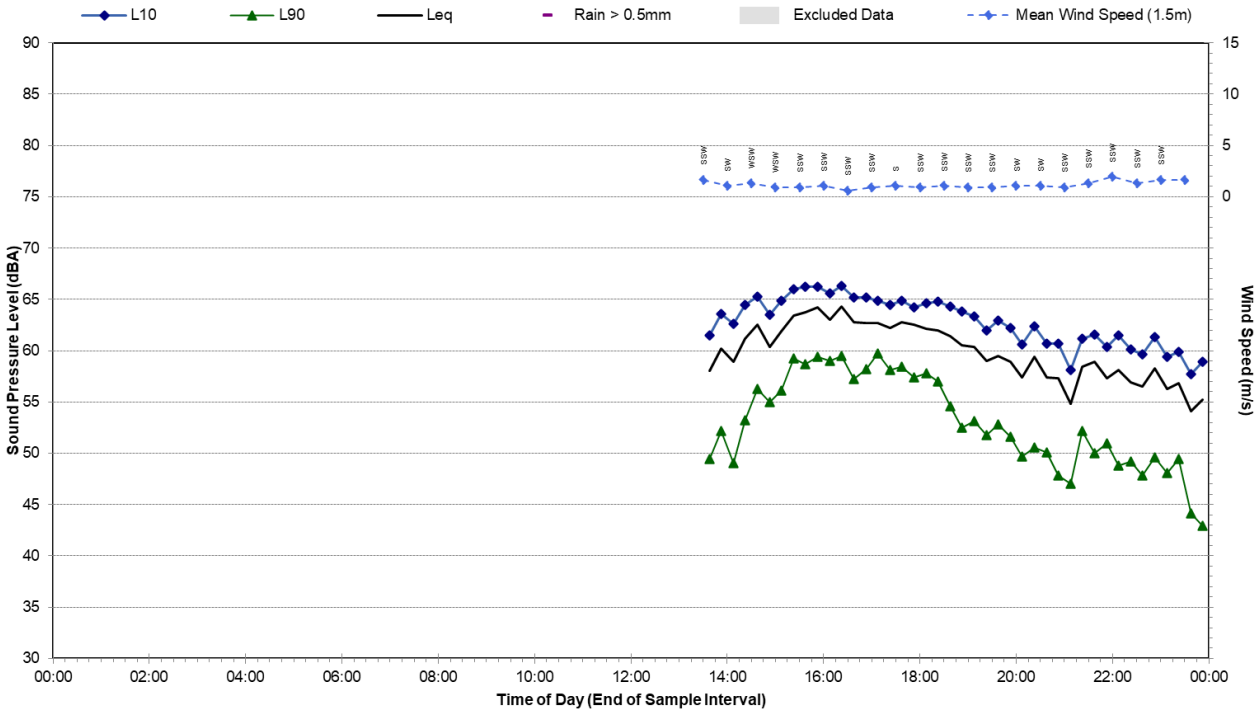
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
17/06/2022	13:23	49	57	70

