42 - 52 RAYMOND AVENUE, MATRAVILLE

SSDA Noise Impact Assessment

Prepared for:

HALE Capital Partners
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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 HALE Capital Partners (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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EXECUTIVE SUMMARY

SLR Consulting Australia Pty Ltd has been commissioned by Hale Capital on behalf of Ubris Pty Ltd to undertake a noise impact assessment in support of a State Significant Development application for a multi-level warehouse at 42-52 Raymond Avenue, Matraville.

The proposed development includes redevelopment of the site to construct and operate a two-storey warehouse and distribution centre including ancillary office space, landscaping, bicycle and car parking.

Unattended noise monitoring was completed in the study area in November 2021. The measured noise levels have been used to determine the existing noise environment and to set the criteria used to assess the potential impacts from the proposal.

Construction noise levels are expected to comply with the management levels at the nearest residential receivers. Exceedances are predicted at the nearest commercial receivers, however, this would only be expected to occur when noisy work is being completed close to the site boundary. When work is in other areas of the site, or when less noise intensive equipment is being used, the noise levels are expected comply with the management levels. Standard mitigation measures have been recommended to address the potential construction impacts.

Operational noise levels are generally expected to comply with the trigger levels at the nearest receivers. A relatively minor exceedance was predicted at the nearest residential receiver to the east during the night-time. A range of feasible and reasonable mitigation measures have been recommended to control the impacts.

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

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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Hale Capital to undertake a noise impact assessment in support of a State Significant Development (SSD) application (SSD 31552370) for a multi-level warehouse at 42-52 Raymond Avenue, Matraville.

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

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

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

1.1 Proposal Description

The proposed development includes a two-storey warehouse and distribution centre including ancillary office space, landscaping, bicycle and car parking.

The proposal comprises the redevelopment of the site as summarised below:

- Construction, fit out and operation of a two-storey warehouse and distribution centre comprising approximately 19,460 m^2 GFA including:
  - 17,789 m^2 of warehouse and distribution GFA; and
  - 1,671 m^2 GFA ancillary office space.
- Provision of 11 bicycle parking spaces and 101 car parking spaces at ground.
- Approximately 2,250 m^2 of hard and soft landscaping at ground.
- Provision of one additional access crossover from Raymond Avenue.
- Provision of internal vehicle access route and loading docks.
- Upgrades to existing on-site infrastructure.
- Building identification signage.
- Operation 24 hours per day seven days per week.

The site location is shown in **Figure 1** and the layout of the warehouses are shown in **Figure 2** and **Figure 3**.

The identified sources of noise from the proposed development include:

- Mechanical plant
- Operation of the ground and first-floor breezeways
- Truck movements on internal access roads, ramps and within breezeways
- Light vehicle movements on internal access roads and parking areas.

Figure 1 Site Location, Surrounding Receivers and Noise Monitoring Locations

Figure 2 Proposed Development – Ground Floor

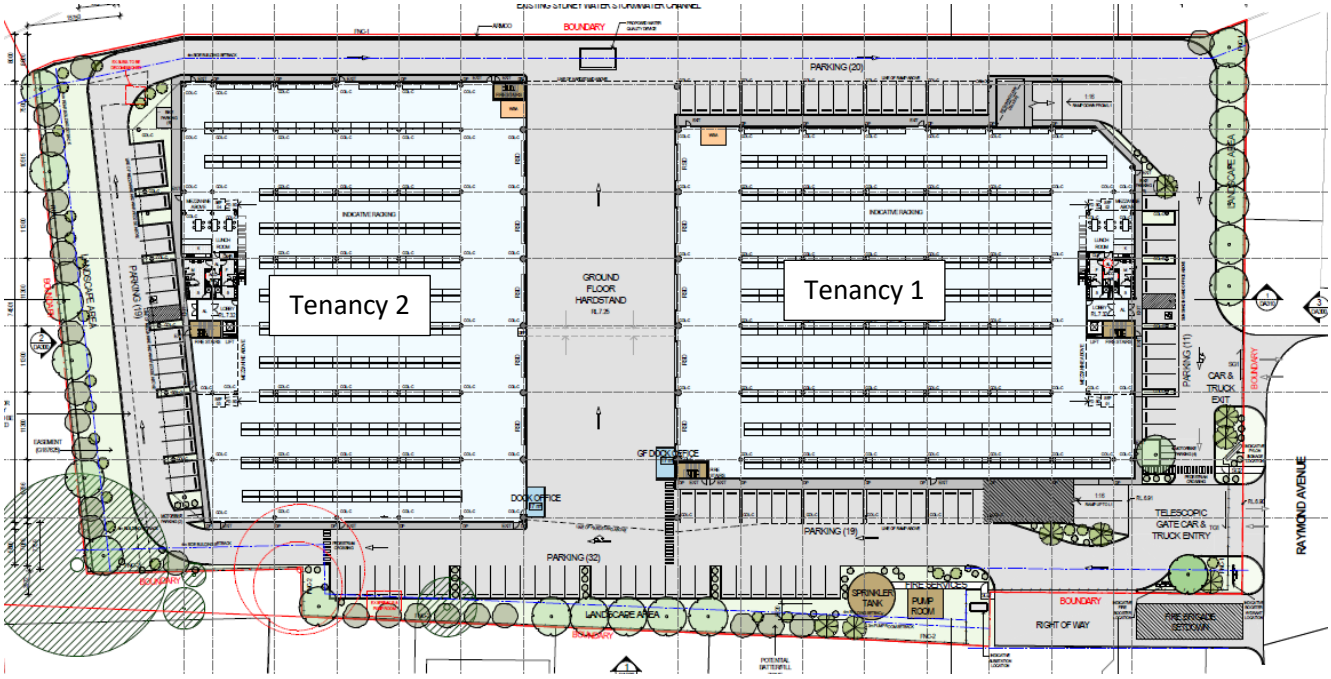
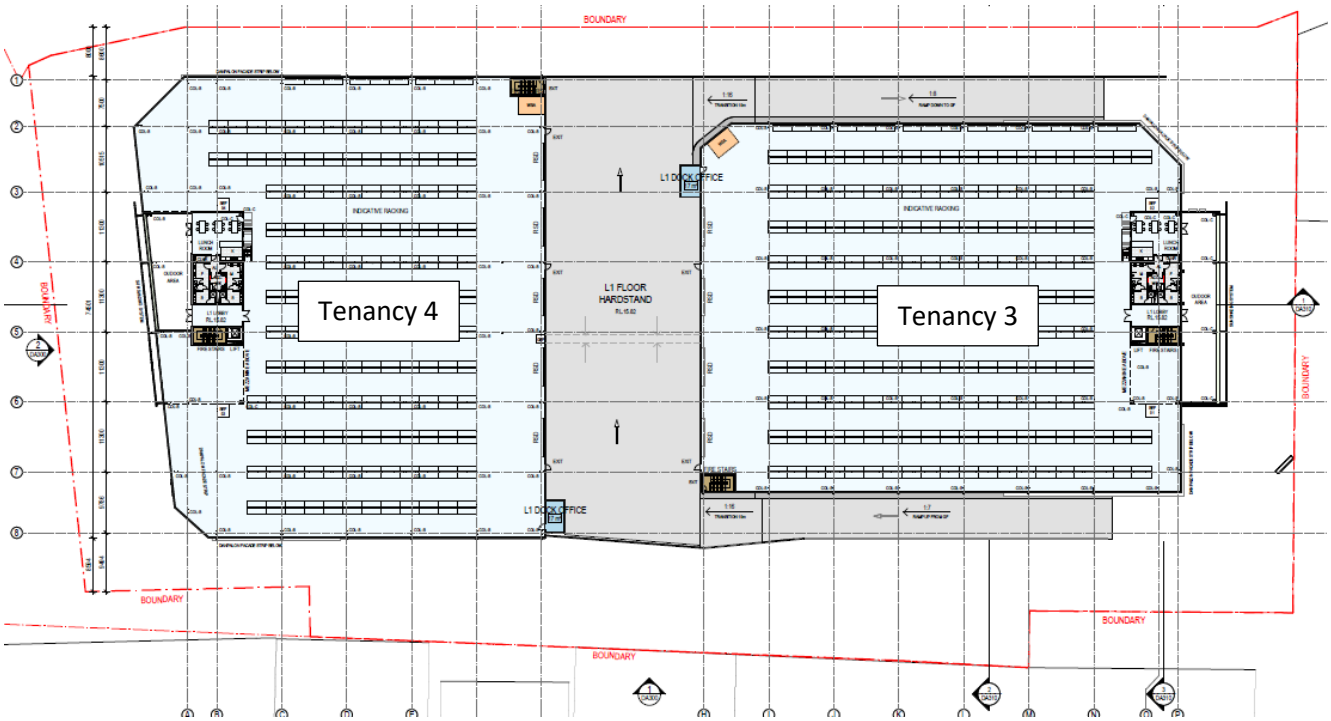


Figure 3 Proposed Development – First Floor



1.2 Secretary's Environmental Assessment Requirements – SSD 31552370

The Secretary's Environmental Assessment Requirements (SEARs) for SSD 31552370 were issued by the Department of Planning, Industry and Environment (DPIE) in November 2021. The requirements relevant to noise and vibration are shown in **Table 1**.

