ASPECT INDUSTRIAL ESTATE

State Significant Development Application
Noise and Vibration Impact Assessment

Prepared for:

Mirvac Projects Pty Ltd
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200 George Street
Sydney NSW 2000

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BASIS OF REPORT

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

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DOCUMENT CONTROL

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1 Introduction

Mirvac Projects Pty Ltd is proposing to develop a new industrial estate, the Aspect Industrial Estate (the site), that will be located at Mamre Road, Kemps Creek, in New South Wales (NSW).

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Mirvac Projects to prepare a Noise Impact Assessment (NIA) for the site to assess potential noise impacts associated with the construction and operation of the project. This report forms part of the State Significant Development Application (SSDA) for the site.

This report has been prepared in consideration of the Planning Secretary's Environmental Assessment Requirements (SEARs) issued for the proposal (SSD-10448) issued on 30 April 2020 (see **Section 1.1**).

This report summarises the results of ambient noise measurements undertaken at the site and assesses the potential noise impacts on the surrounding sensitive receivers from construction and operation of the site.

The assessment uses specific acoustic terminology. An explanation of common terms is included in **Appendix A**.

1.1 Secretary's Environmental Assessment Requirements (SEARs)

The requirements of the project SEARs (SSD-10448) in relation to noise and vibration are reproduced in **Table 1**.

Table 1 Project SEARs (SSD-10448) Relevant to Noise and Vibration

Key Issue	Requirement	Where Addressed in this Document
Noise and Vibration	A quantitative noise and vibration impact assessment for construction and operation of the development, including traffic noise, undertaken by a suitably qualified person in accordance with the relevant Environment Protection Authority guidelines and including an assessment of nearby sensitive receivers	Noise and vibration criteria and assessment methodology is detailed in **Section 4** Construction noise and vibration is assessed in **Section 5** Operational noise is assessed in **Section 6**
Noise and Vibration	Cumulative impacts of other existing and proposed developments and	Cumulative impacts are discussed in **Section 6.3**
Noise and Vibration	Details and justification of the proposed noise mitigation, management and monitoring measures	Construction noise and vibration management measures are discussed in **Section 5.6** Operational noise management measures are discussed in **Section 6.5**

2 Project Description

Aspect Industrial Estate (the site) is legally described as Lots 54-58 in DP 259135, with an area of approximately 56.3 hectares (ha). The site is located east of Mamre Road, Kemps Creek, within the Penrith Local Government Area (LGA).

The site has approximately 950 m of direct frontage to Mamre Road with a proposed intersection providing vehicular access via Mamre Road to the M4 Motorway and Great Western Highway to the north and Elizabeth Drive to the south.

The site is located approximately 4 km northeast of the future Western Sydney Nancy-Bird Walton Airport, 13 km southeast of the Penrith CBD and 40 km west of the Sydney CBD.

The Department of Planning, Industry and Environment (DPIE) rezoned the Mamre Road Precinct, including the site, in June 2020 under the *State Environmental Planning Policy (Western Sydney Employment Area) 2009* (WSEA SEPP). The rezoning of this precinct responds to the demand for industrial land in Western Sydney. The site is primarily zoned IN1 General Industrial with a small sliver of land zoned E2 Environmental Conservation.

Consistent with the above, this report has been prepared to support a Development Application under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the purpose of:

- a Concept Masterplan for the site comprising 11 industrial buildings, internal road network layout, building locations, gross floor area (GFA), car parking, concept landscaping, building heights, setbacks and built form parameters
- Stage 1 development of the site including:
  - the demolition, removal of existing rural structures and remediation works
  - heritage salvage works (if applicable)
  - clearing of existing vegetation on the subject site and associated dam dewatering and decommissioning
  - realignment of existing creek and E2 Environmental Conservation zone
  - onsite bulk earthworks including any required ground dewatering
  - the importation, placement and compaction of spoil material
  - boundary retaining walls
  - catchment level stormwater infrastructure, trunk services connections, utility infrastructure, roads and access infrastructure (signalised intersection with Mamre Road) associated with Stage 1
  - construction, fit out and 24 hours per day, 7 days per week use of warehouse and distribution centre within Stage 1
  - detailed on lot earthworks, stormwater, services and utility infrastructure associated with the construction of warehouse and distribution centre within Stage 1
  - boundary stormwater management, fencing and landscaping
  - stage subdivision of Stage 1.

2.1 Site Layout

The Masterplan site consists of 11 warehouses and associated offices, hardstands, parking and landscaping spread across 11 defined lots. The site would be developed in two or more stages. Stage 1 of the site would include preparation of the site, along with construction and operation of warehouses on Lots 1 and 3. The Stage 1 development is detailed in **Section 2**. The other stages would consist of the construction and operation of warehouses and associated facilities on the remaining lots.

The site is surrounded primarily by rural residential properties and agricultural land. Several schools and a childcare centre are located around 800 m to the north of the site. Other large industrial estates including Erskine Business Park, Oakdale West and Oakdale South, are located around 1 to 2 km to the north, northeast and east of the site. The nearest receivers are located on land now zoned IN1 General Industrial as part of the Mamre Road Precinct.

The locations of the site and surrounding receivers are shown in **Figure 1**. The Masterplan design is shown in **Figure 2** and the Stage 1 design is shown in **Figure 3**.

Figure 1 Site Location, Sensitive Receivers Areas and Modelled Buildings

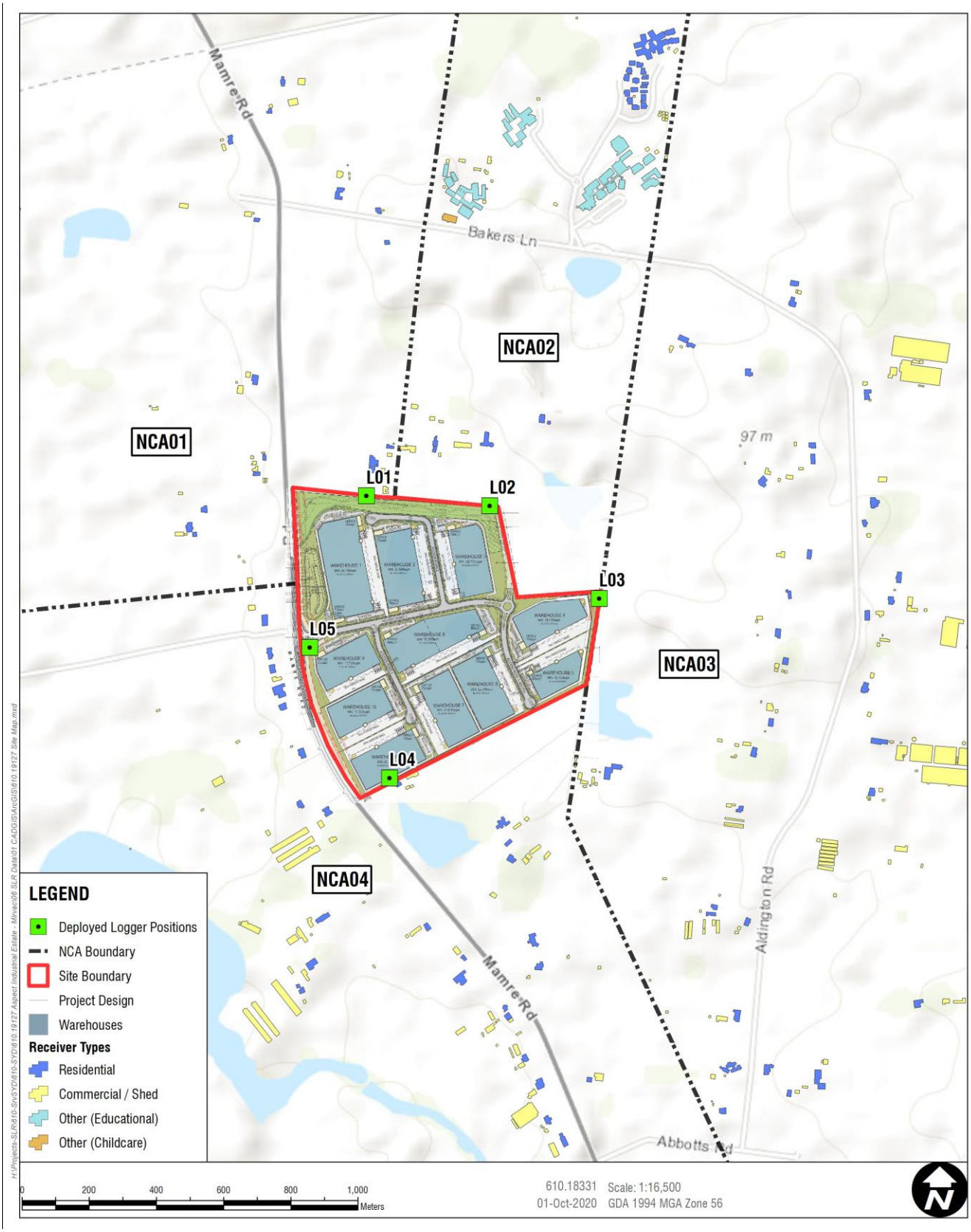


Figure 2 Proposed Masterplan Design

Note 1: Drawing provided by Mirvac, dated 20 September 2020.

Figure 3 Proposed Stage 1 Design

Note 1: Drawing provided by Mirvac, dated 20 September 2020.

2.2 Operating Hours

The site proposes to operate 24 hours per day, 7 days per week. Deliveries to and from the site may occur at any time during the operating hours, on any day of the week.

The identified sources of operational noise from the proposed site include:

- Heavy vehicles on site access roads and hardstands
- Light vehicles on site access roads and parking areas.
- Truck unloading operations including forklift use
- Mechanical plant

The access to the site is via a new signalled intersection from Mamre Road, to the west of the site. The main access road runs through the centre of the site with the warehouses, hardstands and parking areas to either side.

2.3 Nearest Sensitive Receivers

The area surrounding the site has been divided into four Noise Catchment Areas (NCAs). The NCAs group together sensitive receivers with similar existing noise environments.

The NCAs and sensitive receivers in the area around the site are detailed in **Table 2** and are shown in **Figure 1.**

Table 2 Sensitive Receivers

NCA	Direction from Site	Description
NCA01	Northwest North	This NCA includes receivers to the north and northwest of the site where the noise environment is influenced by road traffic noise from Mamre Road. The receivers in this NCA are primarily scattered rural residential dwellings with associated commercial/shed structures. The closest residential receivers to the site boundary are around 70 m to the north and around 100 m to the northwest.
NCA02	North	This NCA includes receivers to the north of the site where the noise environment is less influenced by road traffic noise from Mamre Road. Distant road traffic, natural noises (such as wind and insects), and local traffic on Bakers Lane primarily influence the noise environment in this NCA. The receivers close to the site in this NCA include scattered rural residential dwellings with associated commercial/shed structures. Several schools, a childcare centre, and the Emmaus Village residential area are located in this NCA to the north of Bakers Lane, further from the site. The closest residential receivers to the site boundary are around 140 m to the north, with the closest childcare and educational receivers around 800 m to the north.
NCA03	East	This NCA includes receivers to the east of the site where the noise environment is influenced by distant road traffic noise, natural noises (such as wind and insects), and local road traffic on Aldington Road. The receivers in this NCA are primarily scattered rural residential dwellings with associated commercial/shed structures. The closest residential receivers to the site boundary are around 250 m to the southeast and around 500 m to the east.
NCA04	South Southwest West	This NCA includes receivers to the south, southwest and west of the site where the noise environment is influenced primarily by road traffic noise from Mamre Road. The receivers in this NCA are primarily scattered rural residential dwellings with associated commercial/shed structures. The closest residential receivers to the site boundary are around 5 m to the south and around 70 m to the west.

3 Existing Environment

3.1 Unattended Ambient Noise Monitoring

Unattended noise monitoring was completed at five locations around the boundary of the site in November 2019 to measure the existing ambient noise environment of the area. The noise logger locations were selected with consideration of other noise sources which may influence the measurements, security of noise monitoring equipment and gaining access permission from residents and landowners. The noise logger locations are shown in **Figure 1**.

Calibration of the loggers was checked prior to and following measurements, and drift in calibration did not exceed acceptable tolerances. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

The measured data was processed with reference to the NSW EPA's *Noise Policy for Industry* (NPfI) and the data was filtered to remove extraneous noise events and periods affected by adverse weather conditions, based on Bureau of Meteorology automated weather station data (Horsley Park AWS 67119). A summary of the background noise monitoring locations and results is provided in **Table 3** and **Table 4**.

Table 3 Ambient Noise Monitoring Locations

Noise Monitoring Location ID	Location Address	Representative Receiver Area	Monitoring Dates	Location Details
L01	Lot 58 DP259135	NCA01	15 November 2019 to 26 November 2019	Noise logger deployed in an open area at the northern site boundary, approximately 230 m from Mamre Road, adjacent to the nearest residence in NCA01.
L02	Lot 58 DP259135	NCA02	15 November 2019 to 26 November 2019	Noise logger deployed in an open area at the northeastern site boundary, approximately 600 m from Mamre Road.
L03	Lot 56 DP259135	NCA03	15 November 2019 to 26 November 2019	Noise logger deployed in an open area at the eastern site boundary, approximately 900 m from Mamre Road.
L04	Lot 54 DP259135	NCA04	15 November 2019 to 26 November 2019	Noise logger deployed in an open area at the southern site boundary, approximately 120 m from Mamre Road, adjacent to the nearest residence in NCA04.
L05	Lot 56 DP259135	n/a (used for assessment of maximum noise levels adjacent to Mamre Road)	15 November 2019 to 26 November 2019	Noise logger deployed in open area near the western boundary of the site, approximately 40 m from Mamre Road, indicative of the distance from the closest receivers to Mamre Road.

Table 4 Summary of Ambient Noise Levels

Location ID	Measured Noise Level (dBA)[1]					
	Daytime		Evening		Night-time	
	RBL	L_{Aeq}	RBL	L_{Aeq}	RBL	L_{Aeq}
L01	39	50	39	49	32	50
L02	35	43	33	42	32	43
L03	34	44	33	41	29	41
L04	39	52	40	53	32	54
L05	42	59	43	59	34	56

Note 1: The Rating Background Levels (RBLs) and LAeq noise levels have been obtained from the measured data using the calculation procedures outlined in the NPfI.

Note 2: NPfI time periods – Day: 7:00 am to 6:00 pm Monday to Saturday, 8:00 am to 6:00 pm Sundays and public holidays; Evening: 6:00 pm to 10:00 pm; Night: the remaining periods.

Daily graphs representing the measured noise levels are presented in **Appendix B**. The graphs represent each 24-hour period during the survey and show the L_{Amax}, L_{A10}, L_{Aeq} and L_{A90} noise levels in 15-minute intervals.

3.2 Attended Noise Monitoring

Short-term attended noise monitoring was conducted on-site on Friday 15 November 2019. The purpose of the attended measurements was to determine the various contributors to the acoustic environment. A summary of the attended monitoring is provided in **Appendix B**.

The attended measurements indicated that the ambient noise levels were dominated by road traffic noise from Mamre Road at locations near to the road, with the influence becoming more distant and natural noises (such as wind and insects) becoming more prominent at greater distances from the road. Existing industrial estates to the north and east were not audible during the attended noise monitoring.

3.3 Prevailing Weather Conditions

Certain meteorological/weather conditions can increase noise levels. This can occur during temperature inversions (where temperatures increase with height above ground level), or where there is a wind gradient (where wind speed increases with height).

In order to determine the prevailing weather conditions for the site area, 12 months of weather data (January to December 2016) was obtained from the Bureau of Meteorology automatic weather station at Horsley Park, which is approximately 6 km to the east of the site. This data was analysed to determine the frequency of noise-enhancing wind and temperature inversion conditions which may affect noise levels at the site.

3.3.1 Wind

Wind has the potential to increase noise at a receiver when it is light and stable, and blows from the direction of the source of noise to the receiver. At higher wind speeds, the noise produced by the wind can obscure noise generated from industrial and transport sources.

Wind effects need to be considered where wind is a feature of the project area. The NPfI states that where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30% of the daytime, evening or night-time in any season, then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

The measured weather data was analysed to determine the frequency of occurrence of wind speeds up to 3 m/s in each period. The results of the wind analysis for the daytime, evening and night-time periods are presented in **Table 5**, **Table 6** and **Table 7**, respectively. In each table, the wind direction and percentage occurrence are those dominant during each season.

Table 5 Seasonal Frequency of Occurrence of Wind Speed Intervals in 2016 – Daytime

Season	Dominant Wind Direction	Frequency of Occurrence			
		Calm	Up to 2 m/s	2 to 3 m/s	Up to 3 m/s
Annual	N	10.2%	14.7%	5.7%	20.4%
Summer	NNE	11.2%	14.3%	7.3%	21.6%
Autumn	N	10.9%	15.9%	5.9%	21.8%
Winter	NW	12.8%	18.8%	5.6%	24.4%

Table 6 Seasonal Frequency of Occurrence of Wind Speed Intervals in 2016 – Evening

Season	Dominant Wind Direction	Frequency of Occurrence			
		Calm	Up to 2 m/s	2 to 3 m/s	Up to 3 m/s
Annual	ESE	17.8%	9.1%	6.1%	15.2%
Summer	E	9.5%	10.4%	10.3%	20.8%
Autumn	S	25.4%	12.1%	6.3%	18.4%
Winter	WSW	24.1%	15.3%	8.2%	23.5%

Table 7 Seasonal Frequency of Occurrence of Wind Speed Intervals in 2016 – Night-time

Season	Dominant Wind Direction	Frequency of Occurrence			
		Calm	Up to 2 m/s	2 to 3 m/s	Up to 3 m/s
Annual	SW	37.8%	17.9%	8.7%	26.6%
Summer	SSW	42.0%	18.7%	8.8%	27.5%
Autumn	SW, WSW	44.0%	21.0%, 20.7%	10.6%, 9.7%	**31.6%, 30.3%**
Winter	WSW	32.1%	17.6%	9.9%	27.5%

The above indicates that during the daytime and evening periods, winds of up to 3 m/s did not exceed the 30% threshold during any season. However, the 30% threshold was exceeded during the night-time period in autumn, in both the SW and WSW directions.

On this basis, assessment of noise-enhancing weather during the daytime and evening periods is not required, although consideration of noise-enhancing conditions (wind) for night-time operations is required.

3.3.2 Temperature Inversions

Temperature inversions have the ability to increase noise levels by focusing sound waves towards sensitive receivers. Temperature inversions occur predominantly at night-time when the atmosphere is stable and temperatures are cooler. For a noise-enhancing temperature inversion to be a significant characteristic of the area, the NPfI requires it to occur for at least 30% of the total night-time during any one season. This equates to approximately two nights per week.

There are seven atmospheric stability classes, ranging from extremely stable to extremely unstable, and these are shown in **Table 8**.

Table 8 Description of Atmospheric Stability Classes

Atmospheric Stability Class	Category Description
A	Extremely unstable
B	Moderately unstable
C	Slightly unstable
D	Neutral
E	Slightly stable
F	Moderately stable
G	Extremely stable

The measured weather data has been analysed to determine the frequency of occurrence of each stability class and is presented in **Table 9**. Noise-enhancing temperature inversions are categorised as atmospheric stability Class F or Class G.

Table 9 Night-time Stability Class Distribution – 2016

Stability Class	Frequency of Occurrence				
	Annual	Summer	Autumn	Winter	Spring
A	0.0%	0.0%	0.0%	0.0%	0.0%
B	0.0%	0.0%	0.0%	0.0%	0.0%
C	0.0%	0.0%	0.0%	0.0%	0.0%
D	39.5%	37.4%	34.7%	45.2%	41.5%
E	12.0%	11.7%	10.5%	12.4%	13.6%
F	12.9%	11.2%	13.7%	14.0%	12.9%
G	**35.5%**	**39.7%**	**41.1%**	28.5%	**32.0%**
F+G	**48.4%**	**50.9%**	**54.8%**	**42.4%**	**44.9%**

The above indicates that temperature inversions of Class F or Class G occur more than 30% of the night-time period during all four seasons. Therefore, noise-enhancing temperature inversions are required to be included in the assessment of noise impacts during the night-time period.

4 Noise and Vibration Assessment Criteria

4.1 Construction Noise Guidelines

4.1.1 NSW Interim Construction Noise Guideline (ICNG)

The NSW *Interim Construction Noise Guideline* (ICNG) sets out ways to assess and manage the impacts of 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 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.

4.1.1.1 Residential Receivers

The approach provided in the ICNG for determining NMLs for a project at residential receivers is presented in **Table 10**.

More stringent requirements are placed on works that are completed outside of Standard Construction Hours which reflects the greater sensitivity of communities to noise impacts during these periods.

Table 10 Determination of NMLs for Residential Receivers

Time of Day	NML $L_{Aeq(15minute)}$[1]	How to Apply
Standard 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	RBL + 10 dBA	• 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 practises 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.

Time of Day	NML $L_{Aeq(15minute)}$[1]	How to Apply
Outside recommended standard hours	RBL + 5 dBA	• 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 dBA above the noise affected level, the proponent should negotiate with the community.

Note 1 The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW *Noise Policy for Industry*.

4.1.1.2 Sleep Disturbance

Where construction works are planned to extend over more than two consecutive nights, the ICNG recommends that an assessment of sleep disturbance impacts be completed.

A method for assessing sleep disturbance is contained in the EPA's *Noise Policy for Industry* (NPfI). Although the NPfI sleep disturbance screening level relates to industrial noise, it is also considered relevant for reviewing potential impacts from construction noise as a screening level to identify the need for further assessment.

The NPfI notes that a detailed maximum noise level assessment should be undertaken where a project results in night-time noise levels which exceed:

- 52 dBA L_{AFmax} or the prevailing background level plus 15 dB, whichever is the greater.

4.1.1.3 Summary of Residential NMLs

The residential NMLs for the project have been determined using the background noise monitoring and are shown in **Table 11**.

Table 11 Residential Receiver Construction NMLs

NCA	Representative Background Monitoring Location	Measured RBL – dBA			NML ($L_{Aeq(15minute)}$ – dBA)				Sleep Disturbance Screening Level (L_{Amax} dBA)
					Standard Construction Hours (RBL+10dB)	Out of Hours (RBL+5dB)			
		Day	Evening	Night	Day	Day	Evening	Night	Night
NCA01	L01	39	39	32	49	44	44	37	52
NCA02	L02	35	33	32	45	40	38	37	52
NCA03	L03	35[1]	33	30[1]	45[1]	40	38	35	52
NCA04	L04	39	39[2]	32	49	44	44[2]	37	52

Note 1: RBL increased to the minimum RBL specified in the NPfI.

Note 2: RBL reduced to be no higher than the daytime RBL.

4.1.1.4 Other Sensitive Land Uses and Commercial Receivers

A number of non-residential land uses have been identified in the study area. These include 'other sensitive' land uses, such as educational institutes, childcare centres, and commercial premises. The NMLs recommended in the ICNG for other sensitive receivers are shown in **Table 12**.

Table 12 ICNG NMLs for Other Sensitive Receivers

Land Use	NML $L_{Aeq(15minute)}$ (Applied when property is in use)
Classrooms at schools and other education institutions	Internal noise level 45 dBA[1]
Commercial	External noise level 70 dBA

Note 1: 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 schools and 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.

The ICNG references AS 2107 for criteria for other sensitive receivers which are not listed in the guideline, however, neither the ICNG or AS2107 provide specific guideline noise levels for childcare centres. Childcare centres generally have internal play areas and sleeping areas. For internal play areas an internal NML of 55 dBA LAeq(15minute) has been adopted together with an internal NML of 40 dBA LAeq(15minute) (when in use) for sleeping areas.

On the assumption that windows and doors of childcare centres may be opened, an external NML of 65 dBA $L_{Aeq(15minute)}$ for play areas has been applied at the facade and would also be applicable to external play areas. For sleeping areas on the assumption that windows are open, an external NML of 50 dBA $L_{Aeq(15minute)}$ has been applied. Given specific layouts for childcare centres are unknown during the preparation of the NIA, a NML of 50 dBA has been used to assess construction noise impacts to childcare centres.

4.2 Construction Road Traffic Noise Guidelines

The potential impacts from construction traffic on public roads are assessed under the *Road Noise Policy* (RNP) and Roads and Maritime Services *Construction Noise and Vibration Guideline* (CNVG).

To assess noise impacts that may result from construction traffic, an initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2 dB with the addition of construction traffic at nearby residential and other sensitive receivers. Where this is considered likely further assessment is required using the RNP base criteria shown in **Table 13**.

Table 13 RNP Criteria for Assessing Construction Vehicles 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)

4.3 Construction Ground-borne Noise Guidelines

Construction works can cause ground-borne noise impacts in nearby buildings when vibration generating equipment is in use. Vibration can be transmitted through the ground and into the structure of nearby buildings, which can then create audible noise impacts inside buildings. The ICNG provides evening and night-time ground-borne noise NMLs for residences to protect the amenity and sleep of residents. The ICNG ground-borne noise NMLs are:

- Evening $L_{Aeq(15minute)}$ 40 dBA
- Night-time $L_{Aeq(15minute)}$ 35 dBA

The NMLs only apply where internal ground-borne noise levels are higher than noise transmitted through the air. This situation can occur where buildings near to construction works have high performing facades which attenuate the airborne component or where sensitive internal areas do not have facades which face the construction works.

4.4 Construction Vibration Guidelines

The effects of vibration on buildings can be divided into three main categories:

- Those in which the occupants or users of the building are inconvenienced or possibly disturbed
- Those where the building contents may be affected
- Those in which the integrity of the building or the structure itself may be prejudiced.

4.4.1 Human Comfort Vibration

People can 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 14**. Vibration generating activities should be designed to achieve the preferred values where an area is not already exposed to vibration. Where all feasible and reasonable measures have been applied, values up to the maximum may be used.

Table 14 Vibration Dose Values for Intermittent Vibration

Building Types	Assessment Period	Vibration Dose Value ($m/s^{1.75}$)	
		Preferred	Maximum
Critical Working Areas (eg hospital operating theatres, precision 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

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.

4.4.2 Effects on Building Contents

Humans 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 which can have more stringent vibration requirements than those for human comfort, are located in buildings near to construction works. No such receivers have been identified in the study area.

4.4.3 Cosmetic Damage Vibration

If vibration from construction works is high enough it can cause damage to 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.

BS 7385

British Standard BS 7385 recommends vibration limits for transient vibration which are judged to give a minimal risk of vibration induced damage to effected buildings. The limits for residential and industrial buildings are shown in **Table 15**.

Table 15 Transient Vibration Guide Values – Minimal Risk of Cosmetic Damage

Line	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"*.

4.4.4 Minimum Working Distances for Vibration Intensive Works

Minimum working distances for typical vibration intensive construction equipment are provided in the CNVG and are summarised in **Table 16**. The minimum working distances are for both cosmetic damage (from BS 7358) and human comfort (from the NSW EPA Vibration Guideline) and 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 16 Recommended Minimum Working Distances from Vibration Intensive Equipment

Plant Item	Rating / Description	Minimum Distance	
		Cosmetic Damage (BS 7385)	Human Response (NSW EPA Guideline)
Vibratory Roller	< 50 kN (Typically 1-2t)	5 m	15 m to 20 m
	< 100 kN (Typically 2-4t)	6 m	20 m
	< 200 kN (Typically 4-6t)	12 m	40 m
	< 300 kN (Typically 7-13t)	15 m	100 m
	> 300 kN (Typically 13-18t)	20 m	100 m
	> 300 kN (Typically > 18t)	25 m	100 m
Small Hydraulic Hammer	300 kg - 5 to 12t excavator	2 m	7 m
Medium Hydraulic Hammer	900 kg - 12 to 18t excavator	7 m	23 m
Large Hydraulic Hammer	1600 kg - 18 to 34t excavator	22 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 to 100 m
Pile Boring	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Hand held	1 m (nominal)	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.

4.5 Operational Noise Guidelines

4.5.1 Noise Policy for Industry

The *Noise Policy for Industry* (NPfI) was released in 2017 and sets out the NSW Environment Protection Authority's (EPA's) requirements for the assessment and management of noise from industry in NSW.

4.5.1.1 Trigger Levels

The NPfI describes 'trigger levels' which indicate the noise level at which feasible and reasonable noise management measures should be considered. Two forms of noise criteria are provided – 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 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.

While the area surrounding the proposal is now zoned IN1 General Industrial, for this assessment the receivers are considered to be 'rural' given their existing setting. Consideration of their future use is discussed in **Section 6.5.1**.

4.5.1.2 Project Specific Criteria

The noise emission trigger levels for operational noise generated by the site are provided in **Table 17**. The Project Noise Trigger Level (PNTL) is the lowest value of the intrusiveness or amenity noise level for each period and are shown below in bold.

Table 17 Project Trigger Noise Levels

NCA	Receiver Type	Period	Recommended Amenity Noise Level $L_{Aeq(period)}$ (dBA)	Measured Noise Level (dBA)		Project Noise Trigger Levels $L_{Aeq(15minute)}$ (dBA)	
				RBL[1]	$L_{Aeq(period)}$	Intrusiveness	Amenity[2,3]
NCA01	Residential	Day	50	39	50	**44**	48
		Evening	45	39	49	44	**43**
		Night	40	32	50	**37**	38
NCA02	Residential	Day	50	35	43	**40**	48
		Evening	45	33	42	**38**	43
		Night	40	32	43	**37**	38
NCA03	Residential	Day	50	35[4] (34 actual)	44	**40**	48
		Evening	45	33	41	**38**	43
		Night	40	30[4] (29 actual)	41	**35**	38
NCA04	Residential	Day	50	39	52	**44**	48
		Evening	45	39[5] (40 actual)	53	44	**43**
		Night	40	32	54	**37**	38
NCA02	Childcare[6,7]	When in use	50	n/a	n/a	n/a	**48**
NCA02	Educational[6]	When in use	45	n/a	n/a	n/a	**43**
All	Commercial	When in use	65	n/a	n/a	n/a	**63**

Note 1: RBL = Rating Background Level.

Note 2: The recommended amenity noise levels have been reduced by 5 dB to give the project amenity noise levels due to other sources of industrial noise being present in the area, as outlined in the NPfI.

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

Note 4: RBL increased to the minimum RBL specified in the NPfI.

Note 5: RBL reduced to be no higher than the daytime RBL.

Note 6: 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 schools and 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 7: The NPfI and AS2107 do not provide specific guideline noise levels for childcare centres, as such an internal criteria of 40 dBA $L_{Aeq(15minute)}$ has been adopted.

4.5.2 Sleep Disturbance

Guidance for assessing the potential for sleep disturbance impacts on nearby residences is provided in Section 2.5 of the NPfI, which states:

> *Where the subject development/premises night-time noise levels at a residential location exceed:*
>
> - $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
> - L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,
>
> *a detailed maximum noise level event assessment should be undertaken*

Note that the $L_{Aeq(15minute)}$ criteria would be equal to or higher than the Project Noise Trigger Levels outlined in **Table 17**. As such, the assessment against Project Noise Trigger Levels is considered to address this part.

The night-time sleep disturbance L_{Amax} screening noise levels for the residential areas in the vicinity of the site are presented in **Table 18**.

Table 18 Night-time Sleep Disturbance Screening Noise Levels

Residential Receiver Area	Noise Level (dBA)	
	Measured Night-time RBL	Sleep Disturbance Screening Noise Level (L_{Amax})
NCA01	32	52
NCA02	32	52
NCA03	29	52
NCA04	32	52

Where the sleep disturbance screening noise level is predicted to be exceeded then a detailed maximum noise level event assessment should be undertaken.

The detailed assessment should discuss the predicted level of the events, the exceedance of the screening level, existing maximum noise levels, and consider guidance from current literature regarding sleep disturbance, such as the *Road Noise Policy*.

4.6 Operational Road Traffic Noise Guidelines

The potential impacts from operational traffic once it moves off-site and onto public roads are assessed under the NSW EPA *Road Noise Policy* (RNP).

To assess noise impacts that may result from off-site operational road traffic, an initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2 dB with the addition of the traffic from the site at nearby residential and other sensitive receivers. Where this is considered likely further assessment is required using the RNP base criteria shown in **Table 19**.

Table 19 RNP Criteria for Assessing Operational Vehicles 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)

5 Construction Noise and Vibration Assessment

Exact details on the construction of the site are not currently known at this stage of the project. As such, it has been necessary to make certain assumptions as to the type and location of equipment together with details regarding construction activities. These assumptions are defined in the following sections.

5.1 Construction Works

5.1.1 Working Hours

Where possible, the majority of construction works would be undertaken in accordance with the ICNG during the standard daytime construction working hours of:

- 7:00 am to 6:00 pm Monday to Friday
- 8:00 am to 1:00 pm on Saturdays.

Where works are required to be undertaken outside standard construction hours, the works will be conducted in accordance with an approved Out of Hours protocol to be prepared, submitted and approved as part of the Construction Environmental Management Plan (CEMP) prior to commencement of the works.

5.1.2 Construction Works Scenarios

The assessment uses 'realistic worst-case' scenarios to determine the potential airborne noise impacts from the noisiest 15-minute period for each work scenario, as required by the ICNG. Scenarios have been categorised into 'Peak' and 'Typical' works which have been used to define the likely range of potential noise impacts:

- '**Peak**' works represent the noisiest stages and can require noise intensive equipment, such as rockbreakers or concrete saws. 'Peak' works scenarios also include multiple items of the same construction equipment where the works are conducted concurrently in several locations of the site. While 'Peak' works would be required at times, the noisiest works would not occur for the full duration of the works.
- '**Typical**' works represent typical noise emissions when noise intensive equipment is not in use. The 'Typical' works generally include most items of equipment for a given activity except for the loudest item. These items generally support the 'Peak' works activity and are referred to as 'supporting equipment'.

Construction activities would occur sequentially and it is expected that there would be relatively long periods where construction noise levels are much lower than the 'Peak' and 'Typical' worst-case levels presented in this assessment. There would also be times when works are not audible at receivers due to no noisy items of equipment being used.

The general 'Typical' and 'Peak' construction activities required to be undertaken in order to construct the site are described in **Table 20**. Sound power levels for the typical operation of construction equipment used in the modelling have been taken from verified test data and global standards that form part of SLR's noise database and are listed in **Appendix C**.

Table 20 Construction Scenario Descriptions

Scenario	Description
Enabling and remediation works	These works are required to prepare the site for construction occupation and would include works such as survey control, investigative drilling, archaeological salvage works and relocation of flora and fauna species (if required). Relocation of services or third-party assets may also be required. Remediation works would include: - Remediation of heavy metal (zinc, copper) and staining hotspots - Remediation of total recoverable hydrocarbon hotspots - Removal of asbestos pipe and surface fragments - Removal of hazardous building material including asbestos, lead paint and synthetic mineral fibre - Removal of anthropogenic plastics (irrigation pipes etc) from market garden areas. Some enabling and remediation works would require the use of noisy earthmoving equipment for activities such as dam decommissioning, topsoil stripping, excavation of contaminated materials, and construction of temporary access roads. Noise intensive demolition works would require the use of a rockbreaker. The works are divided into the following 'Typical' and 'Peak' categories: - 'Typical' works generally include operation of supporting equipment (such as generators, water tankers and utility vehicles) as well as earth moving equipment and loading of heavy vehicles. - 'Peak' works include the use of noise intensive rockbreakers and concrete saws at times, especially during demolition of existing structures.
Site establishment	These works are required to establish the construction compounds and works areas. This scenario would include works such as setup of perimeter fencing, compound facilities, signage, lighting, etc. Site establishment works would require the use of noisy earthmoving equipment for activities such as diversion of catchment drains. Noise intensive vegetation clearing works would require the use of chainsaws and woodchippers. The works are divided into the following 'Typical' and 'Peak' categories: - 'Typical' works generally include operation of low noise supporting equipment as well as earth moving equipment. - 'Peak' works include the use of noise intensive chainsaws and woodchippers during vegetation clearing.
Bulk earthworks	This scenario covers the majority of earthmoving activities which would require the use of noisy earthmoving equipment for activities such as: - Stripping of top soil - Stockpiling and relocation and compaction of selected material for earthworks balance and batter stabilization - Construction of fill embankments including foundation drainage - Importation, placement and compaction of fill materials to meet earthworks balance requirements Noise intensive excavation works may require the use of a rockbreaker for excavation of a cutting through hard rock. The Bulk earthworks are divided into the following 'Typical' and 'Peak' categories: - 'Typical' works include general operation of earth moving equipment. - 'Peak' works include the use of a noise intensive rockbreaker during excavation of hard rock.

Scenario	Description
Stage 1 infrastructure works	These works are required to construct the Stage 1 infrastructure components of the site and are generally limited to the northern half of the site and the site access roads as depicted in **Figure 3**. Stage 1 infrastructure works are divided into the following 'Typical' and 'Peak' categories: - 'Typical' works generally include construction of roads, hardstands, service connections, buildings and landscaping. - 'Peak' works include operation earth moving equipment for construction of a stormwater detention basin.

5.2 Construction Airborne Noise Assessment

SoundPLAN has been used for modelling the airborne noise emissions from construction of the site using the ISO 9613 noise prediction algorithms. The three-dimensional model includes ground topography, buildings and representative noise sources.

5.2.1 Overview of Predicted Construction Airborne Noise Levels

The following overview is based on the predicted impacts at the most affected receivers and is representative of the realistic worst-case noise levels (without additional mitigation) that are likely to occur during construction. Receivers which are further away from the works and/or shielded from view would have substantially lower impacts. The assessment is generally considered conservative as the calculations assume several items of construction equipment are in use at the same time within individual scenarios.

The assessment shows the predicted impacts based on the exceedance of the management levels, as per the categories in **Table 21**. The likely subjective response of people affected by the impacts is also shown in the table, noting that the subjective response would vary and depends on the period in which the impacts occur (eg people are generally less sensitive to impacts during the daytime and more sensitive in the evening and night-time).

Table 21 Exceedance Bands and Corresponding Subjective Response to Impacts

Exceedance of Management Level	Likely Subjective Response	Impact Colouring
No exceedance	No impact	
1 to 10 dB	Minor to marginal	
11 dB to 20 dB	Moderate	
>20 dB	High	

'Typical' and 'Peak' noise impacts are presented in **Table 22** for each scenario, where appropriate. The noise levels are also shown as a range (eg 55 to 68 dBA), which represents the likely noise levels when works are 'near' to 'far' from a particular receiver.

For most construction activities, it is expected that the construction noise levels would frequently be lower than predicted at the most-exposed receiver, as the noise levels presented in this report are based on each scenario occurring at the site boundary.