Photo of Noise Monitoring Location

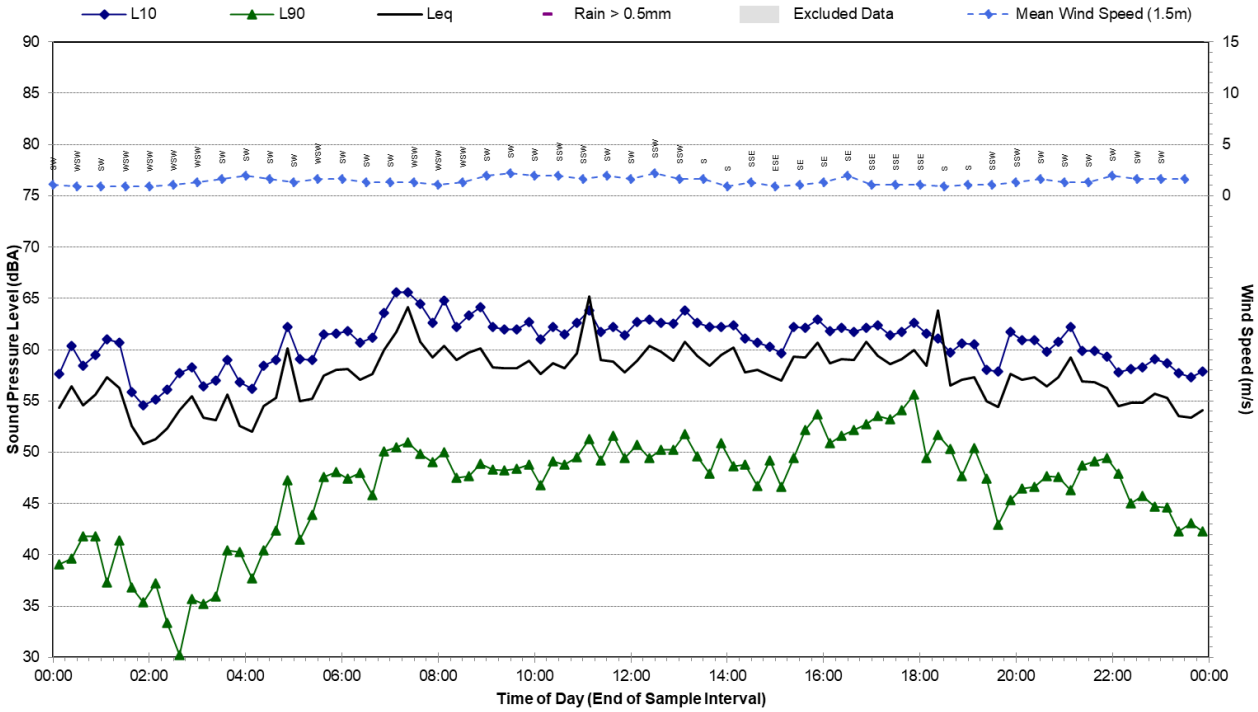
Statistical Ambient Noise Levels

L05 - Friday, 17 June 2022



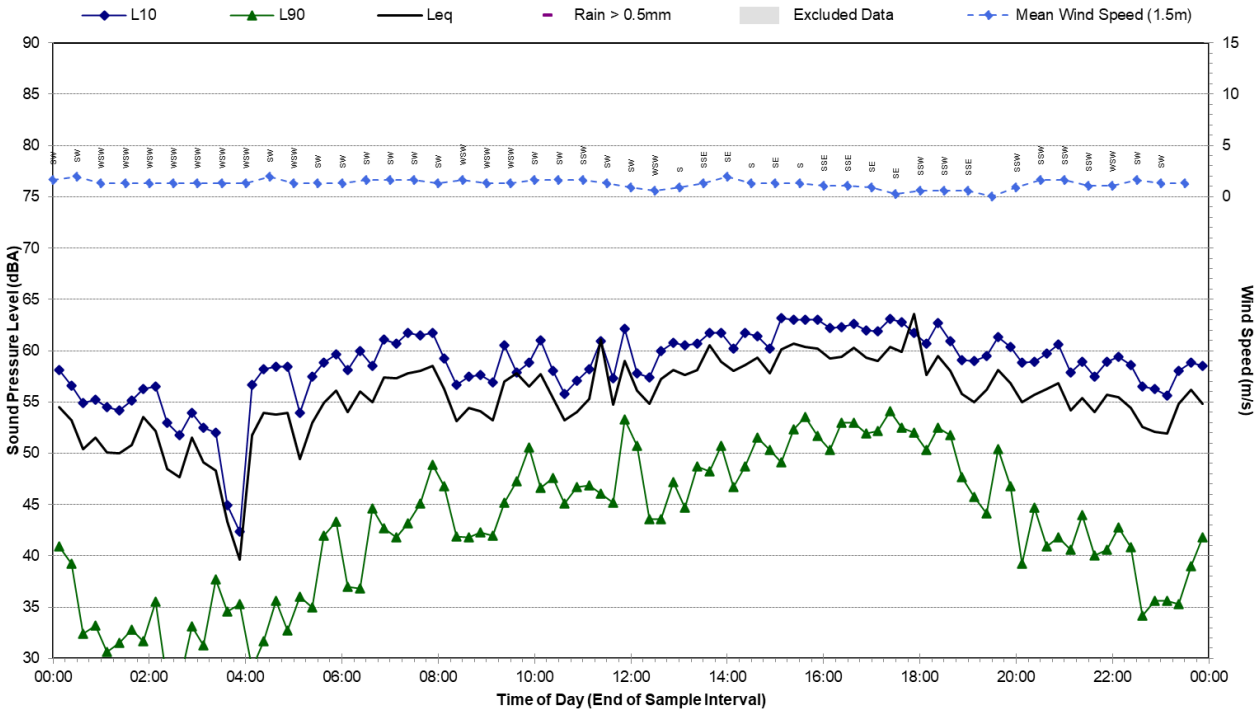
Statistical Ambient Noise Levels

L05 - Saturday, 18 June 2022



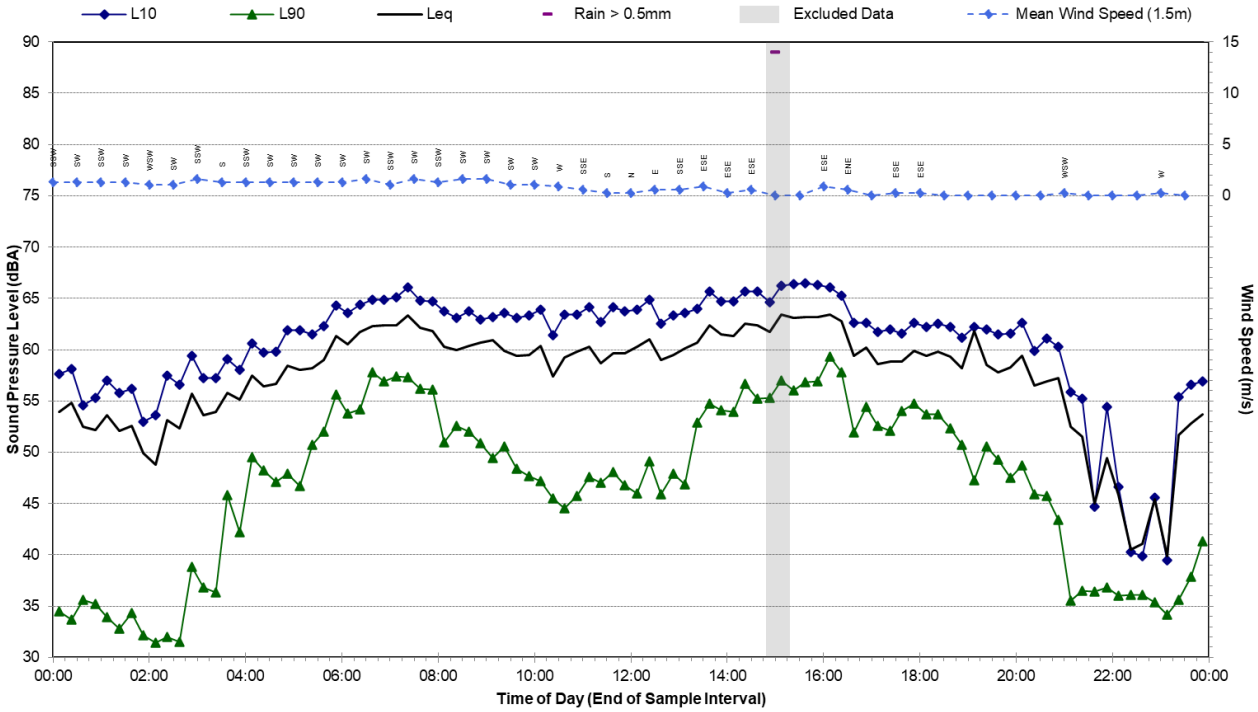
Statistical Ambient Noise Levels

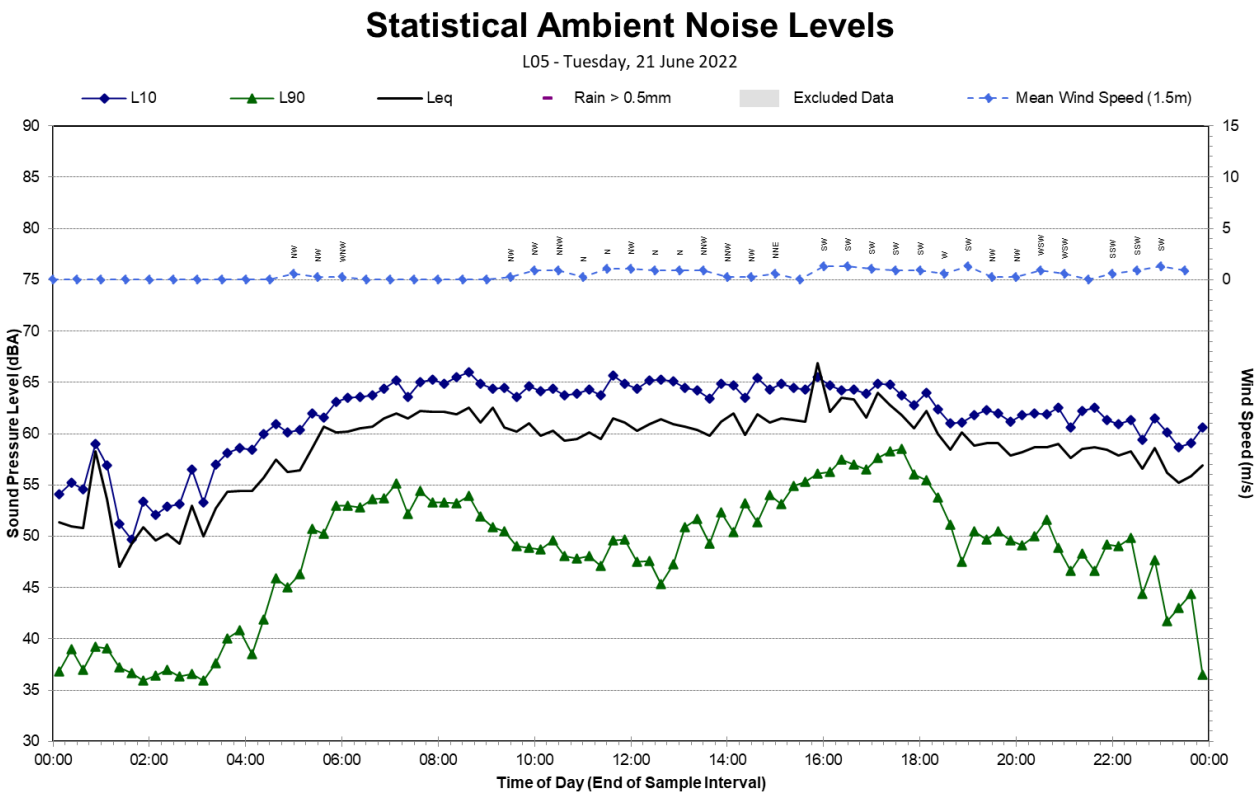
L05 - Sunday, 19 June 2022

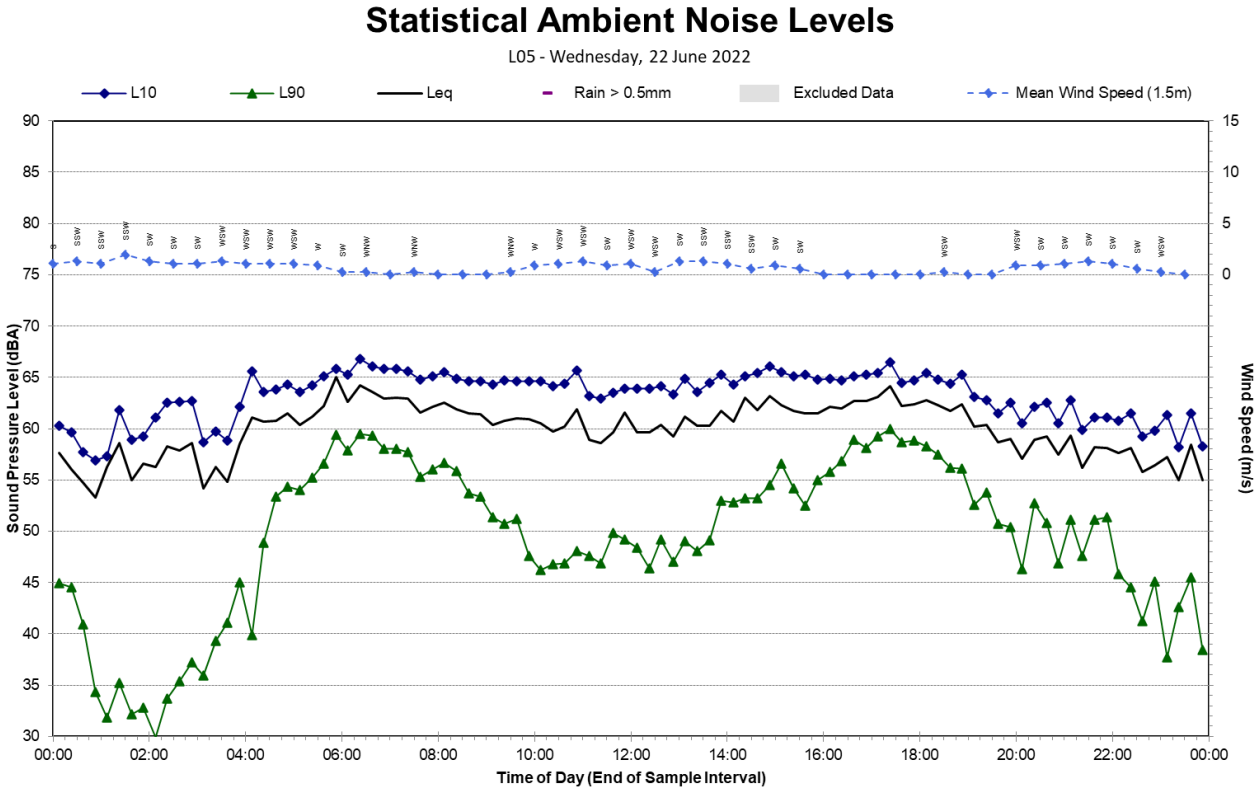


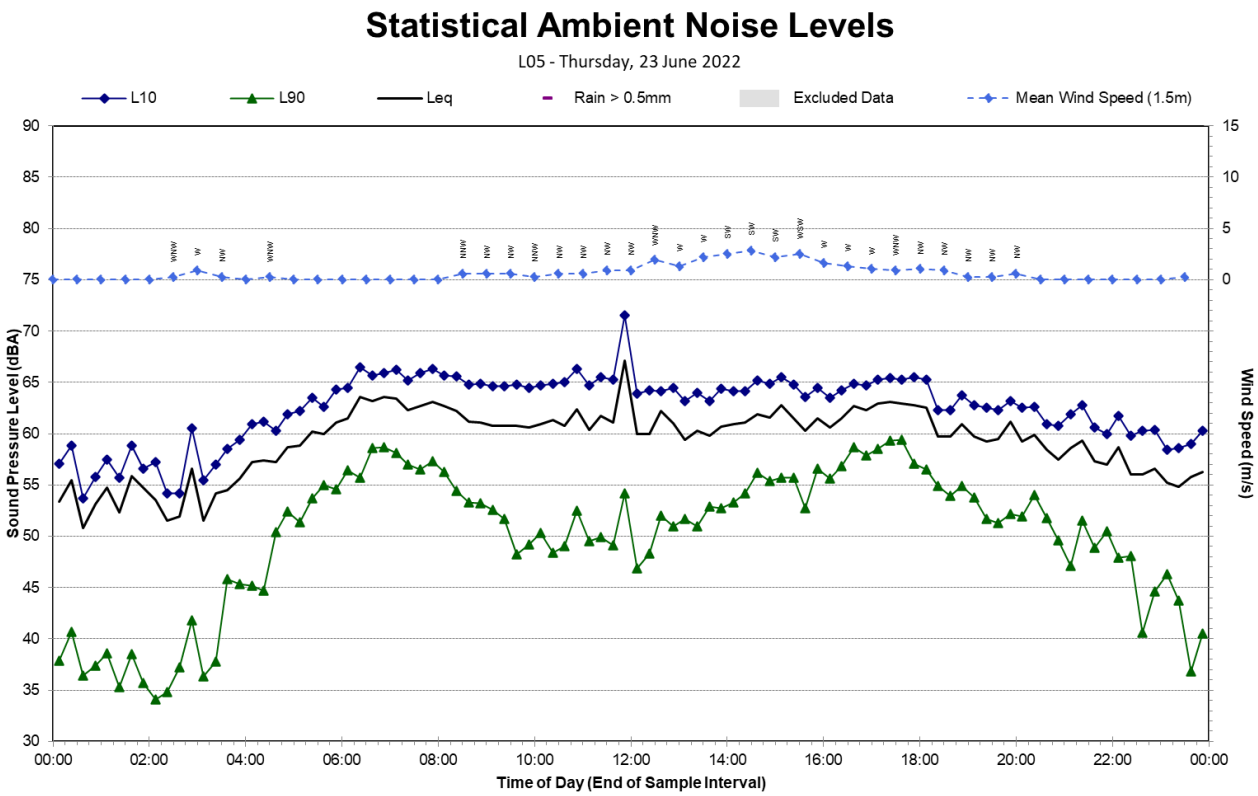
Statistical Ambient Noise Levels