Table 1 Secretary's Environmental Assessment Requirements, SSD 31552370, 18 November 2021

Noise and Vibration	Where Addressed
Provide a noise and vibration assessment prepared in accordance with the relevant EPA guidelines. The assessment must detail construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that would be implemented.	**Construction:** **Section 4.1** **Section 5.1** **Section 5.2** **Operation:** **Section 4.2** **Section 5.3** **Mitigation:** **Section 6**

1.3 Nearest Receivers

The nearest receivers are commercial developments located 10 m to the north and east of the site. Industrial developments are located 20 m to the north-west of the site. The nearest residential receivers are located around 170 m to north-east of the site. The nearest receivers are shown in **Figure 1** and detailed in **Table 2**.

Table 2 Surrounding Sensitive Receivers

ID	Address	Type	Distance (m)	Direction
R01	40 McCauley Street, Matraville	Commercial	10	East
R02	33 Raymond Avenue, Matraville	Commercial	30	North-east
R03	17 McCauley Street, Matraville	Residential	170	North-east
R04	40 Raymond Avenue, Matraville	Commercial	10	North
R05	73-79 Beauchamp Road, Banksmeadow	Industrial	20	North-west

2 Existing Noise Environment

Unattended noise monitoring was completed in the study area in November 2021. The measured noise levels have been used to determine the existing noise environment and to set the criteria used to assess the potential impacts from the proposal.

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

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

The measured data has been processed to exclude noise from extraneous events and periods affected by adverse weather conditions, such as strong wind or rain (measured at the BOM weather station at Little Bay (The Coast Golf Club)), to establish representative existing noise levels in the study area.

The noise monitoring location is shown in **Figure 1** and the results are summarised in **Table 3**. Details of the unattended monitoring together with graphs of the measured daily noise levels are provided in **Appendix B**.

Table 3 Summary of Unattended Noise Monitoring Results

ID	Address	Measured Noise Levels (dBA)[1]					
		Background Noise (RBL)			Average Noise (L_{Aeq})		
		Day	Evening	Night	Day	Evening	Night
L01	15 McCauley Street, Matraville	44	42	42	56	52	50

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

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

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

3 Assessment Criteria

3.1 Construction Noise Criteria

3.1.1 Interim Construction Noise Guideline

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

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

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

3.1.1.1 Residential Receivers

The ICNG approach for determining NMLs at residential receivers is shown in **Table 4**.

Table 4 ICNG NMLs for Residential Receivers

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

	Highly Noise Affected 75 dBA	• The Highly Noise Affected (HNA) level represents the point above which there may be strong community reaction to noise
		• Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account:
		  ◦ Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools or mid-morning or mid-afternoon for works near residences
		  ◦ If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Time of Day	NML $L_{Aeq(15minute)}$	How to Apply
Outside Standard Construction Hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours • The proponent should apply all feasible and reasonable work practices to meet the noise affected level • Where all feasible and reasonable practises have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

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

3.1.1.2 'Other Sensitive' Land Uses and Commercial Receivers

The ICNG NMLs for 'other sensitive' non-residential land uses are shown in **Table 5**.

Table 5 Construction NMLs at 'Other Sensitive' Land Uses

Land Use	Noise Management Level $L_{Aeq(15minute)}$ (dBA) (applied when the property is in use)	
	Internal	External
ICNG 'Other Sensitive' Receivers		
Classrooms at schools and other educational institutions	45	55[1]
Hospital wards and operating theatres	45	65[2]
Places of worship	45	55[1]
Active recreation areas (characterised by sporting activities and activities which generate noise)	-	65
Passive recreation areas (characterised by contemplative activities that generate little noise)	-	60
Commercial	-	70
Industrial	-	75
Non-ICNG 'Other Sensitive' Receivers		
n/a	-	-

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

Note 2: It is assumed that these receivers have fixed windows which conservatively results in internal noise levels being around 20 dB lower than the external noise level.

3.1.1.3 NML Summary

The construction NMLs for the proposal have been determined using the results from the unattended noise monitoring and are shown in **Table 6**.

Table 6 Project Specific Noise Management Levels (dBA)

Receiver Type	Monitoring Location	Noise Management Level ($L_{Aeq(15minute)}$ – dBA)			
		Standard Construction (RBL +10 dB)[1]	Out of Hours (RBL +5 dB)		
		Daytime	Daytime[1]	Evening	Night-time
Residential (R03)	L01	54	49	47	47
Commercial (R01, R02, R04)	-	70	-	-	-
Industrial (R05)	-	75	-	-	-

Note 1: RBL = Rating Background Level.

Note 2: Daytime out of hours is 7 am to 8 am and 1 pm to 6 pm on Saturday, and 8 am to 6 pm on Sunday and public holidays.

3.2 Vibration Guidelines

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

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

3.2.1 Human Comfort Vibration

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

Vibration from construction works tends to be intermittent in nature and the EPA's *Assessing Vibration: a technical guideline* (2006) provides criteria for intermittent vibration based on the Vibration Dose Value (VDV). The 'preferred' and 'maximum' VDVs for human comfort impacts are shown in **Table 7**.

Table 7 Vibration Dose Values for Intermittent Vibration

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

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

3.2.2 Effects on Building Contents

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

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

3.2.3 Structural and Cosmetic Damage Vibration

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

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

BS 7385

British Standard BS 7385 recommends vibration limits for transient vibration judged to give a minimal risk of vibration induced damage to affected buildings. The limits for residential and industrial buildings are shown in **Table 8**.

Table 8 BS 7385 Transient Vibration Values for Minimal Risk of Damage

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

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

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

DIN 4150

German Standard DIN 4150 also provides guideline vibration limits for different buildings. Damage is not expected to occur where the values are complied with and the values are generally recognised to be conservative. The DIN 4150 values for buildings and structures are shown in **Table 9**.

Table 9 DIN 4150 Guideline Values for Short-term Vibration on Structures

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

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

3.2.4 Minimum Working Distances for Vibration Intensive Works

Minimum working distances for typical vibration intensive construction equipment are provided in the Roads and Maritime (now Transport for NSW) *Construction Noise and Vibration Guideline* (CNVG) and are shown in **Table 10**. The minimum working distances are for both cosmetic damage (from BS 7385 and DIN 4150) and human comfort (from the NSW EPA Vibration Guideline). They are based on empirical data which suggests that where works are further from receivers than the quoted minimum distances then impacts are not considered likely.

Table 10 Recommended Minimum Working Distances from Vibration Intensive Equipment

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

Plant Item	Rating/Description	Minimum Distance		
		Cosmetic Damage		Human Response (NSW EPA Guideline)
		Residential and Light Commercial (BS 7385)	Heritage Items (DIN 4150, Group 3)	
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	5 m	4 m
Jackhammer	Hand held	1 m (nominal)	3 m	2 m

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

3.3 Operational Noise Criteria

3.3.1 Noise Policy for Industry

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

3.3.1.1 Industrial Noise Trigger Levels

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

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

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

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

The NPfI provides guidance on assigning residential receiver amenity noise categories based on the site-specific features shown in **Table 11**.