Table 22 Predicted Worst-Case Construction Airborne Noise Levels – Standard Daytime Construction Hours

Receiver Category	NCA	Day NML[1]	Predicted Worst-case LAeq(15minute) Noise Level (dBA)															
			Enabling and remediation works				Site establishment				Bulk earthworks				Stage 1 infrastructure works			
			'Typical'		'Peak'		'Typical'		'Peak'		'Typical'		'Peak'		'Typical'		'Peak'	
			Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near	Far	Near
			Supporting works		Demolition of existing structures		Supporting and earthmoving		Vegetation clearing		General earthworks		Excavation through hard rock		Construction works		Earthworks	
Residential	NCA01	49	38 to 61		51 to 74		40 to 63		48 to 71		42 To 65		52 to 75		38 to 61		41 to 64	
	NCA02	45	36 To 55		49 to 68		38 to 57		46 to 65		40 To 59		50 to 69		39 to 55		42 to 58	
	NCA03	45	37 to 52		50 to 65		39 to 54		47 to 62		41 To 56		51 to 66		37 to 51		40 to 54	
	NCA04	49	39 to 78		52 to 91		41 to 80		49 to 88		43 To 82		53 to 92		41 to 61		44 to 64	
Other Sensitive[1]	NCA01	-	- to -		- to -		- to -		- to -		- To -		- to -		- to -		- to -	
	NCA02	-	<30 to 38		42 to 51		31 to 40		39 to 48		33 To 42		43 to 52		30 to 38		33 to 41	
	NCA03	-	- to -		- to -		- to -		- to -		- To -		- to -		- to -		- to -	
	NCA04	-	- to -		- to -		- to -		- to -		- To -		- to -		- to -		- to -	

Note 1 NMLs for other sensitive receivers vary according to receiver category and a single NML cannot be used for all categories. Other sensitive results cannot by colour coded in the above table.

Legend

No Exceedance | 1 - 10 dB above NML | 11 - 20 dB above NML | >20 dB above NML

The above assessment shows that:

- The highest impacts are predicted during 'Peak' works activities associated with enabling and remediation works, site establishment, and bulk earthworks which involve the use of noise intensive equipment in close proximity to the nearest sensitive receivers. These works are, however, limited to daytime hours and would only be apparent for a relatively short duration compared to the overall construction program. Noise levels and impacts during 'Typical' works which do not require noise intensive equipment are considerably lower.
- Worst-case noise levels in NCAs with close receivers are predicted to be around 70 to 90 dBA.
- Individual receivers would be subject to a large range of worst-case impacts, depending on how far from the works they are. The highest impacts are seen when works are 'near' to receivers and are generally much lower when works are 'far', due to the increased separation distance. For example, several works with 'High' impacts at the potentially most affected receiver in a NCA are predicted to be compliant with the NMLs when the works are conducted further away.
- All works scenarios are predicted to be compliant with the NMLs at all receivers during 'Typical' works activities when the works are not close to receivers.
- The NCA with the highest predicted impacts is NCA04 which has a residential receiver located around 5 m from the construction site boundary.
- The impacts at childcare, educational and commercial receivers are predicted to be compliant with the management levels for all construction scenarios and activities.

Implementation of feasible and reasonable construction noise mitigation measures should be undertaken where exceedances of the NMLs are predicted. Construction noise and vibration mitigation measures are discussed in **Section 5.6**.

5.2.2 Detailed Construction Airborne Noise Level Predictions

5.2.2.1 Number of NML Exceedances

The predicted airborne noise impacts from construction works are summarised in **Table 23** for all sensitive receiver types. The predictions are representative of the highest noise levels that would likely be experienced at the surrounding receivers when the works are at their closest.

The number of receivers predicted to experience exceedances of the NMLs are summarised in bands of 10 dB and are separated by construction works scenarios and activities.

Table 23 Overview of NML Exceedances – All Receiver Types

Receiver Category	NCA	Number of Receivers									
		Total	Exceedance Category[1]	With NML Exceedance[2]							
				Enabling and remediation works		Site establishment		Bulk earthworks		Stage 1: Infrastructure works	
				'Typical'	'Peak'	'Typical'	'Peak'	'Typical'	'Peak'	'Typical'	'Peak'
				Supporting works	Demolition of existing structures	Supporting and earthmoving	Vegetation clearing	General earthworks	Excavation through hard rock	Construction works	Earthworks
Residential	NCA01	18	1-10 dB	6	7	6	5	6	8	6	7
			11-20 dB	1	7	2	6	3	6	1	2
			>20 dB	-	2	-	1	-	3	-	-
			HNA	-	-	-	-	-	1	-	-
	NCA02	22	1-10 dB	5	8	4	1	2	12	5	3
			11-20 dB	-	3	1	5	3	2	-	2
			>20 dB	-	2	-	-	-	3	-	-
			HNA	-	-	-	-	-	-	-	
	NCA03	42	1-10 dB	1	37	2	21	5	36	1	1
			11-20 dB	-	3	-	1	1	5	-	-
			>20 dB	-	-	-	-	-	1	-	-
			HNA	-	-	-	-	-	-	-	-
	NCA04	28	1-10 dB	6	16	2	14	5	15	4	3
			11-20 dB	3	4	7	6	7	5	1	4
			>20 dB	1	8	1	4	1	8	-	-
			HNA	1	2	1	1	1	4	-	-
Other Sensitive	All NCAs	110	1-10 dB	-	-	-	-	-	-	-	-
			11-20 dB	-	-	-	-	-	-	-	-
			>20 dB	-	-	-	-	-	-	-	-
			HNA	-	-	-	-	-	-	-	-

Note 1: HNA = Highly Noise Affected, based on ICNG definition (ie predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Note 2: Based on worst-case predicted noise levels.

The construction works are predicted to result in 'high' worst-case noise impacts at the nearest receivers during higher noise generating activities. The impacts are generally limited to the closest few receivers in each NCA01, NCA02 and NCA03. A greater number of 'high' worst-case noise impacts are predicted in NCA04 as it contains a greater number of sensitive receivers within 70 metres of the construction site boundary.

The highest impacts are during 'Peak' scenarios which use noise intensive equipment such as rockbreakers and woodchippers. These items would, however, only be used intermittently during the works program. When noise intensive equipment is not in use during 'Typical' works, the worst-case impacts are predicted to generally be reduced to 'minor' or 'moderate' at the nearest receivers.

The highest noise impacts are predicted for the 'Peak' works activities associated with Bulk earthworks. This scenario is predicted to result in 'High' impacts in all NCAs for the nearest residential receivers within around 70 meters of the construction site boundary as shown in **Figure 4**.

More commonly, the 'Typical' worst-case predicted impacts shown in **Figure 5** are predicted when works occur close to sensitive receivers. The greatest impacts are predicted to be 'Moderate' for the most affected receivers in all NCAs with the exception of NCA04 which has 'High' predicted impacts at one receiver immediately adjacent the construction site boundary.

Figure 4 Worst-case Airborne Noise Impacts –Noise Intensive Bulk Earthworks 'Peak' Works

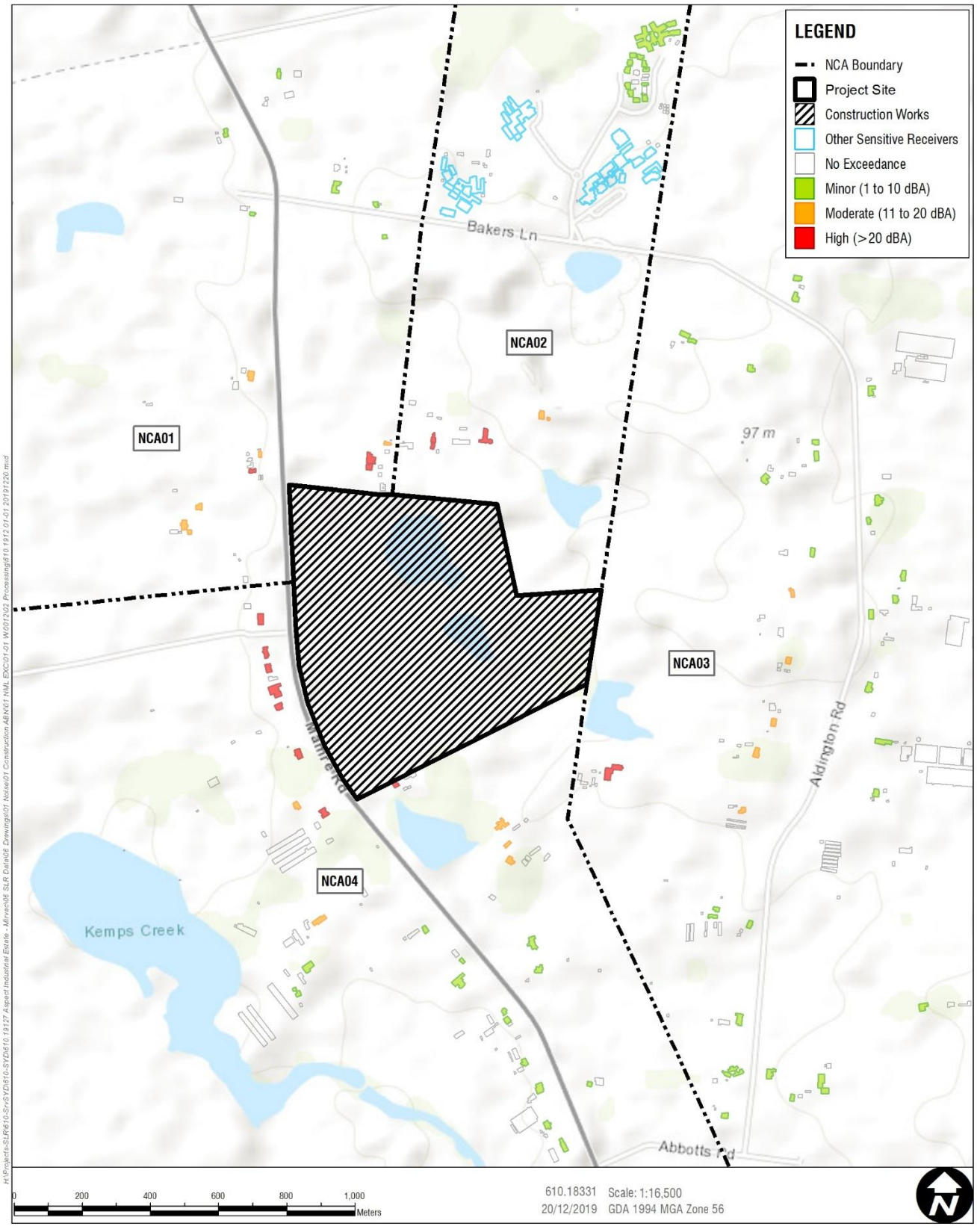
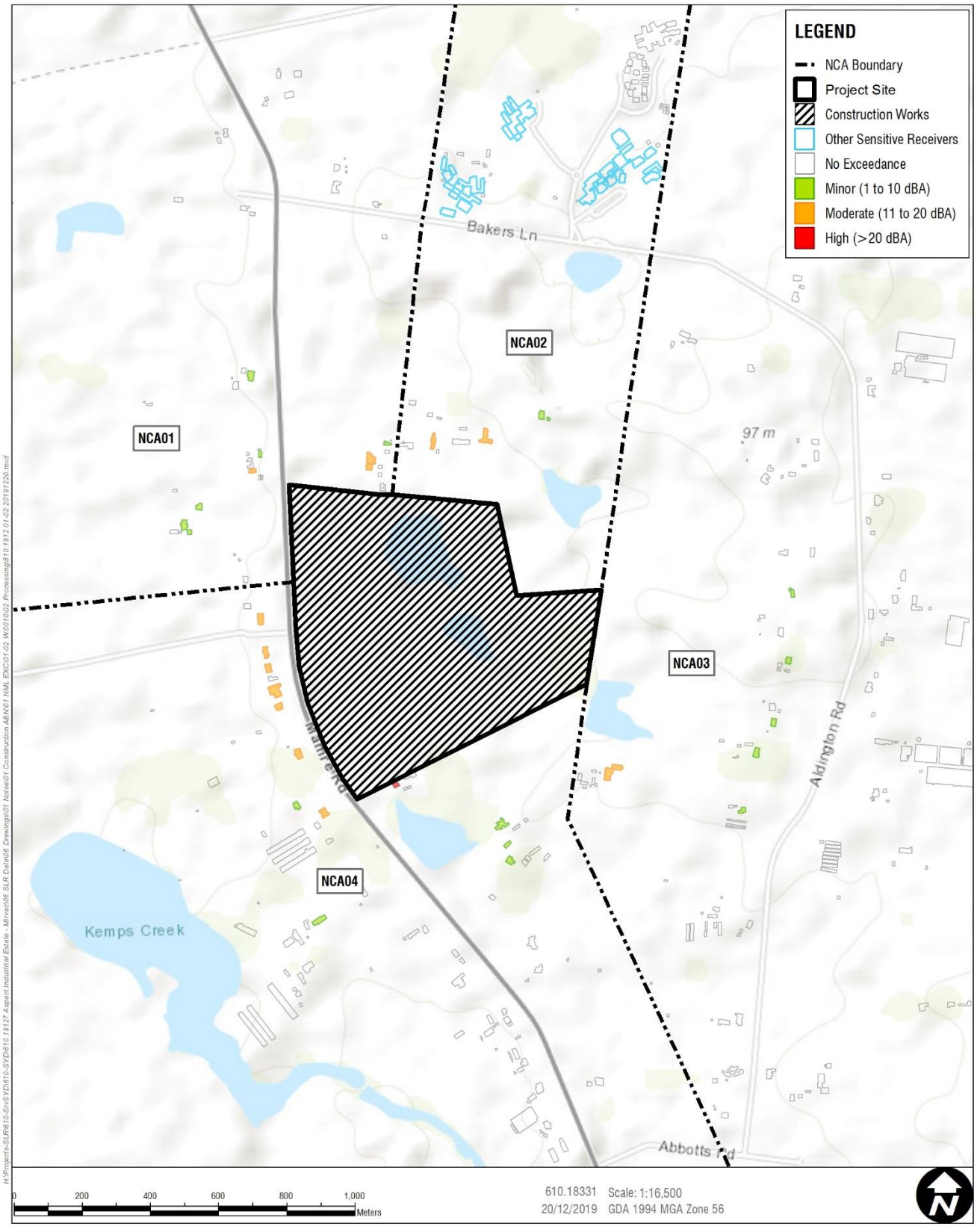


Figure 5 Worst-case Airborne Noise Impacts – Bulk Earthworks 'Typical' Works



Stage 1 infrastructure works would be limited to the northern half of the site and the site access roads. The worst-case predicted noise impacts for these activities are generally 'Minor' or 'Moderate' for the nearest sensitive receivers as shown in **Figure 6** and **Figure 7** for the 'Peak' and 'Typical' impacts respectively.

Figure 6 Worst-case Airborne Noise Impacts –Noise Intensive Stage 1 'Peak' Works

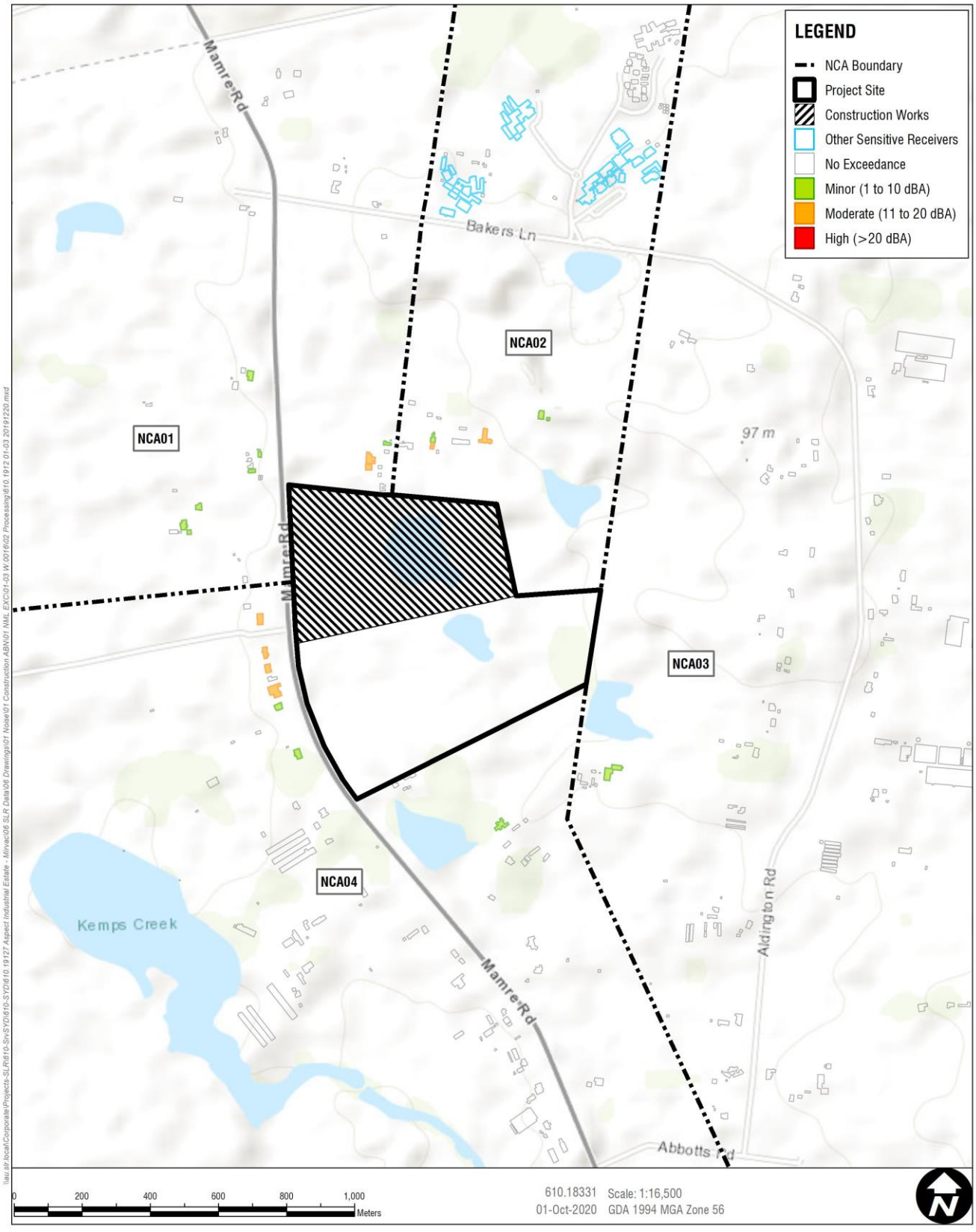
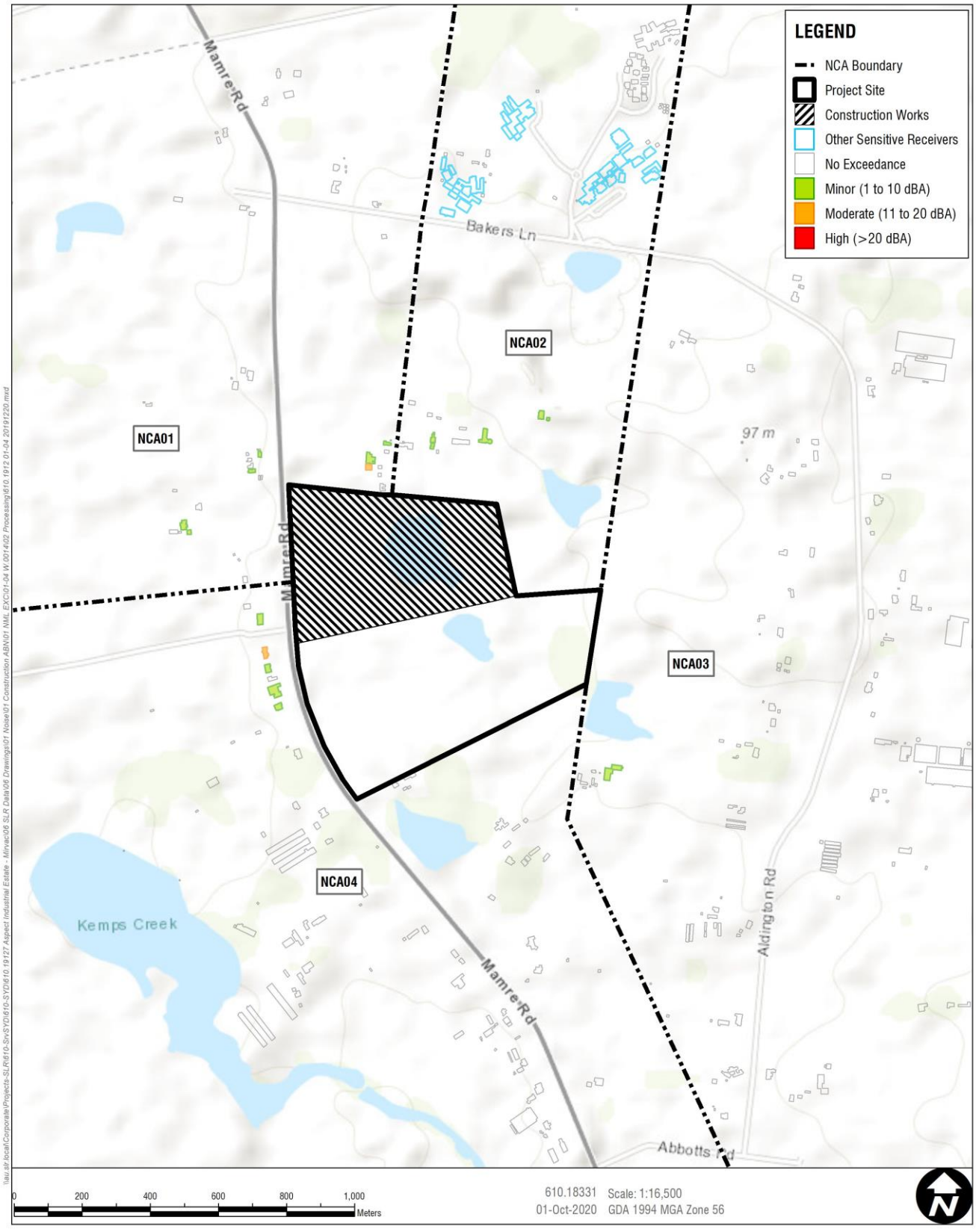


Figure 7 Worst-case Airborne Noise Impacts – Stage 1 'Typical' Works

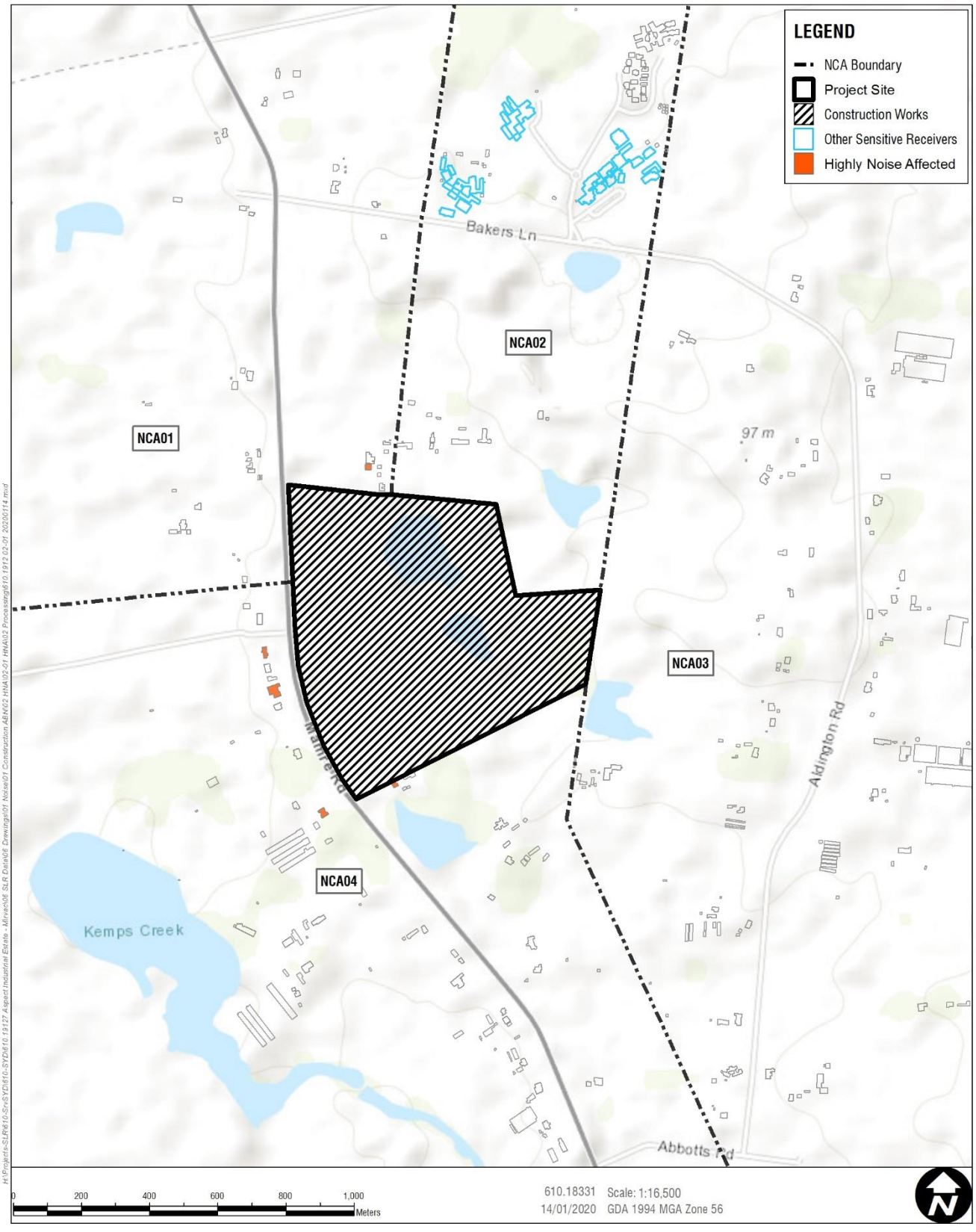


5.2.2.2 Highly Noise Affected Residential Receivers

The receivers predicted to be Highly Noise Affected during the worst-case impacts are summarised in **Table 23** and shown in **Figure 8** for all sensitive receiver types. The table shows the number of residential receivers separated by works activity and NCA.

The assessment shows that the nearest receivers to the site are predicted to be Highly Noise Affected during daytime works involving the use of noise intensive equipment and at receivers in very close proximity to the construction site boundary.

Figure 8 Highly Noise Affected Residential Receivers (During Any Works)



5.2.2.3 Works Outside Standard Construction Hours

No works outside of standard construction hours are currently planned for the site.

Should the need for out of hours works arise, the works will be conducted in accordance with an approved Out of Hours protocol to be prepared, submitted and approved as part of the Construction Environmental Management Plan (CEMP) prior to commencement of the works.

5.3 Construction Road Traffic Noise Assessment

The construction road traffic (heavy vehicles and employee vehicles) is anticipated to access the site via Mamre Road, travelling from the Great Western Highway or M4 Motorway in the north, or Elizabeth Drive in the south.

During fill importation works, peak construction vehicle movements are expected to be approximately 400 heavy vehicles and 200 light vehicles per day.

During Stage 1 infrastructure works, peak construction vehicle movements are expected to be approximately 100 heavy vehicles and 200 light vehicles per day.

Existing peak traffic volumes on Mamre Road (from 2018) have been extracted from the Traffic Impact Assessment (TIA) for the site prepared by Ason Group (Ref: 1029r02v3, dated 29 May 2020). It is noted that existing daily volumes were not available to SLR at the time of this assessment.

Construction road traffic noise predictions are shown in **Table 24**.

Table 24 Construction Traffic Noise Predictions

Construction Activity	Road Name	Road Type	Existing 2018 Traffic Volume (Peak Hour)[1]		Construction Traffic (Peak Hourly)[2]		Predicted Increase in Noise Level (dB)
			Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	
Fill importation	Mamre Road	Arterial Road	1,210	181	18	36	0.5
Stage 1 infrastructure	Mamre Road	Arterial Road	1,210	181	18	9	<0.5

Note 1: Existing AM Peak traffic of 1,391 in TIA with 13% heavy vehicles (heavy vehicle percent based on Mamre Rd 2026 volumes in TIA).

Note 2: Peak hourly construction traffic assumes an even split of the daily construction traffic across standard construction hours.

Based on the above, the proposed construction traffic is predicted to result in a minimal increase in the overall traffic noise levels along the construction vehicle routes to the site.

Note that this is assessment is based on the peak vehicle movements and peak hour traffic, as this was the only data available at the time of this assessment. During the rest of the daytime period when existing vehicle volumes are lower, increases in overall traffic noise levels due to construction traffic have the potential to be marginally higher than those outlined in the table above.

5.4 Construction Ground-borne Noise

Construction works can cause ground-borne noise impacts in nearby buildings when vibration generating equipment is in use. Ground-borne noise impacts should be considered where the ground-borne noise levels are higher than noise transmitted through the air, such as where buildings near to construction works have high performing facades which attenuate the airborne component.

The majority of receivers are sufficiently distant from the works for ground-borne noise impacts to be minimal. Due to the surface nature of the construction works for the site, airborne noise levels would typically be dominant over the ground-borne component where receivers are located near to construction works.

5.5 Construction Vibration Assessment

Vibration intensive items of plant proposed for use during the construction of the site would include rockbreakers and vibratory rollers. These items of equipment are proposed to be used primarily during enabling works and bulk earthworks.

Site specific vibration mitigation measures should be utilised where works requiring the use of vibration intensive items of plant are proposed within the minimum working distances of sensitive receivers (outlined in **Table 16**). Receivers within the minimum working distances are shown in **Figure 9**. This figure assumes that vibration intensive works are occurring at the site boundaries.

Figure 9 Receivers within Construction Vibration Minimum Working Distances

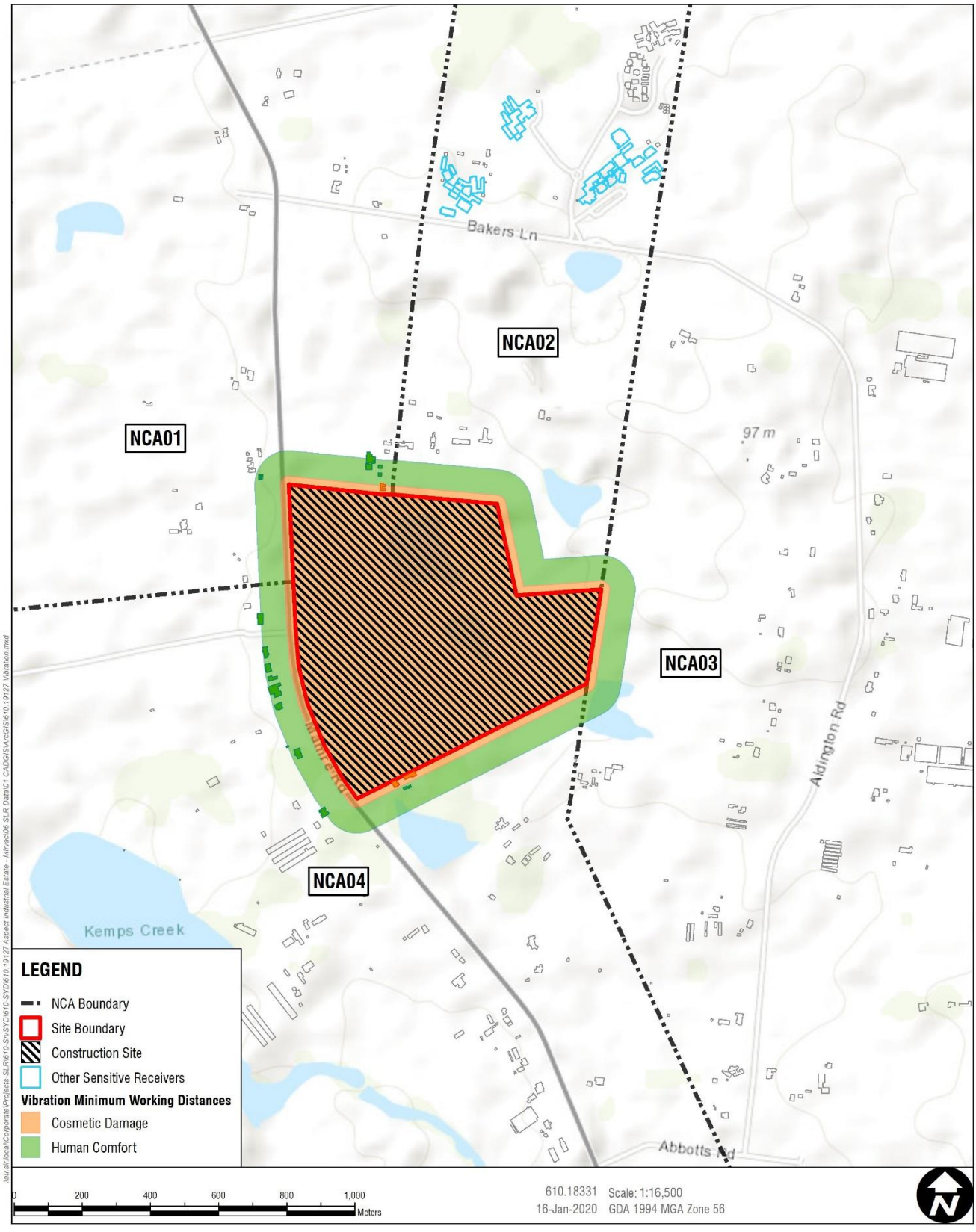


Figure 9 shows that there is one residential receiver (in NCA04) and two commercial/shed structures (in NCA01 and NCA04) that may be within the minimum working distances for cosmetic damage should rockbreaking or vibratory rolling works be required at the site boundaries closest to these receivers.

For human comfort vibration, a total of ten residential receivers and nine commercial/shed structures (in NCA01 and NCA04) may be within the minimum working distances should rockbreaking or vibratory rolling works be required at the site boundaries closest to these receivers.

5.6 Construction Noise and Vibration Mitigation Measures

The ICNG acknowledges that due to the nature of construction works it is inevitable that there will be impacts where construction is near to sensitive receivers. Examples of potential mitigation and management measures which could be applied to the project to minimise the impacts are provided below.

Specific strategies would be determined as the project progresses and detailed in the Construction Environmental Management Plan (CEMP) for the project before any works begin. This plan provides a detailed assessment of the potential impacts from the work and define the site specific mitigation and management measures to be used to control the impacts, particularly where evening or night-time works are required.

5.6.1 Standard Mitigation

The Roads and Maritime *Construction Noise and Vibration Guideline* (CNVG) contains a number of standard measures for mitigating and managing construction impacts on development projects.

The measures are shown in **Table 25** and should be applied where feasible and reasonable to minimise the impacts from the works as far as practicable.

Table 25 Recommended 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. Website (If required) Contact telephone number for community Email distribution list (if required) Community drop in session (if required by approval conditions).

Action Required	Applies To	Details
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.
Behavioural 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.
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	Respite Offers should be considered made where there are high noise and vibration generating activities near receivers. As a guide work should be carried out in continuous blocks that do not exceed 3 hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers.
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	Noise generating equipment will be regularly checked and effectively maintained, including checking of hatches/enclosures regularly to ensure that seals are in good condition and doors close properly against seals
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.

Action Required	Applies To	Details
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 cannot be undertaken during the day, it should be completed before 11:00 pm. 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.
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	Compounds and worksites will be designed to promote one-way traffic and minimise the need for vehicle reversing. Where practicable, work compounds, parking areas, and equipment and material stockpiles will be positioned away from noise-sensitive locations and take advantage of existing screening from local topography. 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	Where practicable, work compounds, parking areas, and equipment and material stockpiles will be positioned away from noise-sensitive locations and take advantage of existing screening from local topography.
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.

6 Operational Noise Assessment

Exact details on the various uses of the site are not currently known at this stage of the project. As such, it has been necessary to make certain assumptions as to the type and location of equipment together with details regarding operational measures. These assumptions are defined in the following sections.

6.1 Operational Noise Modelling

SoundPLAN has been used for modelling the noise emissions from the operation of the site using the CONCAWE industrial noise prediction algorithms. The three-dimensional model includes ground topography, buildings and representative noise sources.

Based on the analysis of prevailing weather conditions (refer to **Section 3.3**), the noise model includes standard weather conditions during the daytime and evening periods, with noise-enhancing weather conditions during the night-time period, using an F-class temperature inversion with a 2 m/s source to receiver drainage flow.

6.1.1 Noise Model Inputs

In order to assess the operational noise impacts from the site, worst-case peak light and heavy vehicle movements have been modelled. Light vehicles have been modelled on the access roads and in the car parking areas, and heavy vehicles on the access roads and in the hardstand areas.

Vehicle volumes were provided by Mirvac, taken from the Traffic Impact Assessment (TIA) for the site prepared by Ason Group (Ref: 1029r02v3, dated 29 May 2020). The following assumptions have been adopted based the information provided:

- Daytime/Evening Peak 1-hour – 550 vehicle movements
- Night-time Peak 1-hour – approximately 30% of Day Peak movements, ie 165 vehicle movements.
- Light vehicles comprise 72% of the total vehicles, with heavy vehicles the remaining 28%.

Based on the above, the modelled vehicle movements have been divided amongst the warehouses onsite based on the floor area of each warehouse, ie bigger warehouses have more vehicle movements assigned to them than smaller warehouses.

The peak 1-hour movements outlined above were further broken down to peak 15-minute movements in order to assess the noise emissions against the NPfI criteria. The peak 1-hour movements have been assumed to be spread evenly across each 15 minute period.

External forklift movements (ie outside of the warehouses) have been modelled in the at-grade dock areas of the hardstands. It has been assumed that forklifts would operate continuously during any one 15-minute period. One forklift per heavy vehicle onsite has been modelled operating externally in the hardstand areas for each of the warehouses.

Sound power levels (SWLs) and speed assumptions for the modelled vehicle movements are outlined in **Table 26**.

Table 26 Sound Power Levels for Onsite Vehicle Movements

Noise Source	Sound Power Level (SWL)	Average Speed
Heavy Vehicles	103 dBA[1]	25 km/h
Light Vehicles	96 dBA	40 km/h
Gas-powered Forklifts[2]	93 dBA	n/a

Note 1: Based on SLR's noise measurement database, this sound power level is typical of trucks travelling at low speeds, such as within industrial estates.

Note 2: If electric forklifts are proposed for the site, noise emissions from forklifts would be considerably lower than gas-powered forklifts.

External fixed mechanical plant has been modelled on the warehouse rooftops. Rooftop fixed plant units have been modelled with an indicative cumulative SWL of 90 dBA per warehouse.

In order to assess the possibility of sleep disturbance, in addition to the above noise sources, heavy vehicle brake releases and reverse alarms (non-tonal) have been modelled along the heavy vehicle routes and in the hardstand areas of the site with a L_{Amax} SWL of 118 dBA, and light vehicles have been modelled with a L_{Amax} SWL of 100 dBA.

6.2 Predicted Operational Noise Impacts

6.2.1 Masterplan Site

The predicted operational noise levels at the nearest receivers from industrial noise emissions for the fully operational Masterplan site are summarised in **Table 27**. Noise contours are provided for day/evening (standard weather) in **Figure 10** and night-time (noise-enhancing weather) in **Figure 11**.