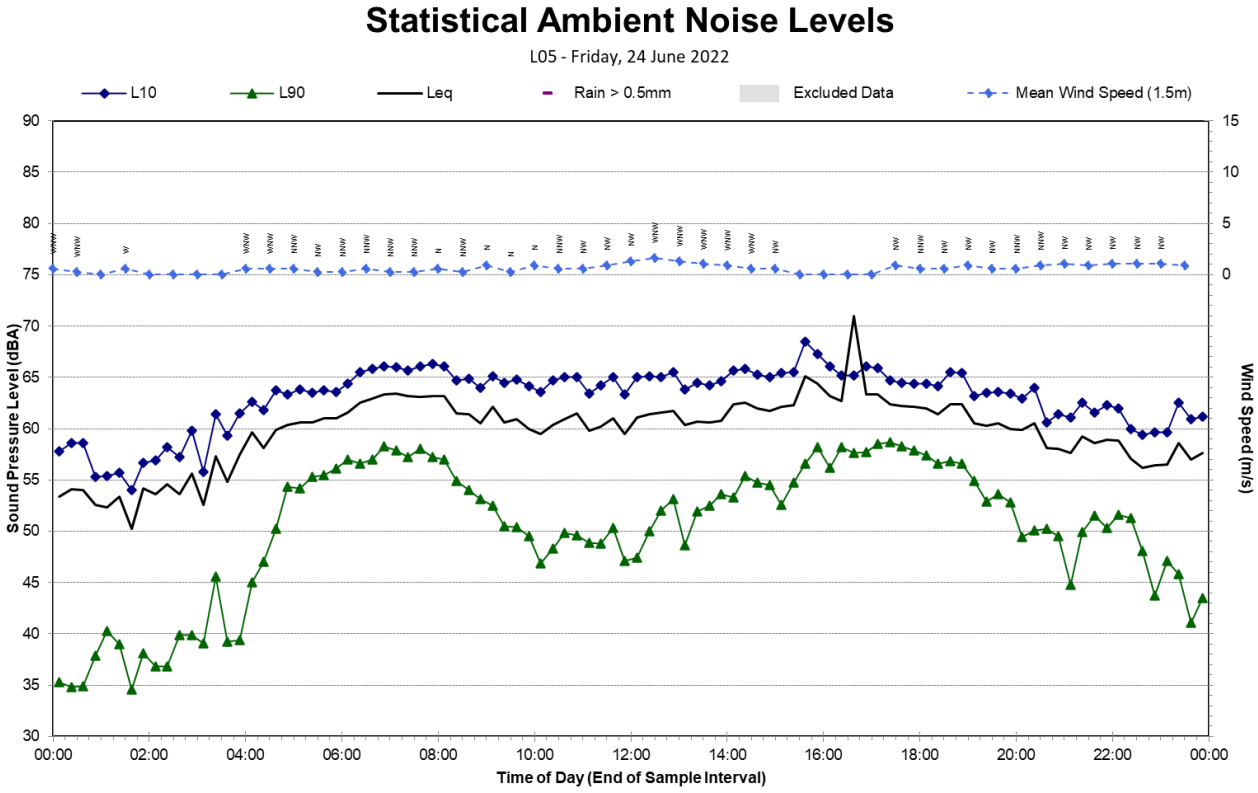
L05 - Monday, 20 June 2022




Statistical Ambient Noise Levels
L05 - Tuesday, 21 June 2022
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

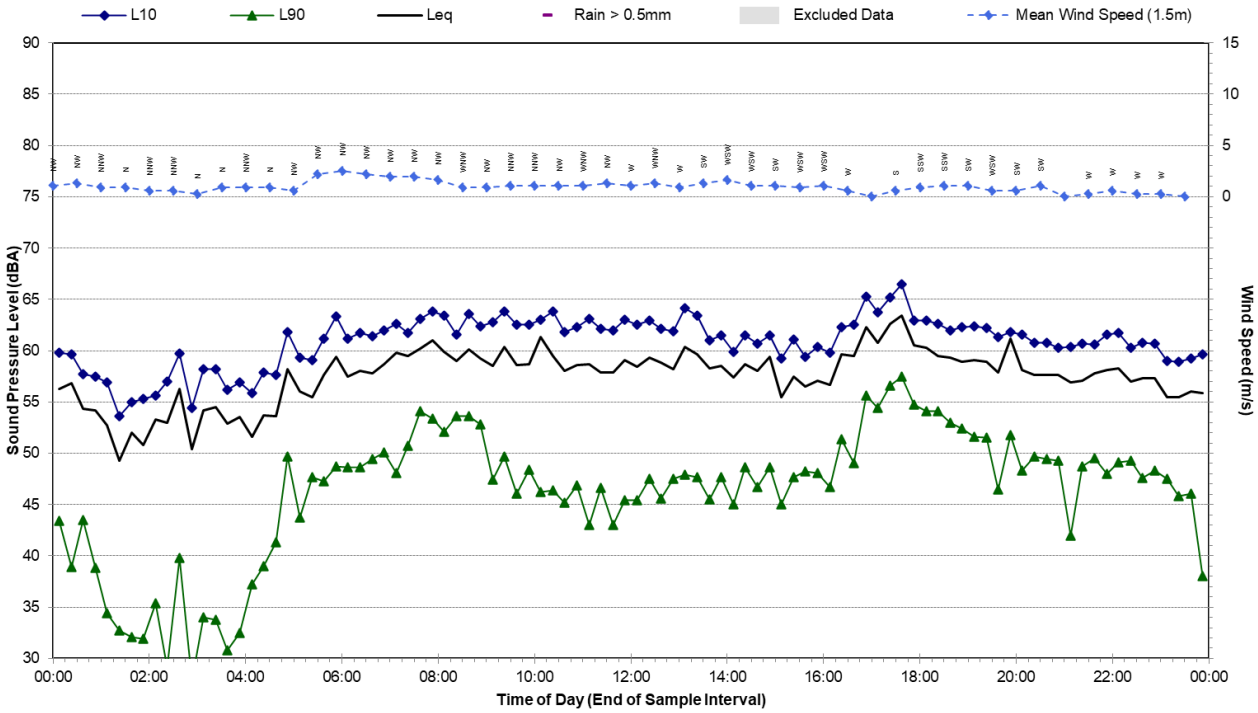

Statistical Ambient Noise Levels
L05 - Wednesday, 22 June 2022
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L05 - Thursday, 23 June 2022
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L05 - Friday, 24 June 2022
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