Table 11 Residential Receiver Amenity

Receiver Category	Typical Planning Land Use Zoning	Typical Existing Background Noise Levels (RBL)	Description
Rural	RU1 – primary production RU2 – rural landscape RU4 – primary production small lots R5 – large lot residential E4 – environmental living	Daytime <40 dBA Evening <35 dBA Night <30 dBA	Rural – an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels. Settlement patterns would be typically sparse. Note: Where background noise levels are higher than those presented due to existing industry or intensive agricultural activities, the selection of a higher noise amenity area should be considered.
Suburban residential	RU5 – village RU6 – transition R2 – low density residential R3 – medium density residential E2 – environmental conservation E3 – environmental management	Daytime <45 dBA Evening <40 dBA Night <35dBA	Suburban – an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristic: evening ambient noise levels defined by the natural environment and human activity.
Urban residential	R1 – general residential R4 – high density residential B1 – neighbourhood centre (boarding houses and shop-top housing) B2 – local centre (boarding houses) B4 – mixed use	Daytime >45 dBA Evening >40 dBA Night >35 dBA	Urban – an area with an acoustical environment that: • Is dominated by 'urban hum' or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources • Has through-traffic with characteristically heavy and continuous traffic flows during peak periods • Is near commercial districts or industrial districts • Has any combination of the above.

Amenity noise categories for the surrounding receivers have been determined with reference to the NPFI. The assessment is shown in **Table 12**.

Table 12 Residential Receiver Amenity Category Assessment

Area	Land Use Zoning	Existing Background Noise Levels RBL (dBA)			Resulting Amenity Classification	Discussion
		Day	Eve	Night		
North east (R03)	R2 – low density residential	44	42	42	Urban	The surrounding area is zoned as R2 – low density residential, however, residences have been classified as urban due to high existing background noise levels that are dominated by road traffic and industrial noise, and due to the location being near to existing commercial/industrial districts.

3.3.1.2 Project Noise Trigger Levels

The trigger levels for industrial noise from the proposal are summarised in **Table 13**. They are based on the previously measured background noise levels, where appropriate. The Project Noise Trigger Levels (PNTL) are the most stringent of the intrusiveness and amenity trigger level for each period and are highlighted below.

Table 13 Project Noise Trigger Levels

Receiver Type	Period	Amenity Noise Level L_{Aeq} (dBA)	Measured Noise Level (dBA)		Project Noise Trigger Levels $L_{Aeq(15minute)}$ (dBA)	
			RBL[1]	$L_{Aeq(period)}$	Intrusiveness	Amenity[2,3]
Commercial (R01, R02, R04)	When in use	65	-	-	-	63
Residential (R03)	Day	60	44	56	**49**	58
	Evening	50	42	52	**47**	48
	Night	45	42	50	47	**43**
Industrial (R05)	When in use	70	-	-	-	68

Note 1: RBL = Rating Background Level.

Note 2: The recommended amenity noise levels have been reduced by 5 dB, where appropriate, 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.

3.3.1.3 Sleep Disturbance

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

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

The sleep disturbance screening levels for the development are shown in **Table 14**.

Table 14 Sleep Disturbance Screening Levels

Location	Noise Level (dBA)	
	Measured Prevailing Night-time Background Level	Sleep Disturbance Screening Level[1]
R03	42	57

Note 1: The sleep disturbance screening level as 52 dBA L_{AFmax} or the prevailing background level plus 15 dB, whichever is greater

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

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

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

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

3.3.2 Corrections for Annoying Noise Characteristics

Sources of industrial noise can cause greater annoyance where they contain certain characteristics, such as tonality, intermittency or dominant low-frequency content. The NPfI specifies the following modifying factor corrections, shown in **Table 15**, which are to be applied where annoying characteristics are present. The corrections are to be added to the noise level at the receiver before comparison with the Project Noise Trigger Levels.

Table 15 NPfI Modifying Factor Corrections

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

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

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

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

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

3.3.3 Traffic on Surrounding Roads

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

An initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2.0 dB. Where this is considered likely, further assessment is required using the RNP criteria shown in **Table 16**.

Table 16 RNP/NCG Criteria for Assessing Traffic on Public Roads

Road Category	Type of Project/Land Use	Assessment Criteria (dBA)	
		Daytime (7 am – 10 pm)	Night-time (10 pm – 7 am)
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hour)}$ 60 (external)	$L_{Aeq(9hour)}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hour)}$ 55 (external)	$L_{Aeq(1hour)}$ 50 (external)

4 Methodology

4.1 Construction Noise and Vibration Assessment

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

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

4.1.1 Construction Activities

Representative scenarios have been developed to assess the likely impacts from the various construction phases of the proposal. These scenarios are shown in **Table 17**.

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

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

Table 17 Construction Equipment

Scenario	Equipment
Civil Works	Excavator (30t), articulated dump truck (30t), roller (20t), water cart
Piling[1]	Piling rig - bored, concrete mixer truck, excavator (15t), mobile crane - franna, water cart
Structural Steel	Mobile crane (100t), elevated working platform, mobile crane - franna, hand tools, hiab truck, watercart
Fitout (Internal)	Concrete mixer truck, concrete pump, elevated working platform, scissor lift, hand tools, mobile crane – franna, forklift
Stormwater and Pavements	Concrete mixer truck, excavator (15t), forklift, hand tools, roller (20t), roller (7t), tipper truck, truck and dog, water cart

Note 1: Piling has been included as an indicative scenario and may not be required.

4.1.2 Hours of Construction

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

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

4.2 Operational Noise Assessment

The project is in the early design stages and the future tenants are currently unknown. Several assumptions have been made regarding the future tenants and sources of noise, based on the likely warehouse and distribution uses. These assumptions have been used to develop representative worst-case noise modelling scenarios that reflect the highest noise emissions that the development would likely emit.

The potential operational noise levels from the proposal have been predicted to the surrounding receivers using the CONCAWE industrial noise algorithm in SoundPLAN. The model includes ground topography, ground type (ground absorption modelled as 0 for the development site and 0.5 for residential areas), buildings and representative worst-case noise sources from the proposal.

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

4.2.1 Operational Noise Sources

42 Raymond Avenue is a speculative development with no tenants committed. The facility has been designed to accommodate typical warehouse and distribution centre occupiers in accordance with the permitted use of IN1 zoning under the Three Ports SEPP. The site's location close to Port Botany is expected to attract port users including third party logistics providers and import/export businesses.

The ground floor has been designed to meet the needs of this target market, accommodating for a wide range of freight vehicles up to b-doubles. One way circulation allows heavy vehicles to efficiently side load within the undercover breezeway. Medium rigid vehicles and smaller are able to rear load via the on-grade doors to each warehouse. Unloading of containers would take place on the hardstand within the breezeway.

The site's close proximity to the airport and urban population, lends itself to last mile and ecommerce users who rely on short delivery times as a key function of their business. It is common for these types of users to adopt a hub and spoke model, with a distribution centre located in Western Sydney where larger footprints are prevalent and more economical, and with smaller facilities in last mile locations closer to population centres. These occupiers typically use forklifts and manual handling to load goods into the rear of vans and rigid vehicles. It is anticipated that the use of articulated heavy vehicles will be limited.

Internal operations could include manual loading, forklift use and potentially minor automation including autonomous mobile robots (AMR). There will be no use of overhead gantry cranes and other manufacturing equipment within the facility.

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

- On-site light and heavy vehicle movements (accessing both ground and first floor levels)
- Loading dock activities within breezeways (on both ground and first floor levels)
- Mechanical plant
- Off-site vehicle movements.

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

On-Site Traffic

On-site vehicles have been modelled using the data in **Table 18**. The volumes are representative of the worst-case 15-minute period for the daytime, evening and night-time. The volumes conservatively assume that light and heavy vehicles concurrently access the various warehouse tenancies during the worst-case 15-minute assessment period. In reality, vehicle access to each warehouse would be unlikely to occur concurrently, particularly during the night-time.

Heavy vehicle deliveries to the ground floor warehouses would be via a range of freight vehicles up to large trucks (ie semi-trailers or b-doubles). The majority of deliveries to the first-floor warehouses are expected to be with small or medium trucks (ie rigid trucks). Two assessment scenarios have been considered – one which conservatively assumes large truck deliveries to both floors and one assuming for large trucks at ground floor and medium trucks at first floor.