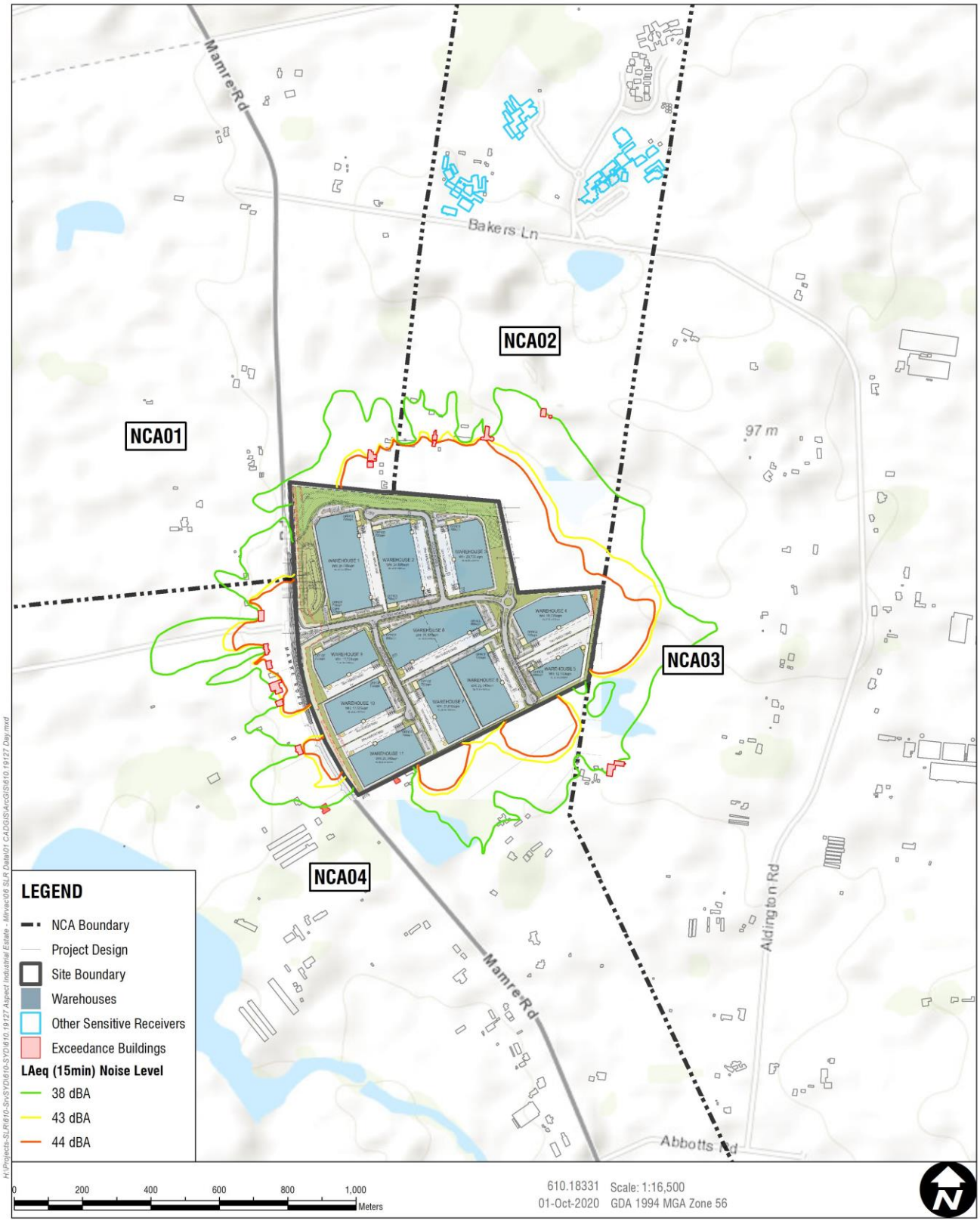
Table 27 Predicted Operational Noise Levels – Most-affected Receiver – Masterplan Site

NCA	Receiver Type	Period (weather)	$L_{Aeq(15\ minutes)}$ Noise Level (dBA)				L_{Amax} Noise Level (dBA)			
			Project Noise Trigger Level	Predicted	Exceedance	Compliance	Sleep Disturbance Screening Noise Level	Predicted	Exceedance	Compliance
NCA01	Residential	Daytime (standard)	44	**48**	**4**	**No**	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Evening (standard)	43	**48**	**5**	**No**	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Night-time (standard)	37	**44**	**7**	**No**	52	**67**	**15**	**No**
		Night-time (noise-enhancing)	37	**47**	**10**	**No**	52	**69**	**17**	**No**
NCA02	Residential	Daytime (standard)	40	**46**	**6**	**No**	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Evening (standard)	38	**46**	**8**	**No**	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Night-time (standard)	37	**42**	**5**	**No**	52	**62**	**10**	**No**
		Night-time (noise-enhancing)	37	**46**	**9**	**No**	52	**65**	**13**	**No**
NCA03	Residential	Daytime (standard)	40	40	-	Yes	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Evening (standard)	38	**40**	**2**	**No**	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Night-time (standard)	35	**38**	**3**	**No**	52	**57**	**5**	**No**
		Night-time (noise-enhancing)	35	**42**	**7**	**No**	52	**61**	**9**	**No**
NCA04	Residential	Daytime (standard)	44	**52**	**8**	**No**	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Evening (standard)	43	**52**	**9**	**No**	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Night-time (standard)	37	**47**	**10**	**No**	52	**67**	**15**	**No**
		Night-time (noise-enhancing)	37	**50**	**13**	**No**	52	**68**	**16**	**No**
NCA02	Childcare Centre	When in use (all)	48	<30	-	Yes	n/a[2]	n/a[2]	n/a[2]	n/a[2]
NCA02	Educational	When in use (all)	43	<30	-	Yes	n/a[2]	n/a[2]	n/a[2]	n/a[2]

Note 1: **Bold** text indicates an exceedance of the project noise trigger level.

Note 2: L_{Amax} criteria are not applicable during this time period and/or to this receiver type.

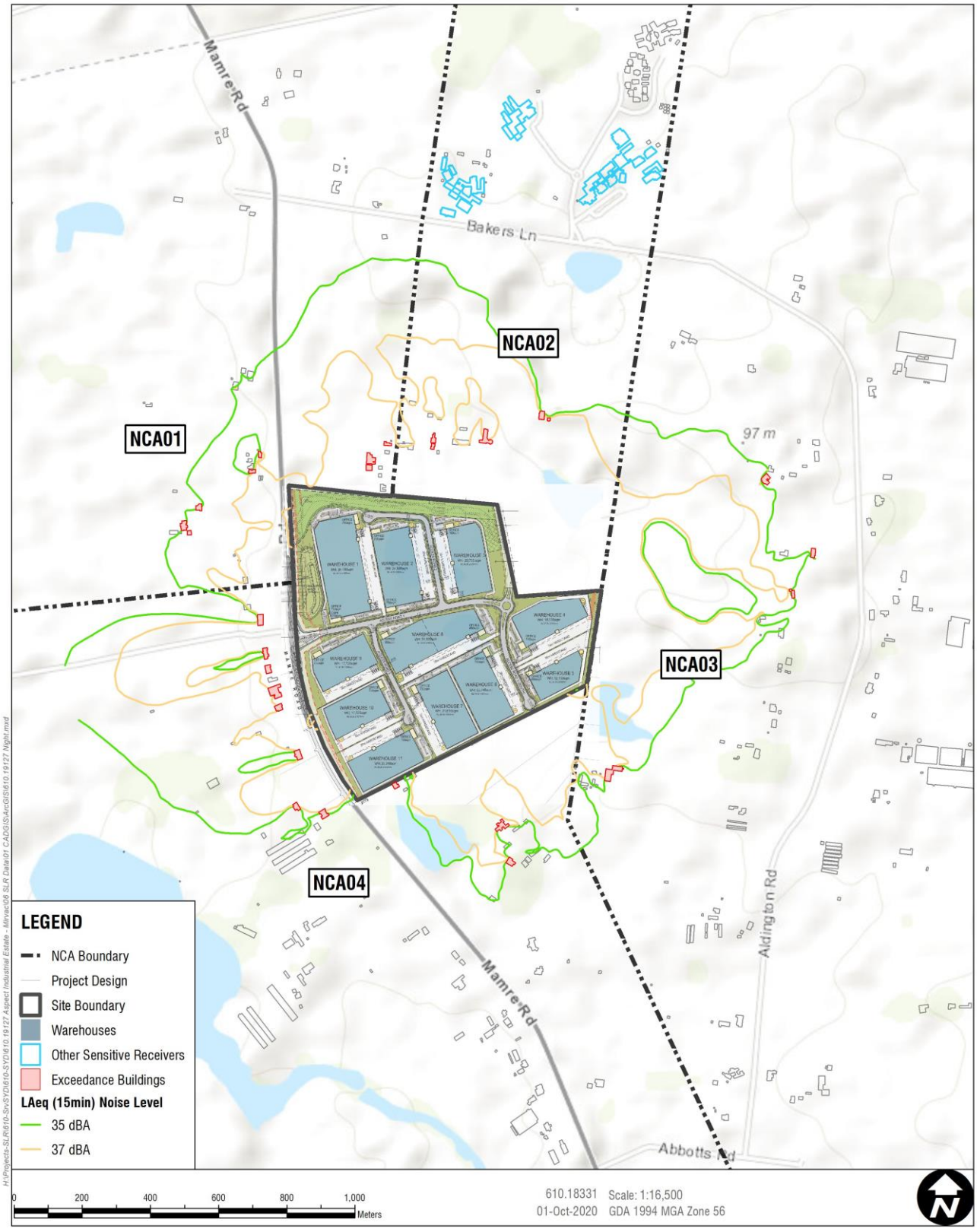
Figure 10 Predicted Noise Levels – Day/Evening – Standard Weather Conditions – Masterplan Site



Note 1: Noise contours calculated at 1.5 m above local ground.

Note 2: Receivers where an exceedance of the relevant criteria is predicted are shown in red.

Figure 11 Predicted Noise Levels – Night – Noise-Enhancing Weather Conditions – Masterplan Site



Note 1: Noise contours calculated at 1.5 m above local ground.

Note 2: Receivers where an exceedance of the relevant criteria is predicted are shown in red.

6.2.1.1 Peak L_{Aeq} Noise Levels

The above shows that operational L_{Aeq} noise levels from the fully operational Masterplan site are predicted to exceed the relevant L_{Aeq} noise criteria at a number of residential receivers in all NCAs during all periods, except in NCA03 during the daytime.

Under standard weather conditions, exceedances of the L_{Aeq} criteria are predicted at up to three residences in NCA01, five residences in NCA02, one residence in NCA03, and six residences in NCA04.

Under noise-enhancing weather conditions, exceedances of the L_{Aeq} criteria are predicted at up to eight residences in NCA01, five residences in NCA02, five residences in NCA03, and eleven residences in NCA04.

No exceedances of the relevant L_{Aeq} noise criteria are predicted at the schools or the childcare centre in NCA02 during any periods under standard or noise-enhancing weather conditions.

Reasonable and feasible operational noise mitigation and management measures should be considered to minimise noise impacts at the receivers where the L_{Aeq} criteria is predicted to be exceeded. Potential operational noise mitigation and management measures are discussed in **Section 6.5**.

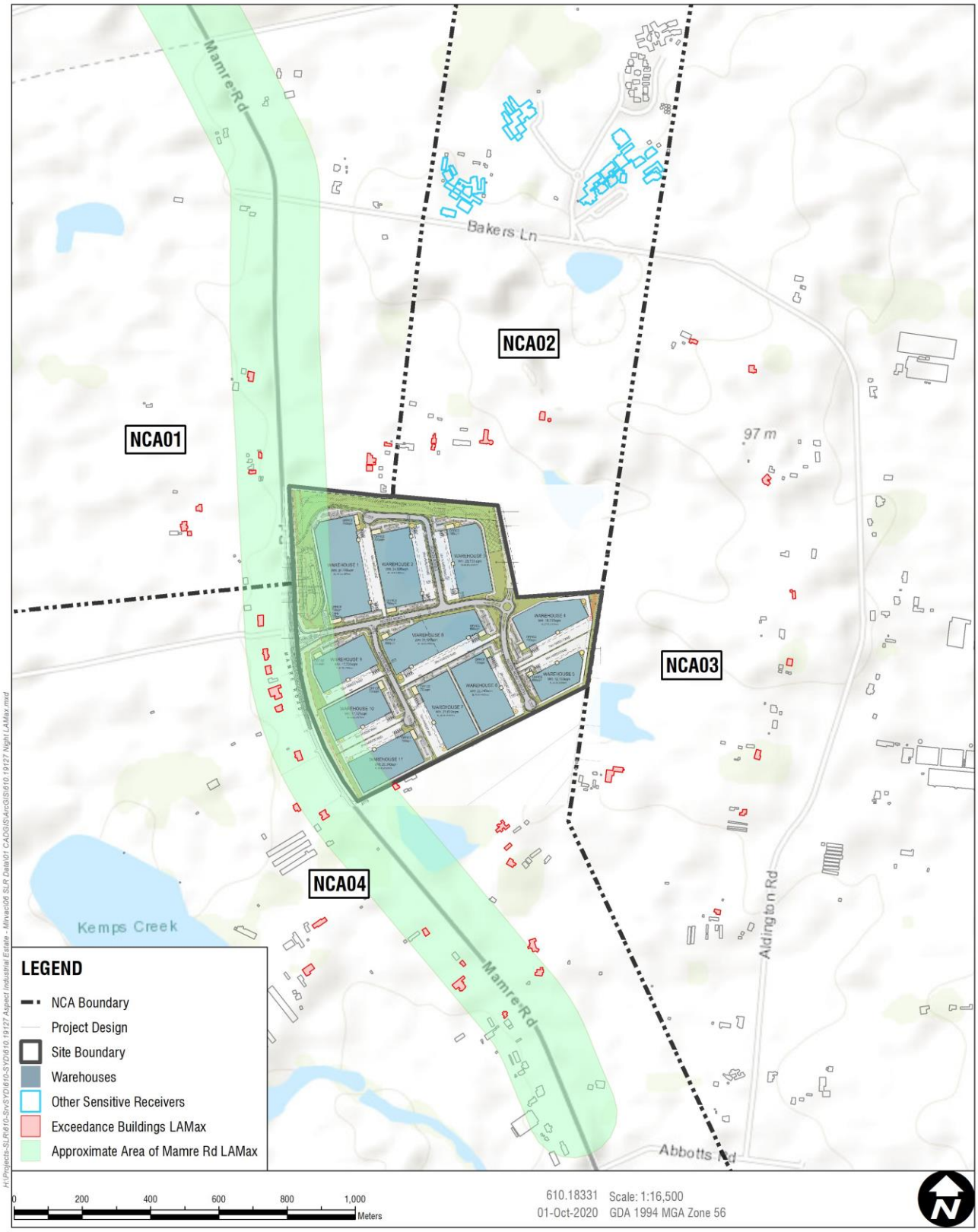
6.2.1.2 Maximum Noise Levels

The above shows that operational L_{Amax} noise levels from the fully operational Masterplan site are predicted to exceed the relevant L_{Amax} sleep disturbance screening level at a number of residential receivers in all NCAs under both standard and noise-enhancing weather conditions.

Under standard weather conditions exceedances of the L_{Amax} screening level are predicted at up to three residences in NCA01, five residences in NCA02, one residence in NCA03, and ten residences in NCA04.

Under noise-enhancing weather conditions exceedances of the L_{Amax} screening level are predicted at up to nine residences in NCA01, five residences in NCA02, ten residences in NCA03, and nineteen residences in NCA04. These exceedances are shown in **Figure 12**.

Figure 12 Predicted Exceedance of Sleep Disturbance Screening Noise Level – Noise-Enhancing Weather Conditions – Masterplan Site



As outlined in **Section 4.5.2**, where the sleep disturbance screening noise level is predicted to be exceeded then a detailed assessment of maximum noise events should be undertaken. The detailed assessment should discuss the predicted level of the events, the exceedance of the screening level, existing maximum noise levels, and consider guidance from current literature regarding sleep disturbance, such as the *Road Noise Policy* (RNP).

The noise monitoring undertaken at the site (refer to **Section 3** and **Appendix B**) measured typical existing maximum noise levels during the night-time period at locations representative of receivers at varying distances from Mamre Road. A summary of the measured existing maximum noise levels is provided in **Table 28**.

Table 28 Typical Existing Maximum Noise Levels

Monitoring Location	Approximate Distance from Mamre Road	Discussion of Typical Maximum Noise Levels
L01	230 m	Measured maximum noise levels during the night-time period were typically around 55-65 dBA. Occasional events over 70 dBA were measured. Attended measurements indicate that events in the typical range are likely to be heavy vehicles on Mamre Road, with higher events likely to be birds and other wildlife.
L02	600 m	Measured maximum noise levels during the night-time period were typically around 45-60 dBA. Occasional events over 65 dBA were measured. Attended measurements indicate that events in the lower end of the typical range are likely to be heavy vehicles on Mamre Road, with higher events likely to be birds and other wildlife.
L03	900 m	Measured maximum noise levels during the night-time period were typically around 45-60 dBA. Occasional events over 65 dBA were measured. Attended measurements indicate that events in the lower end of the typical range are likely to be heavy vehicles on Mamre Road, with higher events likely to be birds and other wildlife.
L04	120 m	Measured maximum noise levels during the night-time period were typically around 60-70 dBA. Occasional events over 75 dBA were measured. Attended measurements indicate that events in the typical range are likely to be heavy vehicles on Mamre Road, with higher events likely to be birds and other wildlife.
L05	40 m	Measured maximum noise levels during the night-time period were typically around 65-75 dBA. Occasional events over 80 dBA were measured. Attended measurements indicate that the majority of events are likely to be heavy vehicles on Mamre Road.

Table 28 shows that at residences within 120 m of Mamre Road, the existing maximum noise levels from heavy vehicles on Mamre Road are likely to be a similar or higher level than the predicted maximum noise levels for the site. At residences which are further away from Mamre Road and close to the site, the level and number of maximum events from the site would be likely to be higher than the existing background maximum events. The 120 m offset from Mamre Road where existing maximum noise levels are likely to be similar or higher than the site is shown in **Figure 12**.

The RNP provides context in relation to maximum noise levels and potential for sleep disturbance. The RNP concludes that maximum internal noise levels of 50-55 dBA are unlikely to awaken people, and one or two events per night with maximum internal noise levels of 65-70 dBA are not likely to affect health and wellbeing significantly. This results in corresponding external noise levels of 60-65 dBA and 75-80 dBA assuming a 10 dB loss through open windows.

At the majority of residences where exceedance of the screening levels are predicted, the predicted maximum noise levels are below the levels outlined in the RNP that would be considered to have potential to cause sleep disturbance. At the nearest residences in NCA01 and NCA04 the predicted maximum noise levels have the potential to be above the levels noted in the RNP that may awaken people, but are below the level likely to affect wellbeing. At receivers near to Mamre Road, existing maximum events from heavy vehicles are potentially above the levels outlined in the RNP.

In summary, while the maximum noise levels from the site are predicted to exceed the sleep disturbance screening level, it is unlikely to result in sleep disturbance at the majority of residences due to the existing maximum noise levels from road traffic on Mamre Road. The potential for sleep disturbance would be limited to the nearest residences to the site which are not already affected by existing high maximum events from Mamre Road. These receivers are generally located to the north of the proposed site in NCA02 and to the south in NCA03 and NCA04.

6.2.2 Stage 1 Site

In order to predict operational noise levels for Stage 1 of the site prior to construction of further stages, noise emissions from the Stage 1 site have been modelled with no structures or noise sources in the other lots.

The predicted operational noise levels at the nearest receivers from industrial noise emissions for the Stage 1 site are summarised in **Table 29**. Noise contours are provided for day/evening (standard weather) in **Figure 13** and night-time (noise-enhancing weather) in **Figure 14**.

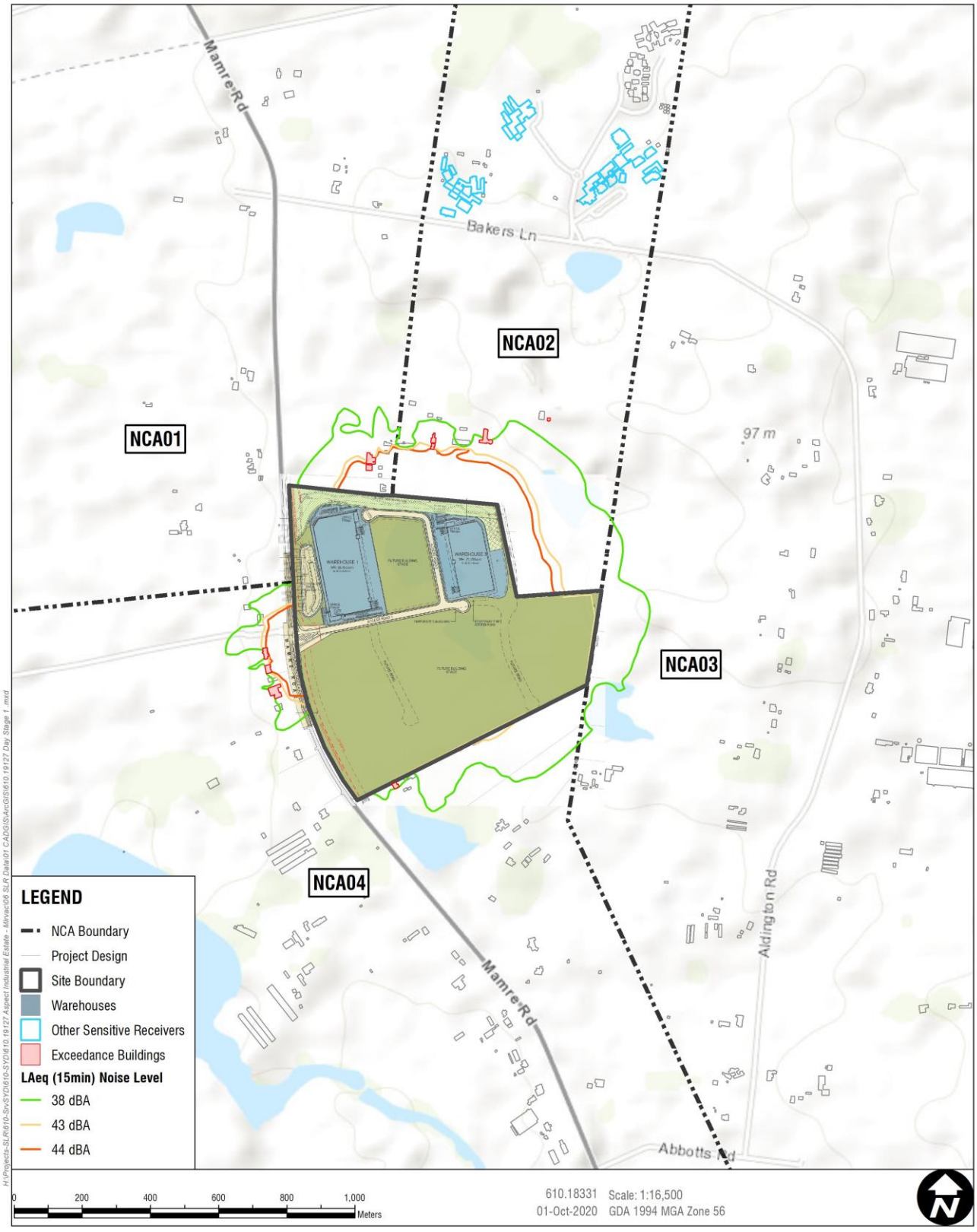
Table 29 Predicted Operational Noise Levels – Most-affected Receiver – Stage 1 Site

NCA	Receiver Type	Period (weather)	$L_{Aeq(15\ minutes)}$ Noise Level (dBA)				L_{Amax} Noise Level (dBA)			
			Project Noise Trigger Level	Predicted	Exceedance	Compliance	Sleep Disturbance Screening Noise Level	Predicted	Exceedance	Compliance
NCA01	Residential	Daytime (standard)	44	**47**	**3**	**No**	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Evening (standard)	43	**47**	**4**	**No**	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Night-time (standard)	37	**43**	**6**	**No**	52	**66**	**14**	**No**
		Night-time (noise-enhancing)	37	**46**	**9**	**No**	52	**67**	**15**	**No**
NCA02	Residential	Daytime (standard)	40	**44**	**4**	**No**	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Evening (standard)	38	**44**	**6**	**No**	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Night-time (standard)	37	**39**	**2**	**No**	52	**62**	**10**	**No**
		Night-time (noise-enhancing)	37	**43**	**6**	**No**	52	**65**	**13**	**No**
NCA03	Residential	Daytime (standard)	40	38	-	Yes	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Evening (standard)	38	38	-	Yes	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Night-time (standard)	35	33	-	Yes	52	**53**	**1**	**No**
		Night-time (noise-enhancing)	35	**39**	**4**	**No**	52	**60**	**8**	**No**
NCA04	Residential	Daytime (standard)	44	**46**	**2**	**No**	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Evening (standard)	43	**46**	**3**	**No**	n/a[2]	n/a[2]	n/a[2]	n/a[2]
		Night-time (standard)	37	**41**	**4**	**No**	52	**67**	**15**	**No**
		Night-time (noise-enhancing)	37	**45**	**8**	**No**	52	**68**	**16**	**No**
NCA02	Childcare Centre	When in use (all)	48	<30	-	Yes	n/a[2]	n/a[2]	n/a[2]	n/a[2]
NCA02	Educational	When in use (all)	43	<30	-	Yes	n/a[2]	n/a[2]	n/a[2]	n/a[2]

Note 1: **Bold** text indicates an exceedance of the project noise trigger level.

Note 2: L_{Amax} criteria are not applicable during this time period and/or to this receiver type.

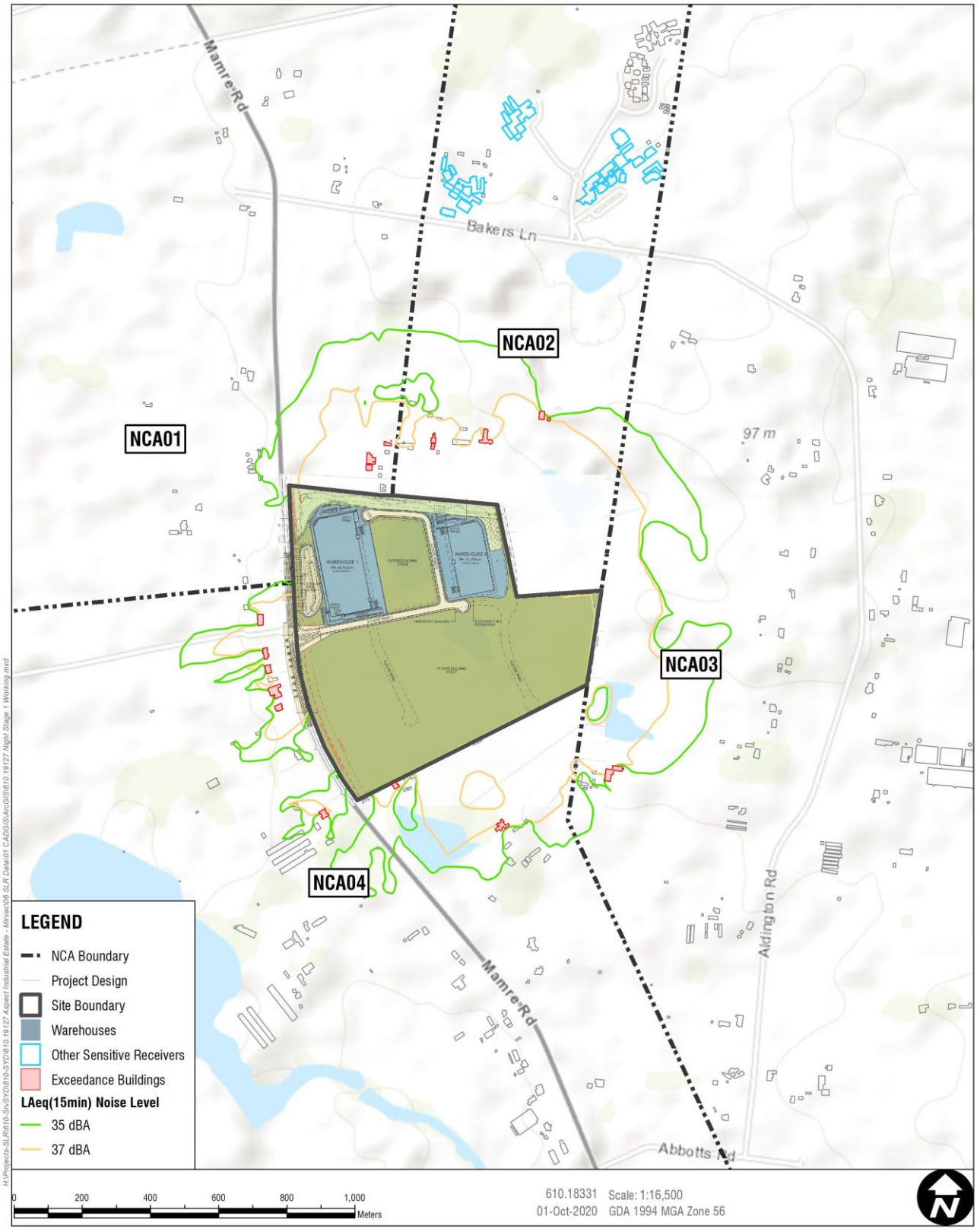
Figure 13 Predicted Noise Levels – Day/Evening – Standard Weather Conditions – Stage 1 Site



Note 1: Noise contours calculated at 1.5 m above local ground.

Note 2: Receivers where an exceedance of the relevant criteria is predicted are shown in red.

Figure 14 Predicted Noise Levels – Night – Noise-Enhancing Weather Conditions – Stage 1 Site



Note 1: Noise contours calculated at 1.5 m above local ground.

Note 2: Receivers where an exceedance of the relevant criteria is predicted are shown in red.

6.2.2.1 Peak L_{Aeq} Noise Levels

The above shows that operational L_{Aeq} noise levels from the Stage 1 site are predicted to exceed the relevant L_{Aeq} noise criteria at a number of residential receivers in NCA01, NCA02 and NCA04 during all periods, and in NCA03 during the night-time under noise-enhancing weather conditions.

Under standard weather conditions, exceedances of the L_{Aeq} criteria are predicted at up to two residences in NCA01, four residences in NCA02, and four residences in NCA04.

Under noise-enhancing weather conditions, exceedances of the L_{Aeq} criteria are predicted at up to three residences in NCA01, five residences in NCA02, one residence in NCA03, and eight residences in NCA04.

No exceedances of the relevant L_{Aeq} noise criteria are predicted at the schools or the childcare centre in NCA02 during any periods under standard or noise-enhancing weather conditions.

Reasonable and feasible operational noise mitigation and management measures should be considered to minimise noise impacts at the receivers where the L_{Aeq} criteria is predicted to be exceeded. Potential operational noise mitigation and management measures are discussed in **Section 6.5**.

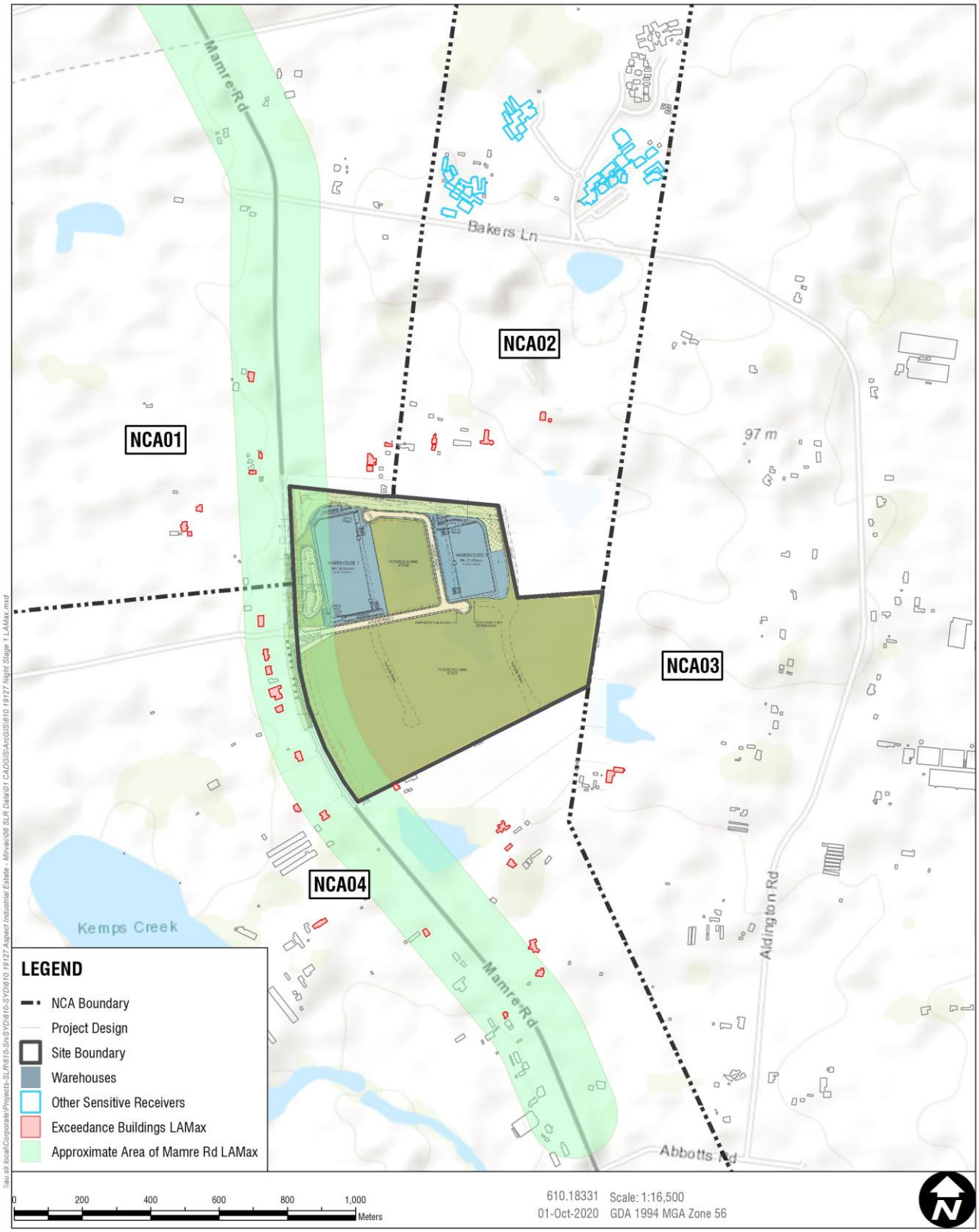
6.2.2.2 Maximum Noise Levels

The above shows that operational L_{Amax} noise levels from the Stage 1 site are predicted to exceed the relevant L_{Amax} sleep disturbance screening level at a number of residential receivers in all NCAs under both standard and noise-enhancing weather conditions.

Under standard weather conditions, exceedances of the L_{Amax} screening level are predicted at up to three residences in NCA01, five residences in NCA02, one residence in NCA03, and nine residences in NCA04.

Under noise-enhancing weather conditions, exceedances of the L_{Amax} screening level are predicted at up to nine residences in NCA01, five residences in NCA02, one residence in NCA03, and seventeen residences in NCA04. These exceedances are shown in **Figure 15**.

Figure 15 Predicted Exceedance of Sleep Disturbance Screening Noise Level – Noise-Enhancing Weather Conditions – Stage 1 Site



Similar L_{Amax} noise levels to those predicted for the Masterplan site are predicted for the Stage 1 site in NCA01, NCA02 and NCA04, with lower levels predicted in NCA03. The number of events would be fewer for the Stage 1 site than the Masterplan site in line with the reduced number of vehicle movements.

As such, the outcomes of the detailed maximum noise assessment for Stage 1 would be consistent with those discussed for the Masterplan site (refer to **Section 6.2.1.2**).

In summary, while the maximum noise levels from the Stage 1 site are predicted to exceed the sleep disturbance screening level, they are unlikely to result in sleep disturbance at the majority of residences due to the existing maximum noise levels from road traffic on Mamre Road (as shown in **Figure 15**). The potential for sleep disturbance would be limited to the nearest residences to the Stage 1 site which are not already affected by existing high maximum events from Mamre Road. These receivers are generally located to the north of the proposed site in NCA02 and to the south in NCA03 and NCA04.

6.3 Cumulative Operational Noise Impacts with Other Industry

The NPfI aims to limit continuing increases in noise levels from progressive developments with the application of the amenity criteria. The recommended amenity noise levels represent the objective for the total industrial noise at a receiver location, whereas the project amenity noise level represents the objective for noise from a single industrial development at a receiver location.

To account for cumulative noise from the site with existing industrial premises in the area, the recommended amenity noise level is reduced by 5 dBA to give the project amenity noise level. The project amenity noise level is used in conjunction with the project intrusiveness noise level to determine the Project Noise Trigger Levels (PTNLs) for operational noise from the site (refer to **Section 4.5**).

As such, it is considered that cumulative noise impacts from the site with existing industrial noise sources in the area have been accounted for with the adoption of the project amenity noise levels in the assessment of operational noise impacts detailed in **Section 6.2**.

6.4 Off-site Operational Traffic Noise Impacts

The operational road traffic (heavy vehicles and employee vehicles) would access the site via the new intersection on Mamre Road, travelling from the Great Western Highway or M4 Motorway in the north, or Elizabeth Drive in the south.

Existing peak traffic volumes on Mamre Road (from 2018) have been extracted from the Traffic Impact Assessment (TIA) for the site prepared by Ason Group (Ref: 1029r02v3, dated 29 May 2020). Future peak traffic volumes on Mamre Road for 2026 have also been extracted from the TIA for comparison. It is noted that daily volumes were not available to SLR at the time of this assessment.

Off-site operational road traffic noise predictions are shown for the Masterplan site in **Table 30** and the Stage 1 site in **Table 31**.

Table 30 Off-Site Operational Traffic Noise Predictions – Masterplan Site

Traffic Timeframe	Road Name	Road Type	Mamre Road Traffic Volume (Peak Hour)[1]		Operational Traffic (Peak Hourly)[2]		Predicted Increase in Noise Level (dB)
			Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	
Existing (2018)	Mamre Road	Arterial Road	1,210	181	396	154	2.0
Future (2026)	Mamre Road	Arterial Road	2,000	300	396	154	1.3

Note 1: Existing (2018) AM Peak traffic of 1,391 in TIA with 13% heavy vehicles (heavy vehicle percent based on Mamre Rd 2026 volumes in TIA).

Note 2: Night-time peak volumes have not been assessed as existing or future traffic volumes for the night-time period were not available to SLR at the time of this assessment.

Table 31 Off-Site Operational Traffic Noise Predictions – Stage 1 Site

Traffic Timeframe	Road Name	Road Type	Existing 2018 Traffic Volume (Peak Hour)[1]		Construction Traffic (Peak Hourly)[2]		Predicted Increase in Noise Level (dB)
			Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles	
Existing (2018)	Mamre Road	Arterial Road	1,210	181	103	40	0.6
Future (2026)	Mamre Road	Arterial Road	2,000	300	103	40	<0.5

Note 1: Existing (2018) AM Peak traffic of 1,391 in TIA with 13% heavy vehicles (heavy vehicle percent based on Mamre Rd 2026 volumes in TIA).