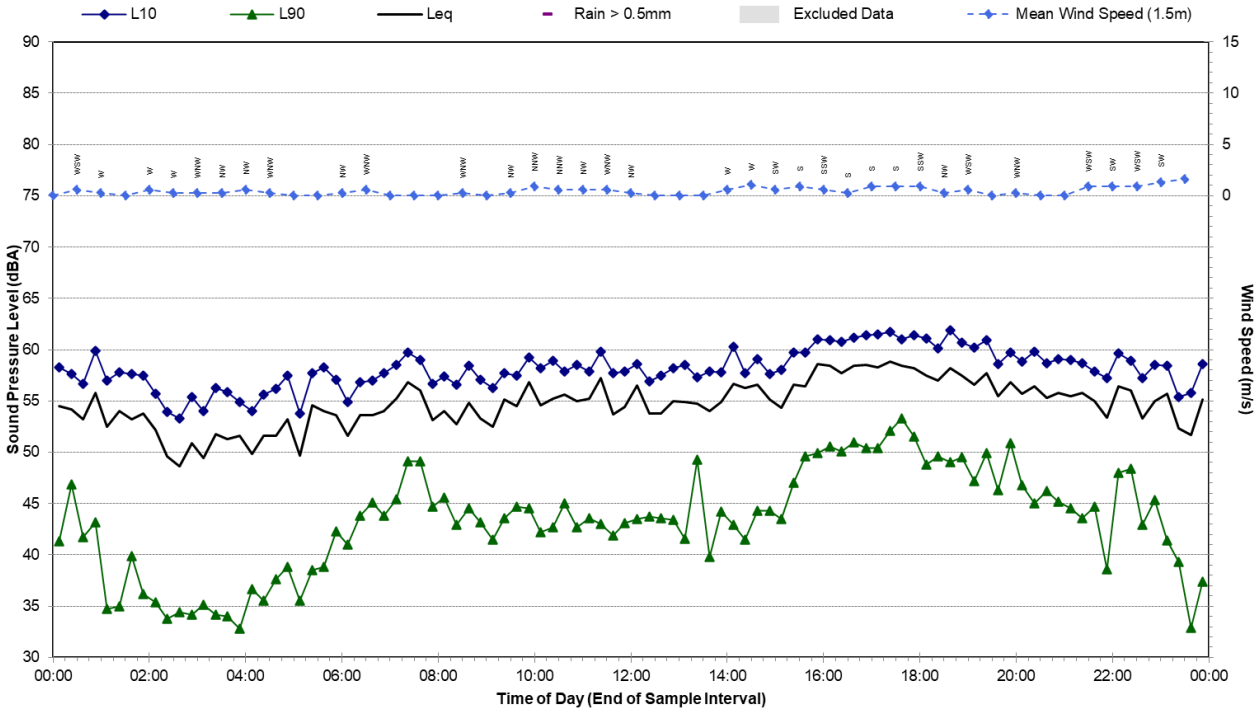
Statistical Ambient Noise Levels

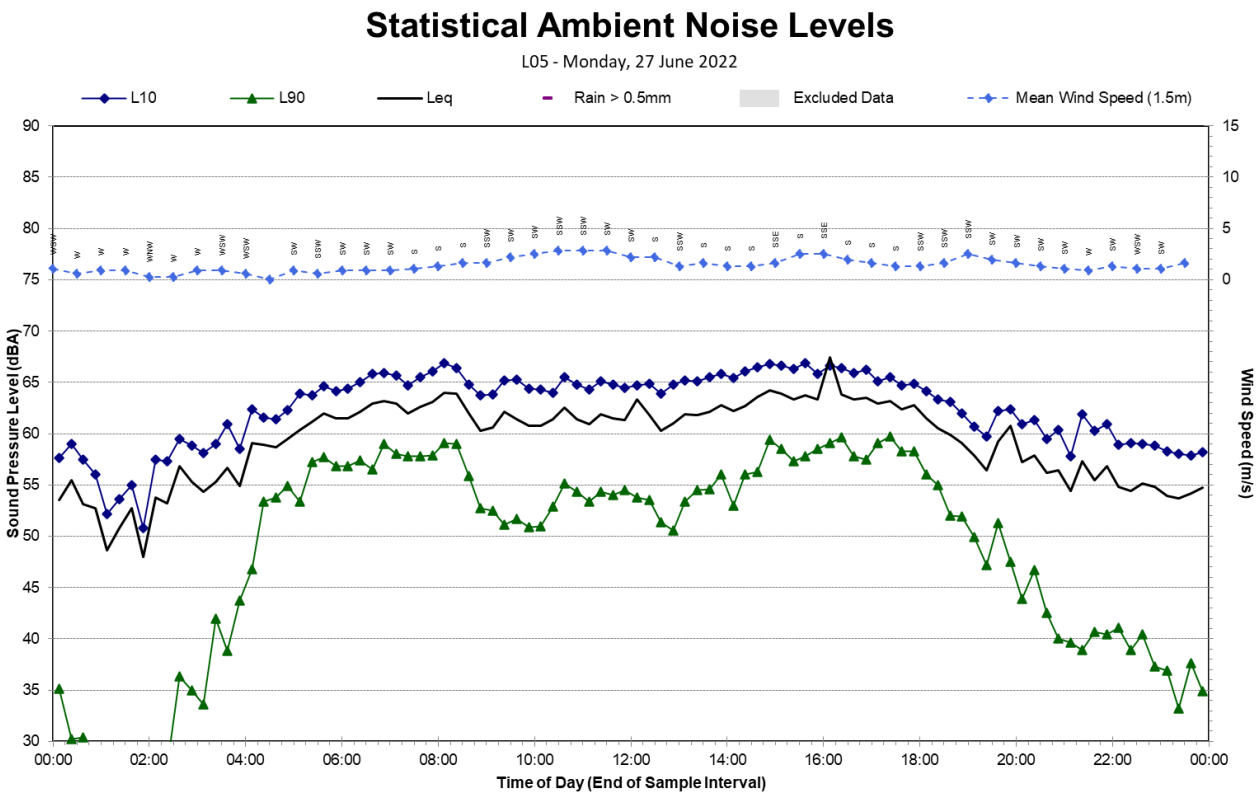
L05 - Saturday, 25 June 2022

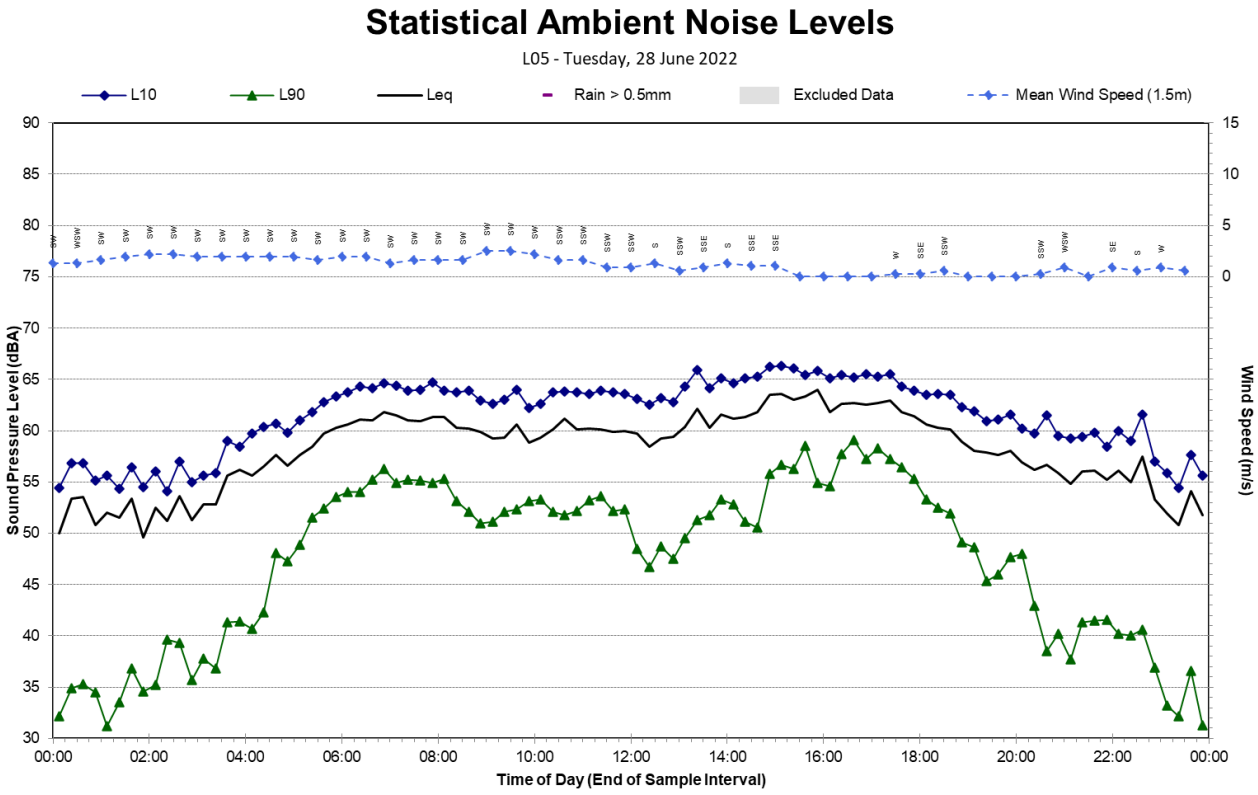


Statistical Ambient Noise Levels

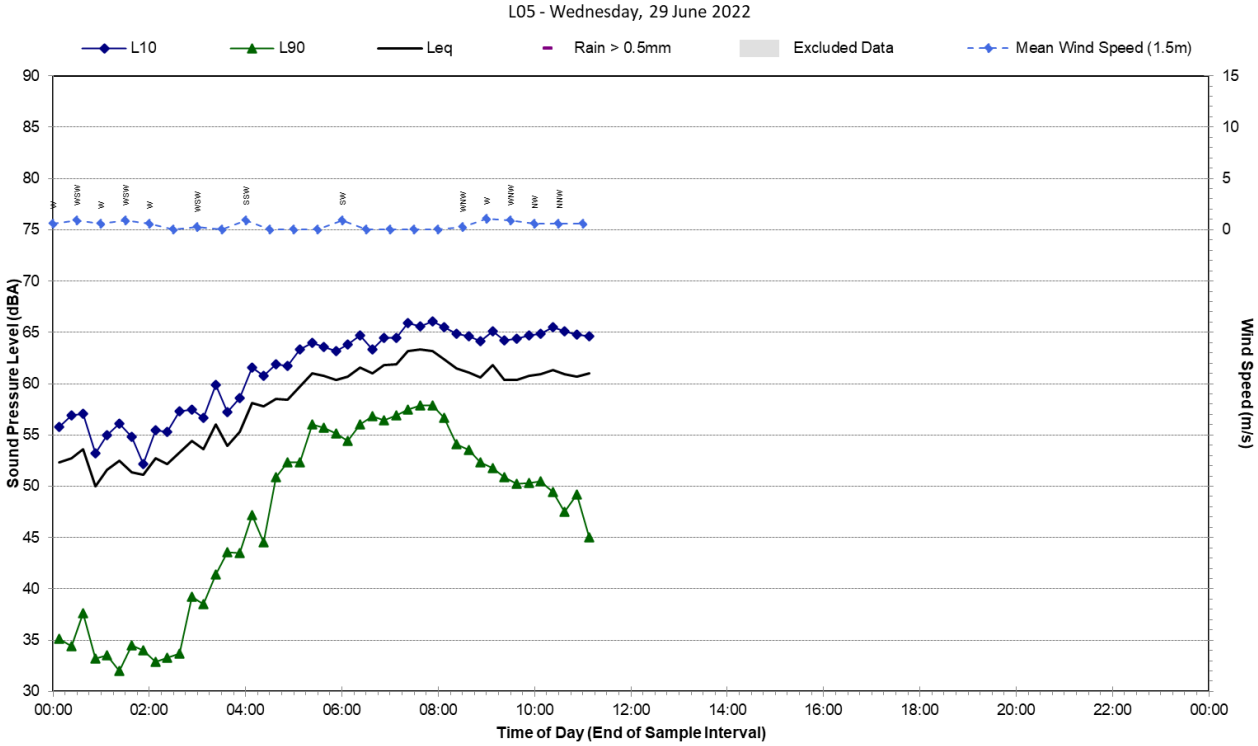
L05 - Sunday, 26 June 2022




Statistical Ambient Noise Levels
L05 - Monday, 27 June 2022
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L05 - Tuesday, 28 June 2022
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