Table 18 Vehicle Traffic Data – Worst-case 15-Minute Period

Vehicle Type	Location	Sound Power Level (dBA)	Vehicle Speed (km/h)	Number of Vehicles in Worst-case 15-minute Period[1]		
				Daytime (7am to 6pm)	Evening (6pm to 10pm)	Night-time (10pm to 7am)
Scenario 1 Large Trucks						
Warehouse Tenancy 1 and 2 (Ground Floor)						
Large trucks	Access routes	108[2,3]	25	2	2	2
	Breezeways		5			
Warehouse Tenancy 3 and 4 (First Floor)						
Large trucks	Access routes	108[2,3]	25	1	1	1
	Breezeways		5			
	Ramps	111[3]	20			
Site Carpark						
Light vehicles	Car park	96[4]	20	13	12	6
Scenario 2 Large Trucks at Ground Floor, Medium Trucks at First Floor						
Warehouse Tenancy 1 and 2 (Ground Floor)						
Large trucks	Access routes	108[2,3]	25	2	2	2
	Breezeways		5			
Warehouse Tenancy 3 and 4 (First Floor)						
Medium trucks	Access routes	102[2,3]	25	2	2	2
	Breezeways		5			
	Ramps	106[3]	20			
Site Carpark						
Light vehicles	Car park	96[4]	20	13	12	6

Note 1: Two-way movement, vehicles conservatively assumed to both enter and exit.

Note 2: Sound power level for large trucks based on 106 dBA for trucks at slow speed for 80% of the time and 111 dBA for trucks accelerating for 20% of the time. Sound power level for medium trucks based on 100 dBA for trucks at slow speed for 80% of the time and 106 dBA for trucks accelerating for 20% of the time.

Note 3: Sound power levels taken from the Federal Highway Administration's Traffic Noise Model.

Note 4: Sound power level taken from *Road Traffic Noise Prediction Model "ASJ RTN-Model 2013" Proposed by the Acoustical Society of Japan – Part 2: Study on Sound Emission of Road Vehicles*, OKADA et al, Internoise 2014, and accounts for vehicles accelerating.

Breezeways and Loading Docks

Details of the breezeway and hardstand loading dock noise sources are shown in **Table 19**. The various sources have been modelled in the hardstand loading dock areas (see **Figure 2**, **Figure 3** and **Figure 4**) based on the corresponding number of heavy vehicle movements in the worst-case 15-minute periods (see **Table 18**).

The warehouses do not have recessed loading docks and it is assumed that all trucks will travel in a forward direction and would typically not require reversing alarms.

Table 19 Typical Breezeway and Loading Dock Noise Sources

Noise Source	Sound Power Level (dBA)	Typical Duration of Use in Worst-case 15-minute Period	Source Height (m)[1]
Forklift reversing alarm[2]	102[3]	90 seconds	0.5
Truck air brakes	118	1 second	1.0
Roller door	94	15 seconds	6.0
Gas forklift	93	900 seconds	1.0

Note 1: Relative to local elevation at ground or first floor level, as appropriate.

Note 2: SWL based on recommendation to use broadband reversing alarms, see **Section 6.2.**

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

Internal Activities

The internal noise-generating activities at all warehouses are expected to generally be minimal. An internal sound power level of 75 dBA has been included for each warehouse to represent breakout from general internal activities through roller shutter doors. Warehouse roller shutter doors are assumed to be open during loading dock activities.

Mechanical Plant

Mechanical plant associated with the proposal includes air-conditioning equipment serving the office buildings and roof mounted extraction fans for each warehouse. Mechanical plant associated with the proposal is shown in **Table 20**. The locations of the sources are shown in **Figure 4**.

The office air-conditioning is assumed to be operational during the daytime period, with the extraction fans operational for a two hour period during the night-time only.

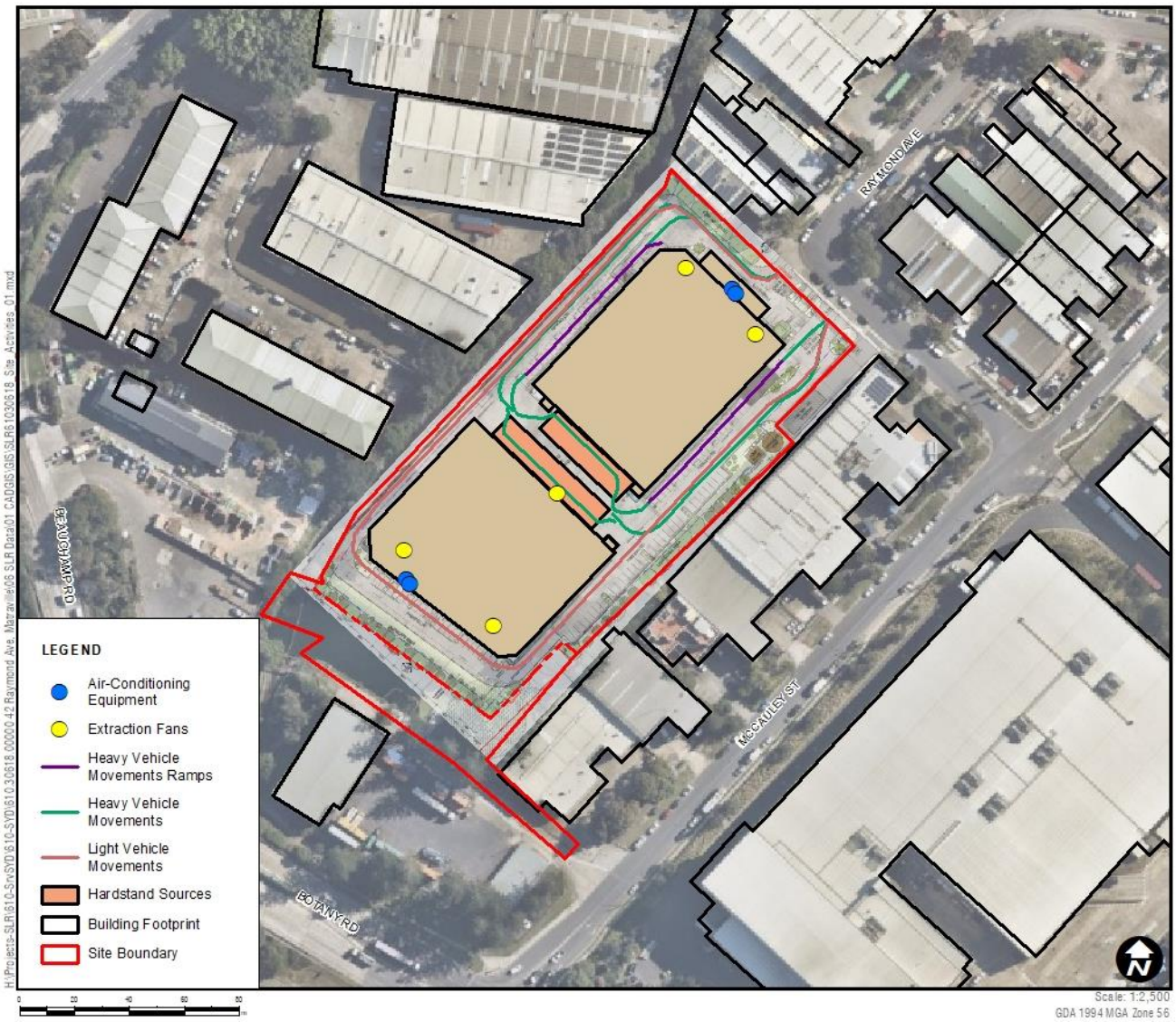
Table 20 Mechanical Plant

Noise Source	Sound Power Level (dBA)	Location	Operational Time
Air-conditioning equipment	72 dBA[1]	• Office 03 roof • Warehouse roof above office 04	8 am to 6 pm
Extraction fans	91 dBA[2] (SEF-1 to 4) 91 dBA[2] (GEF-HS-1)	• Two at north-eastern end • Two at south-western end • One centrally to warehouse roof	Two hours between 10 pm and 7 am.

Note 1: SWL based on sound pressure level at 1 m provided in manufacturer data.

Note 2: SWL based on manufacturer data.