Note 2: Night-time peak volumes have not been assessed as existing or future traffic volumes for the night-time period were not available to SLR at the time of this assessment.

The above results show that the proposed operational road traffic from the Masterplan site would result in minor increases in the overall road traffic noise levels along Mamre Road based on the existing traffic, and to a lesser extent based on the future traffic.

Increases in overall road traffic noise levels along Mamre Road due to the proposed operational road traffic from the Stage 1 site would be minimal during both timeframes.

In all of the assessed scenarios, an increase of greater than 2 dB is not predicted, and as such, mitigation is unlikely to be required for off-site operational road traffic noise.

Note that this is assessment is based on the peak vehicle movements and peak hour traffic, as this was the only data available at the time of this assessment. During the rest of the daytime or night-time periods when vehicle volumes on Mamre Road are lower, increases in overall traffic noise levels due to the site have the potential to be marginally higher than those outlined in the table above.

Another consideration is that the above assessment assumes that all off-site road traffic would travel to the north from the site or all traffic would travel to the south from the site. In reality some traffic would travel north and some south, resulting in lower increases that those assessed, except for receivers adjacent to the site access intersection.

Typical maximum noise levels from heavy vehicles on Mamre Road associated with the site would be consistent with the existing level of maximum noise events from heavy vehicles on Mamre Road. While the number of events would increase in line with the number of trucks accessing the site, it is noted that the changing land uses in the area (such as development of the Western Sydney Aerotropolis), along with the proposed Mamre Road Upgrade and Mamre Road Precinct rezoning would be likely to have a much greater effect on the number of heavy vehicles on Mamre Road.

6.5 Operational Noise Mitigation and Management Measures

Where 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)

The NPfI recognises that residual noise impacts may exist after the implementation of feasible and reasonable noise mitigation and management measures.

The NPfI generally considers the significance of residual impacts as summarised in **Table 32**.

Table 32 Significance of Residual Impacts

Exceedance of the Criteria	Significance of Residual Noise Impacts	Example of Potential Treatment
0 to 2 dBA	Negligible	The exceedances would generally not be discernible by the average listener and therefore would not warrant receiver-based treatments or controls.
3 to 5 dBA with minimal increase to cumulative industrial noise	Marginal	Provision of mechanical ventilation to enable windows to be closed without compromising internal air quality/amenity.
3 to 5 dBA with significant increase to cumulative industrial noise	Moderate	Provision of mechanical ventilation along with upgrade facade elements, such as windows, doors or roof insulation, to further increase the ability of the building facade to reduce noise levels.
>5 dBA but less than recommended amenity noise level		
>5 dBA and greater than recommended amenity noise level	Significant	May include suitable commercial agreements where considered feasible and reasonable.

The significance of any potential residual noise impacts should be taken into account when considering the reasonableness and feasibleness of operational noise mitigation and management measures.

The below sections discuss potential options for mitigating and managing operational noise emissions from the site. These measures should be investigated further during detailed design/construction certificate stage of the site, including an assessment of whether the option is feasible and reasonable for the benefit that it provides.

6.5.1 Consideration of Changing Acoustic Environment

When evaluating the noise impacts associated with the proposed site it is important to consider the changing land use of the surrounding environment. The site and nearby sensitive receivers are part of the Broader Western Sydney Employment Area which will be impacted by the following current and future major developments:

- Mamre Road Precinct
- Western Sydney Airport
- Western Sydney Aerotropolis
- Mamre Road Upgrade

The strategic intent under the Mamre Road Precinct is for the land surrounding the site to become a warehousing industrial hub providing around 17,000 new jobs in Western Sydney. The land within the Mamre Road Precinct was rezoned in June 2020 in order to facilitate this intent. The NSW Department of Planning, Industry and Environment (DPIE) document *"Fast-tracked Assessments: Tranche Two"* also notes that several major proponents are seeking to progress with developments for employment uses within the Precinct. The sensitive receivers predicted to be impacted by the site lie within the Mamre Road Precinct rezoning, which would likely result in the eventual redevelopment of these properties for employment uses.

The site is also located within the Australian Noise Exposure Forecast (ANEF) 20 contour for the approved Western Sydney Airport. The ANEF contour indicates areas which may be impacted by aircraft noise and considers existing and future airport developments. The land surrounding the site, including some of the sensitive receivers identified to be impacted by the site, are also impacted by maximum noise levels associated with aircraft flyovers from the operation of the future Western Sydney Airport. This is important to consider when evaluating the sleep disturbance impacts discussed in **Section 6.2**.

The Western Sydney Aerotropolis includes widespread development around the future Western Sydney Airport, developing the area into Sydney's third major business district, providing housing, employment, infrastructure and services throughout the region, including around 200,000 new jobs. The development of the Western Sydney Aerotropolis would likely result in significant changes to the acoustic environment of the area as the existing primarily rural agriculture uses are developed into the proposed major employment hubs.

The Mamre Road Upgrade is a proposed upgrade to the existing Mamre Road between Kerrs Road to the south of the site and the M4 Motorway to the north of the site. The Mamre Road Upgrade would replace the existing two-lane bi-directional road with a multi-lane divided carriageway road that would meet the future traffic demand associated with the Western Sydney Aerotropolis and improve the safety and reliability of the network. The extra traffic capacity that this project provides would likely increase background noise in the vicinity of the site. This is important to consider when evaluating the operational noise impacts discussed in **Section 6.2**.

While operational noise mitigation and management measures are recommended to be investigated further for the site, it is recommended that the changing land use and associated acoustic environment be considered when evaluating the reasonableness and feasibleness of the measures.

6.5.2 Noise Source Control

It should be noted that the predicted operational noise impacts assume peak 15-minute operations would occur concurrently across all lots within the site. Some of the noise source control measures outlined below would occur naturally as the different offices and warehouse across the site would likely have different shift times for their employees and delivery/pickup times for heavy vehicles, however these could be emphasized further through scheduling, if required.

Potential options for mitigating and managing sources of operational noise may include the combination of several measures, such as:

- Reducing peak 15-minute heavy vehicle movements across the site by staggering delivery/pickup times.
- Reducing peak 15-minute light vehicle movements across the site by staggering shift change times for employees.
- Minimising the concurrent use of forklifts and other mobile plant outside the warehouses (ie in the hardstand areas) and/or limiting their use to the less sensitive daytime and evening periods.
- The use of quieter mobile plant options, such as electric forklifts instead of gas-powered forklifts.
- Locating fixed mechanical plant away from the most-affected sensitive receivers, such as ground-level locations instead of rooftop locations, and/or shielded behind the warehouse/office structures.
- The use of quieter fixed mechanical plant options, noting that this assessment assumes an indicative noise level for modelled mechanical plant.
- Best management practice – such as switching vehicles and plant off when not in use, no yelling/swearing/loud music onsite, education of staff and drivers regarding noise impacts, regular maintenance of plant and equipment to minimise noise emissions, use of silent or non-tonal reverse alarms instead of tonal alarms, minimising use of reverse alarms by providing forward manoeuvring where practicable.

Various combinations of source noise control measures were included in the operational noise model to predict indicative potential reductions compared to the noise impacts with no noise mitigation or management measures in place. The indicative results are summarised in **Table 33**.

Table 33 Indicative Noise Level Reduction with Noise Source Controls

NCA	Predicted Reduction in Noise Levels at Affected Receivers (dBA)											
	Scenario 1 – 100% HV, LV, Forklifts, No Mech Plant		Scenario 2 – 100% HV, LV, Mech Plant, No Forklifts		Scenario 3 – 100% HV, LV, No Mech Plant or Forklifts		Scenario 4 – 50% HV, LV, Forklifts, No Mech Plant		Scenario 5 – 50% HV, LV, Mech Plant, No Forklifts		Scenario 6 – 50% HV, LV, No Mech Plant or Forklifts	
	Typical Reduction across NCA	Most-affected Receiver	Typical Reduction across NCA	Most-affected Receiver	Typical Reduction across NCA	Most-affected Receiver	Typical Reduction across NCA	Most-affected Receiver	Typical Reduction across NCA	Most-affected Receiver	Typical Reduction across NCA	Most-affected Receiver
NCA01	1 to 4	1	0 to 3	2	2 to 5	5	3 to 7	3	3 to 6	4	5 to 7	6
NCA02	0 to 2	1	1 to 2	2	2 to 4	4	2 to 4	2	3 to 5	4	5 to 6	5
NCA03	0 to 4	4	1 to 2	1	2 to 9	9	2 to 6	6	3 to 5	4	4 to 11	11
NCA04	0 to 5	0	0 to 4	0	0 to 9	0	0 to 7	1	0 to 6	1	1 to 10	1

Note 1: Scenario 1 has 100% of peak 15-minute heavy vehicle movements, light vehicle movements, and forklift operations. No noise contributions from mechanical plant are included in this scenario.

Note 2: Scenario 2 has 100% of peak 15-minute heavy vehicle movements, light vehicle movements, and mechanical plant. No noise contributions from forklift operations are included in this scenario.

Note 3: Scenario 3 has 100% of peak 15-minute heavy vehicle movements, and light vehicle movements. No noise contributions from mechanical plant or forklift operations are included in this scenario.

Note 4: Scenario 4 has 50% of peak 15-minute heavy vehicle movements, light vehicle movements, and forklift operations. No noise contributions from mechanical plant are included in this scenario.

Note 5: Scenario 5 has 50% of peak 15-minute heavy vehicle movements, light vehicle movements, and mechanical plant. No noise contributions from forklift operations are included in this scenario.

Note 6: Scenario 6 has 50% of peak 15-minute heavy vehicle movements, and light vehicle movements. No noise contributions from mechanical plant or forklift operations are included in this scenario.

Note 7: The above results present the lowest reductions under standard weather conditions or noise-enhancing weather conditions.

Table 33 shows that reductions in noise impacts can be achieved with a combination of noise source controls. As noted above, the predictions presented in **Section 6.2** represent concurrent peak 15 minute operations occurring across all lots, which in reality is unlikely to occur and as such, it would be expected that the reductions presented in **Table 33** would occur naturally and without scheduling requirements. Mechanical plant may be designed through judicious selection of equipment and installation of silencers or shielding so that it provides minimal contribution to the overall noise levels at the affected receivers.

Depending on the field of view to the site of the most affected receivers, the changes in operations (Scenarios 1 to 6 in **Table 33**) result in varying reductions to the overall noise level, depending on the influence of different noise sources at each receiver. Other mitigation and management measures discussed below may be suitable for receivers where minimal benefits from noise source controls are predicted.

6.5.3 Noise Path Control

Noise path control is typically in the form of noise barriers and/or noise mounds. Barriers and mounds work best when located close to the noise source or close to the receiver.

As the receivers surrounding the site are generally isolated residences on large private lots, construction of noise barriers or mounds close to receivers would be unlikely to be feasible.

Noise barriers of varying heights were modelled around the site, generally either on the site boundary or adjacent to the access roads (where the roads are closest to the boundary). The reduction of operational noise impacts based on a 5 m high barrier at potentially feasible locations around the site is shown in **Table 34**.

Table 34 Indicative Noise Level Reduction with 5 m Noise Barriers Around Site Boundary

NCA	Predicted Potential Reduction in Noise Levels at Affected Receivers (dBA)			
	Standard Weather Conditions		Noise-Enhancing Weather Conditions	
	Typical Reduction	Reduction at the Most-affected Receiver	Typical Reduction	Reduction at the Most-affected Receiver
NCA01	1 to 5	4	1 to 4	4
NCA02	1 to 3	2	1 to 2	1
NCA03	0 to 1	0	0 to 1	0
NCA04	0 to 11	1	0 to 10	1

Table 34 shows that reductions in noise levels were predicted at some receivers adjacent to noise barriers, however, the assessed noise barriers were generally not effective at mitigating noise impacts at the most-affected receivers. This is generally due to restrictions in the location of the noise barrier (such as near the main site access road where a barrier could not be constructed across the roadway) or due to the height difference between the receiver locations and the noise sources (such as NCA02 and NCA03 where the receivers are much higher than the site and a noise barrier would provide insufficient screening).

As such, noise barriers or mounds are not considered reasonable and feasible to mitigate noise impacts from the site and are not considered further.

6.5.4 At-Receiver Control

At-receiver mitigation measures can be utilised to reduce noise impacts where residual noise impacts are present after implementation of feasible and reasonable noise source and path controls, or where those controls are not considered to be feasible and reasonable.

At-receiver mitigation typically involves using architectural treatments such as thicker glazing and doors or upgraded facade constructions to achieve appropriate internal noise levels. Architectural treatments are more effective when they are applied to masonry buildings than lightly clad timber frames structures, and caution should be taken before providing treatments to buildings in a poor state as they may not be effective.

Architectural treatments are typically limited to:

- Fresh air ventilation systems that meet the Building Code of Australia requirements with the windows and doors shut
- Upgraded windows and glazing and solid core doors on the exposed facades of the substantial structures only (eg masonry or insulated weather board cladding with sealed underfloor)
- Upgrading window or door seals and appropriately treating sub-floor ventilation
- The sealing of wall vents
- The sealing of the underfloor below the bearers and appropriately treating sub-floors ventilation
- Roof insulation
- The sealing of eaves.

Alternative at-receiver mitigation can include:

- The installation of acoustic screen walls that break line-of-sight between the affected facade window and the noise sources where they are feasible and reasonable and are preferred by the owner. This option can also minimise noise impacts on outdoor areas of the receiver property, such as laws and courtyards.

Identification of residual noise impacts and receivers eligible for consideration of at-receiver noise treatments would be undertaken during the detailed design/construction certificate stage after consideration of any noise source and path mitigation and management measures.

Due to the large number of variables such as existing facade construction, orientation of the building, where habitable spaces are situated within the building, and owner preferences, the type of treatment cannot be determined until an at-property treatment inspection has been completed.

The identification of eligible receivers and suitable at-property treatments will be determined during the detailed design/construction certificate stage of the project.

7 Conclusion

Assessment of potential noise and vibration impacts has been undertaken for the proposed Aspect Industrial Estate.

Construction works associated with the project are predicted to result in high impacts when peak works activities are undertaken in close proximity to the nearest sensitive receivers. Quieter works and works further from the nearest receivers would result in reduced impacts. Feasible and reasonable noise and vibration mitigation and management measures should be implemented to minimise impacts during construction of the site.

Operational noise impacts are predicted at the nearest residential receivers in all NCAs under both standard and noise-enhancing weather conditions for the Masterplan site. Impacts for the Stage 1 site are generally lower than those of the Masterplan site. Night-time maximum noise levels are predicted to be above the sleep disturbance screening level at the surrounding residences, however residences near to Mamre Road experience existing noise levels similar or higher than the predicted emissions.

When evaluating the noise impacts associated with the proposed site it is important to consider the changing land use of the surrounding environment, which is part of the Mamre Road Precinct and the Broader Western Sydney Employment Area. Other major projects in the vicinity of the site include the Western Sydney Airport, the Western Sydney Aerotropolis and the Mamre Road Upgrade. The sensitive receivers predicted to be impacted by the site lie within the Mamre Road Precinct rezoning, which would likely result in the eventual redevelopment of these properties for employment uses.

While operational noise mitigation and management measures are recommended to be investigated further for the site, it is recommended that the changing land use and associated acoustic environment be considered when evaluating the reasonableness and feasibleness of the measures. Mitigation and management measures, including at-property treatments if required, will be determined during the detailed design/construction certificate stage of the project.

APPENDIX A

Acoustic Terminology

1. Sound Level or Noise Level

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

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

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

2. 'A' Weighted Sound Pressure Level

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

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

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

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

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

3. Sound Power Level

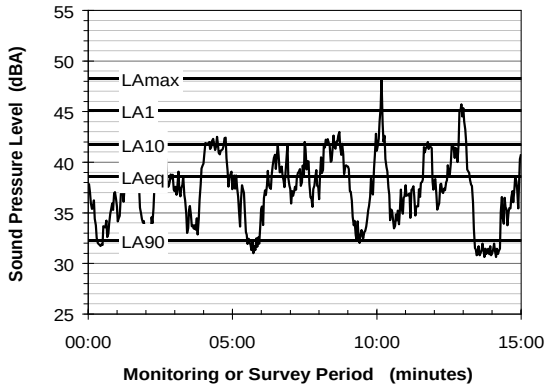
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

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

4. Statistical Noise Levels

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

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



Of particular relevance, are:

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

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

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

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

5. Frequency Analysis

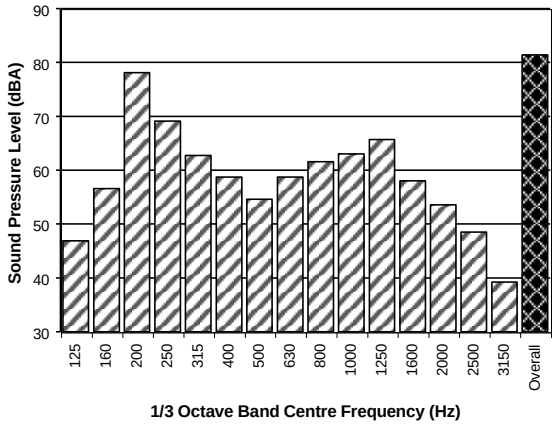
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

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

Frequency analysis can be in:

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

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



6. Annoying Noise (Special Audible Characteristics)

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

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

7. Vibration

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

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

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

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

8. Human Perception of Vibration

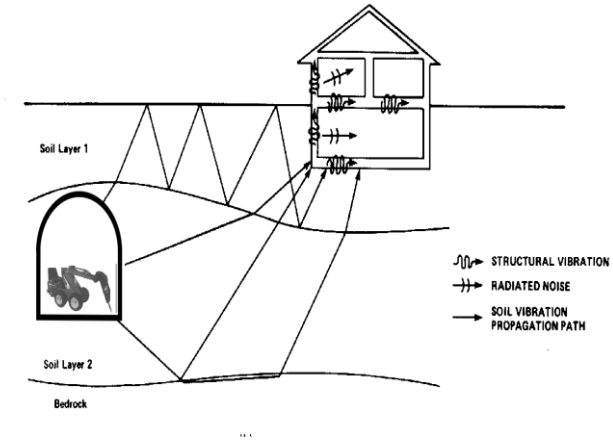
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience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

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

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

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

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



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

APPENDIX B

Noise Monitoring Results

Noise Monitoring Location	L01	Map of Noise Monitoring Location
Noise Monitoring Address	**Lot 58 DP259135 - Northern Site Boundary**	

Logger Device Type: Svantek 957, Logger Serial No: 20644
Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3004636

Ambient noise logger deployed in an open area at the northern site boundary, approximately 230 m from Mamre Road.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from Mamre Road to the west, and at times, an agricultural pump near the dam to the southeast. Aircraft, birds and insects also contribute to the LAeq at this location.

Recorded Noise Levels (LAmax):
15/11/2019: Light-vehicle traffic Mamre Road: 45-50 dBA, Heavy-vehicle traffic Mamre Road: 50-53 dBA, Agricultural pump: 42 dBA, Aircraft: 45-50 dBA, Birds: 51-65 dBA

Ambient Noise Logging Results – NPfI Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L_{10}	L_1
Daytime	39	50	49	56
Evening	39	49	49	55
Night-time	32	50	50	55

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	49	52
Night-time (10pm-7am)	50	53

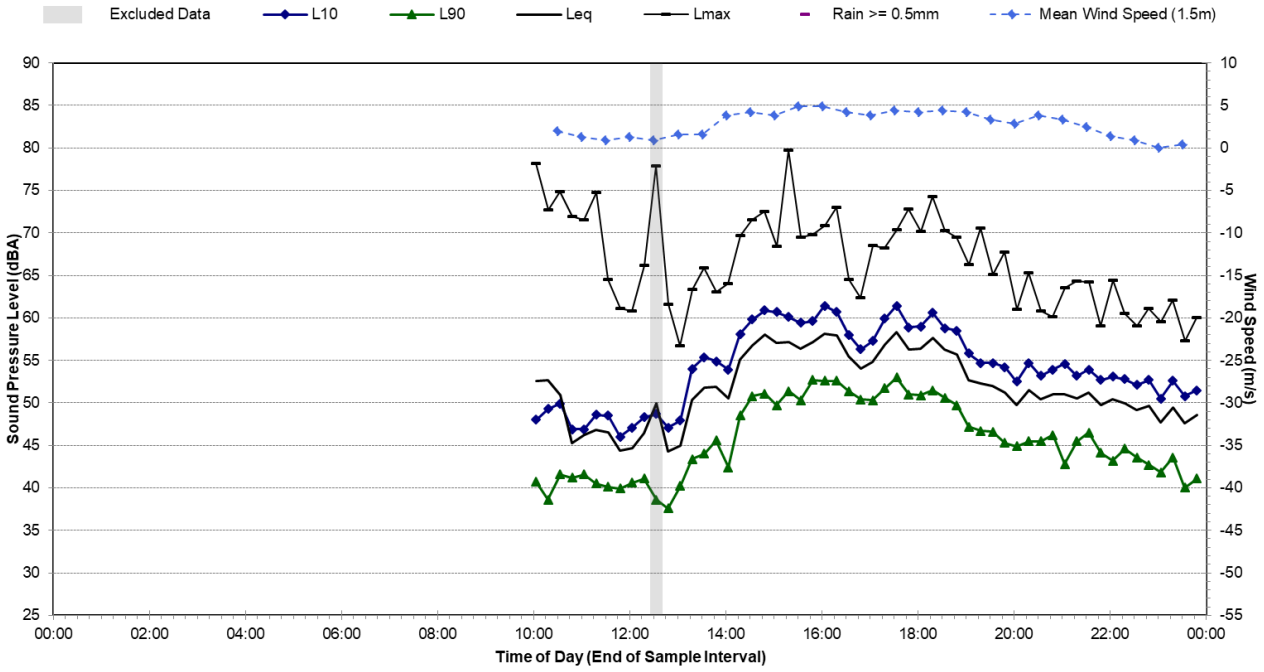
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
15/11/2019	9:44 am	42	46	65