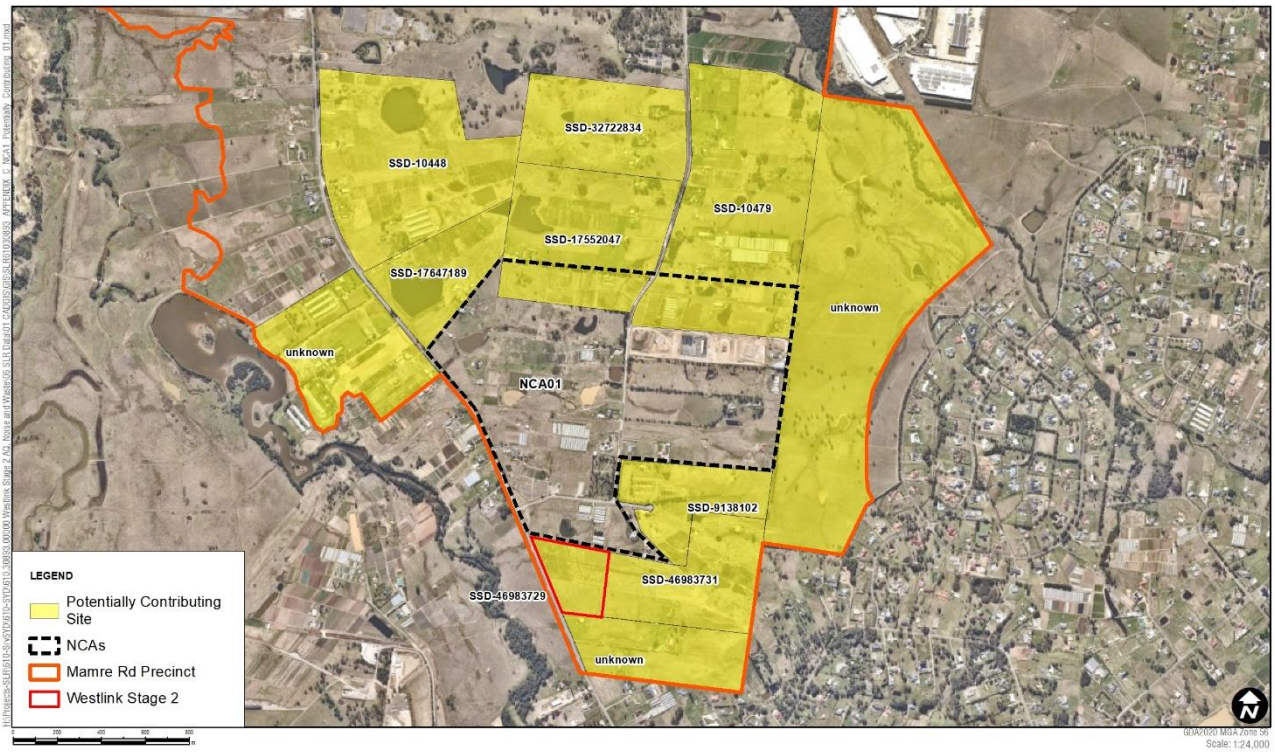
Statistical Ambient Noise Levels



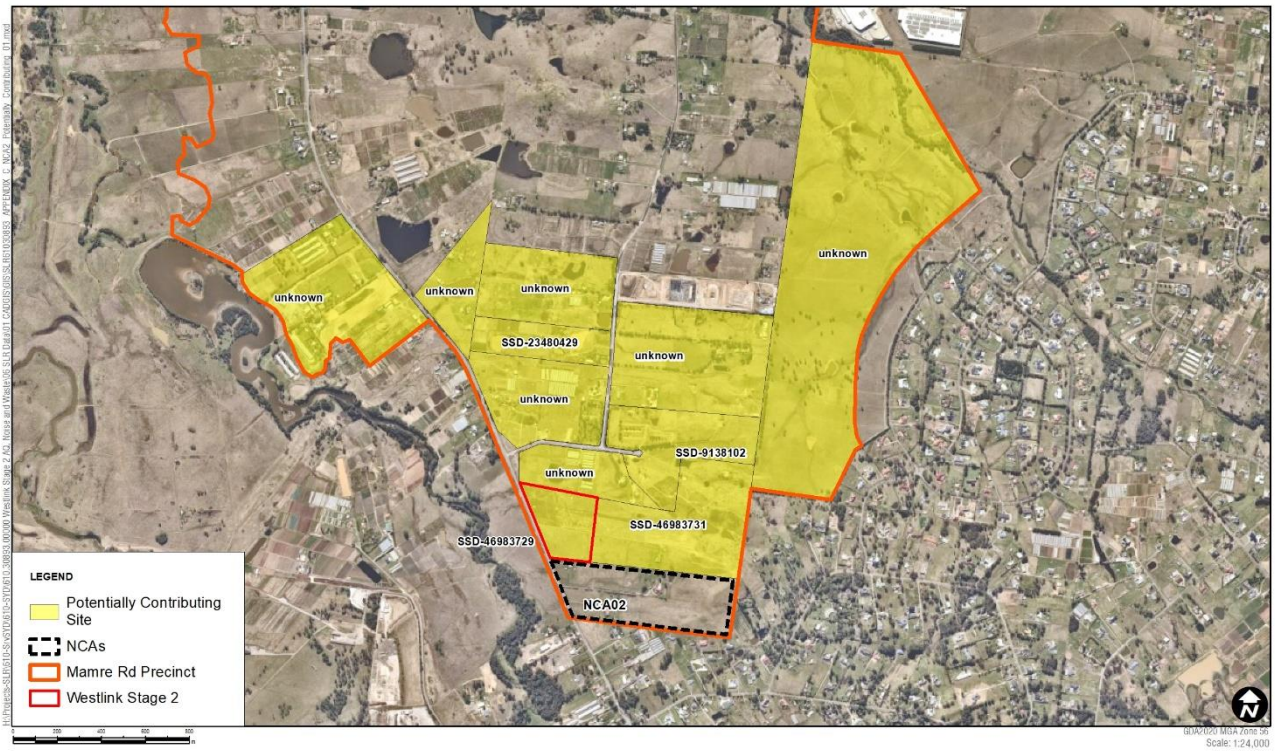
Appendix C

Potentially Contributing Industrial Sites

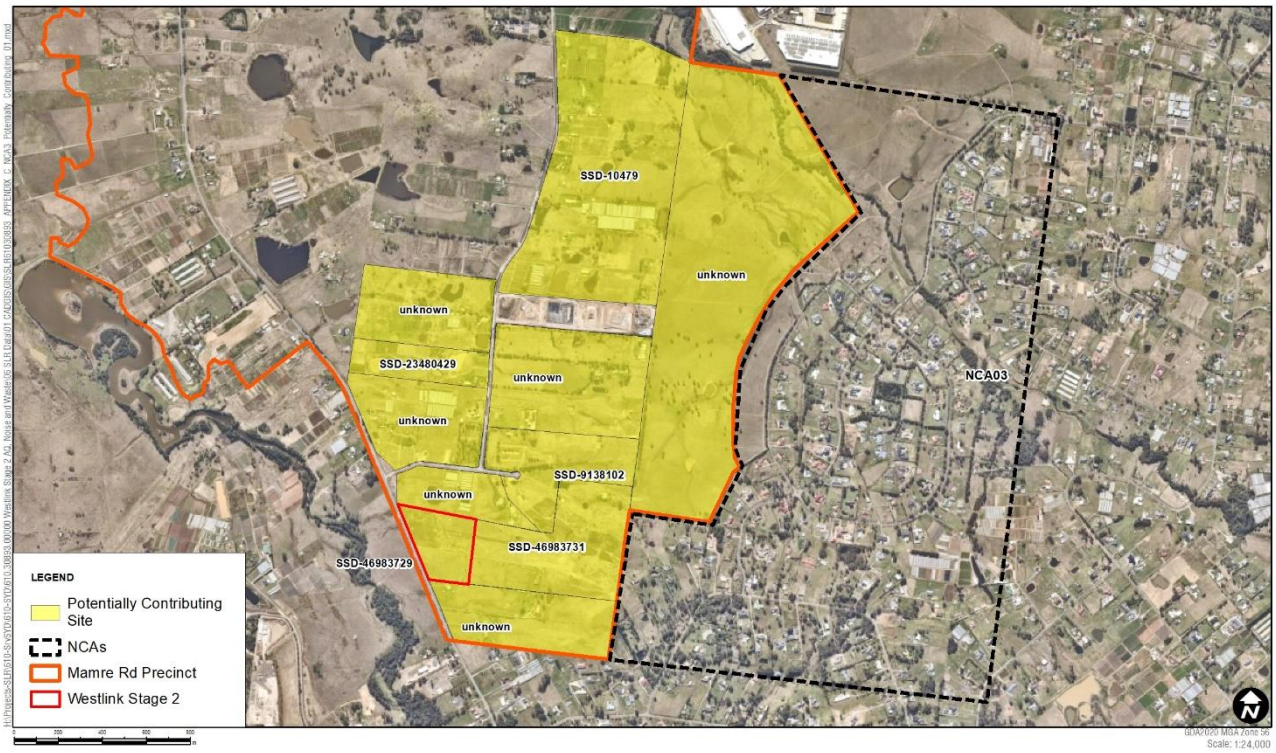
Potentially Contributing Estates to Industrial Noise Levels in NCA01