Figure 4 Modelled Source Locations



4.2.2 Corrections for Annoying Noise Characteristics

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

- **Tonality** – the only source identified with potential tonal characteristics is reversing alarms. However, when considering broadband reversing alarms have been recommended as a noise mitigation measure (see **Section 6.2**), it is unlikely that this noise source would result in tonal noise impacts and no corrections have been applied.
- **Low frequency noise** – previous measurements of sources similar to those operating at the development indicate that no sources are expected to result in low frequency noise impacts.
- **Intermittent noise** – the NPfI defines intermittent noise as noise heard at the receiver where the level suddenly drops or increases several times during the assessment period, with a noticeable change of at least 5 dB. The audibility of noise would depend on several factors occurring at the time of potentially intermittent noise events, including the other noise sources operating at the development site and the existing background noise level at the receiver.

  The only source identified with potential intermittent characteristics is reversing alarms. However, when considering broadband reversing alarms have been recommended as a noise mitigation measure (see **Section 6.2**), and that the loading dock areas are generally screened from view of the nearest residential receivers which are around 170 m away, it is unlikely that this noise source would result in noise impacts at the receiver that change by at least 5 dB. No corrections for intermittent noise have, therefore, been applied.

4.2.3 Noise Sources with Potential for Sleep Disturbance

As the development is proposed to operate 24-hours a day, noise emissions during the night-time require assessment for potential sleep disturbance at the nearest residential receivers. The details of typical activities with the potential to cause sleep disturbance are shown in **Table 21**.

Table 21 Sleep Disturbance Noise Events – L_{Amax} Sound Power Levels

Noise Source	Sound Power Level L_{Amax} (dBA)	Source Height (m)[1]
Large truck airbrake	118	1.0
Forklift reversing alarm	105	0.5
Roller door	94	6.0

Note 1: Relative to local elevation at ground or first floor level. Sources are modelled at ground and first floor as appropriate.

4.2.4 Off-site Road Traffic

The majority of traffic associated with the development is expected to enter and exit the development from the south via McCauley Street and Botany Road. The potential noise impacts from development related traffic on public roads are expected to be negligible given there are no sensitive receivers on this route and Botany Road is a major arterial road with high existing traffic volumes.

4.2.5 Weather Conditions

Certain weather conditions can increase noise levels by focusing noise towards receivers. Noise-enhancing weather conditions can occur where wind blows from the source to the receiver, or where temperature inversions occur.

The NPfI defines 'standard' and 'noise-enhancing' weather conditions as shown in **Table 22**. Noise-enhancing weather should be included in the assessment where it occurs for more than 30% of the daytime, evening or night-time period in any season.

Table 22 Standard and Noise-enhancing Weather Conditions

Weather Conditions	Meteorological Parameters
Standard	Daytime/evening/night-time: stability categories A–D with wind speed up to 0.5 m/s
Noise-enhancing	Daytime/evening: stability categories A–D with light winds up to 3 m/s Night-time: stability categories A–D with light winds up to 3 m/s and/or stability category F with winds up to 2 m/s

The NPfI contains guidance for determining noise enhancing weather conditions. Data measured between January 2013 and December 2021 at BOM weather station at Little Bay (The Coast Golf Club) has been used to determine the occurrence of noise-enhancing weather conditions at the site and a summary is shown in **Table 23**.

Table 23 Occurrence of Noise-enhancing Weather Conditions

Period	Wind Speed from 0.5 to 3 m/s (Frequency of Occurrence > 30%)				Atmospheric Stability Class F or G[1]
	Southerly	South-westerly	Westerly	North-westerly	
Daytime	-	-	-	-	-
Evening	-	-	-	-	-
Night-time	-	-	Yes	Yes	Yes

Note 1: Noise-enhancing conditions for temperature inversions based on atmospheric stability class are only applied to the night-time assessment.

The weather analysis shows that noise-enhancing weather conditions are expected to be a feature of the site during the night-time, with westerly and north-westerly winds up to 3 m/s occurring for more than 30% of the night-time period in autumn, winter and spring. The weather conditions used in the assessment are shown in **Table 24**.

Table 24 Modelled Weather Conditions

Period	Weather Condition	Meteorological Parameters used in Assessment
Daytime	Standard	Stability category D with source to receiver wind up to 0.5 m/s
Evening	Standard	
Night-time	Noise-enhancing	Stability category D with source to receiver wind up to 3 m/s, and stability category F with source to receiver wind up to 2 m/s

5 Assessment of Impacts

5.1 Construction Noise Predictions

The predicted noise levels at the most-affected sensitive receivers surrounding the site are shown in **Table 25** and the exceedances of the NMLs are shown in **Table 26**.

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

Table 25 Predicted Construction Noise Levels at Nearest Receivers

ID	Address	Type	NML	Predicted Noise Level – $L_{Aeq(15minute)}$ (dBA)				
				Civil Works	Piling[2]	Structural Steel	Fitout (Internal)	Stormwater and Pavements
R01	40 McCauley Street, Matraville	Commercial	70	85	84	79	80	85
R02	33 Raymond Avenue, Matraville	Commercial	70	72	71	66	67	72
R03	17 McCauley Street, Matraville	Residential	54	52	51	46	47	52
R04	40 Raymond Avenue, Matraville	Commercial	70	83	82	77	78	83
R05	73-79 Beauchamp Road, Banksmeadow	Industrial	75	80	79	74	75	80

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

Note 2: Piling has been included as an indicative scenario and may not be required.

Table 26 Predicted Exceedance at Nearest Receivers

ID	Address	Type	NML	Exceedance (dB)				
				Civil Works	Piling	Structural Steel	Fitout (Internal)	Stormwater and Pavements
R01	40 McCauley Street, Matraville	Commercial	70	15	14	9	10	15
R02	33 Raymond Avenue, Matraville	Commercial	70	2	1	-	-	2
R03	17 McCauley Street, Matraville	Residential	54	-	-	-	-	-
R04	40 Raymond Avenue, Matraville	Commercial	70	13	12	7	8	13
R05	73-79 Beauchamp Road, Banksmeadow	Industrial	75	5	4	-	-	5

The above shows that noise levels from all construction activities are expected to comply with the NMLs at the nearest residential receivers. No residential receivers are predicted to be Highly Affected during any of the works.

Worst-case exceedances of around 10 to 15 dB are predicted at the adjacent commercial receivers, however, this would only be expected to occur when noisy work is being completed close to the site boundaries. When work is in other areas of the site, or when less noise intensive equipment is being used, the noise levels are expected comply with the NMLs.

5.2 Construction Vibration

The major potential sources of vibration from the proposed construction activities would likely be during 'Civil Works' and 'Stormwater and Pavements' when vibratory rollers are being used.

Vibration offset distances have been determined from the CNVG minimum working distances for cosmetic damage and human response (see **Table 10**) and the assessment is summarised in **Figure 5** and **Figure 6** for a 20 t vibratory roller and 7 t vibratory roller, respectively. Buildings within the minimum working distances are shown in the figures.

Figure 5 Construction Vibration – Vibratory Roller (20 t)