Photo of Noise Monitoring Location

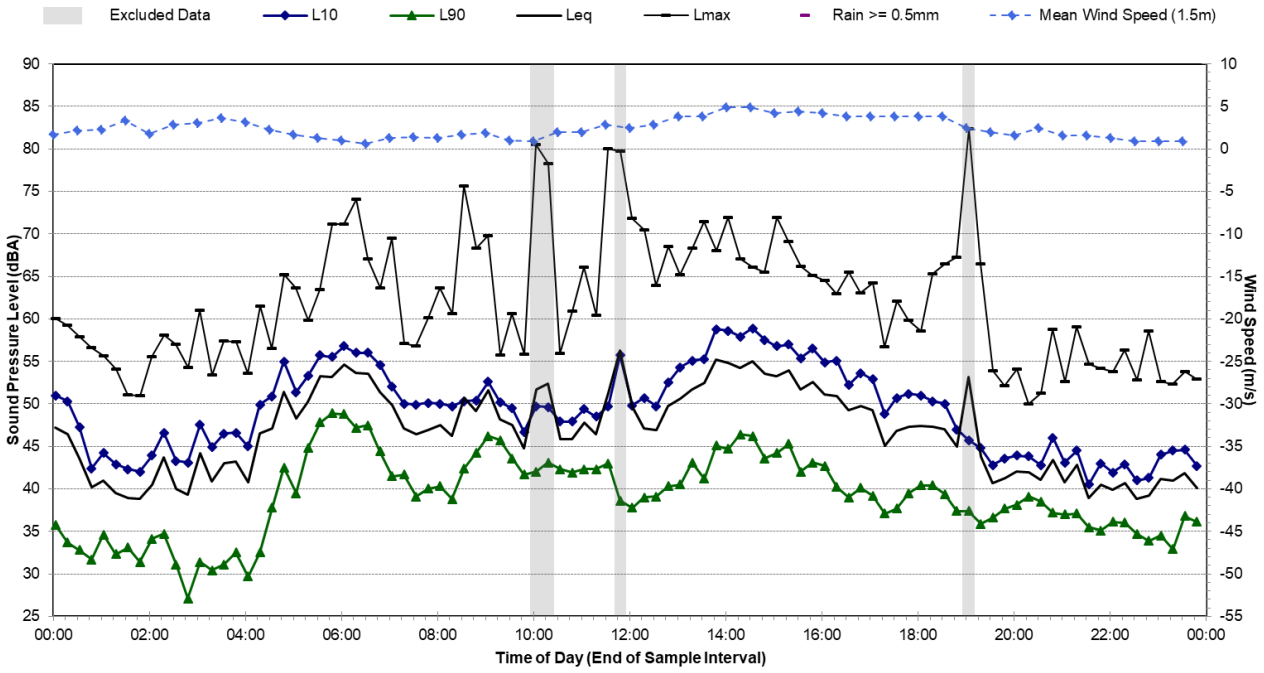
Statistical Ambient Noise Levels

L.01 - Lot 58 DP259135 - Northern Site Boundary - Friday, 15 November 2019



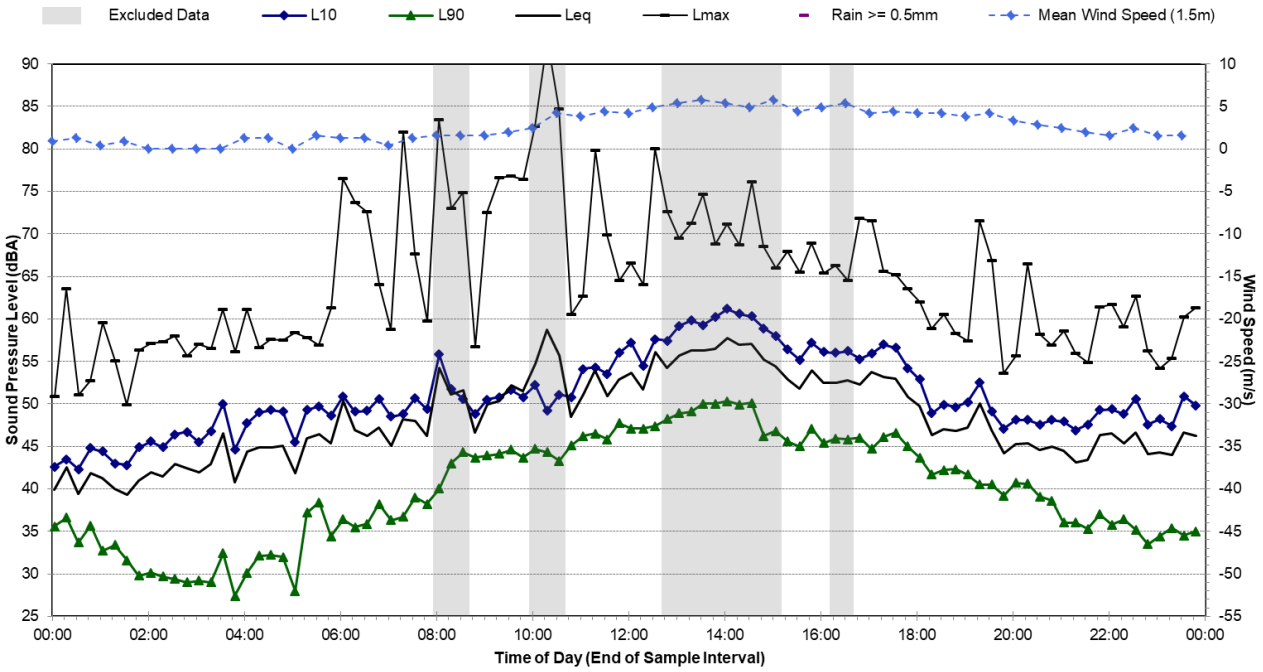
Statistical Ambient Noise Levels

L.01 - Lot 58 DP259135 - Northern Site Boundary - Saturday, 16 November 2019



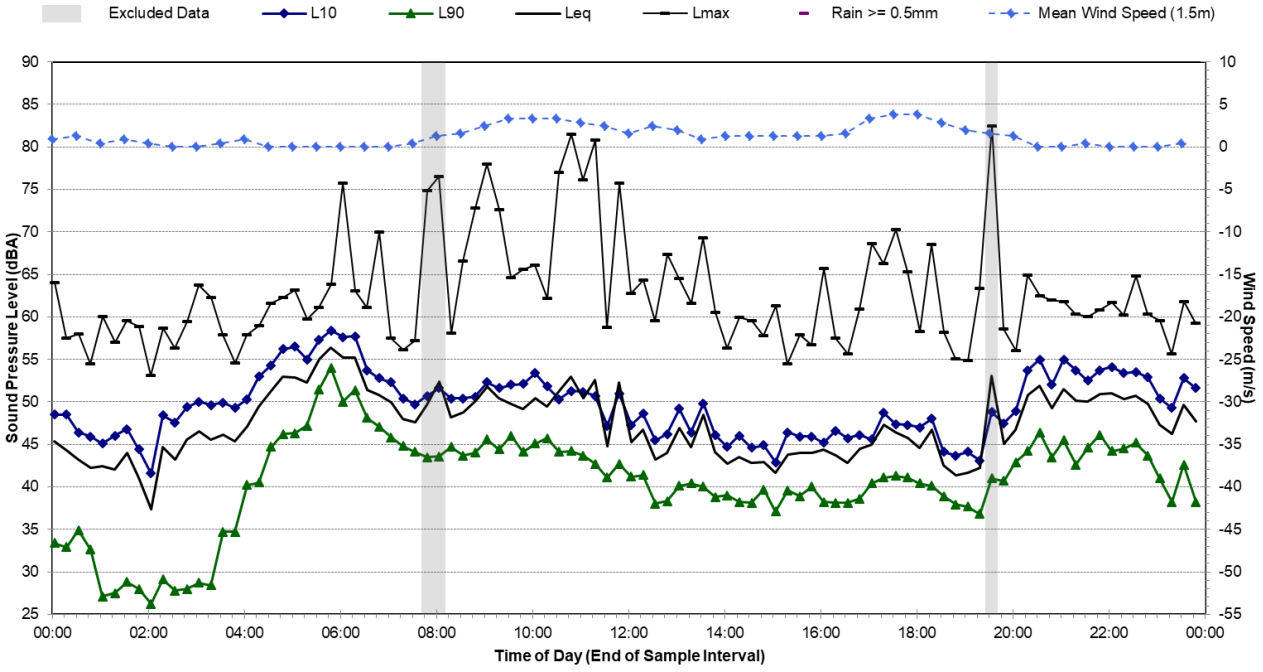
Statistical Ambient Noise Levels

L.01 - Lot 58 DP259135 - Northern Site Boundary - Sunday, 17 November 2019



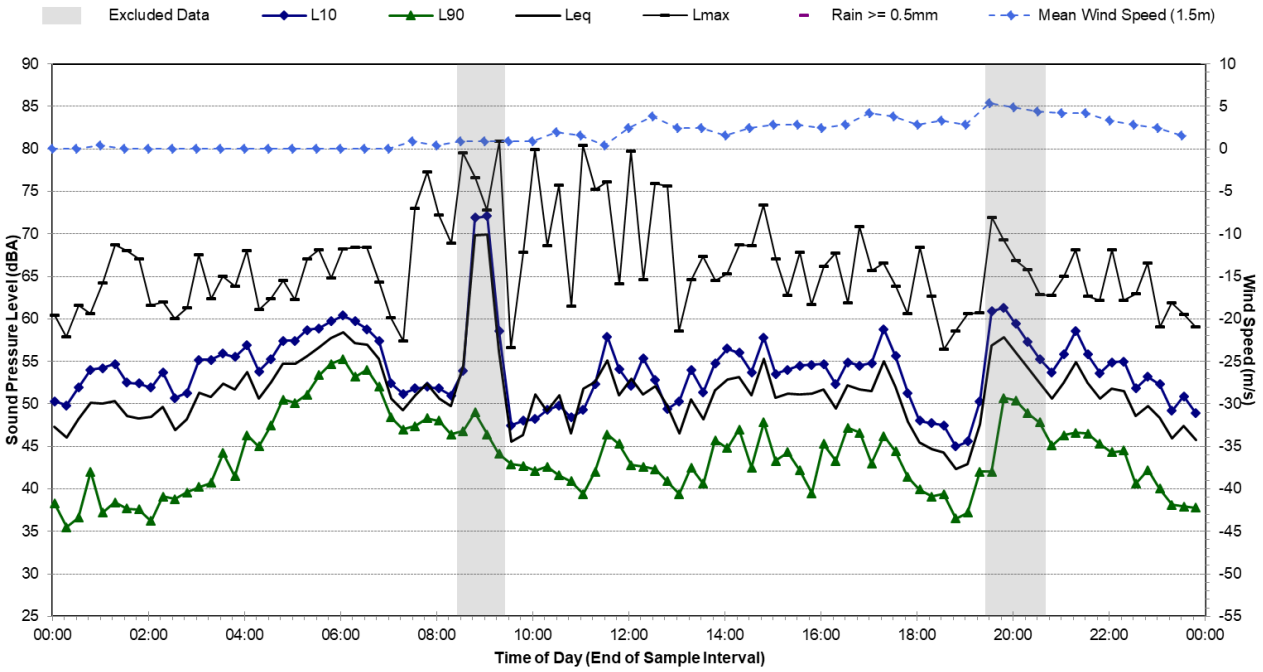
Statistical Ambient Noise Levels

L.01 - Lot 58 DP259135 - Northern Site Boundary - Monday, 18 November 2019



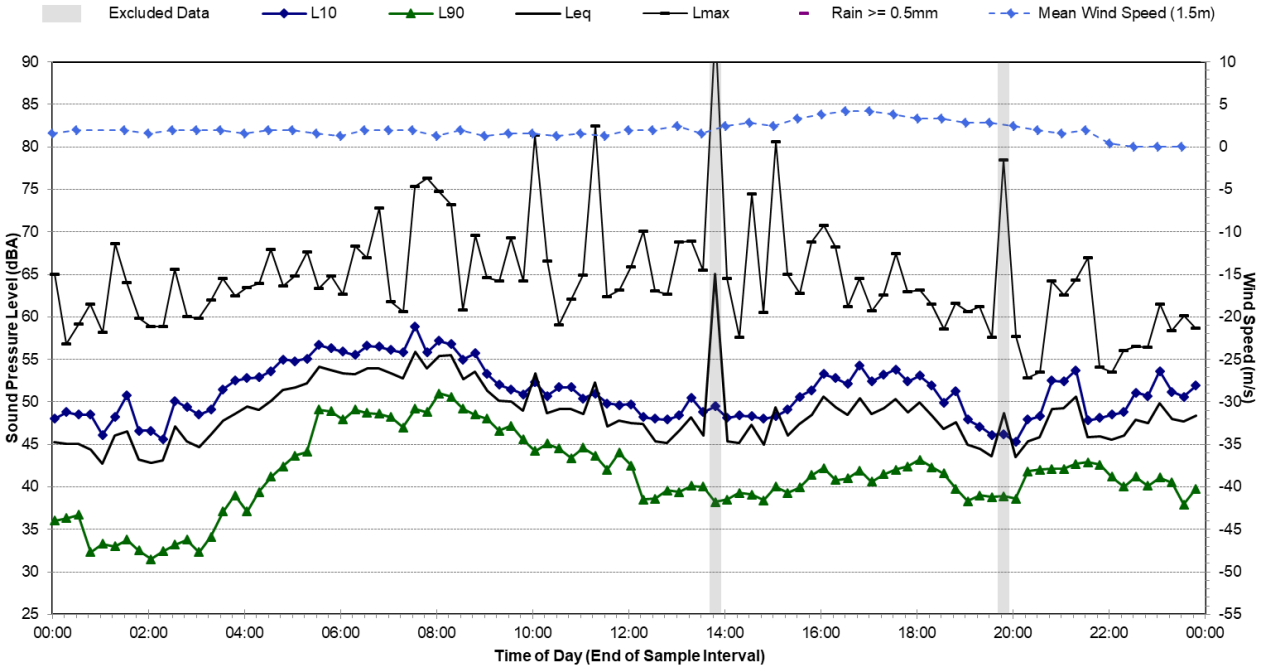
Statistical Ambient Noise Levels

L.01 - Lot 58 DP259135 - Northern Site Boundary - Tuesday, 19 November 2019



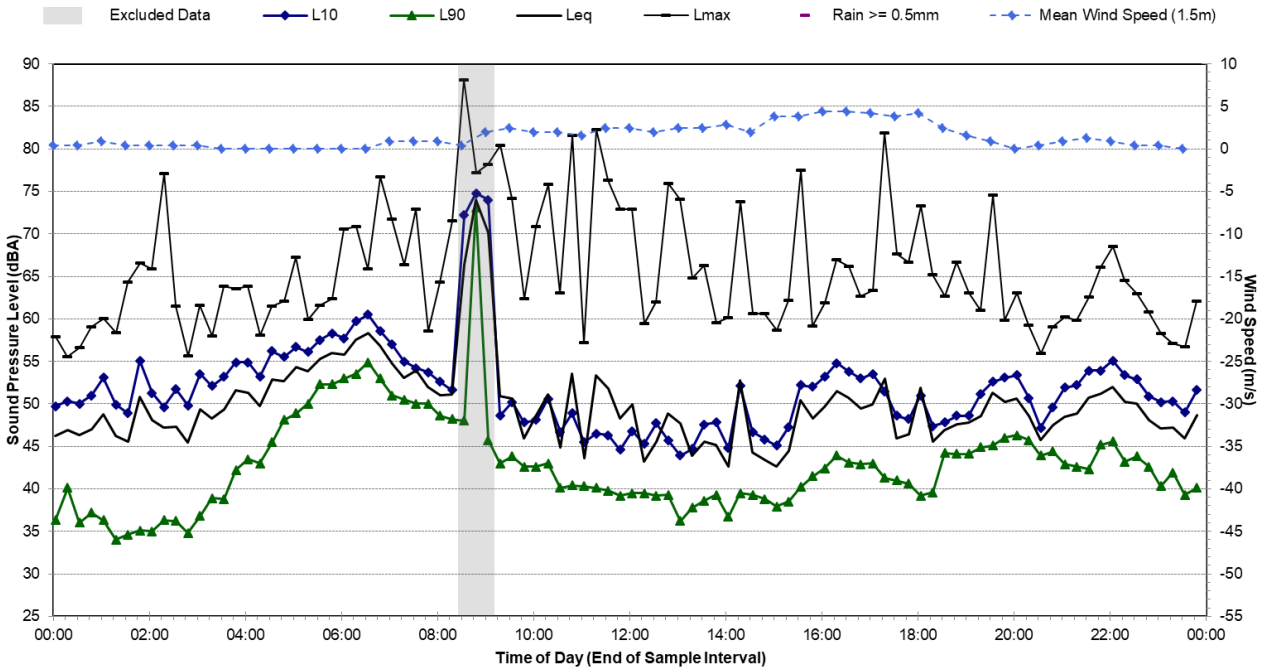
Statistical Ambient Noise Levels

L.01 - Lot 58 DP259135 - Northern Site Boundary - Wednesday, 20 November 2019



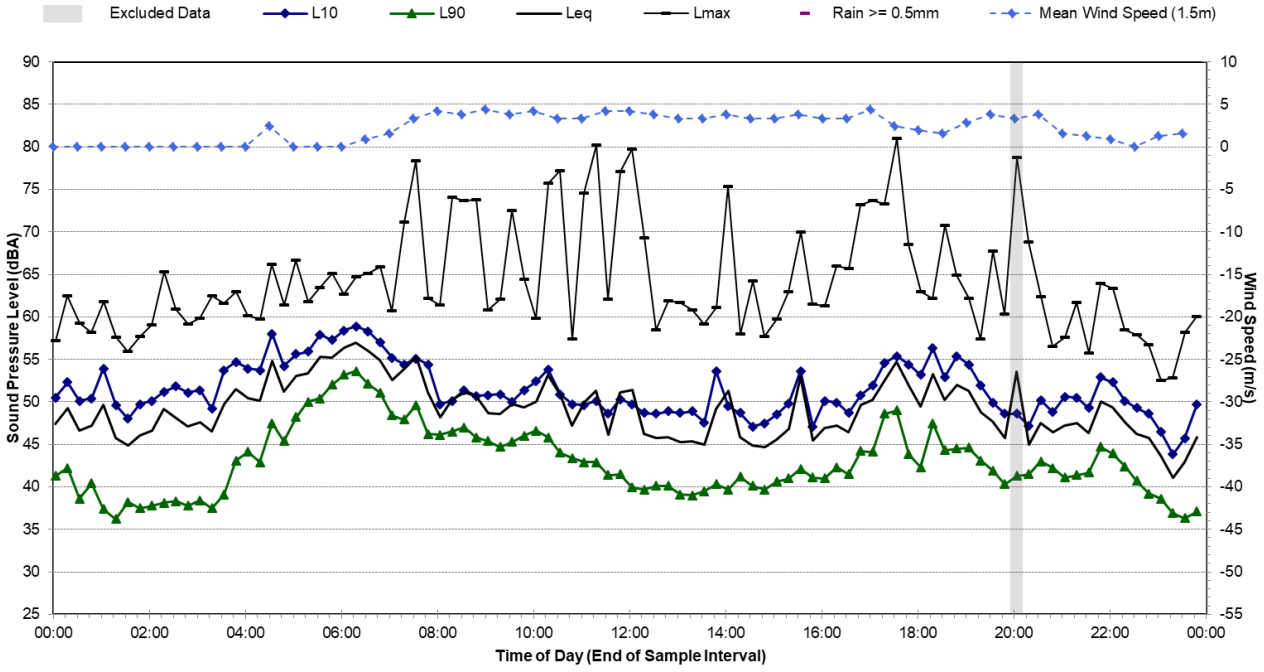
Statistical Ambient Noise Levels

L.01 - Lot 58 DP259135 - Northern Site Boundary - Thursday, 21 November 2019



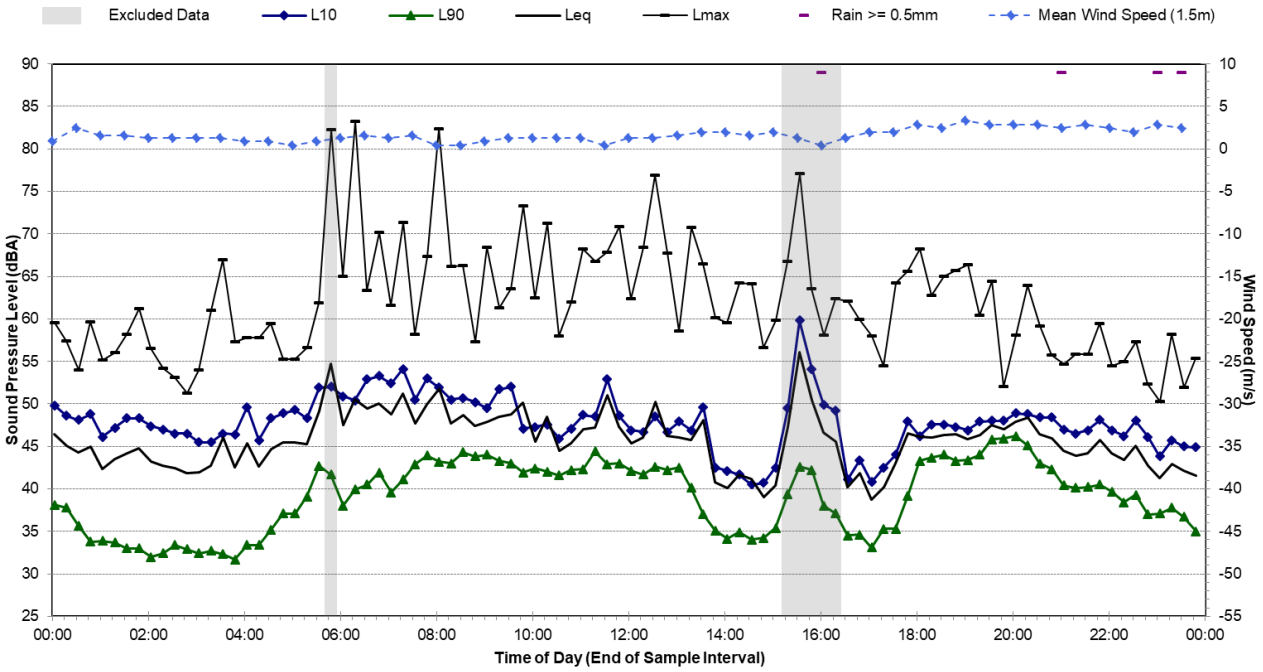
Statistical Ambient Noise Levels

L.01 - Lot 58 DP259135 - Northern Site Boundary - Friday, 22 November 2019



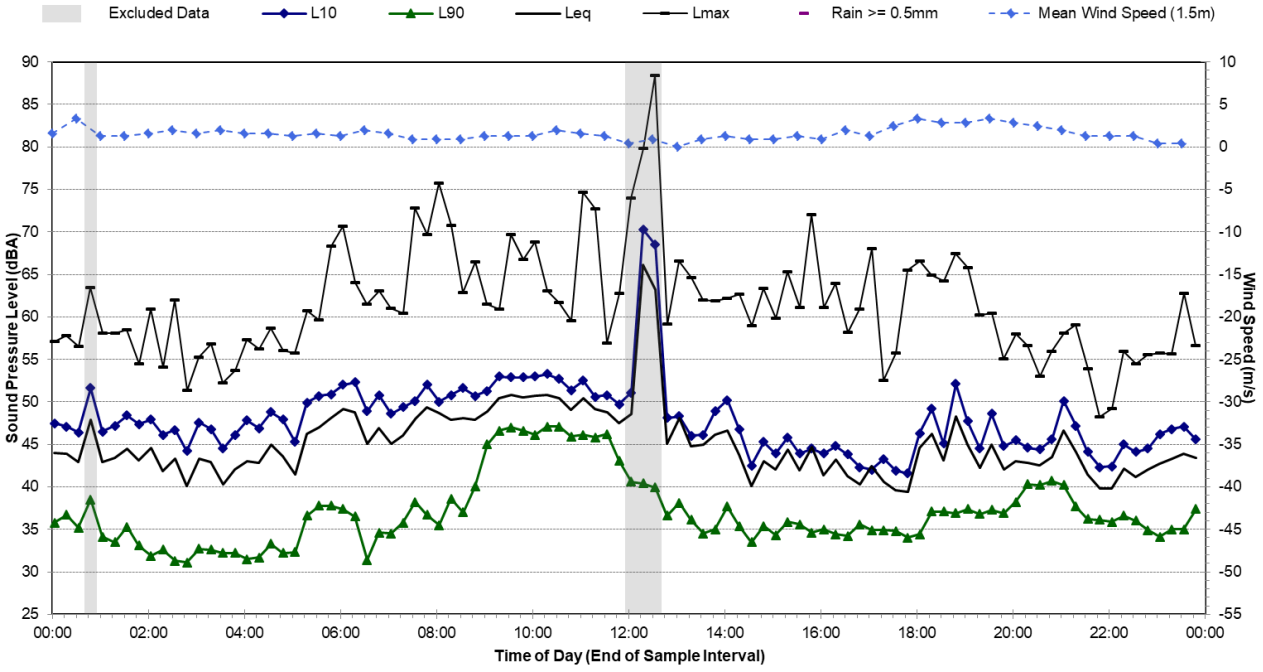
Statistical Ambient Noise Levels

L.01 - Lot 58 DP259135 - Northern Site Boundary - Saturday, 23 November 2019



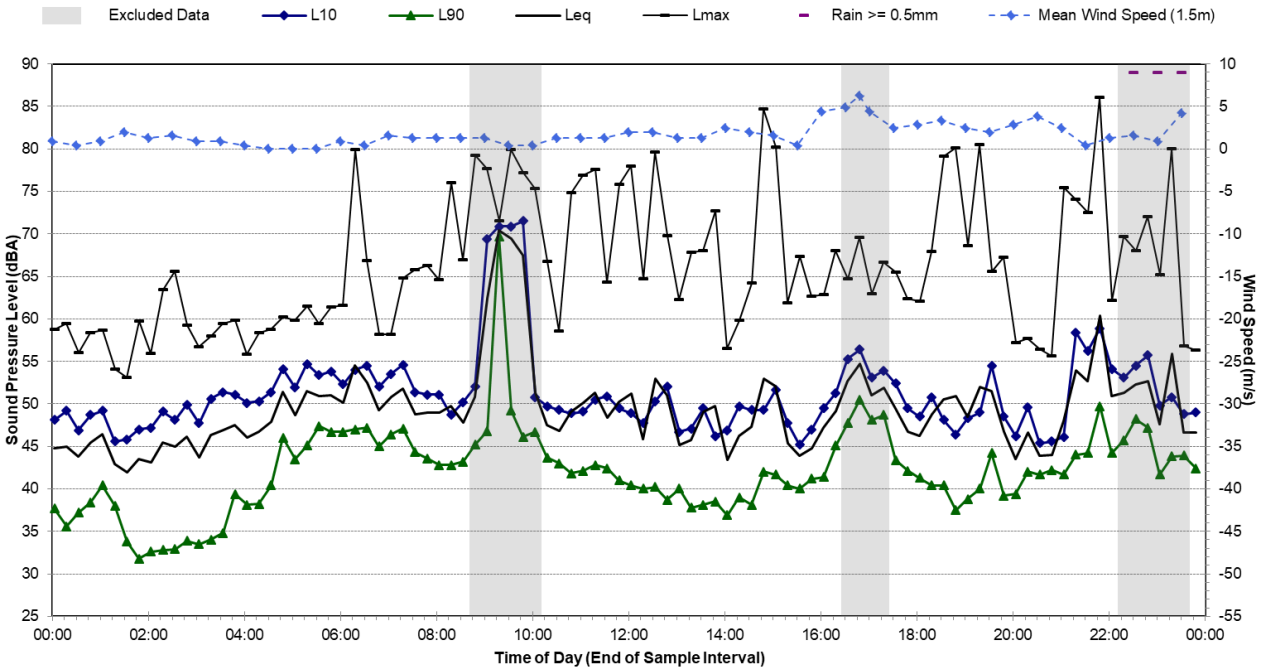
Statistical Ambient Noise Levels

L.01 - Lot 58 DP259135 - Northern Site Boundary - Sunday, 24 November 2019



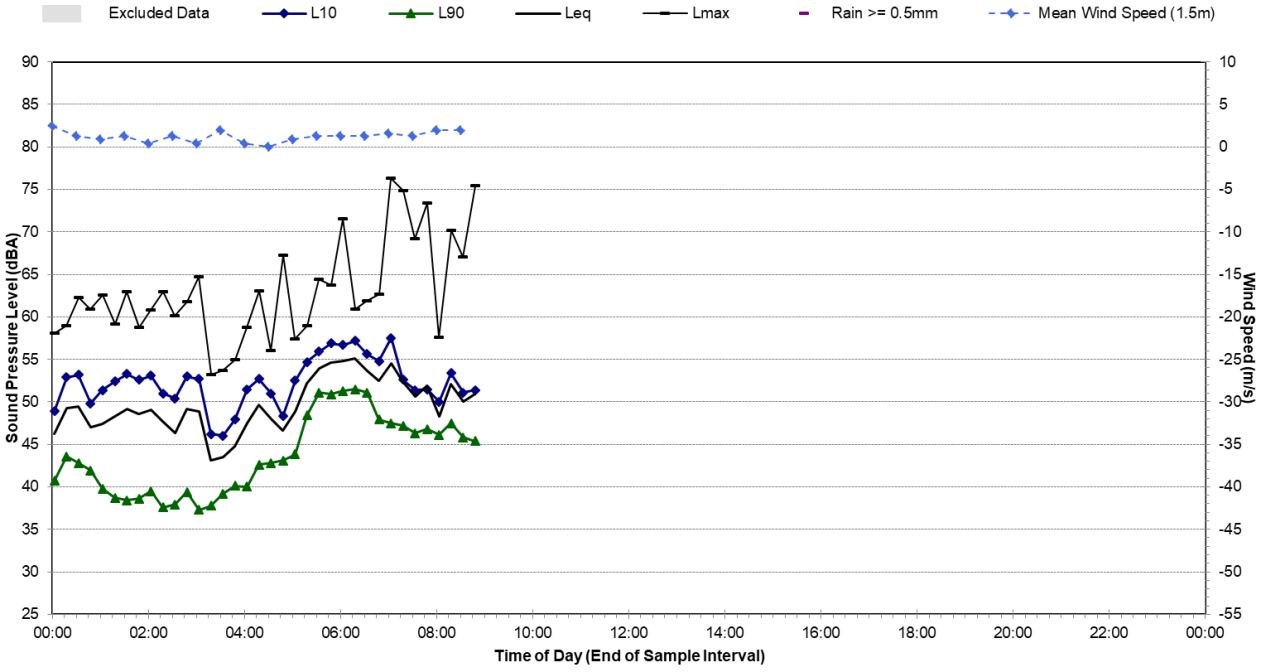
Statistical Ambient Noise Levels

L.01 - Lot 58 DP259135 - Northern Site Boundary - Monday, 25 November 2019



Statistical Ambient Noise Levels

L.01 - Lot 58 DP259135 - Northern Site Boundary - Tuesday, 26 November 2019



Noise Monitoring Location	L02	Map of Noise Monitoring Location
Noise Monitoring Address	**Lot 58 DP259135 – Northeastern Site Boundary**	

Logger Device Type: Svantek 957, Logger Serial No: 23815
Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3004636

Ambient noise logger deployed in an open area at the northeastern site boundary, approximately 600 m from Mamre Road.

Attended noise measurements indicate the ambient noise environment at this location is dominated by distant road traffic noise from Mamre Road to the west, insects, and at times, an agricultural pump near the dam to the west. Aircraft and birds also contribute to the LAeq at this location.

Recorded Noise Levels (LAmax):
15/11/2019: Distant traffic Mamre Road: 35 dBA, Heavy-vehicle traffic Mamre Road: 35-42 dBA, Agricultural pump: 34 dBA, Aircraft: 43-56 dBA, Birds: 54-58 dBA

Ambient Noise Logging Results – NPfI Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L_{10}	L_1
Daytime	35	43	44	51
Evening	33	42	43	49
Night-time	32	43	43	48

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	43	46
Night-time (10pm-7am)	43	50

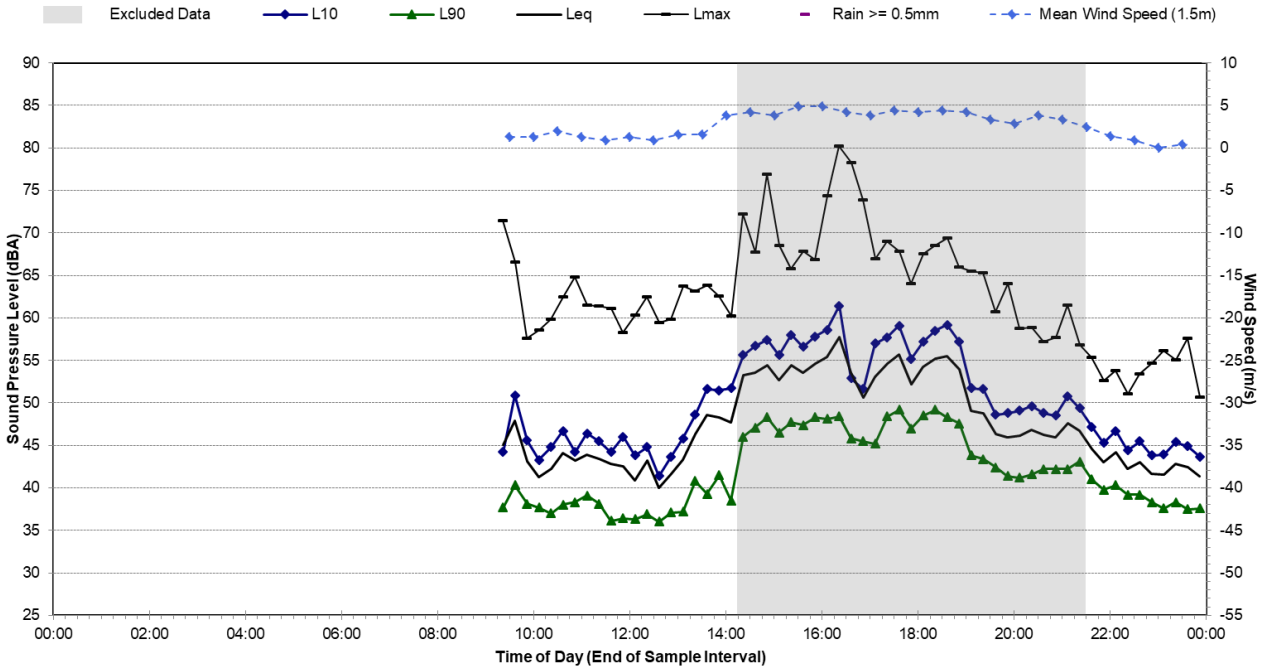
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
15/11/2019	9:06 am	35	42	58

Photo of Noise Monitoring Location

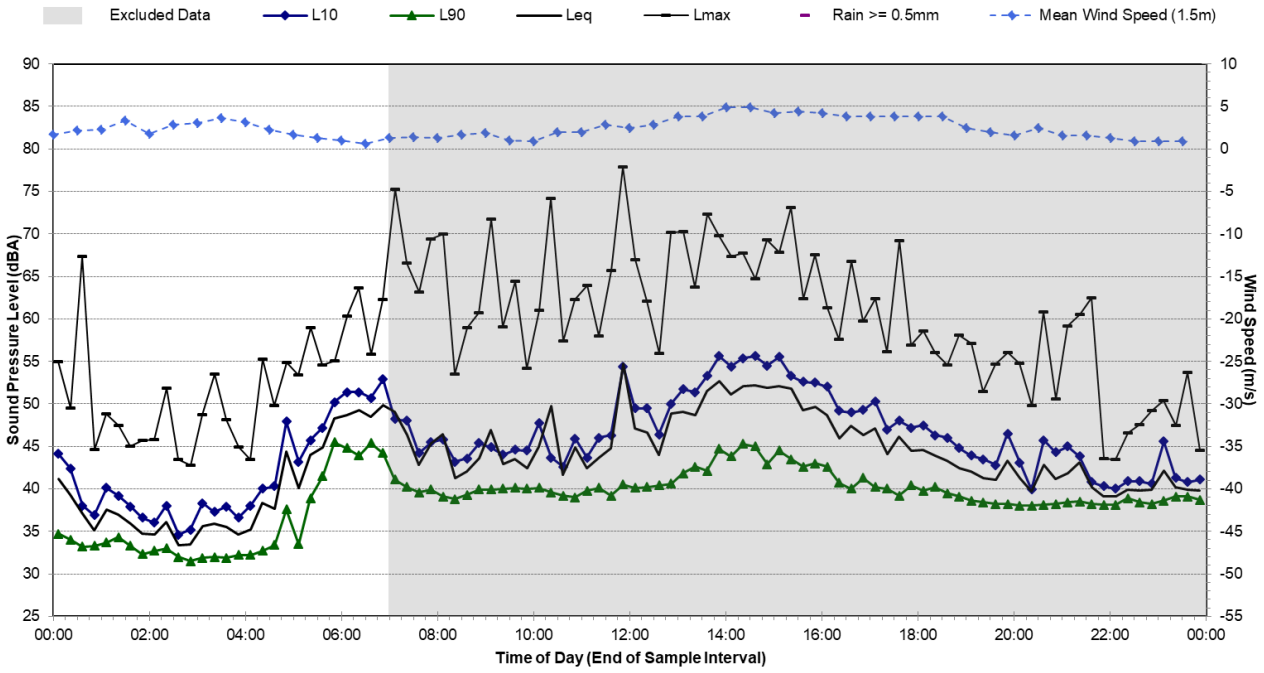
Statistical Ambient Noise Levels

L.02 - Lot 58 DP259135 – Northeastern Site Boundary - Friday, 15 November 2019



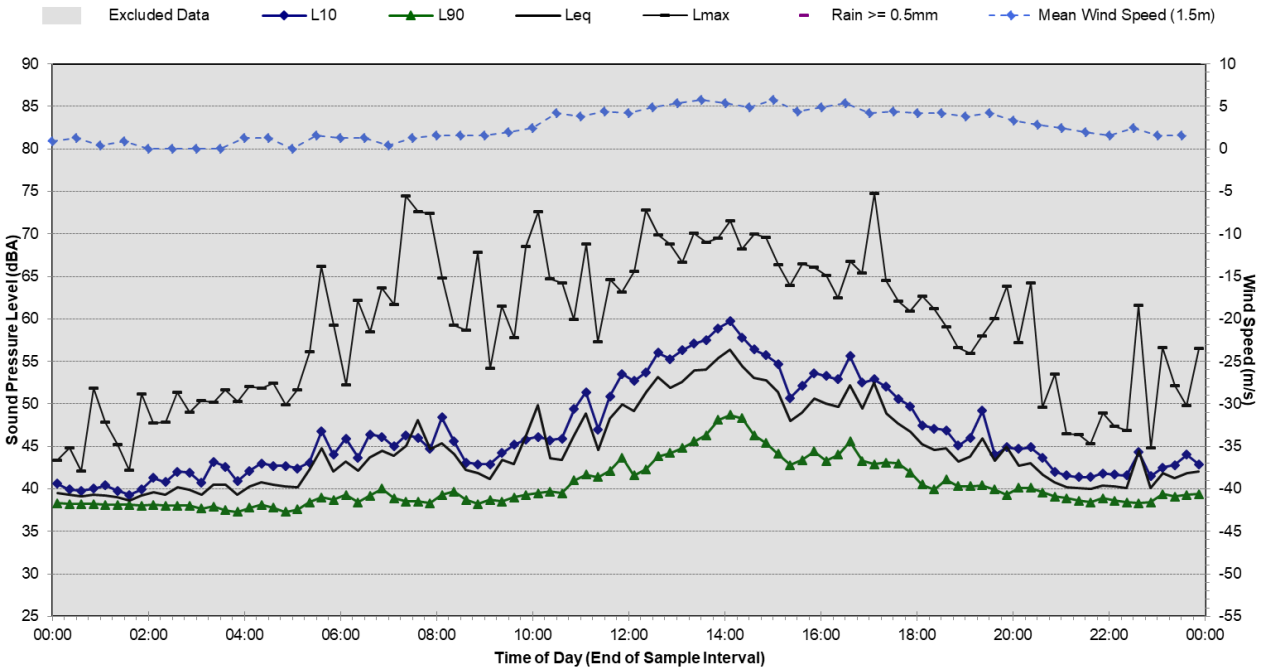
Statistical Ambient Noise Levels

L.02 - Lot 58 DP259135 – Northeastern Site Boundary - Saturday, 16 November 2019



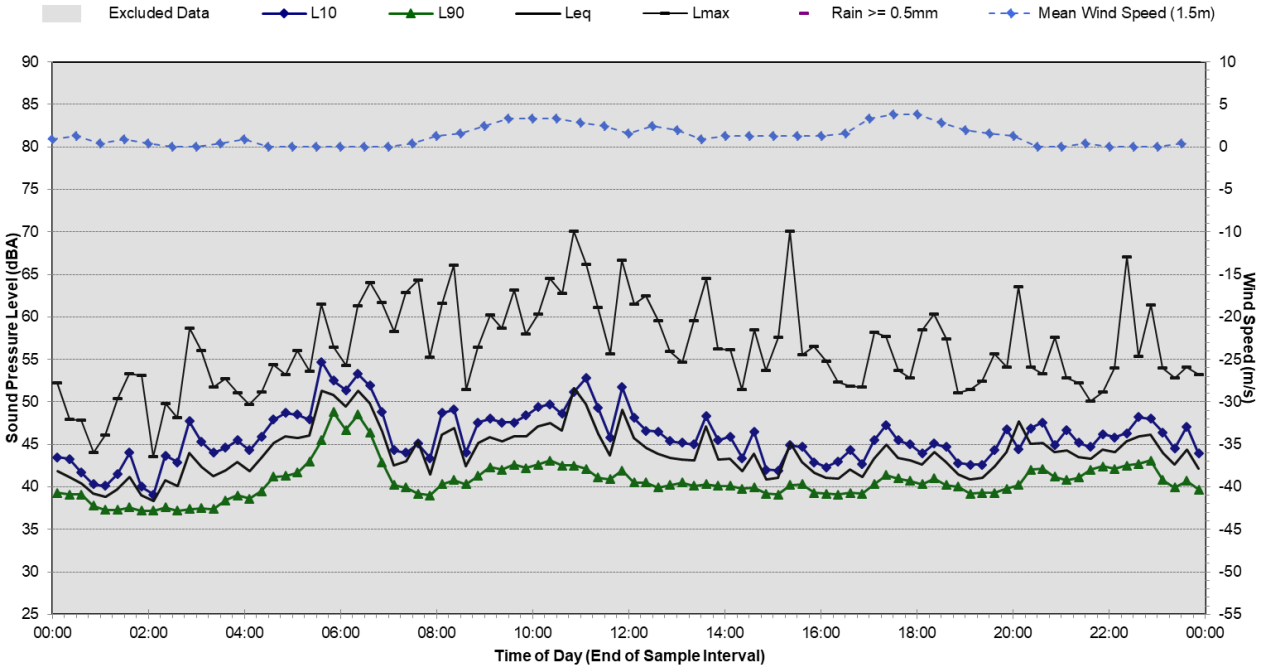
Statistical Ambient Noise Levels

L.02 - Lot 58 DP259135 – Northeastern Site Boundary - Sunday, 17 November 2019



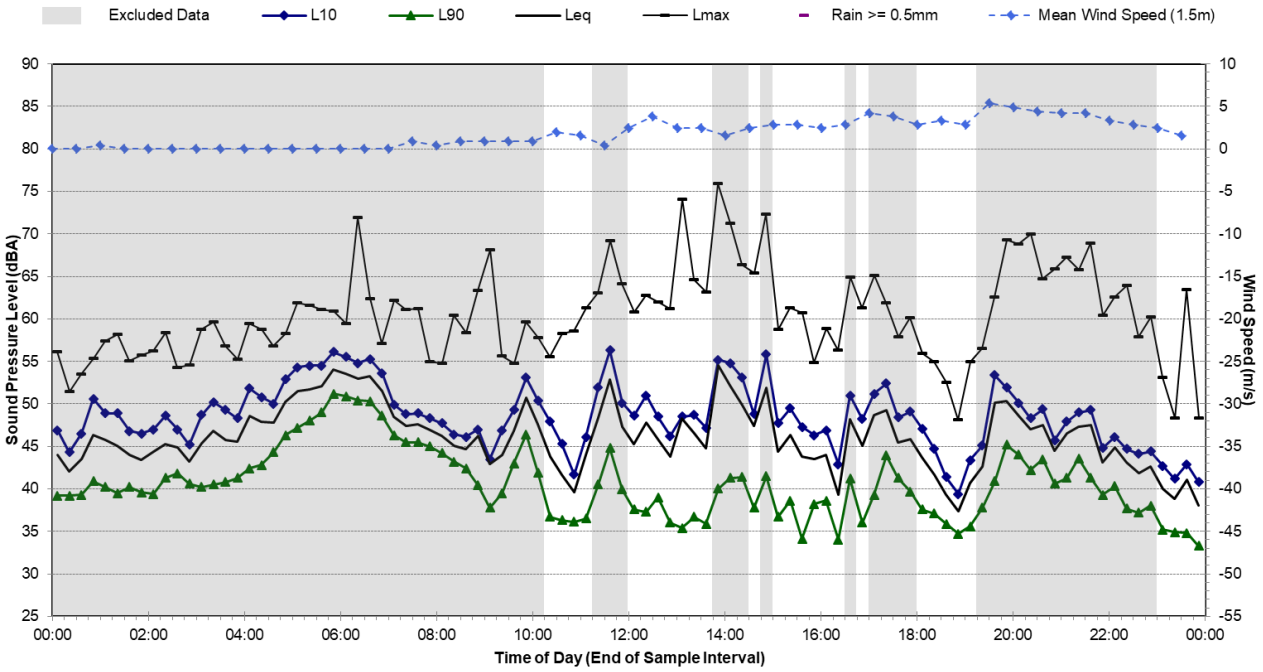
Statistical Ambient Noise Levels

L.02 - Lot 58 DP259135 – Northeastern Site Boundary - Monday, 18 November 2019



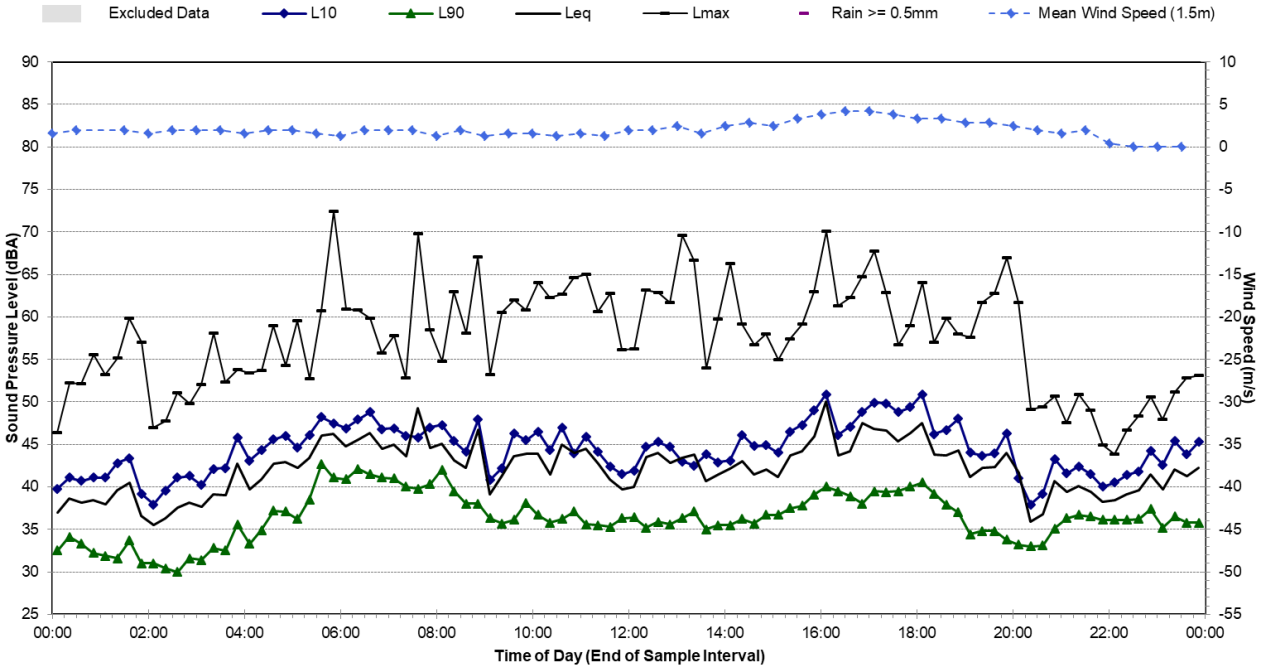
Statistical Ambient Noise Levels

L.02 - Lot 58 DP259135 – Northeastern Site Boundary - Tuesday, 19 November 2019



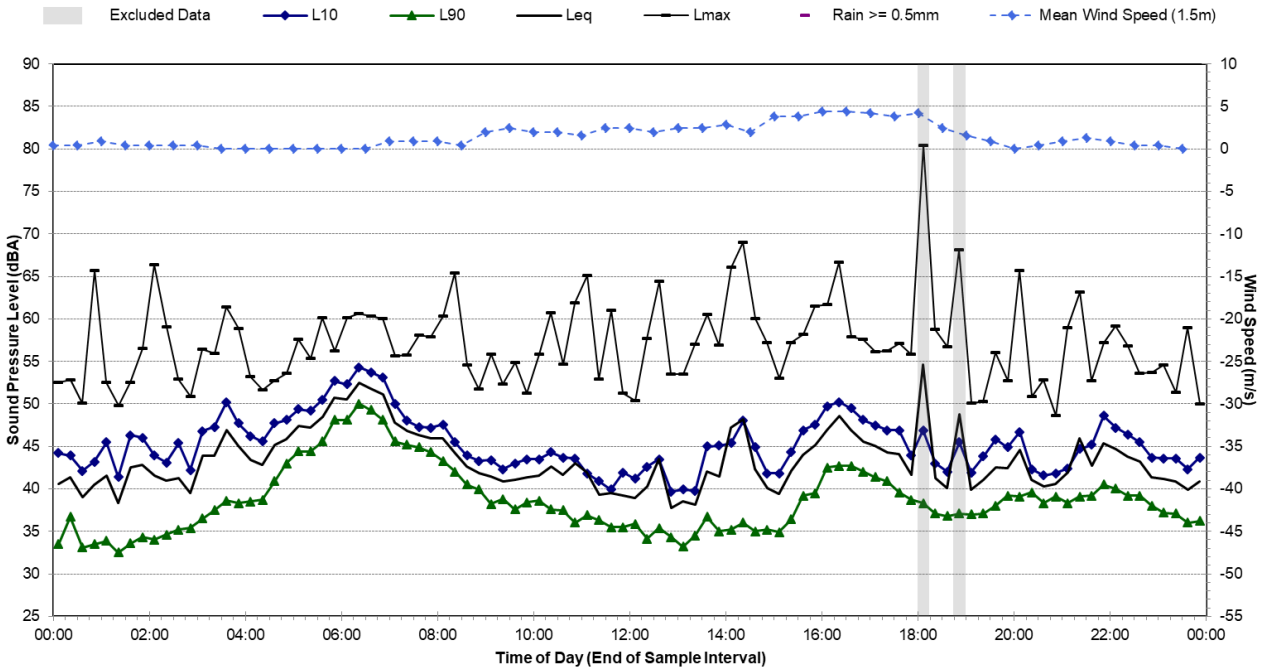
Statistical Ambient Noise Levels

L.02 - Lot 58 DP259135 – Northeastern Site Boundary - Wednesday, 20 November 2019