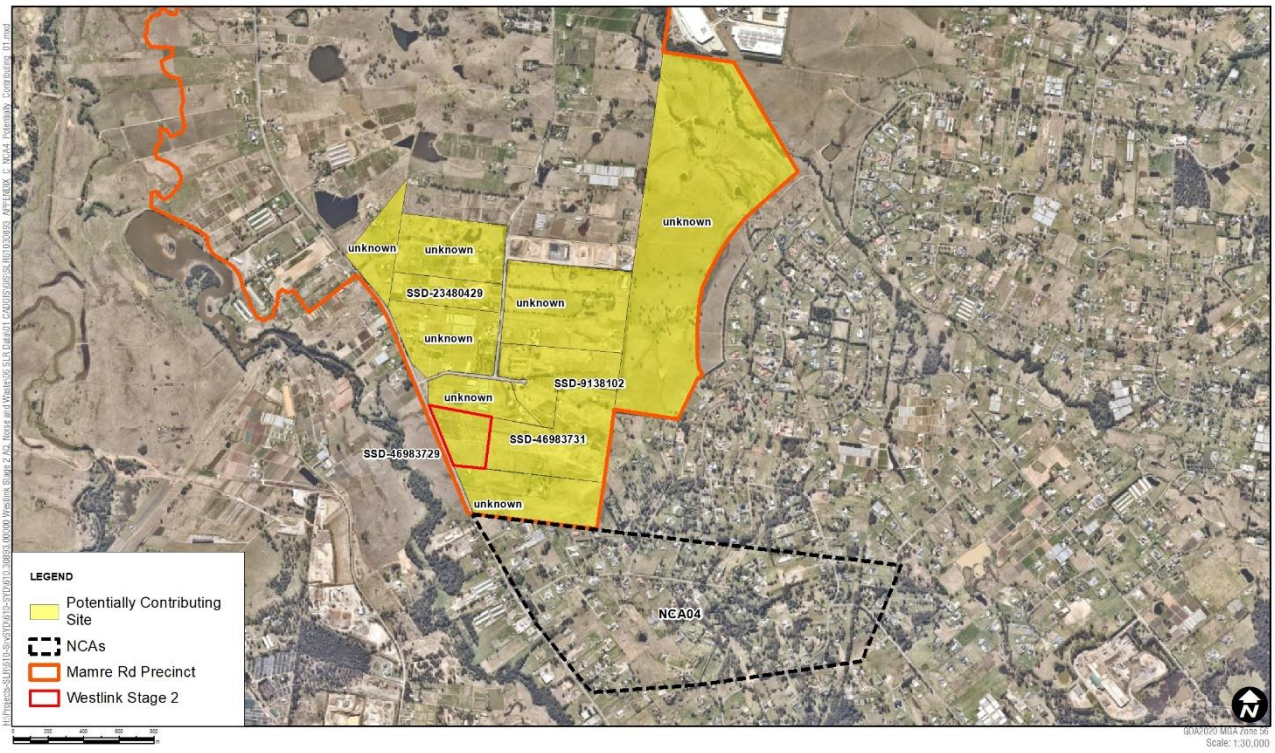
Potentially Contributing Estates to Industrial Noise Levels in NCA02



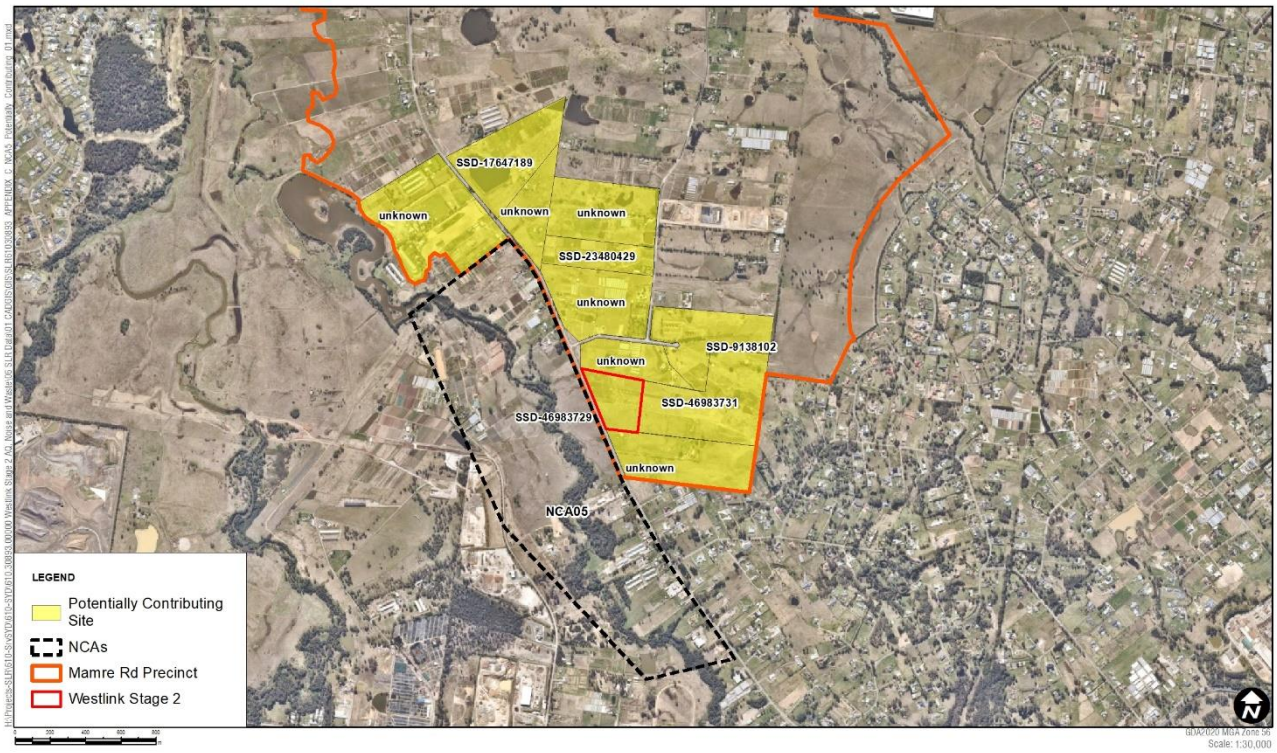
Potentially Contributing Estates to Industrial Noise Levels in NCA03