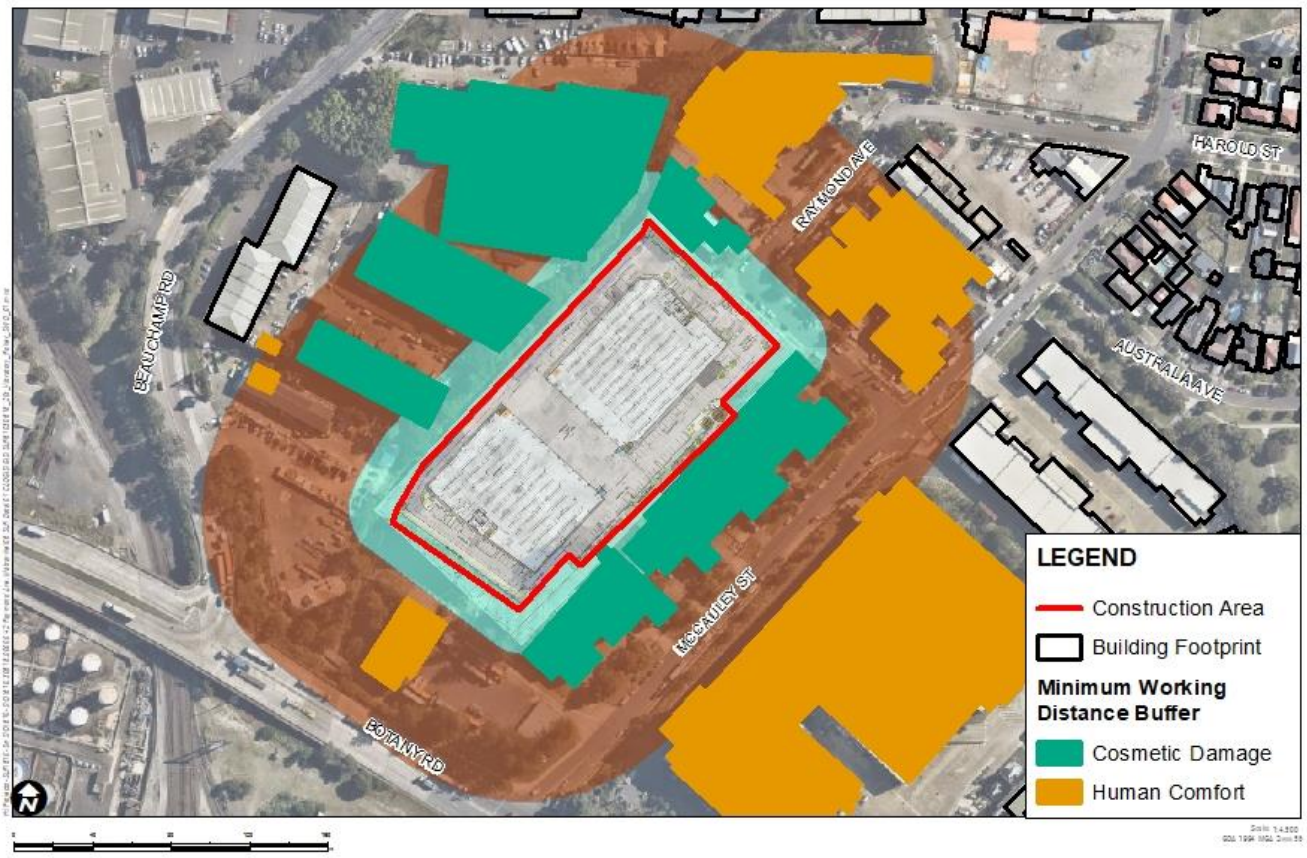
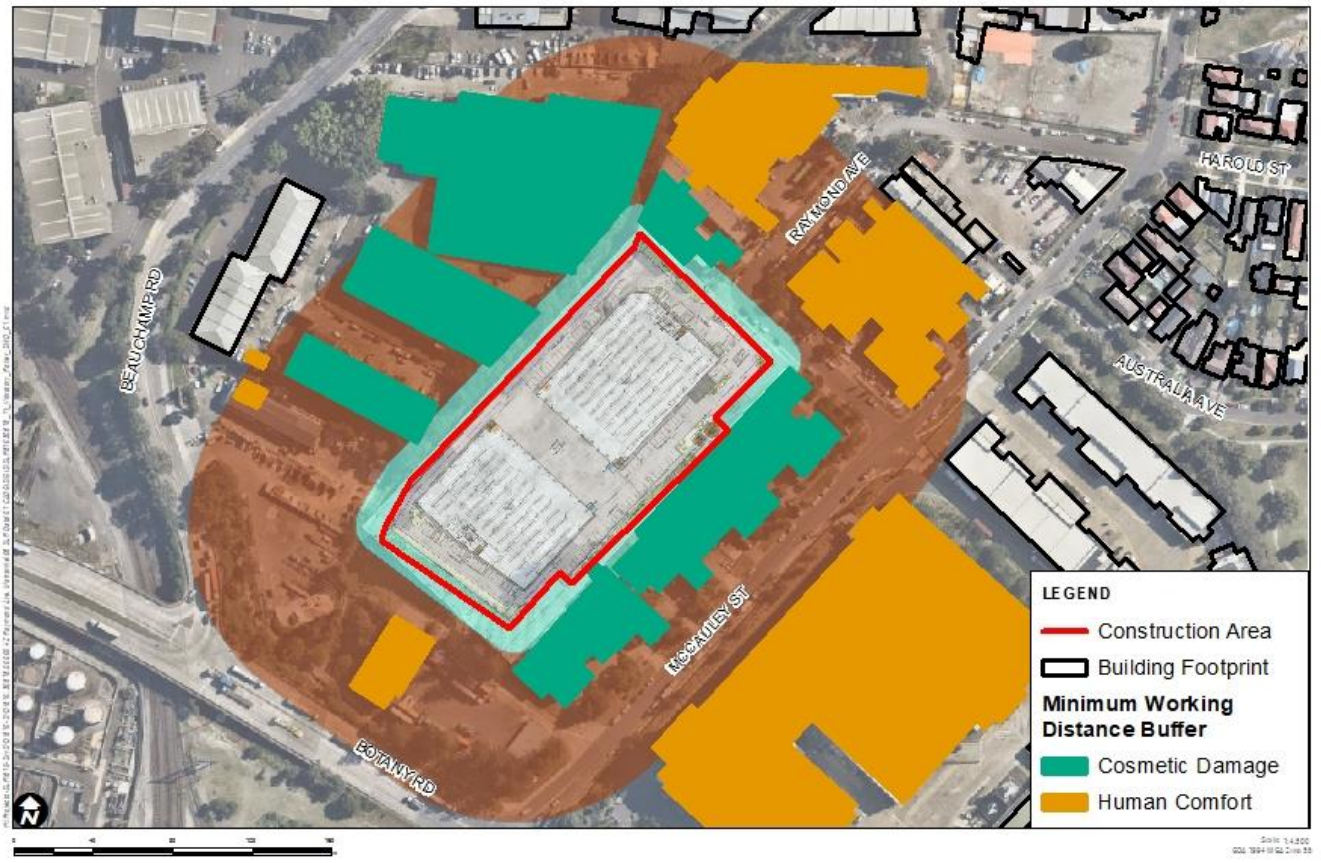


Figure 6 Construction Vibration – Vibratory Roller (7 t)



Cosmetic Damage Assessment

The above figures show that the distance between the construction works and the nearest sensitive receivers is generally sufficient for most receiver buildings to be outside of the cosmetic damage minimum working distance for vibration intensive equipment. However, the nearest commercial buildings are likely to be within the minimum working distances when vibratory rollers are in use nearby.

Construction mitigation and management measures are discussed further in **Section 6**.

Human Comfort Vibration Assessment

The above figures indicate that several commercial and industrial developments are within the human comfort minimum working distance and occupants of these buildings may be able to perceive vibration impacts at times when vibratory rollers are in use nearby. Where impacts are perceptible, they would likely only be apparent for relatively short durations when vibration intensive equipment is in use.

Sydney Water Stormwater Channel

An existing Sydney Water stormwater channel is located near the north-western boundary of the site. There is potential for vibration impacts on this structure when vibration intensive construction work is being completed near this boundary. Appropriate minimum working distances and an exclusion zone to the stormwater channel would be developed with Sydney Water as required as the project progresses. Where vibration intensive construction work is required within the minimum working distances appropriate mitigation and management measures would be used.

5.3 Operational Noise Assessment

5.3.1 Predicted Unmitigated Noise Levels

A summary of the worst-case operational noise assessment at the receivers surrounding the proposal is shown in **Table 27**. Impacts have been predicted at all floors of the nearest receivers. The predicted worst-case levels are compared to the Project Noise Trigger Levels to determine the potential impact from the proposal.