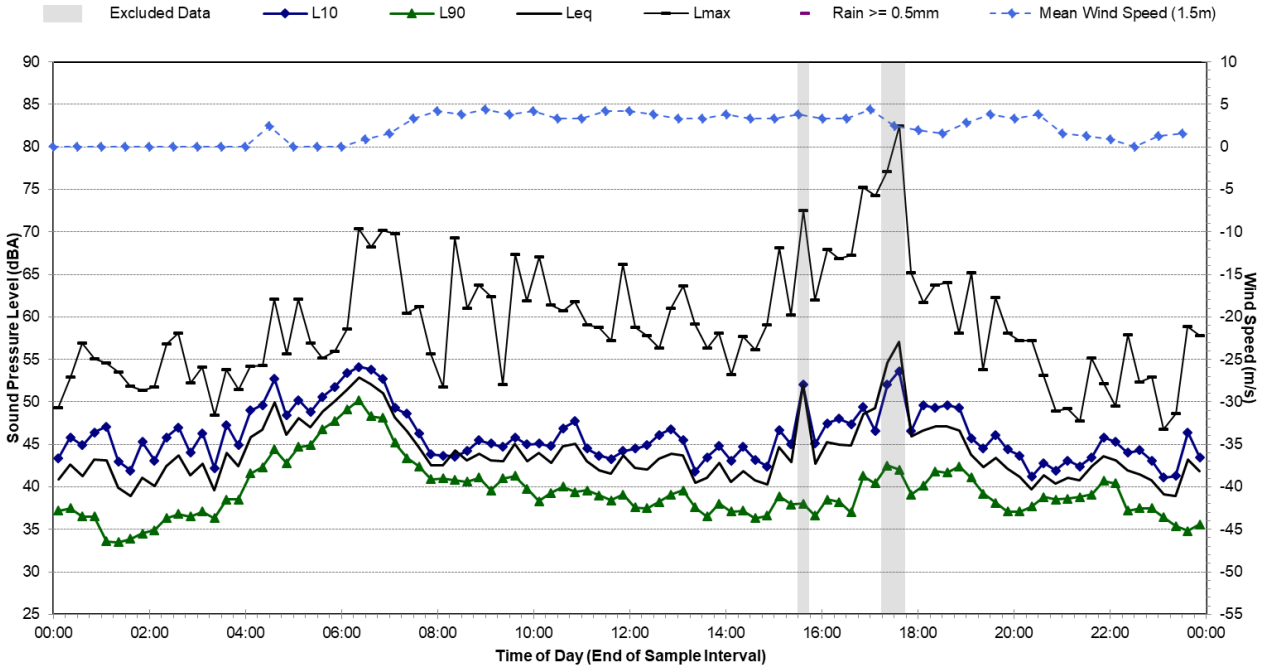
Statistical Ambient Noise Levels

L.02 - Lot 58 DP259135 – Northeastern Site Boundary - Thursday, 21 November 2019



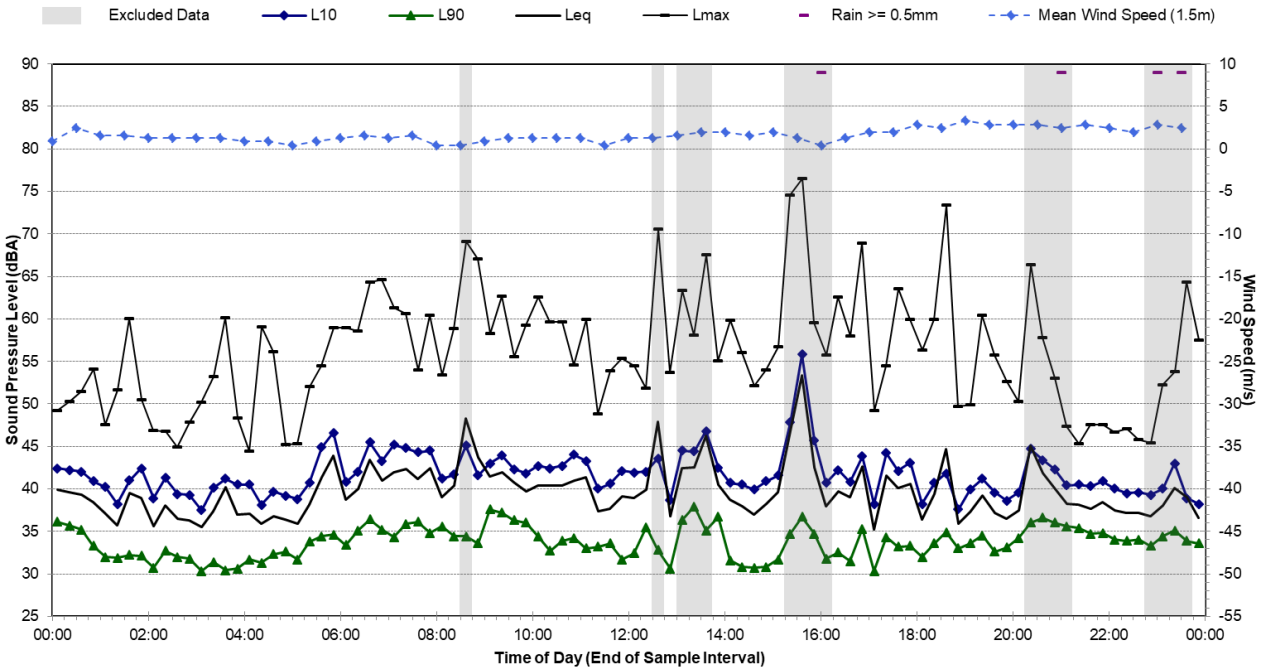
Statistical Ambient Noise Levels

L.02 - Lot 58 DP259135 – Northeastern Site Boundary - Friday, 22 November 2019



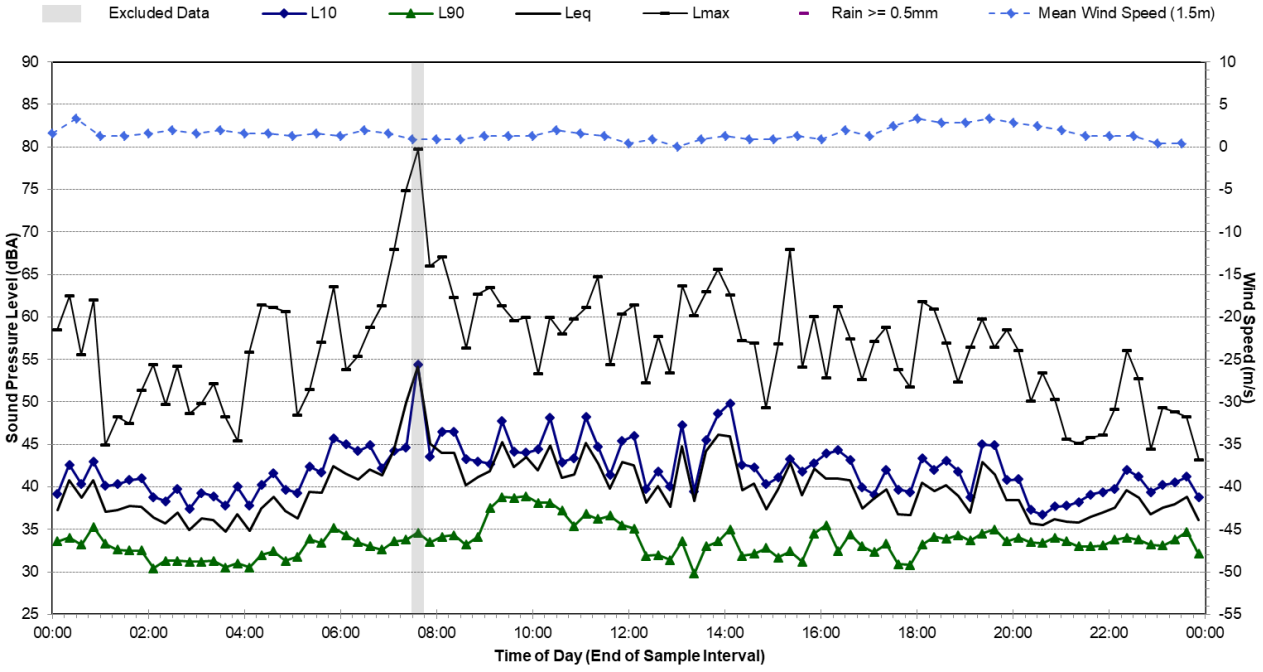
Statistical Ambient Noise Levels

L.02 - Lot 58 DP259135 – Northeastern Site Boundary - Saturday, 23 November 2019



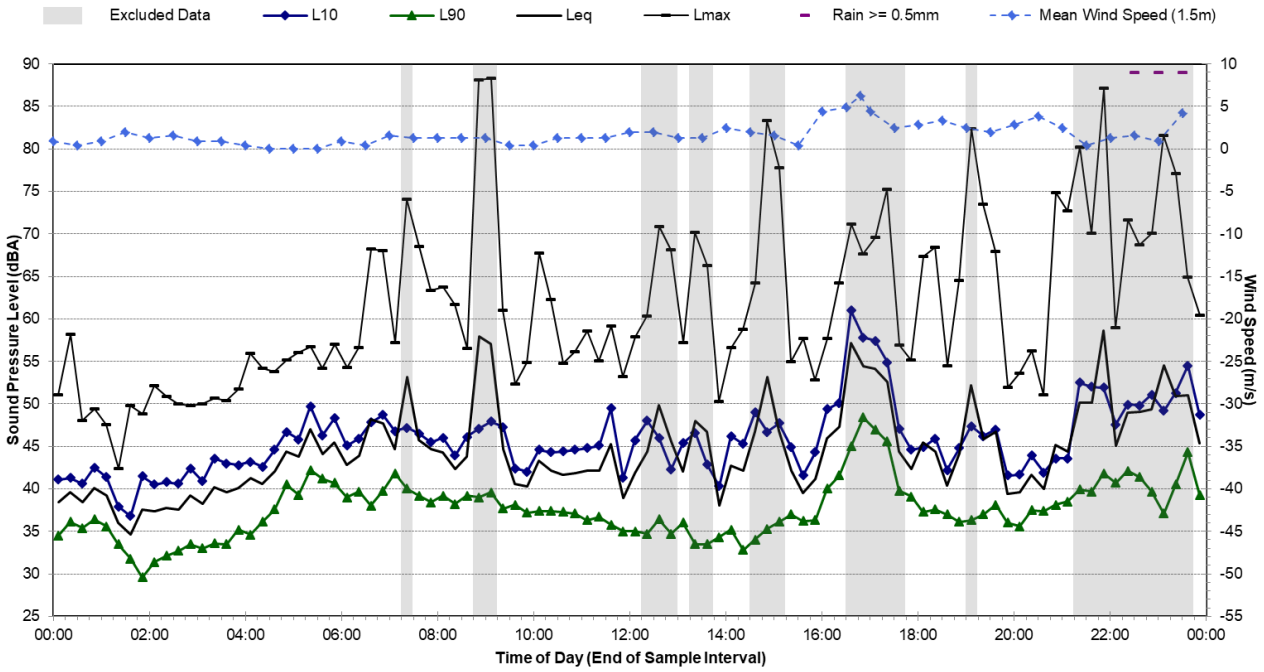
Statistical Ambient Noise Levels

L.02 - Lot 58 DP259135 – Northeastern Site Boundary - Sunday, 24 November 2019



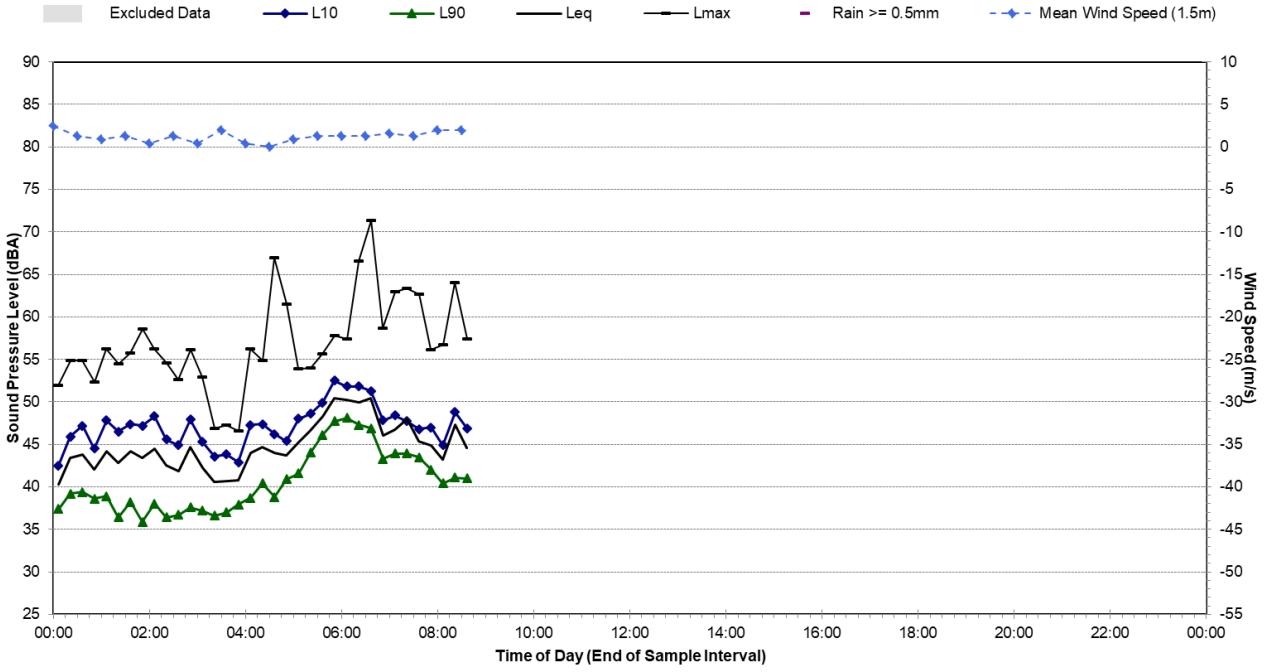
Statistical Ambient Noise Levels

L.02 - Lot 58 DP259135 – Northeastern Site Boundary - Monday, 25 November 2019



Statistical Ambient Noise Levels

L.02 - Lot 58 DP259135 – Northeastern Site Boundary - Tuesday, 26 November 2019



Noise Monitoring Location	L03
Noise Monitoring Address	**Lot 56 DP259135 – Eastern Site Boundary**

Logger Device Type: Svantek 957, Logger Serial No: 23816
Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3004636

Ambient noise logger deployed in an open area at the eastern site boundary, approximately 900 m from Mamre Road.

Attended noise measurements indicate the ambient noise environment at this location is dominated by distant road traffic noise from Mamre Road to the west and insects, and at times, a distant agricultural pump near the dam to the west. Aircraft and birds also contribute to the LAeq at this location.

Recorded Noise Levels (LAmax):
15/11/2019: Distant traffic Mamre Road: 35-39 dBA, Heavy-vehicle traffic Mamre Road: 41-47 dBA, Agricultural pump: 34 dBA, Aircraft: 41-53 dBA, Birds: 54-58 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – NPfI Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	34	44	44	51
Evening	33	41	41	48
Night-time	29	41	40	44

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	43	45
Night-time (10pm-7am)	41	42

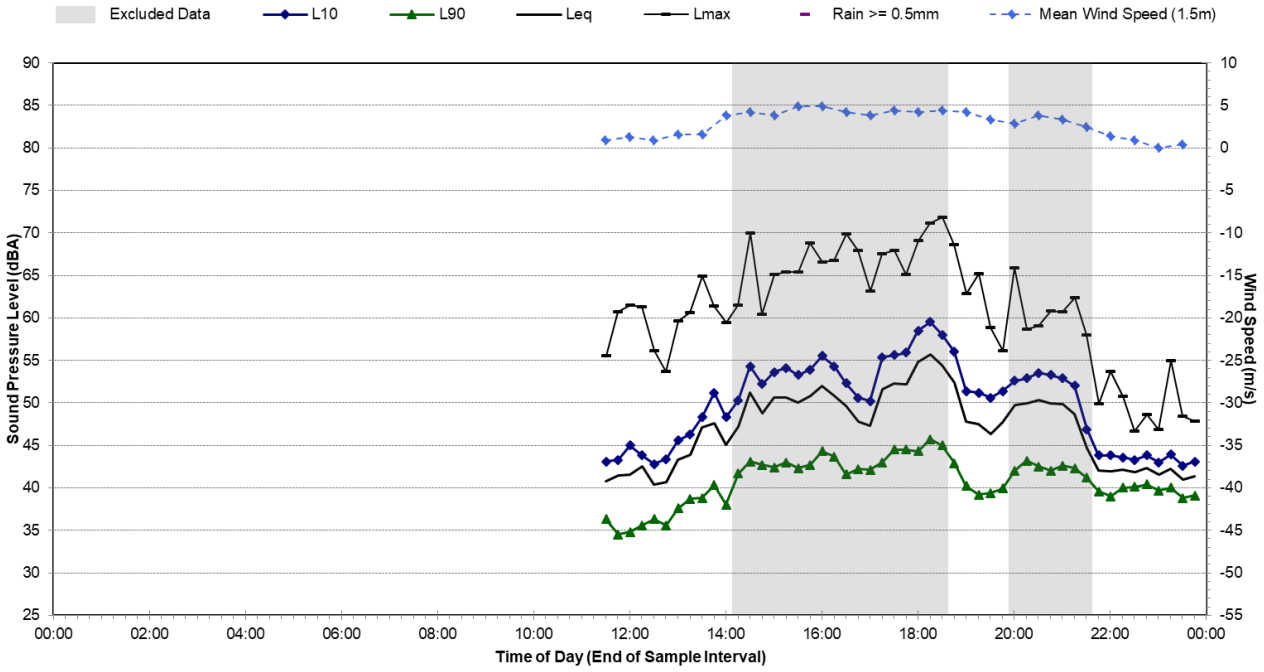
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
15/11/2019	10:48 am	37	42	60