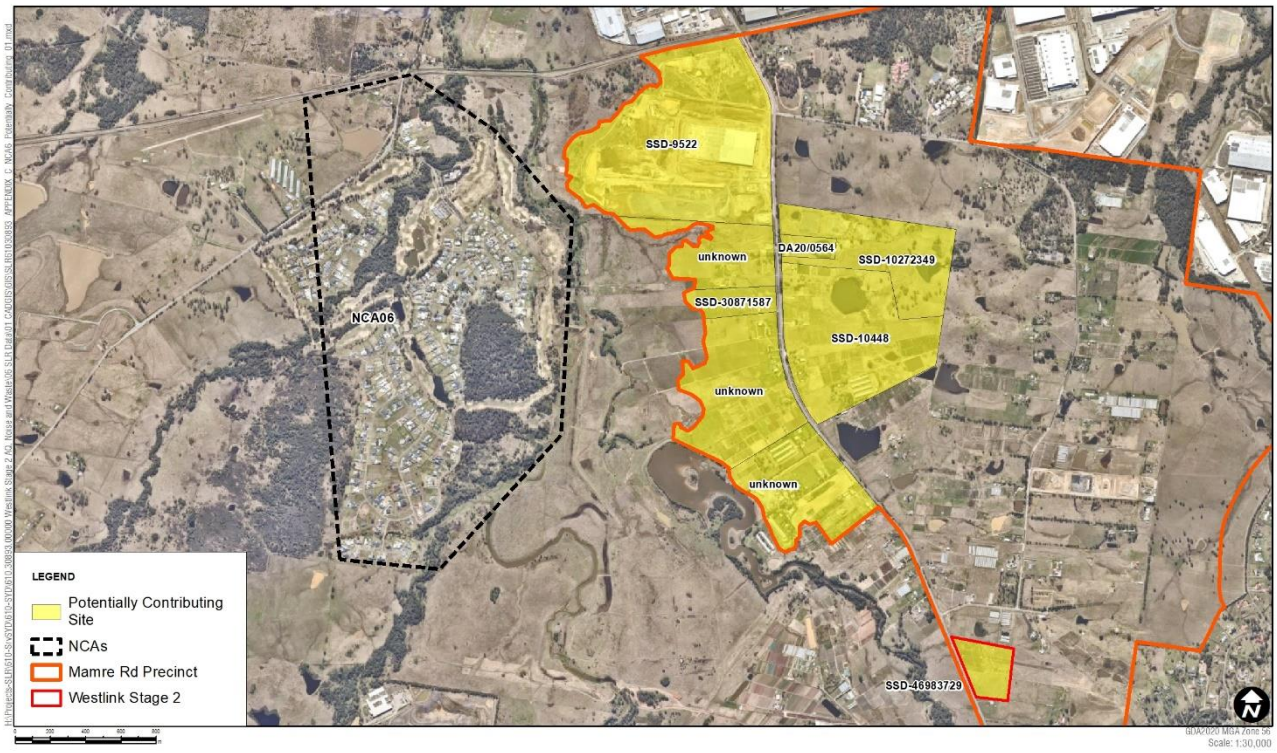
Potentially Contributing Estates to Industrial Noise Levels in NCA04



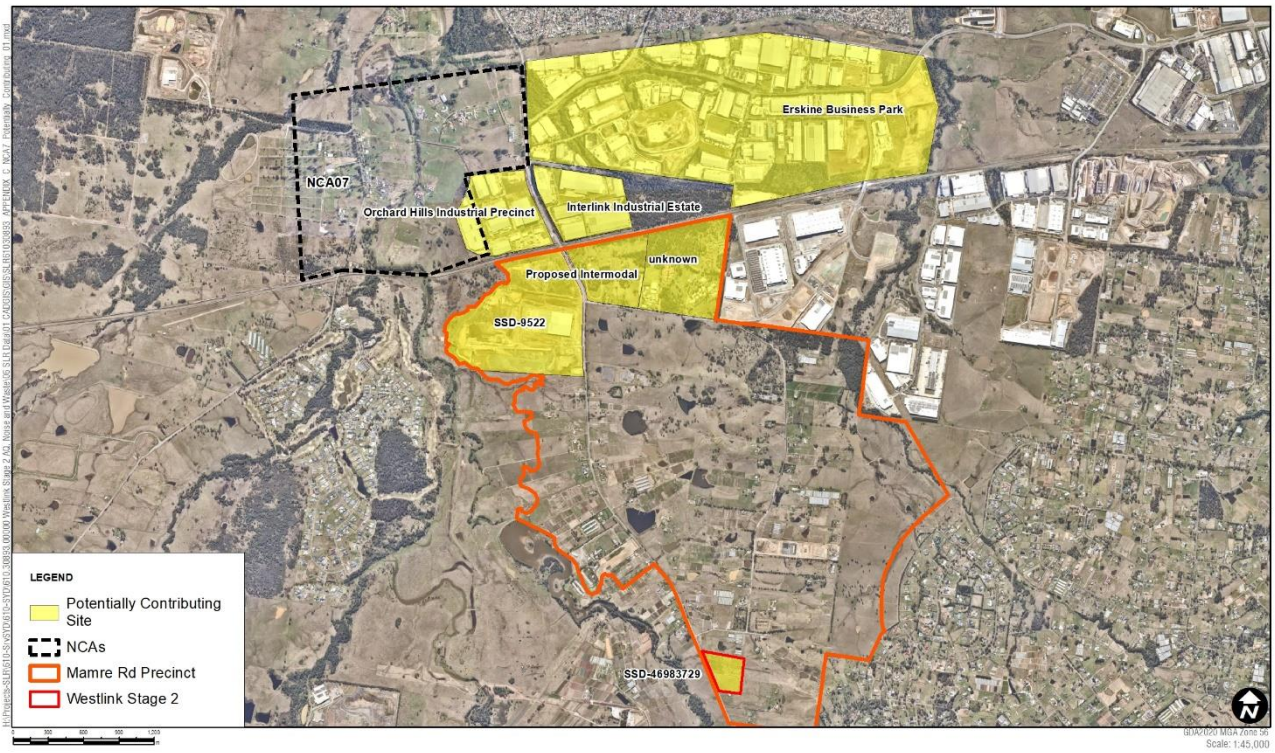
Potentially Contributing Estates to Industrial Noise Levels in NCA05



Potentially Contributing Estates to Industrial Noise Levels in NCA06



Potentially Contributing Estates to Industrial Noise Levels in NCA07



Appendix D

Construction Noise Sources

Construction Noise Sources

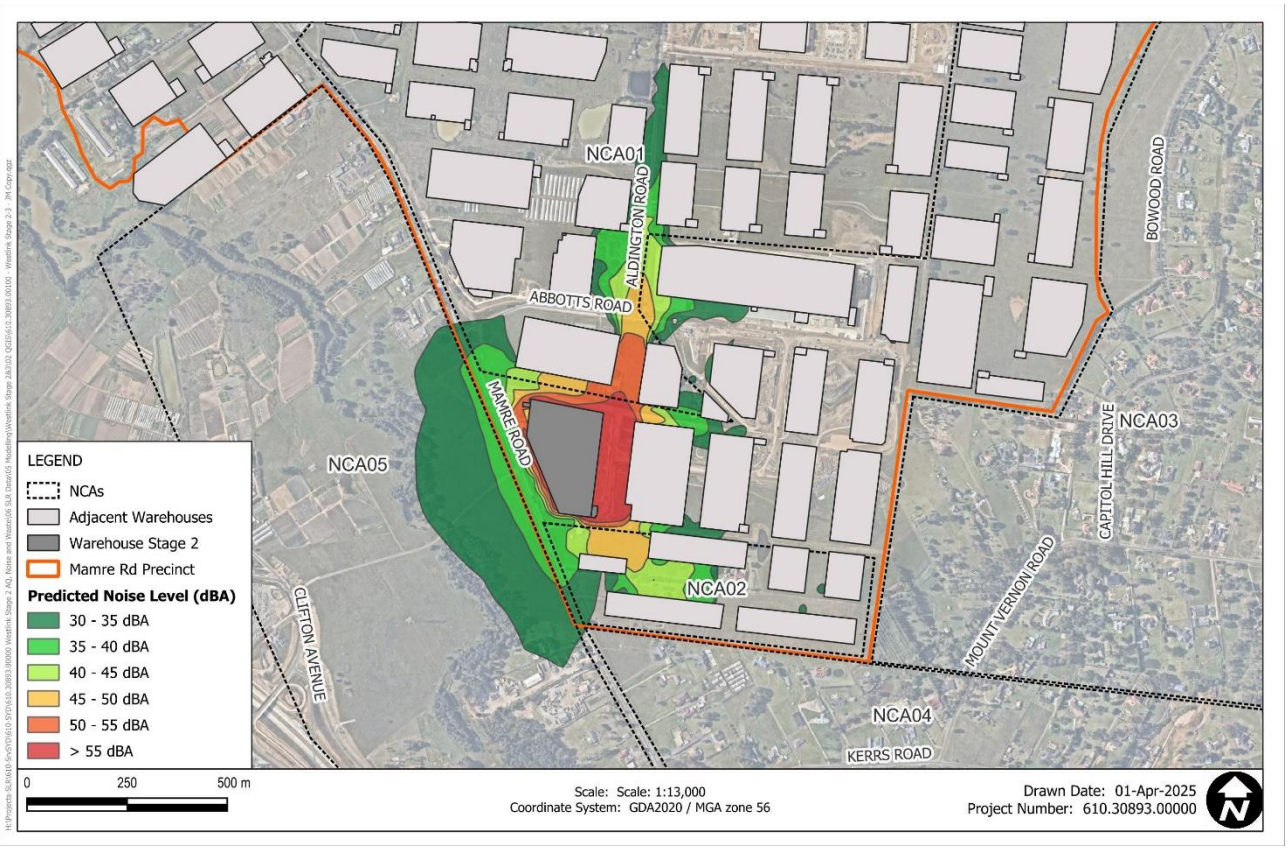
Equipment		Bitumen Spray Truck	Chainsaw	Chipper	Concrete Mixer Truck	Concrete Pump	Concrete Vibrator	Dozer - D9	Dump Truck (approx. 15 tonne)	Elevated Working Platform	Excavator (Rockbreaker)	Excavator (22 tonne)	Flatbed Truck	Front End Loader	Grader	Hand Tools (Electric)	Line Marking Plant	Mobile Crane (100 tonne)	Paving Machine	Roller – Vibratory (12 tonne)	Water Tanker (8000 litre)
Sound Power Level		100	114	120	103	106	102	114	100	97	121	99	100	104	108	96	98	100	105	109	98
Scenario ID	**Activity**																				
Estate Works																					
W.01	Vegetation clearing		X	X				X	X			X		X							X
W.02	Earthworks							X	X			X		X	X					X	X
W.03	Excavation of hard rock							X	X		X	X		X							X
W.04	Construction of roads	X															X		X	X	
W.05	Construction of pads & hardstands				X	X	X														
W.06	Construction of structures									X			X			X		X			

Note 1: Sound power level data is taken from the DEFRA Noise Database, RMS *Construction and Vibration Guideline*, TfNSW *Construction Noise and Vibration Strategy* and SLR's database.