Noise contours of the predicted worst-case operational noise impacts are in **Appendix D.**

Table 27 Operational Noise Assessment – Unmitigated

Scenario	Receiver Location	Period	Noise Level $L_{Aeq(15minute)}$ (dBA)			Compliance
			Noise Criteria	Predicted	Exceedance	
Scenario 1 (large trucks)	R01 - 40 McCauley Street, Matraville (commercial)	When in use	63	61	-	Yes
	R02 - 33 Raymond Avenue, Matraville (commercial)	When in use	63	56	-	Yes
	R03 - 17 McCauley Street, Matraville (residential)	Day	49	44	-	Yes
		Evening	47	44	-	Yes
		Night	43	45	2	**No**
	R04 - 40 Raymond Avenue, Matraville (commercial)	When in use	63	62	-	Yes
	R05 - 73-79 Beauchamp Road, Banksmeadow (industrial)	When in use	68	63	-	Yes
Scenario 2 (large trucks at ground floor, medium trucks at first floor)	R01 - 40 McCauley Street, Matraville (commercial)	When in use	63	61	-	Yes
	R02 - 33 Raymond Avenue, Matraville (commercial)	When in use	63	56	-	Yes
	R03 - 17 McCauley Street, Matraville (residential)	Day	49	44	-	Yes
		Evening	47	44	-	Yes
		Night	43	44	1	**No**
	R04 - 40 Raymond Avenue, Matraville (commercial)	When in use	63	62	-	Yes
	R05 - 73-79 Beauchamp Road, Banksmeadow (industrial)	When in use	68	63	-	Yes

The above assessment indicates that noise from the proposal is predicted to comply with the Project Noise Trigger Levels at most of the surrounding receivers during both Scenario 1 (large trucks) and Scenario 2 (large trucks at ground floor, medium trucks at first floor).

Exceedances of 1 to 2 dB are, however, predicted in Scenario 1 and 2 respectively at the nearest residential receiver (R02) during the night-time. The predicted exceedances are caused by a combination of noise from the roof mounted fans, on-site truck movements and loading activities.

5.3.2 Predicted Mitigated Noise Levels

Feasible and reasonable mitigation measures have been investigated for the development with the aim of reducing noise levels to the Project Noise Trigger Levels. A detailed investigation of feasible and reasonable mitigation is provided in **Section 6.2**.

In summary, the following measures have been applied to reduce noise emissions. These mitigation measures are included in the design and operation of the development:

- Lower noise output roof mounted fans
- Use of broadband and/or ambient noise sensing reversing alarms to minimise potentially annoyance
- Roller doors should be kept closed when un/loading is not occurring.

A summary of the predicted impacts in the mitigated scenario is shown in **Table 28**.

Table 28 Operational Noise Assessment – Mitigated

Scenario	Receiver Location	Period	Noise Level $L_{Aeq(15minute)}$ (dBA)			Compliance
			Noise Criteria	Predicted	Exceedance	
Scenario 1 (large trucks)	R01 - 40 McCauley Street, Matraville (commercial)	When in use	63	61	-	Yes
	R02 - 33 Raymond Avenue, Matraville (commercial)	When in use	63	55	-	Yes
	R03 - 17 McCauley Street, Matraville (residential)	Day	49	41	-	Yes
		Evening	47	41	-	Yes
		Night	43	42	-	Yes
	R04 - 40 Raymond Avenue, Matraville (commercial)	When in use	63	62	-	Yes
	R05 - 73-79 Beauchamp Road, Banksmeadow (industrial)	When in use	68	63	-	Yes
Scenario 2 (large trucks at ground floor, medium trucks at first floor)	R01 - 40 McCauley Street, Matraville (commercial)	When in use	63	61	-	Yes
	R02 - 33 Raymond Avenue, Matraville (commercial)	When in use	63	55	-	Yes
	R03 - 17 McCauley Street, Matraville (residential)	Day	49	41	-	Yes
		Evening	47	41	-	Yes
		Night	43	42	-	Yes
	R04 - 40 Raymond Avenue, Matraville (commercial)	When in use	63	62	-	Yes
	R05 - 73-79 Beauchamp Road, Banksmeadow (industrial)	When in use	68	63	-	Yes

The above assessment indicates that the proposed mitigation measures are expected to reduce noise levels at the nearest receivers to comply with the Project Noise Trigger Levels during all periods.

5.3.3 Sleep Disturbance

The predicted night-time maximum noise levels at the nearest residential receivers are shown in **Table 29**. These include the mitigation measures specified in **Section 5.3.2**.

Table 29 Sleep Disturbance Assessment

Receiver Location	Source	Maximum Noise Level L_{Amax} (dBA)			Below Screening Level
		Sleep Dist. Screening Level	Predicted	Exceedance	
R03 - 17 McCauley Street, Matraville	Forklift reversing alarm	57	52	-	Yes
	Large truck airbrake (ground floor hardstand)		54	-	Yes
	Large truck airbrake (first floor hardstand)		60	3	**No**
	Roller door		41	-	Yes

The above shows that maximum noise levels are generally expected to comply with the sleep disturbance screening level at R03 except for a relatively minor exceedance when truck airbrakes are used at the first-floor hardstand. It is noted that large trucks are not expected to frequently access the first-floor level meaning this impact would not regularly occur.

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

5.3.3.1 Detailed Maximum Noise Level Assessment

The detailed maximum noise level assessment is summarised in **Table 30**. Receiver R03 was predicted to have an exceedance of the sleep disturbance screening level from large truck airbrakes when stopping in the first-floor hardstand.

Table 30 Detailed Maximum Noise Level Assessment

Receiver	Maximum Noise Level L_{Amax} (dBA)					Comments
	Sleep Disturbance Goals (dBA)		Development Related Maximum Noise Events		Existing Maximum Noise Levels	
	Awakening Response[1]	Good Sleep	Predicted	Frequency of Occurrence		
R03	65	Around 55 (10 to 15 times per night)	60	Infrequent, as large trucks are not expected to regularly access the first floor	60-65[3]	**Awakening Response:** maximum noise levels from airbrakes of large trucks when stopping at the first-floor breezeway are predicted to be below the 'awakening response' level. **Good Sleep:** large trucks are not expected to frequently access the first floor of the development during the night-time period. Maximum noise events from large truck airbrakes are, therefore, not expected adversely affect 'good sleep' (ie they not expected to occur more than 10-15 times per night). **Existing maximum noise levels:** The unattended noise monitoring completed at L01 (near to R03) showed that vehicles frequently use McCauley Street during the night-time. Existing maximum noise levels were measured to frequently be in the order of 60 to 65 dBA at R03. Development related maximum noise levels are likely to be similar in magnitude, or lower than, existing maximum noise levels.

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

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

Note 3: Distance corrected from unattended monitoring location (L01) to receiver.

The predicted maximum noise levels at all surrounding receivers are expected to be below the levels outlined in the RNP that would be considered to have the potential to cause sleep disturbance and are expected to be comparable to or lower than existing maximum noise levels from existing vehicles on the surrounding roads.

Based on the above, the predicted sleep disturbance exceedances are considered of low significance and do not warrant any specific mitigation measures.

6 Mitigation and Management Measures

6.1 Construction Impacts

The impacts during construction of the project are predicted to be relatively minor and no works outside of Standard Construction Hours are currently proposed. The use of standard mitigation measures to minimise the impacts is considered sufficient. Examples of measures which could be applied to the work are provided in the Roads and Maritime (now Transport for NSW) *Construction Noise and Vibration Guideline* (see **Appendix E**).

6.2 Operational Noise Impacts

A detailed assessment of all potential feasible and reasonable mitigation measures that can be applied to the development to minimise the impacts has been completed and is summarised in **Table 31**.

Table 31 Feasible and Reasonable Mitigation Options

Mitigation Option	Noise Impact/Benefit	Comments	Reasonable and Feasible to Apply
Source Control			
Roof mounted fans	The roof mounted fans contribute to the predicted exceedances. Reduction in sound power level provides substantial noise benefit	Roof fans sound power level reduced from 91 dBA to 81 dBA.	Yes
Broadband and/or ambient sensing reversing alarms	Reduce potential for annoying noise emissions during the night-time from forklifts	Use broadband and/or ambient sensing alarms on forklifts where they are required to reverse during the night-time.	Yes
Roller doors	Use of roller doors	Roller doors should be kept closed when un/loading is not occurring.	Yes
Path Control			
Not required	n/a	n/a	n/a
Receiver Control			
Not required	n/a	n/a	n/a

The project is a speculative development without any tenants committed and the exact operational procedures of the site are not known at this time. Several assumptions have been made regarding the likely future uses and sources of noise. The noise predictions in this report should be regarded as indicative for planning purposes and are required to be confirmed at a later stage when detailed information is available.

7 Conclusion

SLR has been engaged to assess the potential construction and operational noise emissions from the proposed development at 42 Raymond Avenue, Matraville. The proposal includes the operation of a two-storey warehouse and distribution centre, which would be in use 24/7.