Photo of Noise Monitoring Location

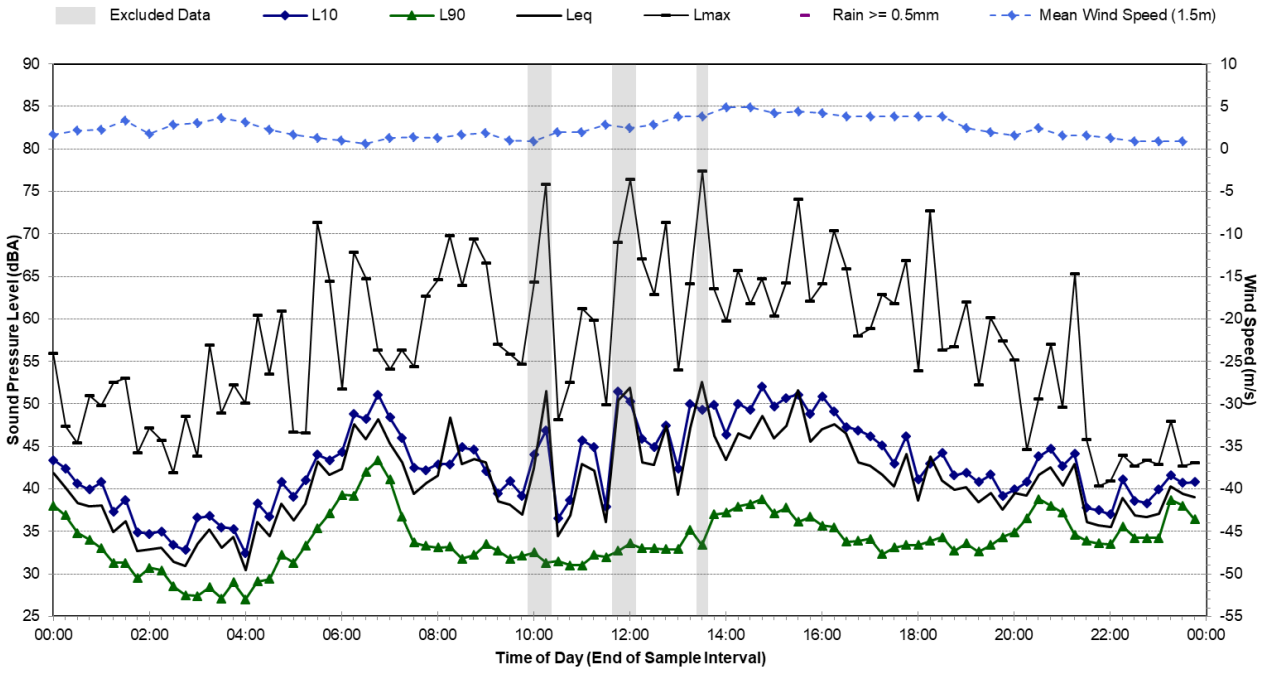
Statistical Ambient Noise Levels

L.03 - Lot 56 DP259135 – Eastern Site Boundary - Friday, 15 November 2019



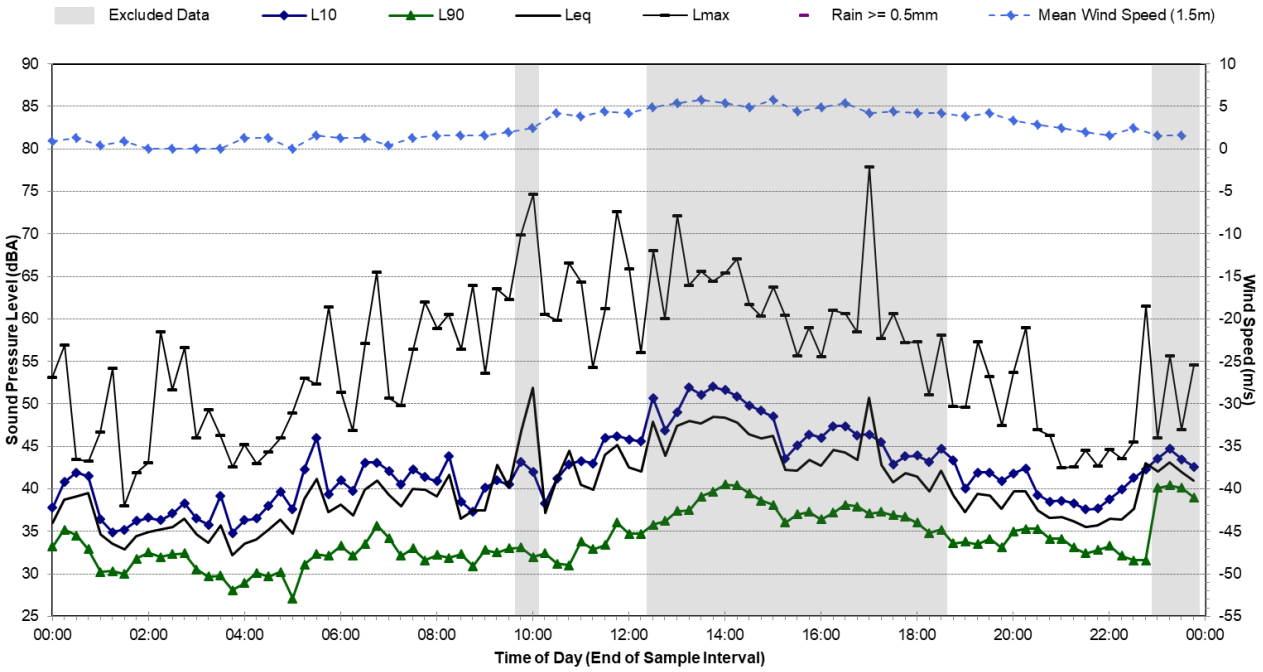
Statistical Ambient Noise Levels

L.03 - Lot 56 DP259135 – Eastern Site Boundary - Saturday, 16 November 2019



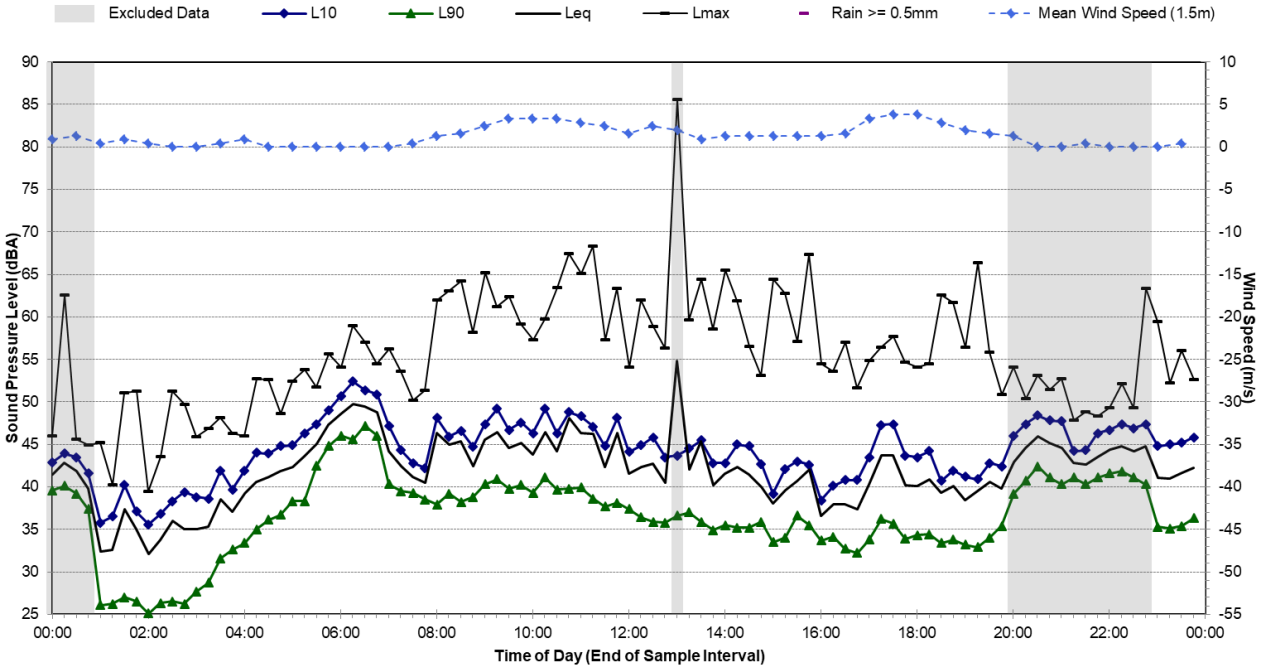
Statistical Ambient Noise Levels

L.03 - Lot 56 DP259135 – Eastern Site Boundary - Sunday, 17 November 2019



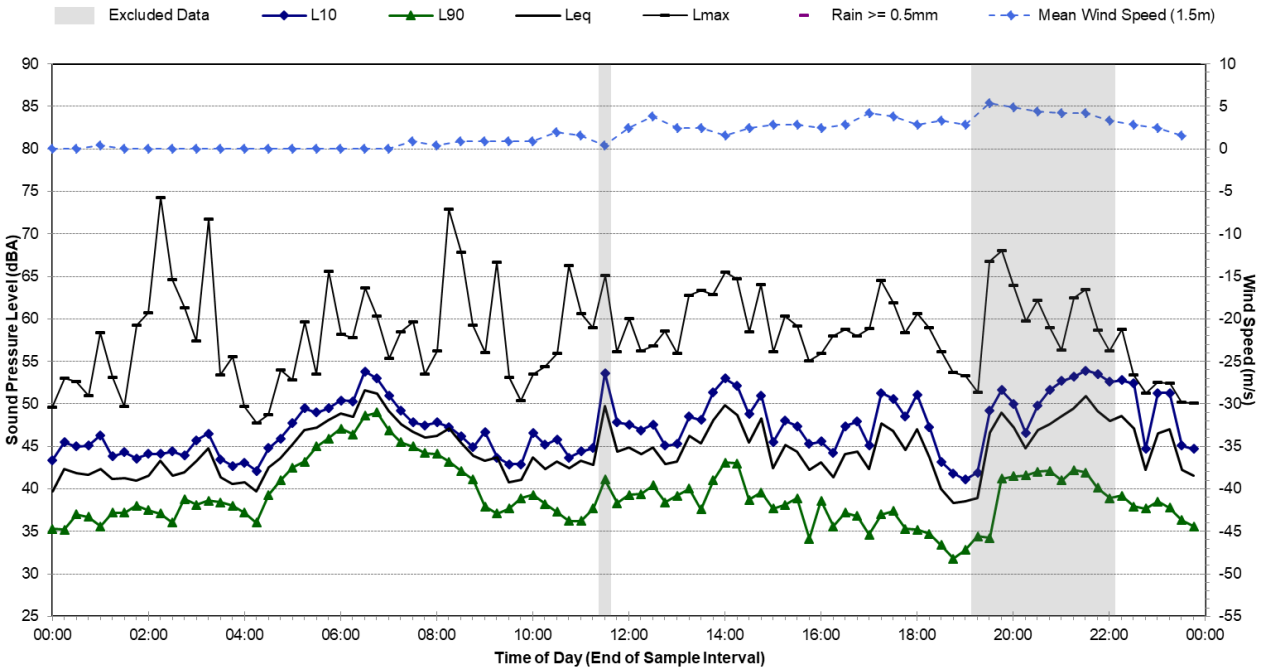
Statistical Ambient Noise Levels

L.03 - Lot 56 DP259135 – Eastern Site Boundary - Monday, 18 November 2019



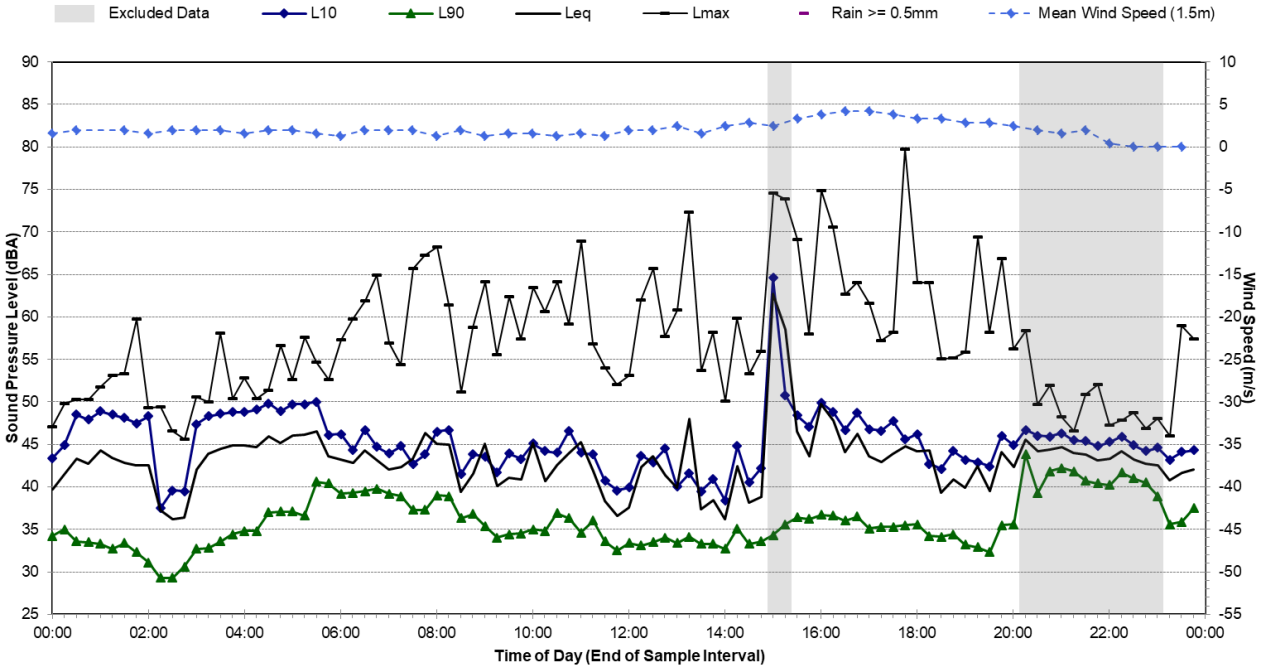
Statistical Ambient Noise Levels

L.03 - Lot 56 DP259135 – Eastern Site Boundary - Tuesday, 19 November 2019



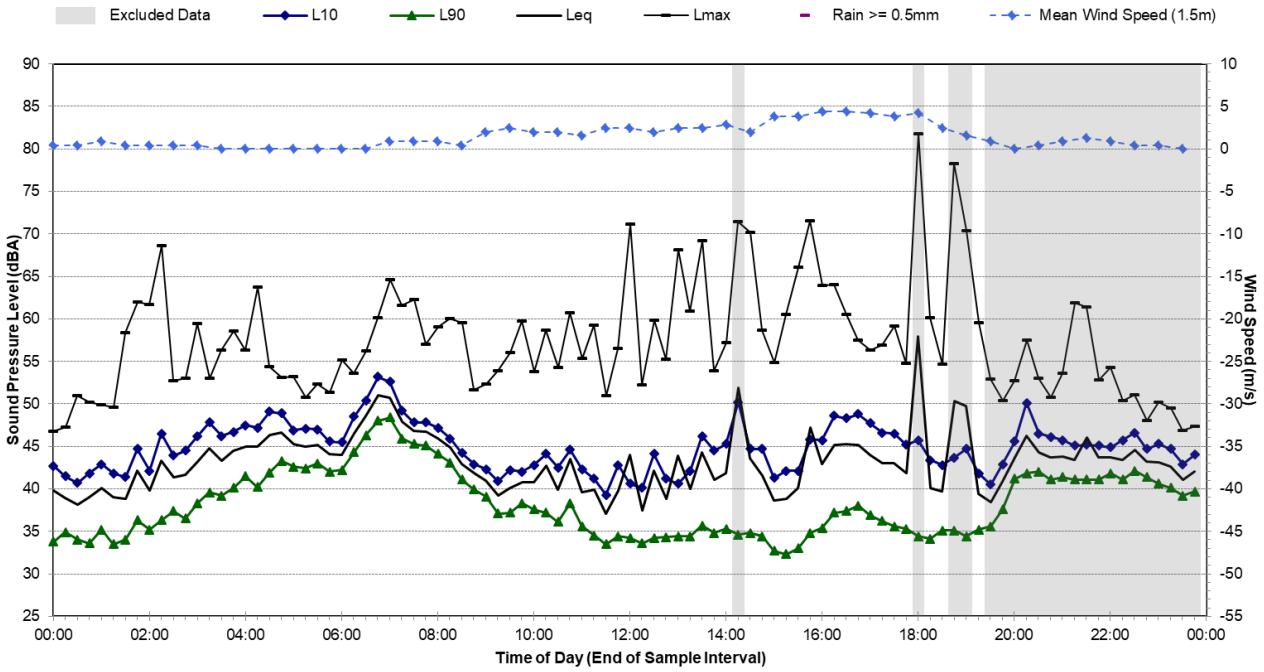
Statistical Ambient Noise Levels

L.03 - Lot 56 DP259135 – Eastern Site Boundary - Wednesday, 20 November 2019



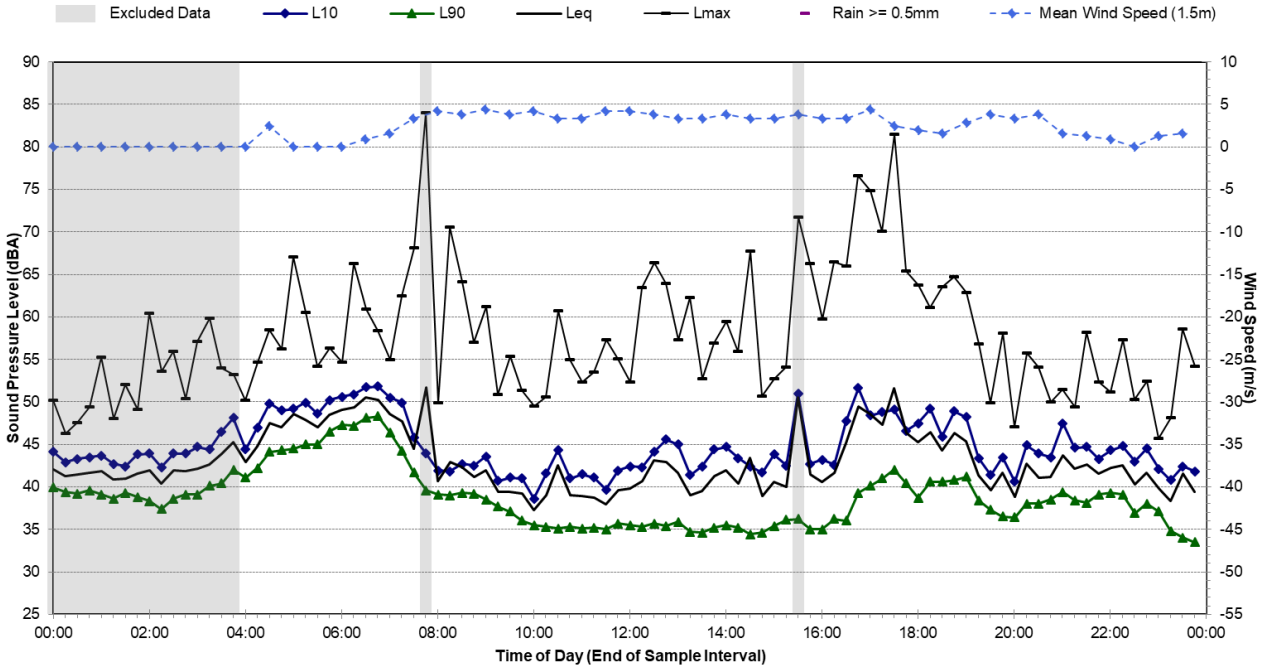
Statistical Ambient Noise Levels

L.03 - Lot 56 DP259135 – Eastern Site Boundary - Thursday, 21 November 2019



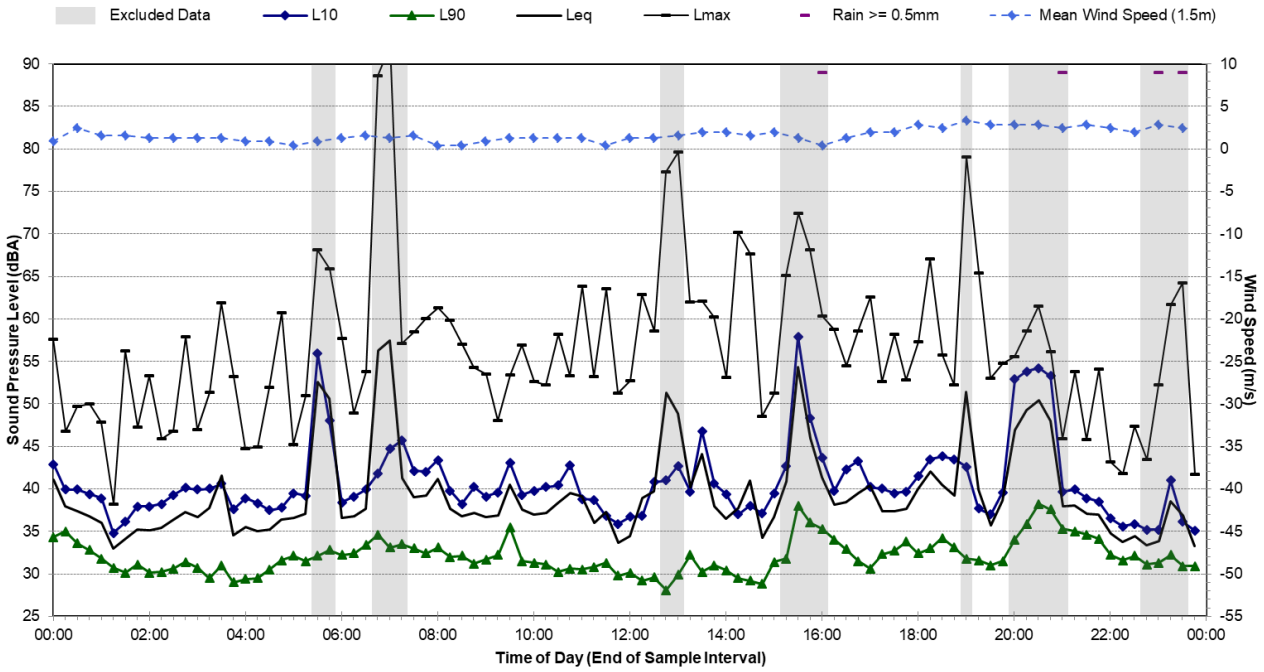
Statistical Ambient Noise Levels

L.03 - Lot 56 DP259135 – Eastern Site Boundary - Friday, 22 November 2019



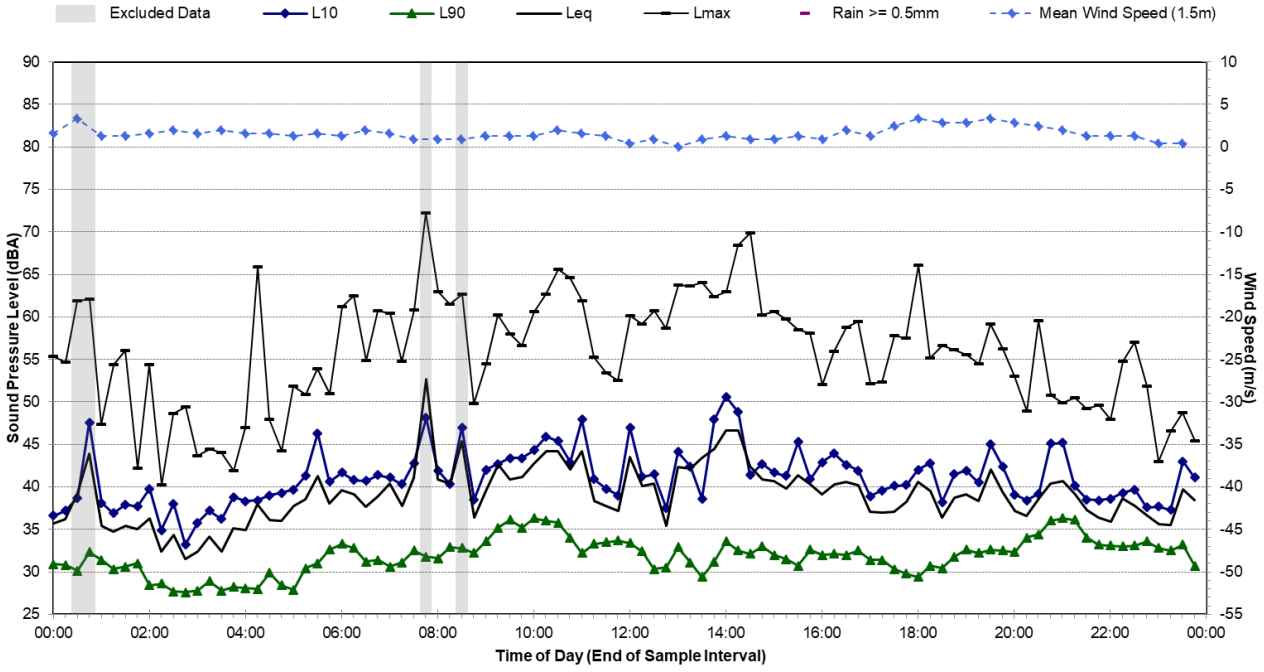
Statistical Ambient Noise Levels

L.03 - Lot 56 DP259135 – Eastern Site Boundary - Saturday, 23 November 2019



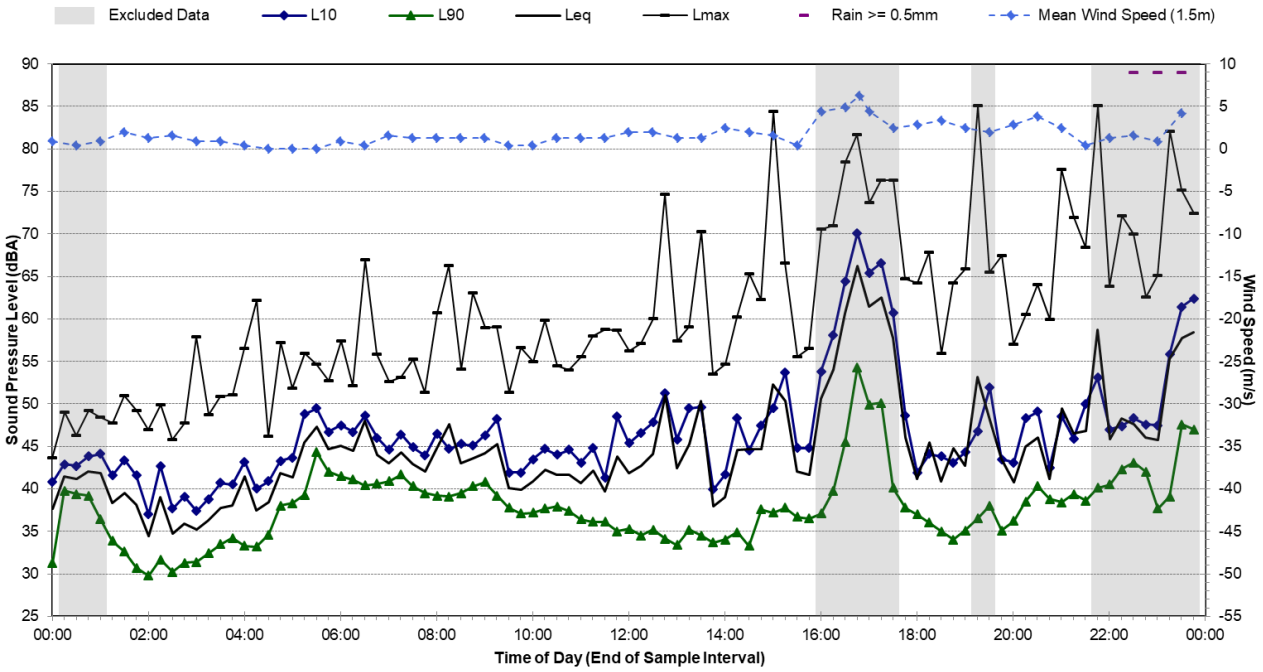
Statistical Ambient Noise Levels

L.03 - Lot 56 DP259135 – Eastern Site Boundary - Sunday, 24 November 2019



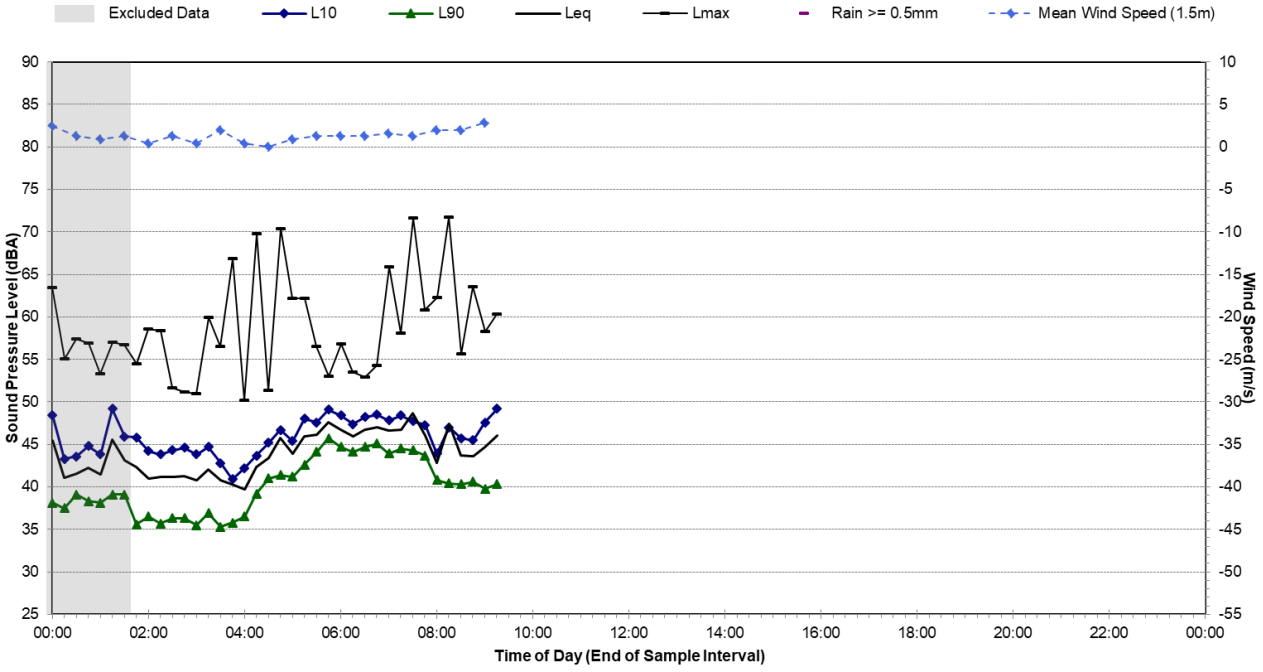
Statistical Ambient Noise Levels

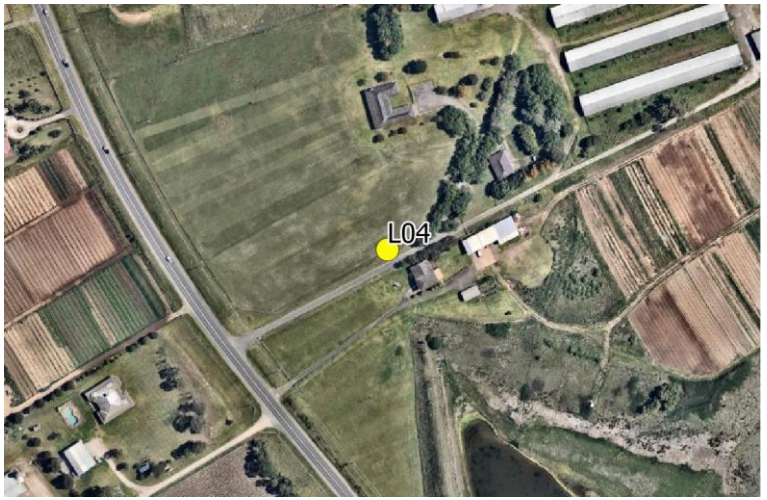
L.03 - Lot 56 DP259135 – Eastern Site Boundary - Monday, 25 November 2019



Statistical Ambient Noise Levels

L.03 - Lot 56 DP259135 – Eastern Site Boundary - Tuesday, 26 November 2019



Noise Monitoring Location	L04	Map of Noise Monitoring Location
Noise Monitoring Address	**Lot 54 DP259135 – Southern Site Boundary**	

Logger Device Type: Svantek 957, Logger Serial No: 27579
Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3004636

Ambient noise logger deployed in an open area at the southern site boundary, approximately 120 m from Mamre Road.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from Mamre Road to the west. Aircraft, birds, livestock and insects also contribute to the LAeq at this location.

Recorded Noise Levels (L_{Amax}):
15/11/2019: Light-vehicle traffic Mamre Road: 42-53 dBA, Heavy-vehicle traffic Mamre Road: 50-57 dBA, Aircrafts: 53-61 dBA, Birds: 47-49 dBA, Livestock: 45-47 dBA, Insects: 39 dBA

Ambient Noise Logging Results – NPfI Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L_{10}	L_1
Daytime	39	52	53	59
Evening	40	53	56	60
Night-time	32	54	55	62

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	52	55
Night-time (10pm-7am)	54	58

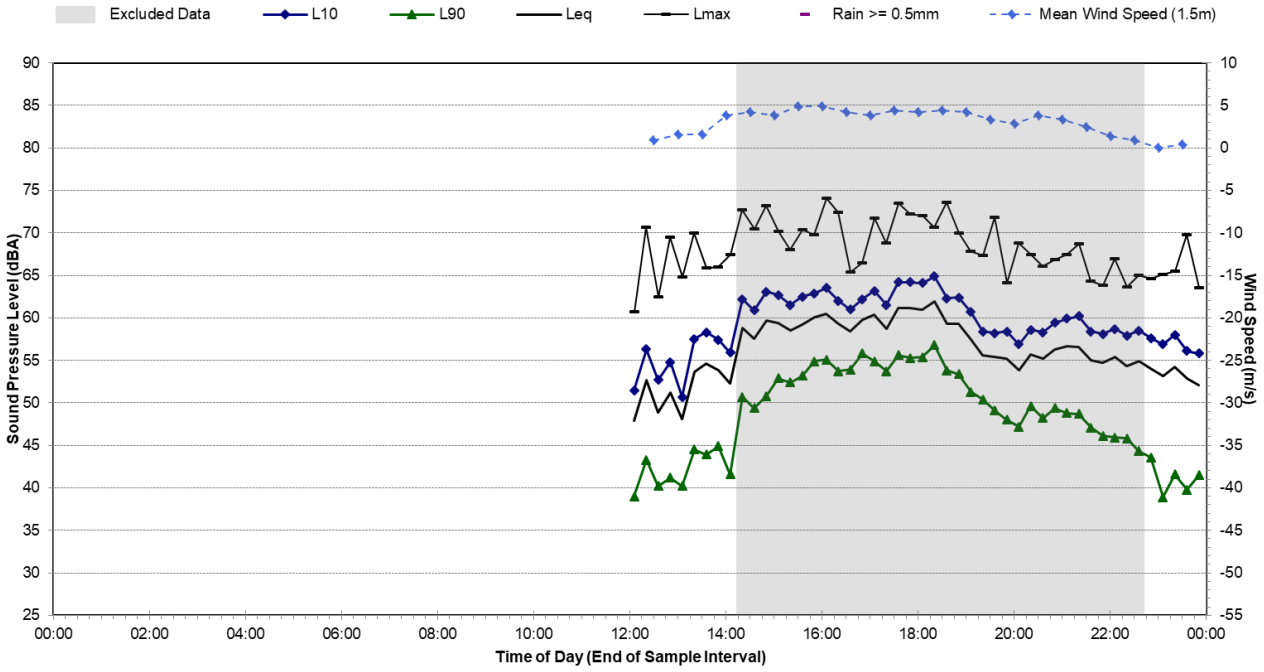
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
15/11/2019	11:50 am	39	48	61

Photo of Noise Monitoring Location

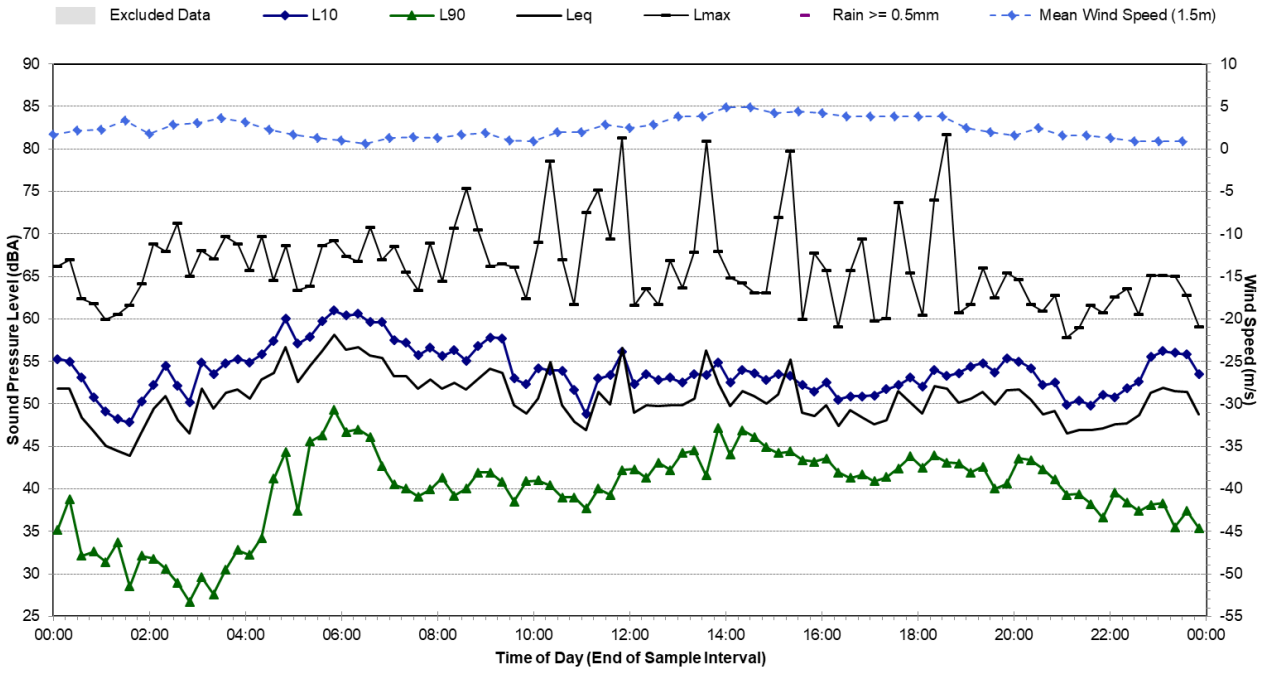
Statistical Ambient Noise Levels

L.04 - Lot 54 DP259135 – Southern Site Boundary - Friday, 15 November 2019



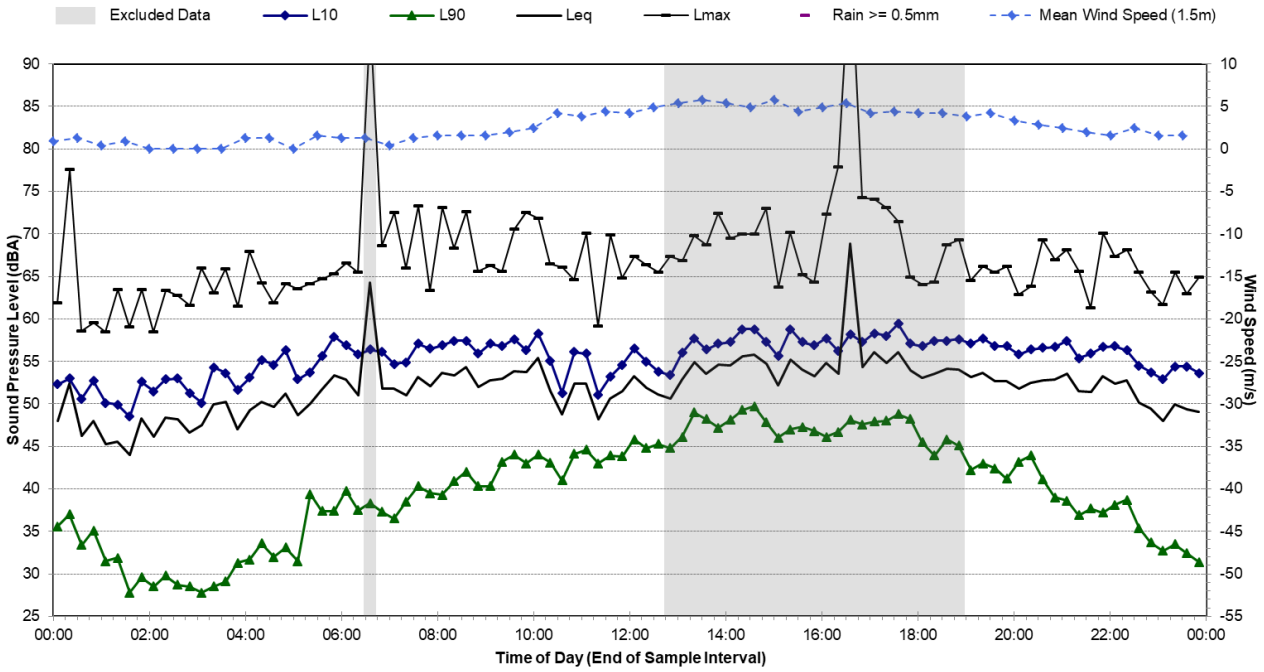
Statistical Ambient Noise Levels

L.04 - Lot 54 DP259135 – Southern Site Boundary - Saturday, 16 November 2019



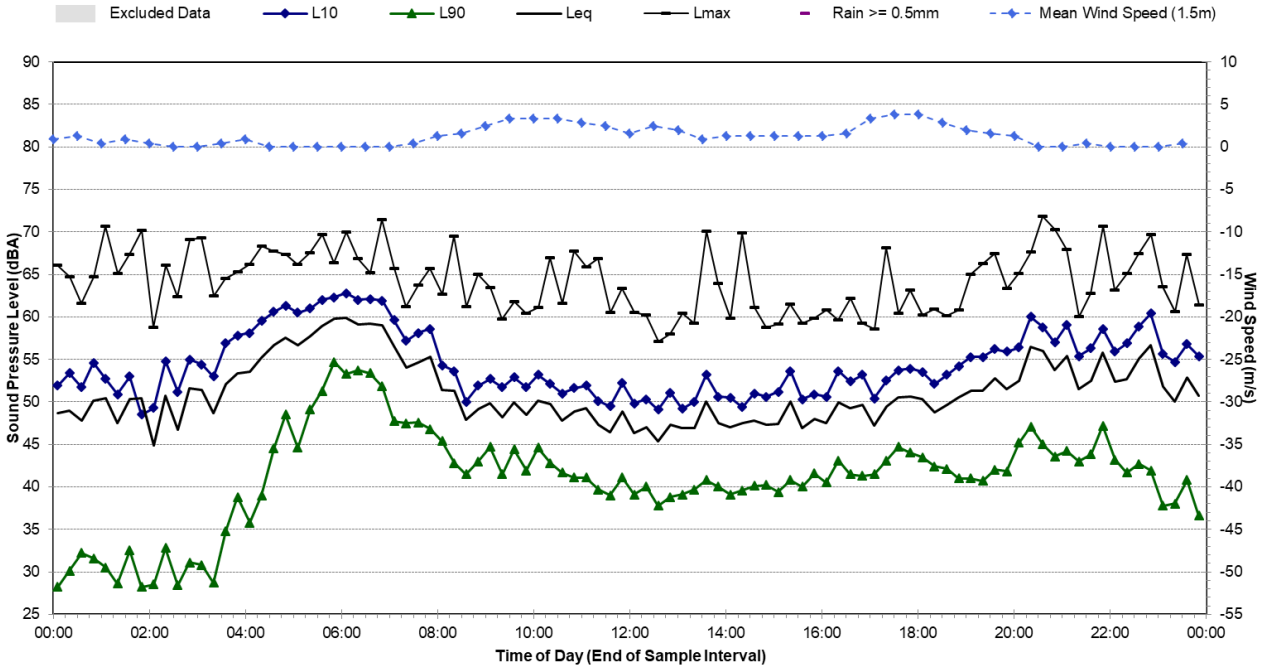
Statistical Ambient Noise Levels

L.04 - Lot 54 DP259135 – Southern Site Boundary - Sunday, 17 November 2019



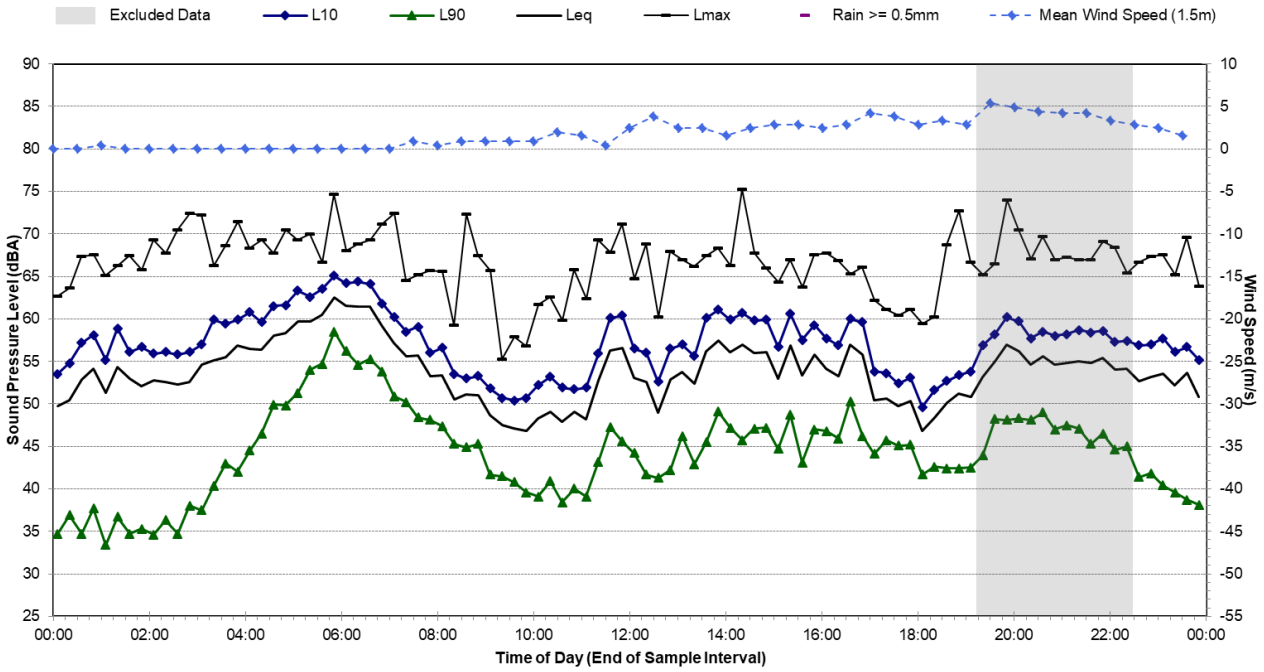
Statistical Ambient Noise Levels

L.04 - Lot 54 DP259135 – Southern Site Boundary - Monday, 18 November 2019



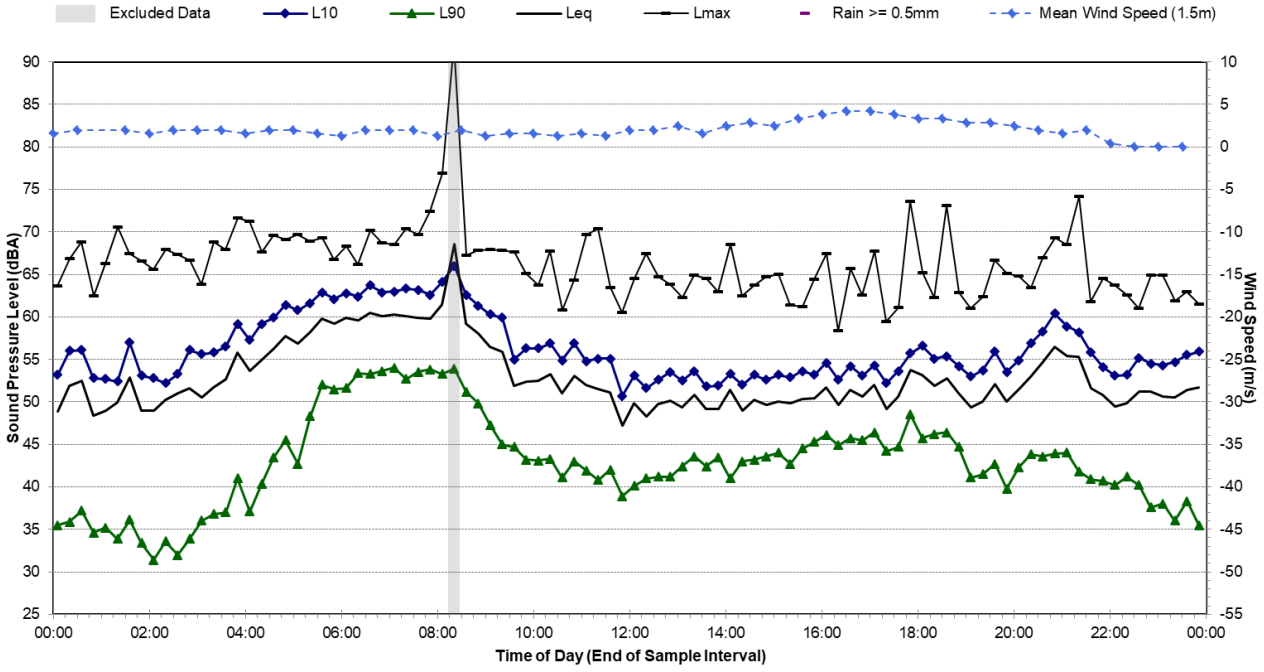
Statistical Ambient Noise Levels

L.04 - Lot 54 DP259135 – Southern Site Boundary - Tuesday, 19 November 2019



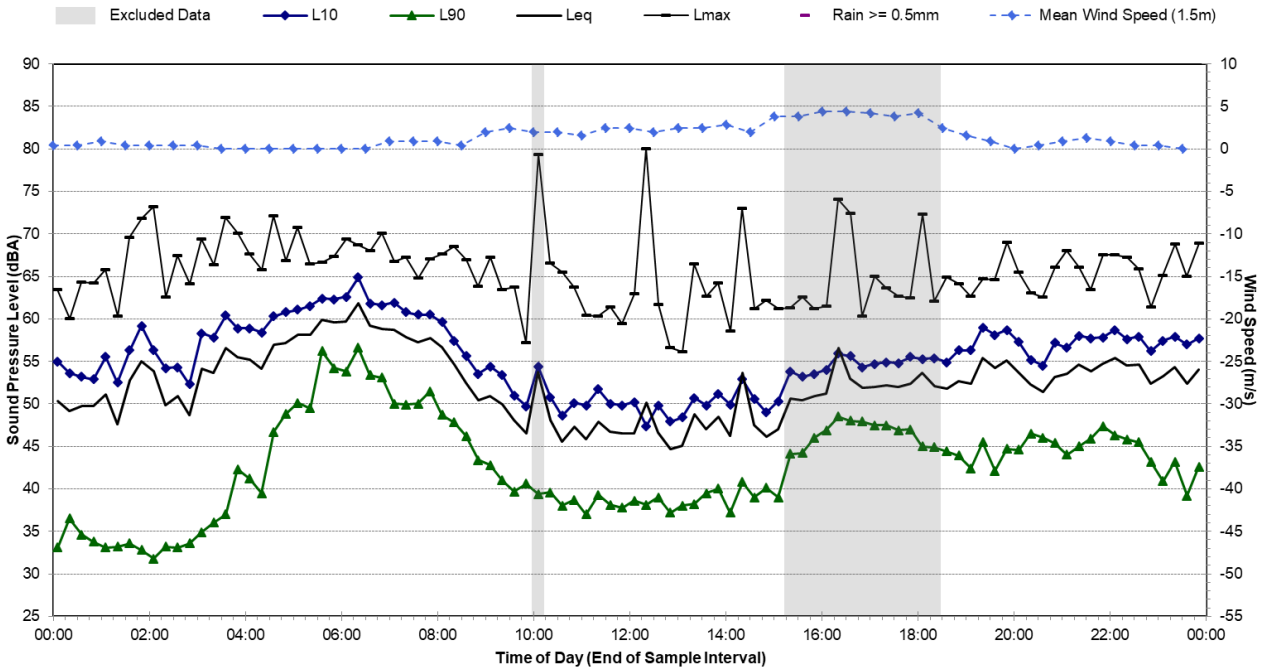
Statistical Ambient Noise Levels

L.04 - Lot 54 DP259135 – Southern Site Boundary - Wednesday, 20 November 2019



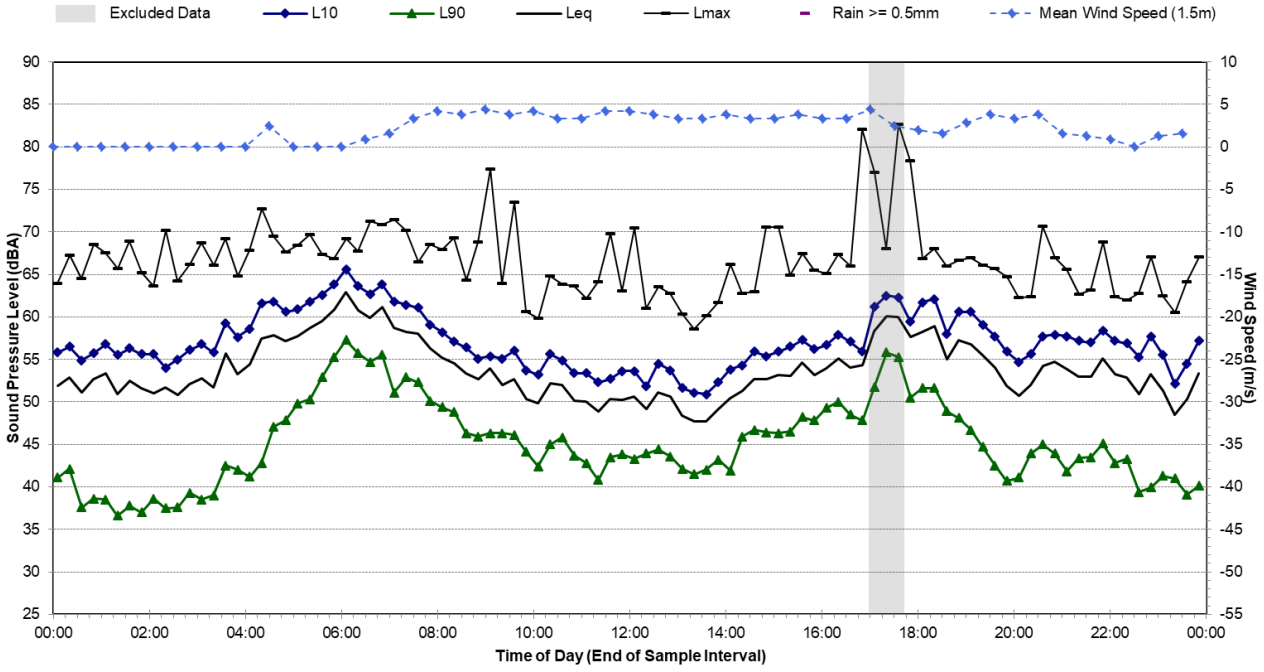
Statistical Ambient Noise Levels

L.04 - Lot 54 DP259135 – Southern Site Boundary - Thursday, 21 November 2019



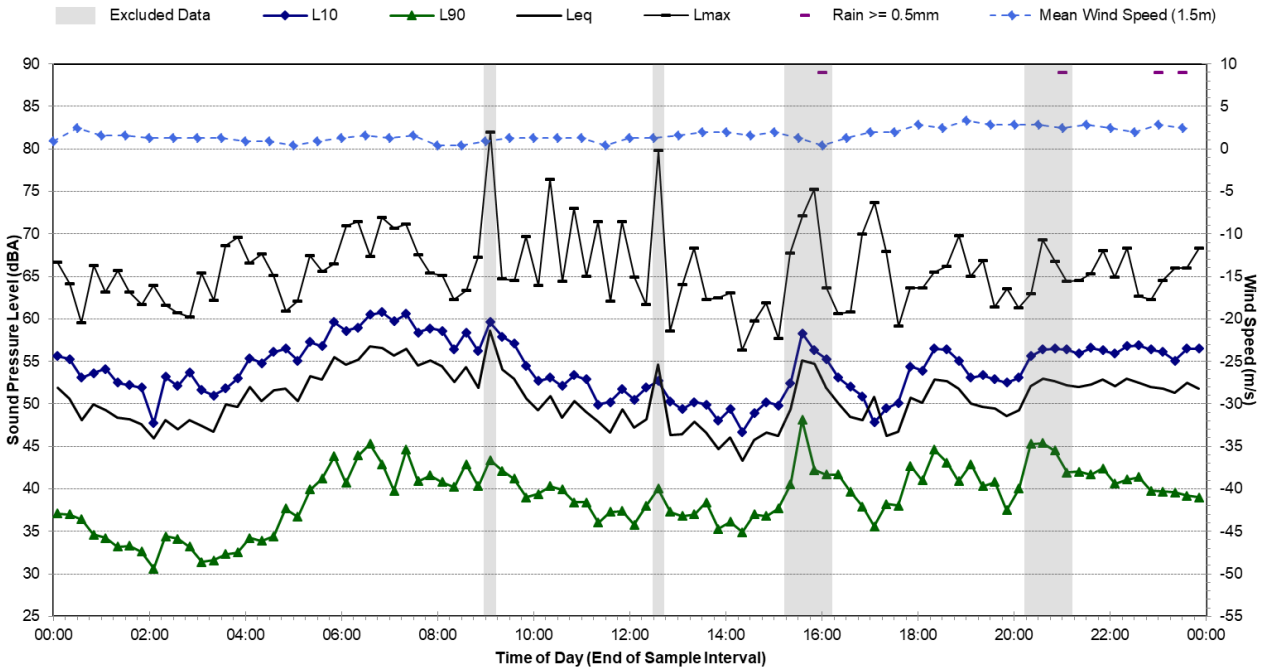
Statistical Ambient Noise Levels

L.04 - Lot 54 DP259135 – Southern Site Boundary - Friday, 22 November 2019



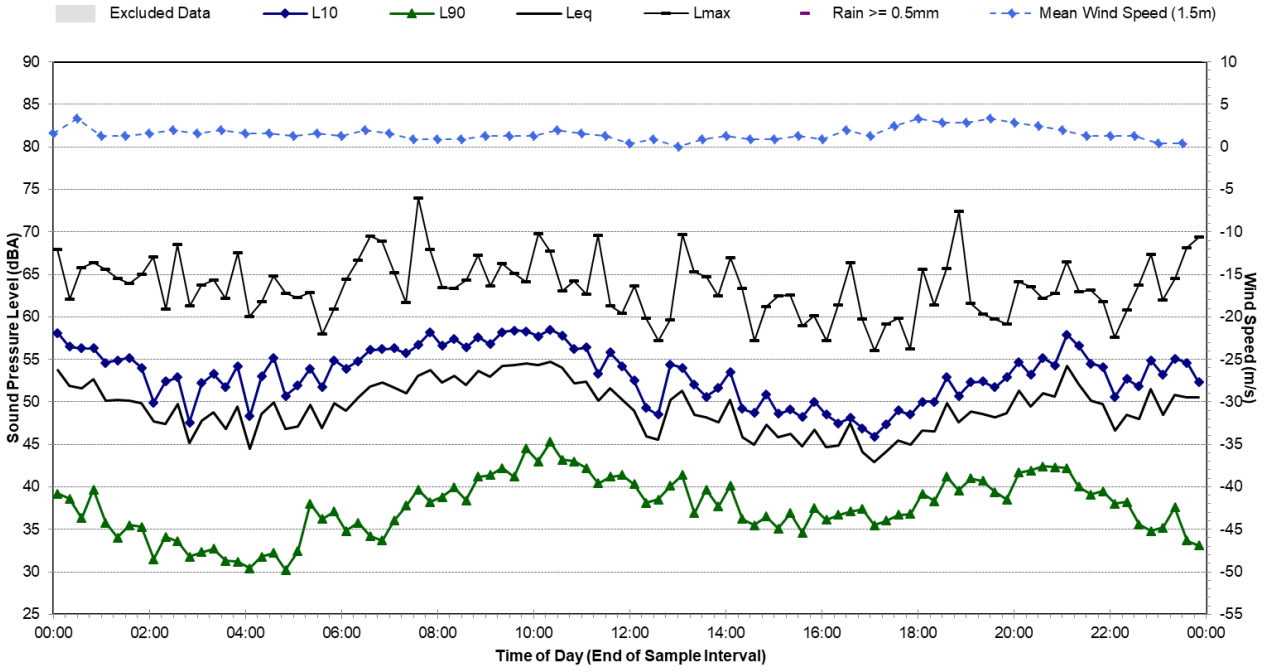
Statistical Ambient Noise Levels

L.04 - Lot 54 DP259135 – Southern Site Boundary - Saturday, 23 November 2019



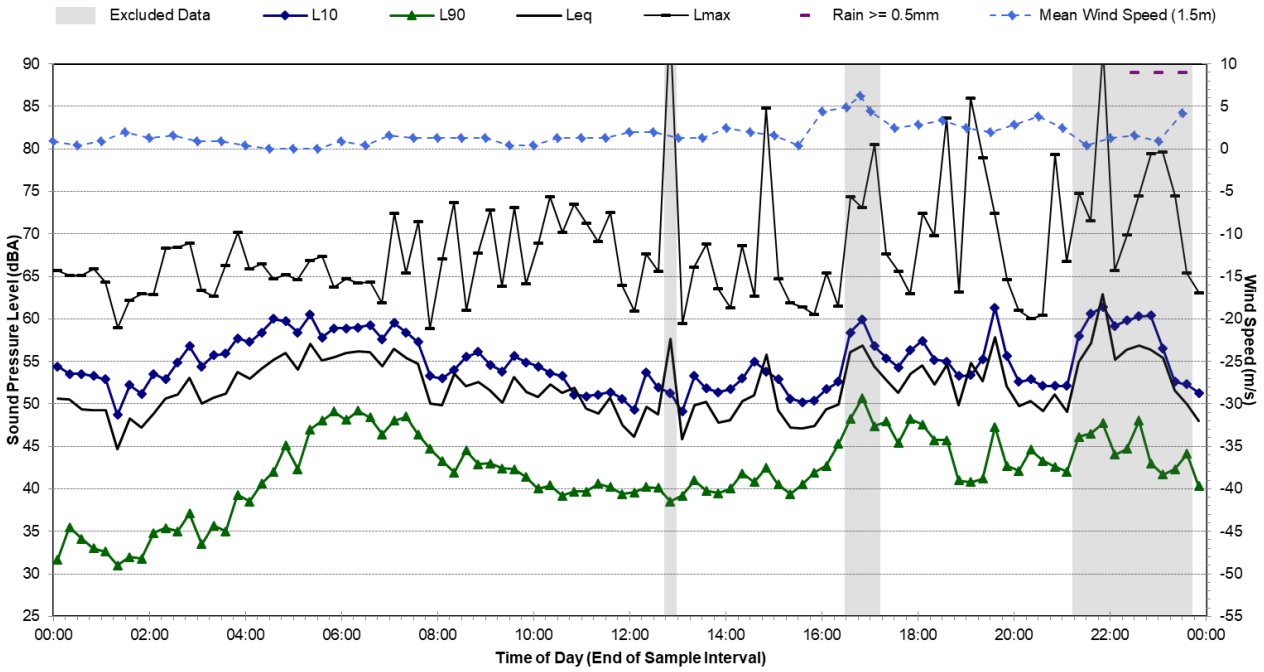
Statistical Ambient Noise Levels

L.04 - Lot 54 DP259135 – Southern Site Boundary - Sunday, 24 November 2019



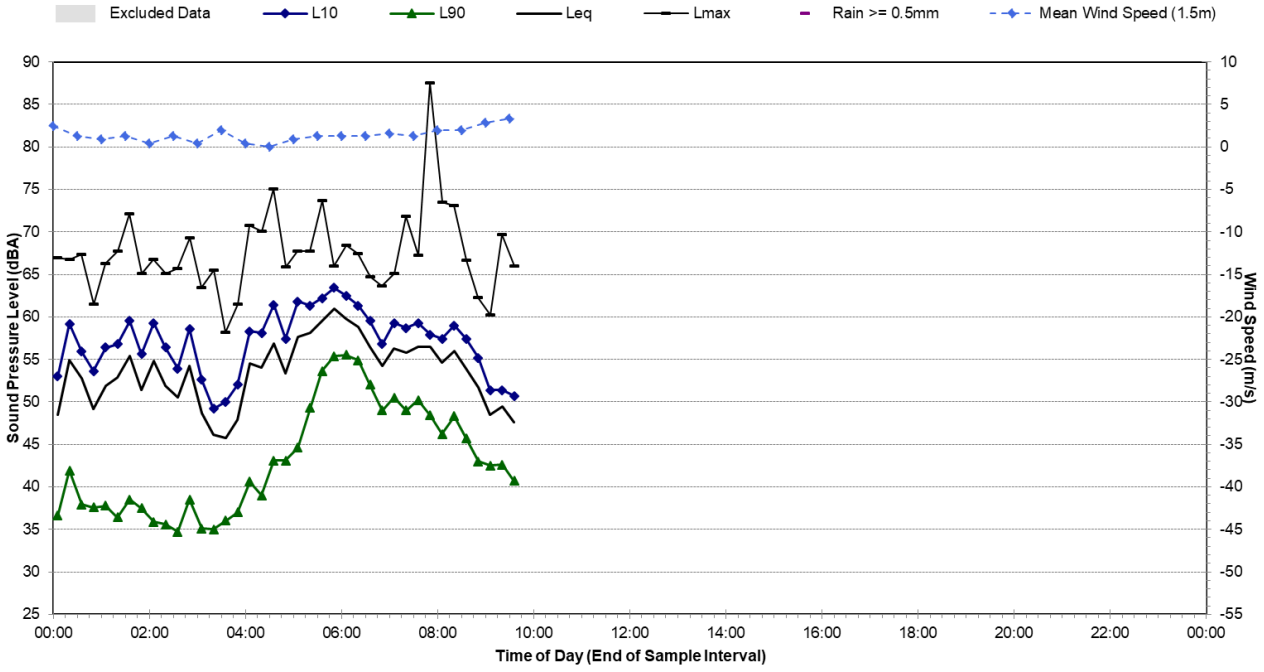
Statistical Ambient Noise Levels

L.04 - Lot 54 DP259135 – Southern Site Boundary - Monday, 25 November 2019



Statistical Ambient Noise Levels

L.04 - Lot 54 DP259135 – Southern Site Boundary - Tuesday, 26 November 2019



Noise Monitoring Location	L05	Map of Noise Monitoring Location
Noise Monitoring Address	**Lot 56 DP259135 – Western Site Boundary**	

Logger Device Type: Svantek 957, Logger Serial No: 20674
Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3004636

Ambient noise logger deployed in an open area near the western site boundary, approximately 40 m from Mamre Road.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from Mamre Road to the west. Birds and insects also contribute to the LAeq at this location.