Appendix E

Operational Noise Contours

Operational Noise Contours – Stage 2 Development – Day



Note: Indicative buildings outside the Stage 2 site are subject to their own Development Applications and as such are subject to change.

Operational Noise Contours – Stage 2 Development – Evening

Note: Indicative buildings outside the Stage 2 site are subject to their own Development Applications and as such are subject to change.

Operational Noise Contours – Stage 2 Development – Night

Note: Indicative buildings outside the Stage 2 site are subject to their own Development Applications and as such are subject to change.

Operational Noise Contours – Stage 2 Development – Morning Shoulder

Note: Indicative buildings outside the Stage 2 site are subject to their own Development Applications and as such are subject to change.

Appendix F

CNVG Mitigation Measures

CNVG Standard Mitigation and Management Measures

Action Required	Applies To	Details
Management measures		
Implementation of any project specific mitigation measures required.	Airborne noise	Implementation of any project specific mitigation measures required.
Implement community consultation or notification measures.	Airborne noise Ground-borne noise & vibration	Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night-time period, any operational noise benefits from the works (where applicable) and contact telephone number. Notification should be a minimum of 7 calendar days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required. Please contact Roads and Maritime Communication and Stakeholder Engagement for guidance. Website (If required) Contact telephone number for community Email distribution list (if required) Community drop-in session (if required by approval conditions).
Site inductions	Airborne noise Ground-borne noise & vibration	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • all project specific and relevant standard noise and vibration mitigation measures • relevant licence and approval conditions • permissible hours of work • any limitations on high noise generating activities • location of nearest sensitive receivers • construction employee parking areas • designated loading/unloading areas and procedures • site opening/closing times (including deliveries) • environmental incident procedures.
Behavioral practices	Airborne noise	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Verification	Airborne noise Ground-borne noise & vibration	Where specified under Appendix C of the CNVG a noise verification program is to be carried out for the duration of the works in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions.
Attended vibration measurements	Ground-borne vibration	Where required attended vibration measurements should be undertaken at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.
Update Construction Environmental Management Plans	Airborne noise Ground-borne noise & vibration	The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.

Action Required	Applies To	Details
Building condition surveys	Vibration Blasting	Undertake building dilapidation surveys on all buildings located within the buffer zone prior to commencement of activities with the potential to cause property damage
Source controls		
Construction hours and scheduling	Airborne noise Ground-borne noise & vibration	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.
Construction respite period during normal hours and out-of-hours work	Ground-borne noise & vibration Airborne noise	See Appendix C of the CNVG for more details on the following respite measures: • Respite Offers (RO) • Respite Period 1 (R1) • Respite Period 2 (R2) • Duration Respite (DR)
Equipment selection.	Airborne noise Ground-borne noise & vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits. Ensure plant including the silencer is well maintained.
Plant noise levels.	Airborne-noise	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria in Appendix H of the CNVG. Implement a noise monitoring audit program to ensure equipment remains within the more stringent of the manufacturers specifications or Appendix H of the CNVG.
Rental plant and equipment.	Airborne-noise	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 2 of the CNVG.
Use and siting of plant.	Airborne-noise	The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers. Only have necessary equipment on site.
Plan worksites and activities to minimise noise and vibration.	Airborne noise Ground-borne vibration	Locate compounds away from sensitive receivers and discourage access from local roads. Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site. Where additional activities or plant may only result in a marginal noise increase and speed up works, consider limiting duration of impact by concentrating noisy activities at one location and move to another as quickly as possible. Very noise activities should be scheduled for normal working hours. If the work can not be undertaken during the day, it should be completed before 11:00pm. Where practicable, work should be scheduled to avoid major student examination periods when students are studying for examinations such as before or during Higher School Certificate and at the end of higher education semesters. If programmed night work is postponed the work should be re-programmed and the approaches in this guideline apply again.

Action Required	Applies To	Details
Reduced equipment power	Airborne noise Ground-borne vibration	Use only the necessary size and power.
Non-tonal and ambient sensitive reversing alarms	Airborne noise	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.
Minimise disturbance arising from delivery of goods to construction sites.	Airborne noise	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible. Avoid or minimise these out of hours movements where possible.
Engine compression brakes	Construction vehicles	Limit the use of engine compression brakes at night and in residential areas. Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedure' and standard.
Path controls		
Shield stationary noise sources such as pumps, compressors, fans etc.	Airborne noise	Stationary noise sources should be enclosed or shielded where feasible and reasonable whilst ensuring that the occupational health and safety of workers is maintained. Appendix D of AS 2436:2010 lists materials suitable for shielding.
Shield sensitive receivers from noisy activities.	Airborne noise	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.
Receptor control		
Structural surveys and vibration monitoring	Ground-borne vibration	Pre-construction surveys of the structural integrity of vibration sensitive buildings may be warranted. At locations where there are high-risk receptors, vibration monitoring should be conducted during the activities causing vibration.
See Appendix C of the CNVG for additional measures	Airborne noise Ground-borne vibration	In some instances, additional mitigation measures may be required.

Appendix G

NPfI Mitigation Measures

Best Management Practice (BMP)

Best management practice (BMP) is the application of particular operational procedures that minimise noise while retaining productive efficiency.

Where applied, these measures and practices are often documented in a noise management plan so that operational practices and undertakings are clearly understood and applied at all levels of an industrial operation. Application of BMP can include the following types of practice:

- Using the quietest plant that can do the job
- Scheduling the use of noisy equipment at the least-sensitive time of day
- Not operating, or reducing operations at night
- Siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise
- Where there are several noisy pieces of equipment, scheduling operations so they are used separately rather than concurrently
- Keeping equipment well-maintained and operating it in a proper and efficient manner
- Using 'quiet' practices when operating equipment, for example, positioning idling trucks in appropriate areas
- Running staff-education programs and regular tool box talks on the effects of noise and the use of quiet work practices.

Best Available Technology Economically Achievable (BATEA)

With 'Best available technology economically achievable' (BATEA), equipment, plant and machinery that produce noise incorporate the most advanced and affordable technology to minimise noise output. Affordability is not necessarily determined by the price of the technology alone. Increased productivity may also result from using more advanced equipment, offsetting the initial outlay, for example, using 'quieter' equipment that can be operated over extended hours. Old or badly-designed equipment can often be a major source of noise.

Where BMP fails to achieve the required noise reduction by itself, the BATEA approach should then be considered. Examples of uses of BATEA include:

- Considering alternatives to tonal reversing alarms (where work health and safety is appropriately considered)
- Using equipment with efficient muffler design
- Using quieter engines, such as electric instead of internal combustion
- Fitting and maintaining noise reduction packages on plant and equipment
- Using efficient enclosures for noise sources
- Damping or lining metal trays or bins
- Active noise control.

For many industries there are a wide range of factors that can restrict the feasibility and reasonableness of applying BMP or BATEA measures on a particular site. Work health and safety considerations must also be taken into account as well as any other regulatory and process requirements.

ASIA PACIFIC OFFICES

ADELAIDE
60 Halifax Street
Adelaide SA 5000
Australia
T: +61 431 516 449

BRISBANE
Level 16, 175 Eagle Street
Brisbane QLD 4000
Australia
T: +61 7 3858 4800
F: +61 7 3858 4801

CAIRNS
Level 1 Suite 1.06
Boland's Centre
14 Spence Street
Cairns QLD 4870
Australia
T: +61 7 4722 8090

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
F: +61 2 9427 8200

DARWIN
Unit 5, 21 Parap Road
Parap NT 0820
Australia
T: +61 8 8998 0100
F: +61 8 9370 0101

GOLD COAST
Level 2, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516

MACKAY
1/25 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300

MELBOURNE
Level 11, 176 Wellington Parade
East Melbourne VIC 3002
Australia
T: +61 3 9249 9400
F: +61 3 9249 9499

NEWCASTLE CBD
Suite 2B, 125 Bull Street
Newcastle West NSW 2302
Australia
T: +61 2 4940 0442

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
F: +61 2 4037 3201

PERTH
Grd Floor, 503 Murray Street
Perth WA 6000
Australia
T: +61 8 9422 5900
F: +61 8 9422 5901

SYDNEY
Tenancy 202 Submarine School
Sub Base Platypus
120 High Street
North Sydney NSW 2060
Australia
T: +61 2 9427 8100
F: +61 2 9427 8200

TOWNSVILLE
12 Cannan Street
South Townsville QLD 4810
Australia
T: +61 7 4722 8000
F: +61 7 4722 8001

WOLLONGONG
Level 1, The Central Building
UoW Innovation Campus
North Wollongong NSW 2500
Australia
T: +61 2 4249 1000

AUCKLAND
Level 4, 12 O'Connell Street
Auckland 1010
New Zealand
T: 0800 757 695

NELSON
6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628

WELLINGTON
12A Waterloo Quay
Wellington 6011
New Zealand
T: +64 2181 7186

SINGAPORE
39b Craig Road
Singapore 089677
T: +65 6822 2203