Recorded Noise Levels (LAmax):
15/11/2019: Light-vehicle traffic Mamre Road: 45-66 dBA, Heavy-vehicle traffic Mamre Road: 50-75 dBA, Birds: 52 dBA, Insects: 38 dBA

Ambient Noise Logging Results – NPfI Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L_{10}	L_1
Daytime	42	59	59	66
Evening	43	59	59	65
Night-time	34	56	57	65

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	59	62
Night-time (10pm-7am)	56	60

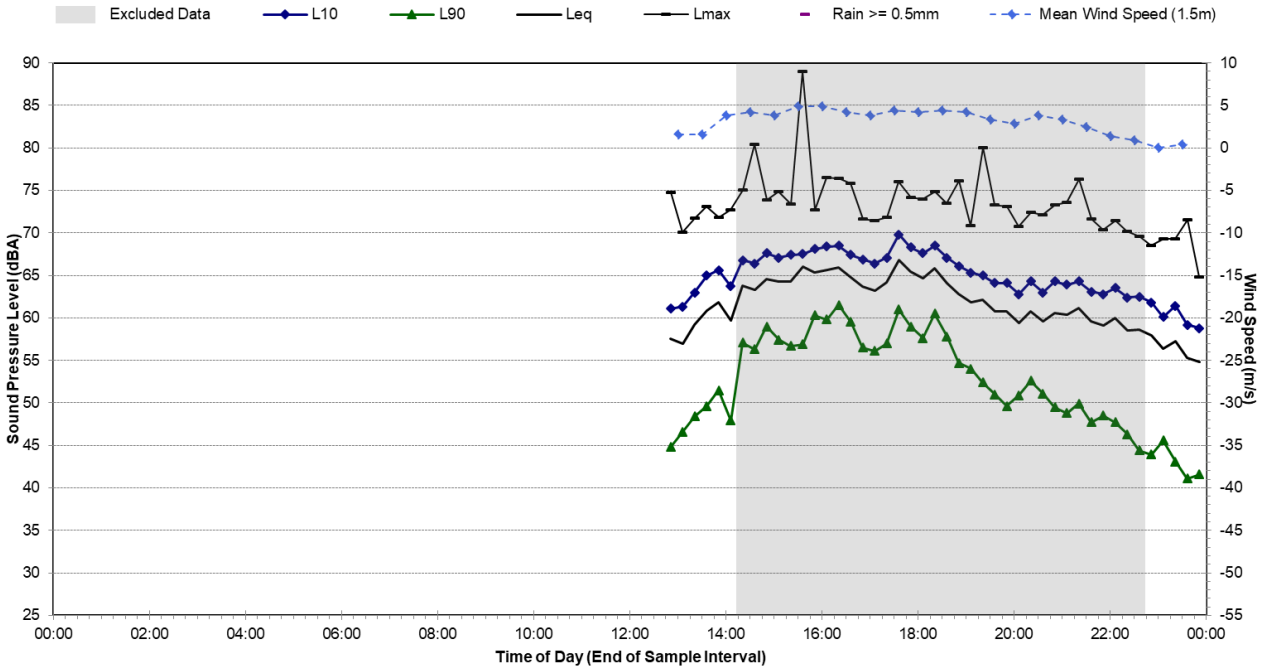
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
15/11/2019	12:33 pm	44	57	75

Photo of Noise Monitoring Location

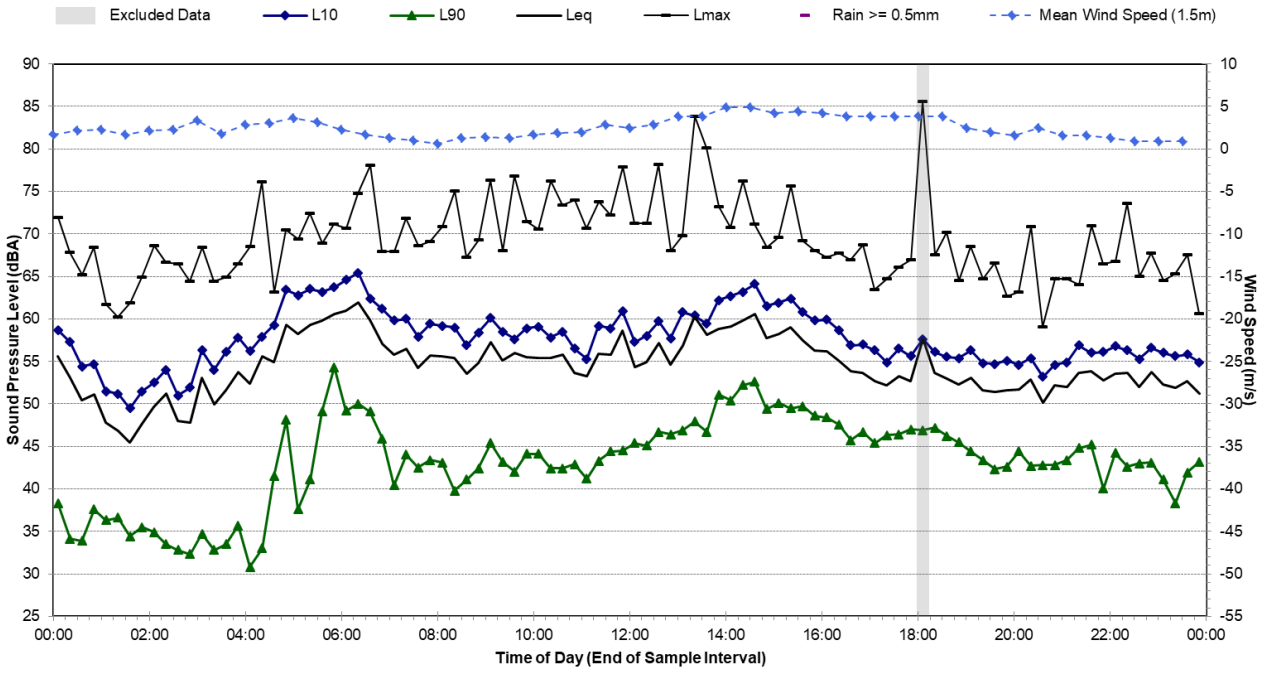
Statistical Ambient Noise Levels

L.05 - Lot 56 DP259135 – Western Site Boundary - Friday, 15 November 2019



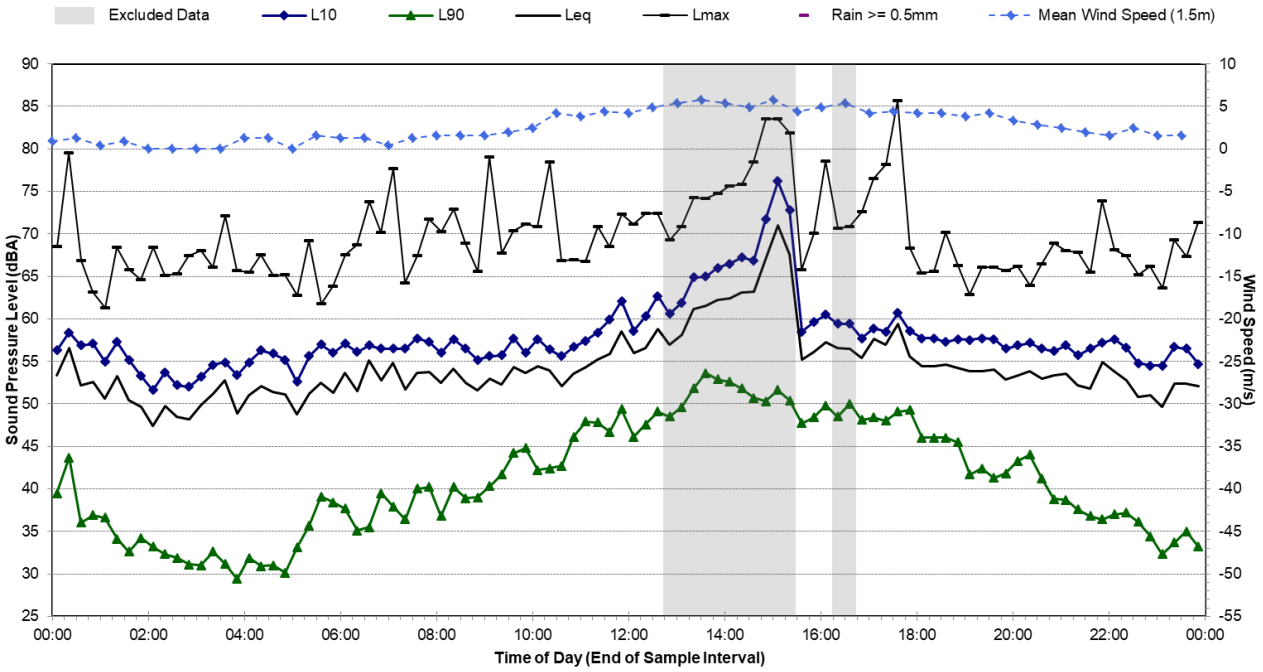
Statistical Ambient Noise Levels

L.05 - Lot 56 DP259135 – Western Site Boundary - Saturday, 16 November 2019



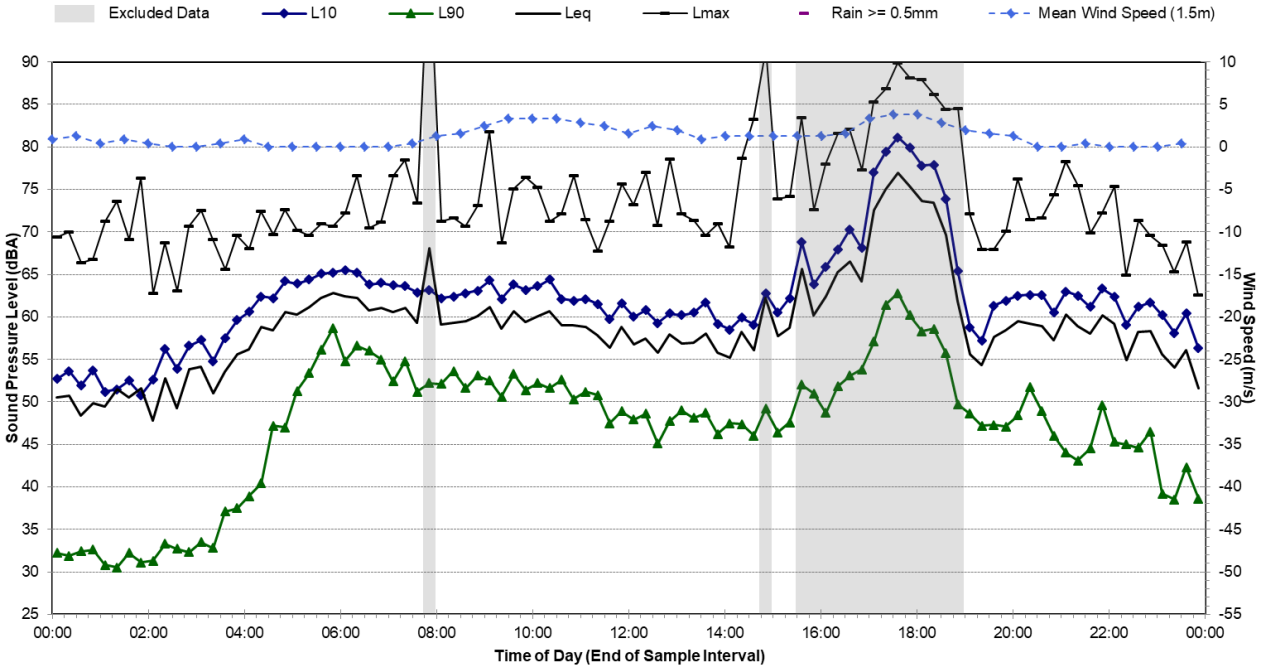
Statistical Ambient Noise Levels

L.05 - Lot 56 DP259135 – Western Site Boundary - Sunday, 17 November 2019



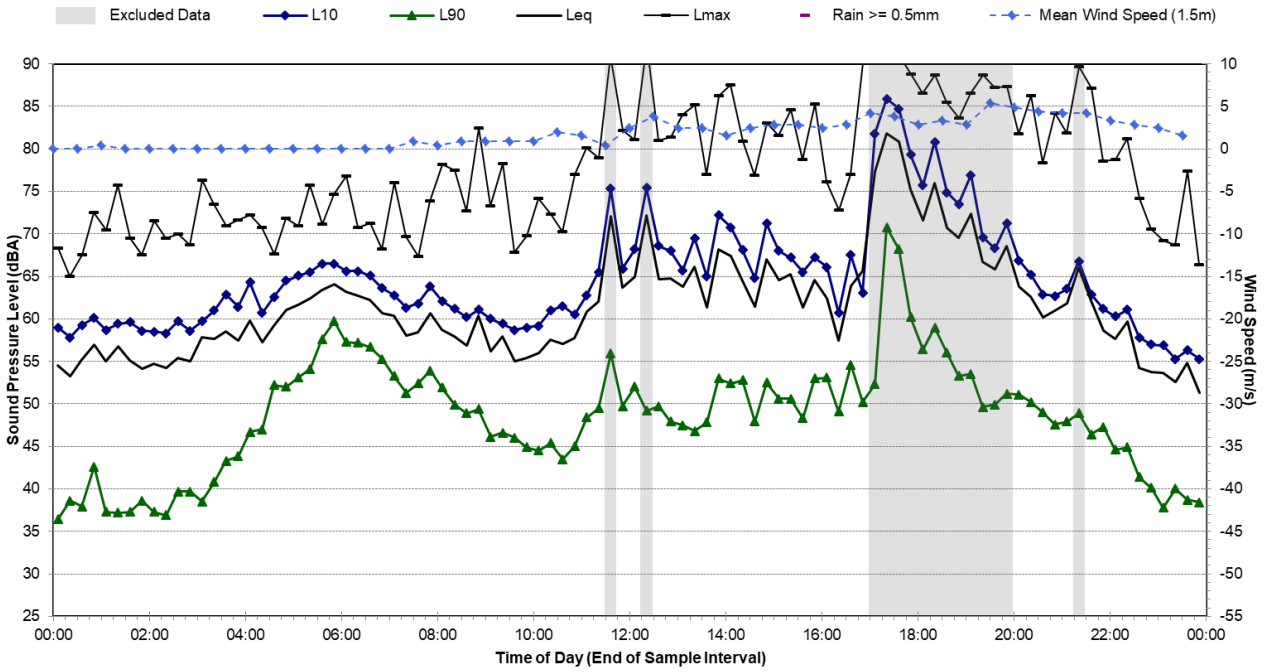
Statistical Ambient Noise Levels

L.05 - Lot 56 DP259135 – Western Site Boundary - Monday, 18 November 2019



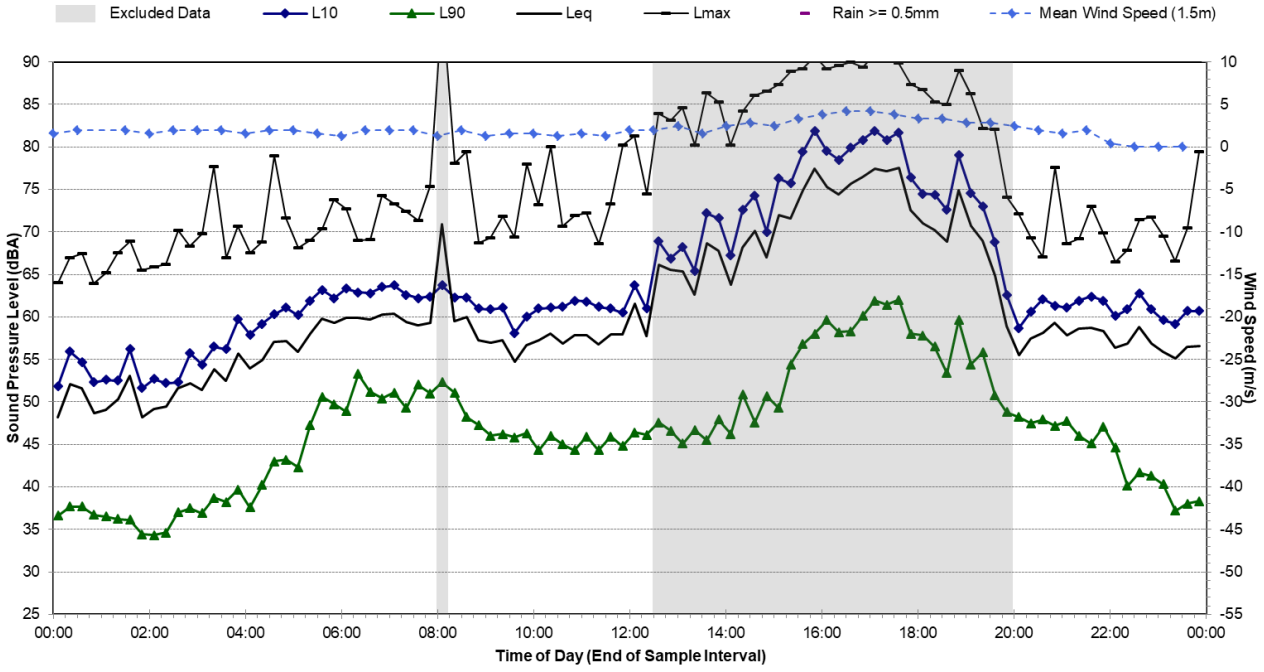
Statistical Ambient Noise Levels

L.05 - Lot 56 DP259135 – Western Site Boundary - Tuesday, 19 November 2019



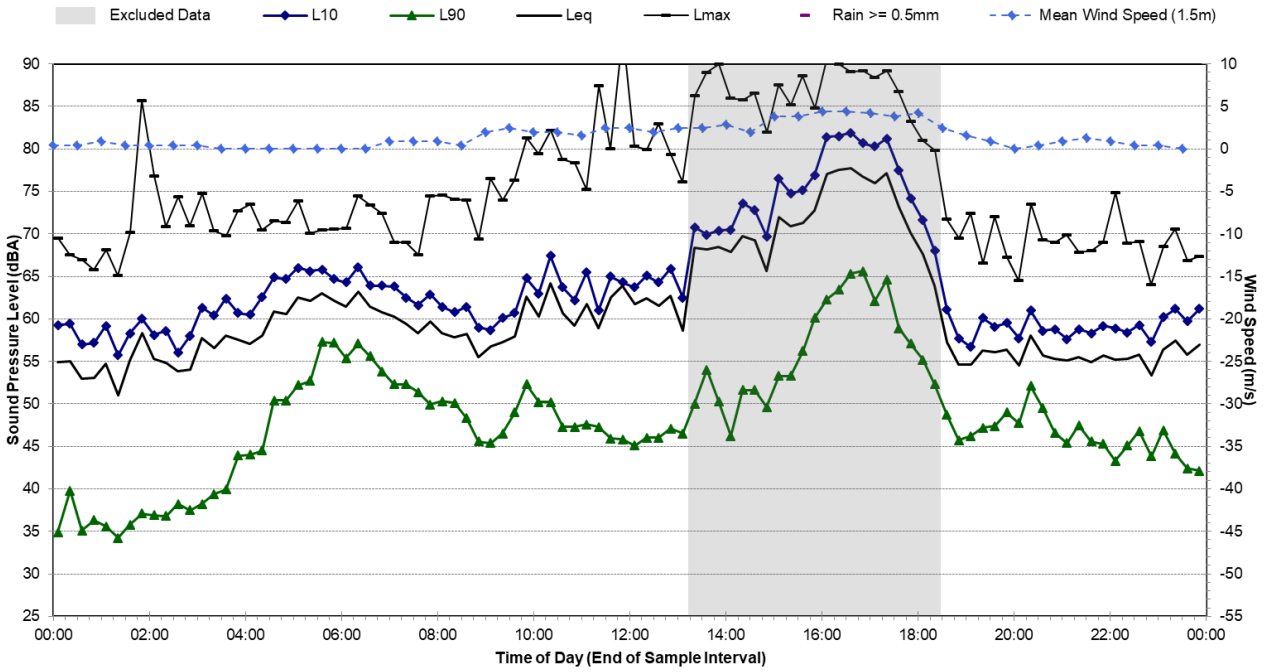
Statistical Ambient Noise Levels

L.05 - Lot 56 DP259135 – Western Site Boundary - Wednesday, 20 November 2019



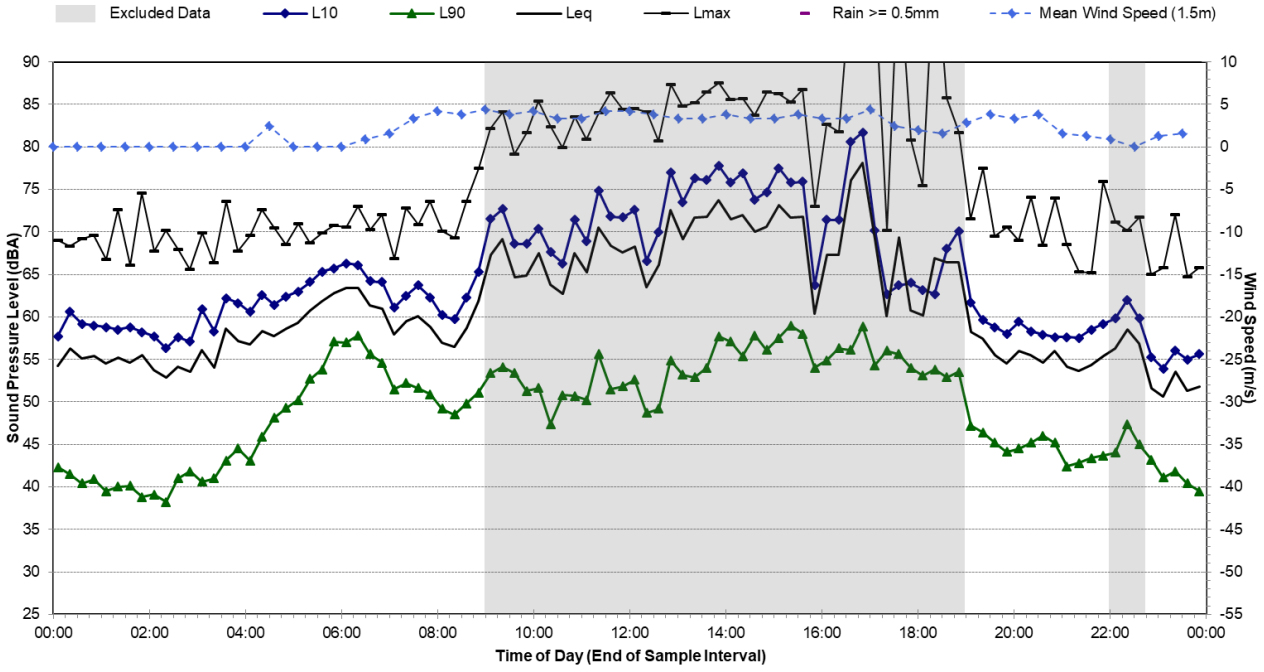
Statistical Ambient Noise Levels

L.05 - Lot 56 DP259135 – Western Site Boundary - Thursday, 21 November 2019



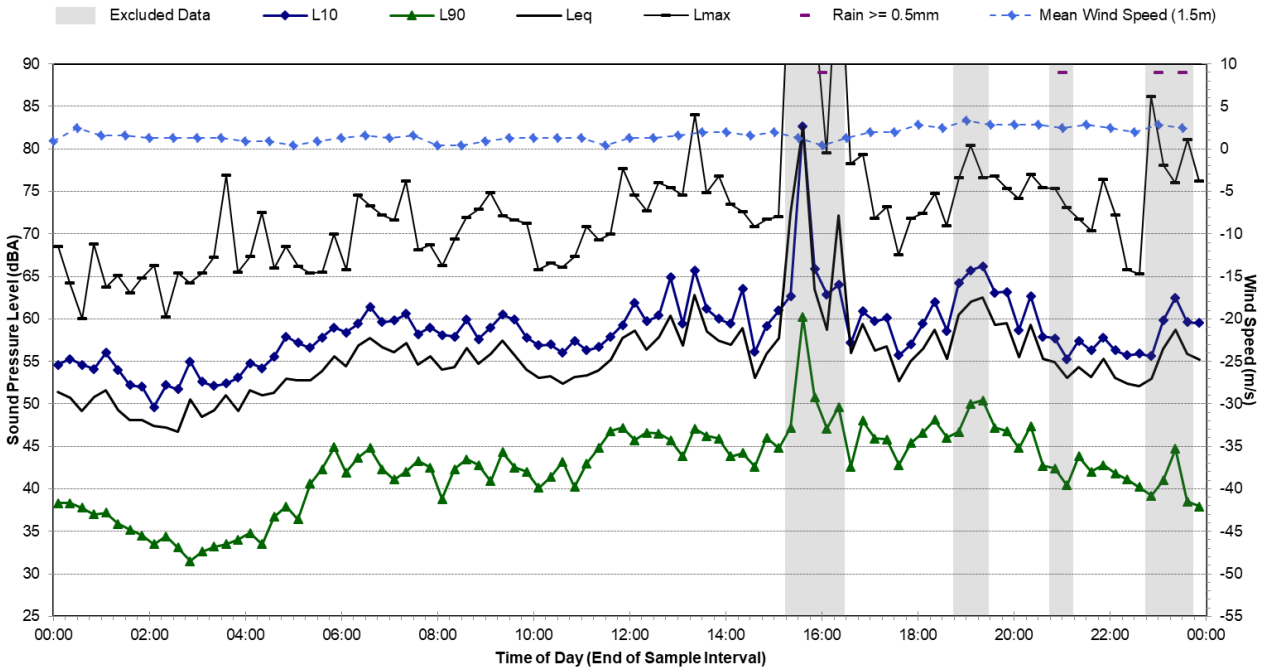
Statistical Ambient Noise Levels

L.05 - Lot 56 DP259135 – Western Site Boundary - Friday, 22 November 2019



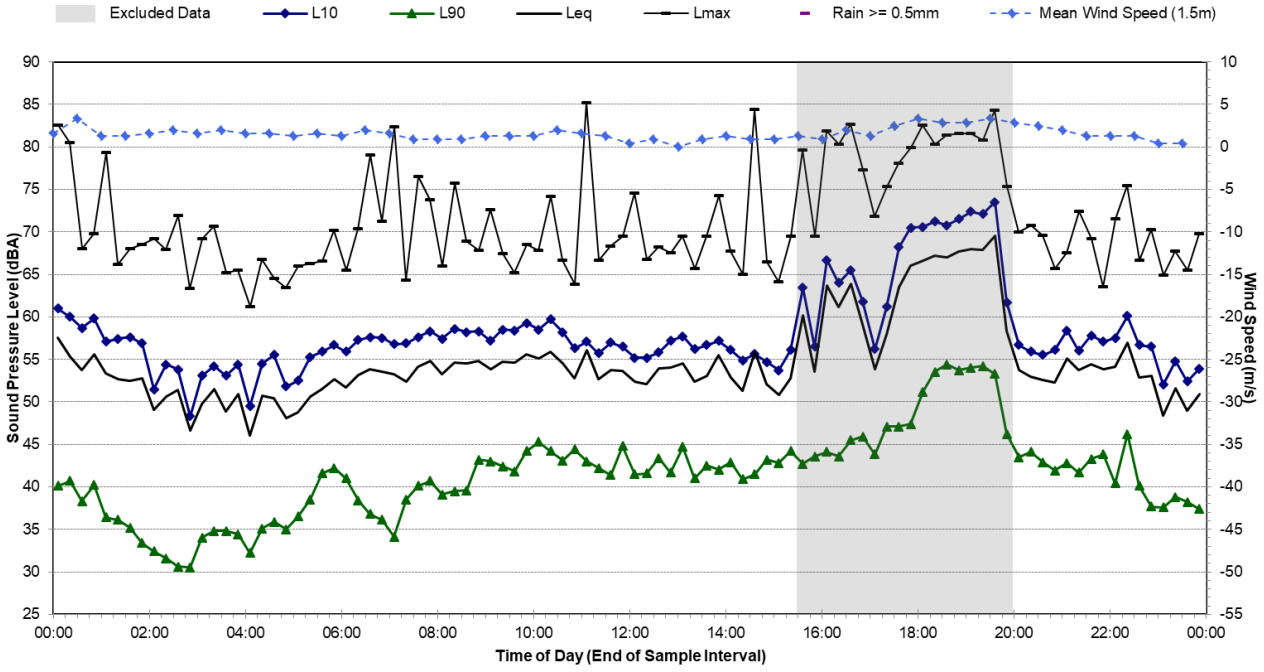
Statistical Ambient Noise Levels

L.05 - Lot 56 DP259135 – Western Site Boundary - Saturday, 23 November 2019



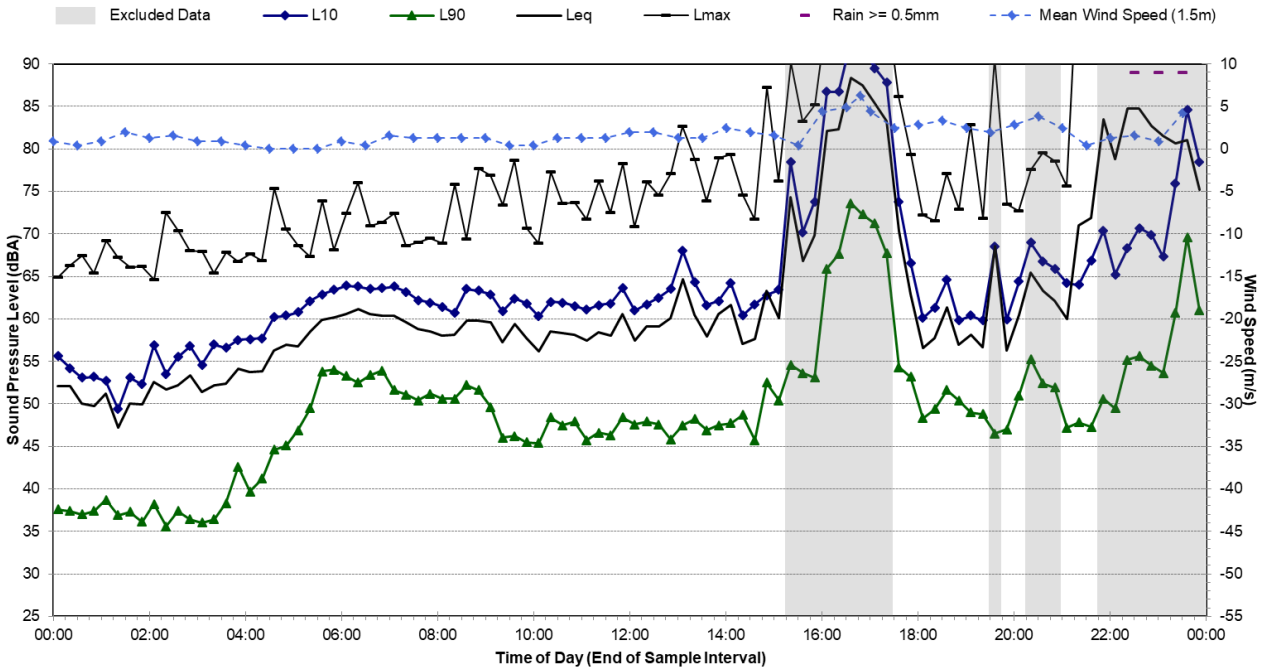
Statistical Ambient Noise Levels

L.05 - Lot 56 DP259135 – Western Site Boundary - Sunday, 24 November 2019



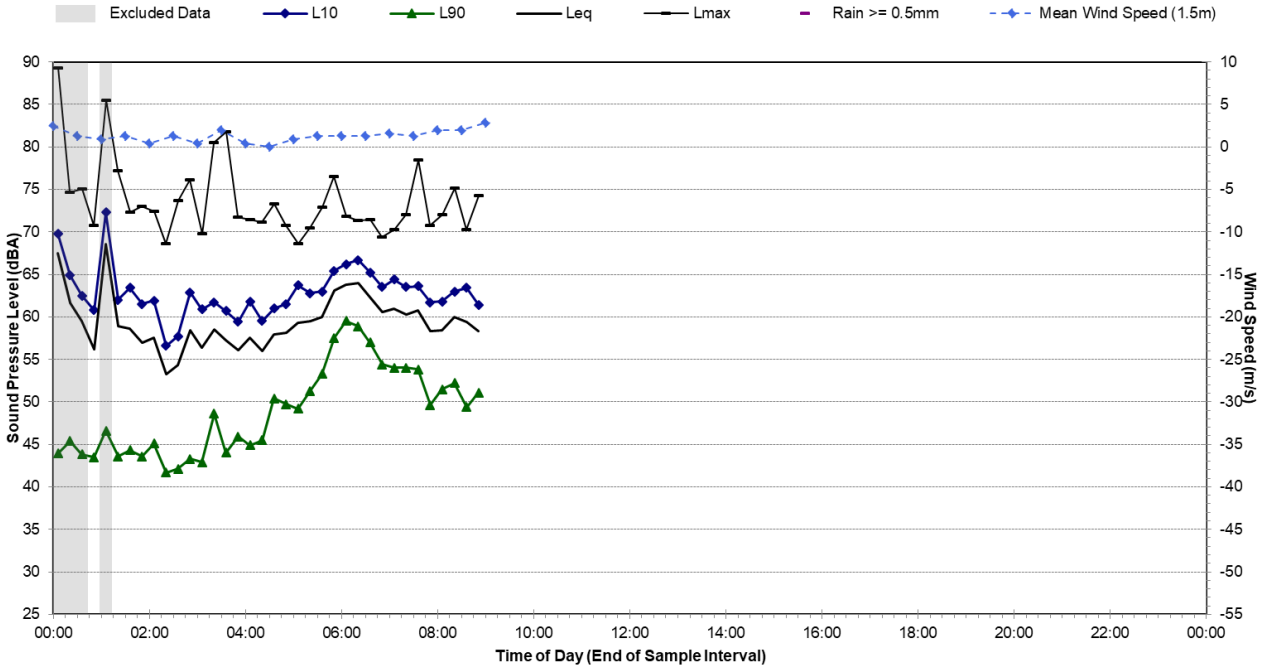
Statistical Ambient Noise Levels

L.05 - Lot 56 DP259135 – Western Site Boundary - Monday, 25 November 2019



Statistical Ambient Noise Levels

L.05 - Lot 56 DP259135 – Western Site Boundary - Tuesday, 26 November 2019



APPENDIX C

Construction Scenarios and Equipment

Table 1 Equipment Lists and Sound Power Levels

Equipment		Backhoe	Bobcat	Chipper	Concrete Mixer Truck	Dozer - D9	Dump Truck (approx. 15 tonne)	Elevated Working Platform	Excavator - Breaker[1]	Excavator (22 tonne)	Front End Loader	Generator	Grader	Hand Tools	Mobile Crane (100 tonne)	Paving Machine	Roller - Smooth Drum	Truck	Ute	Water Pump	Water Tanker (8000 litre)	Excavator - Ripper	Truck (Hiab)
Sound Power Level		102	104	120	103	112	107	97	126	105	110	102	108	94	100	105	107	108	98	83	98	105	108
Scenario	**Activity**																						
Enabling works	Supporting works									X	X	X						X	X		X		
	Demolition of existing structures								X	X	X	X						X	X		X		
Site establishment	Supporting and earthmoving					X				X	X			X				X	X		X		X
	Vegetation clearing			X		X				X	X			X				X	X		X		X
Bulk earthworks	General earthworks					X	X			X	X		X				X	X	X		X	X	
	Excavation through hard rock					X	X		X	X	X		X				X	X	X		X		
Stage 1: Infrastructure works	Construction works		X		X			X						X	X	X		X					
	Earthworks	X				X	X			X	X							X	X		X	X	

Note 1: Equipment classed as 'annoying' in the ICNG and requires a 5 dB correction.

Note 2: Sound power level data is taken from the DEFRA Noise Database, RMS *Construction and Vibration Guideline* and TfNSW *Construction Noise and Vibration Strategy*.

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