Construction noise levels are expected to comply with the management levels at the nearest residential receivers. Exceedances are predicted at the nearest commercial and industrial receivers, however, this would only be expected to occur when noisy work is being completed close to the site boundary. Standard mitigation measures have been recommended to address the potential construction impacts.

Operational noise levels are generally expected to comply with the trigger levels at the nearest receivers. A relatively minor exceedance was predicted at the nearest residential receiver to the east during the night-time. A range of feasible and reasonable mitigation measures have been recommended to control the impacts to meet the Project Noise Trigger Levels.

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

APPENDIX A

Acoustic Terminology

1. Sound Level or Noise Level

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

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

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

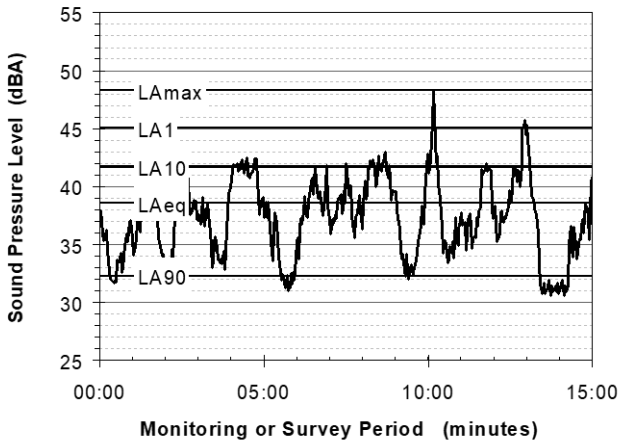
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

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

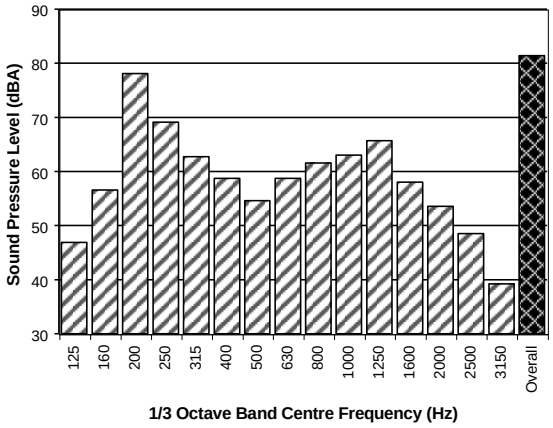
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

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

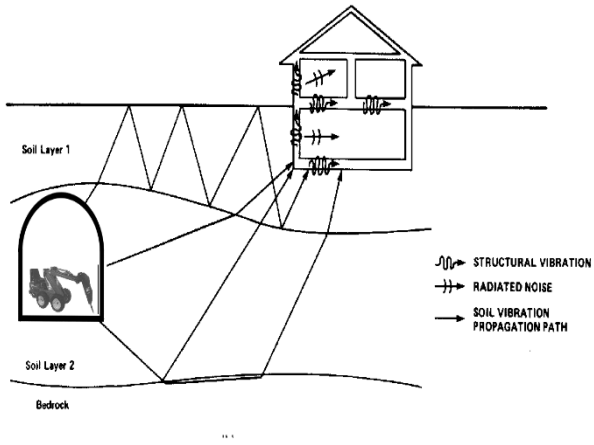
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience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

Noise Monitoring Location	L01
Noise Monitoring Address	**15 McCauley Street, Matraville**

Sound Level Meter Device Type: Brüel and Kjær 2270, Sound Level Meter Serial No: 3029485
Noise Monitor Type: Svan 957, Noise Monitor Serial No: 23293

Attended noise monitoring was conducted adjacent to the monitoring location.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic on McCauley Street and mechanical/industrial noise from local industrial developments.

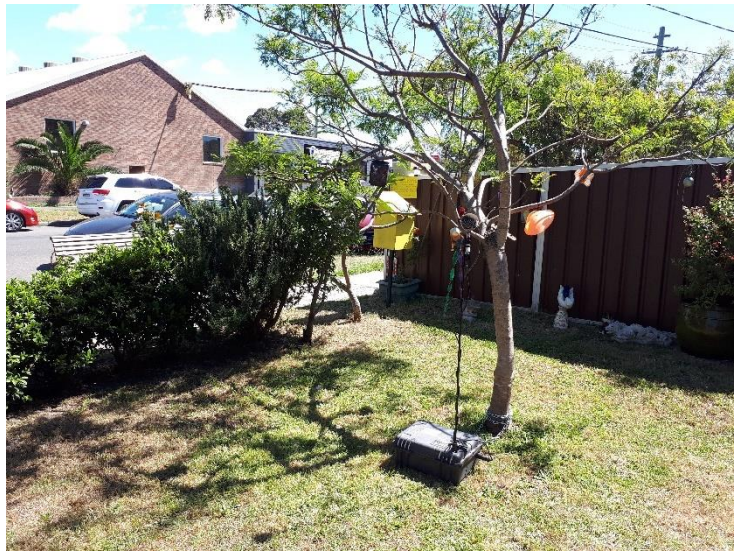
Measured Noise Levels (L_{Amax}):
2/11/2021: Trucks on McCauley Street: 63 - 75 dBA, Cars on McCauley Street: 59 - 63 dBA, Noise from neighbouring commercial developments: 40-45 dBA, Birds: 55 dBA

Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
2/11/2021	10:00 AM	45	57	75

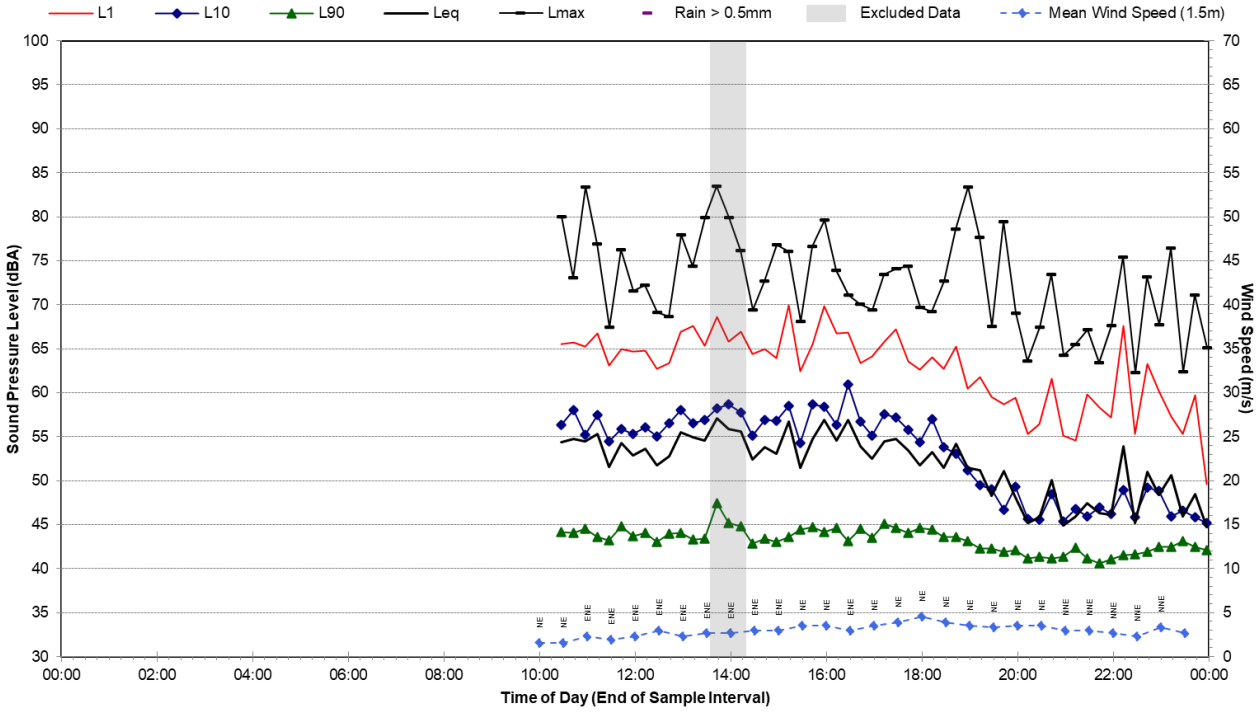
Map of Noise Monitoring Location

Noise Monitor Location



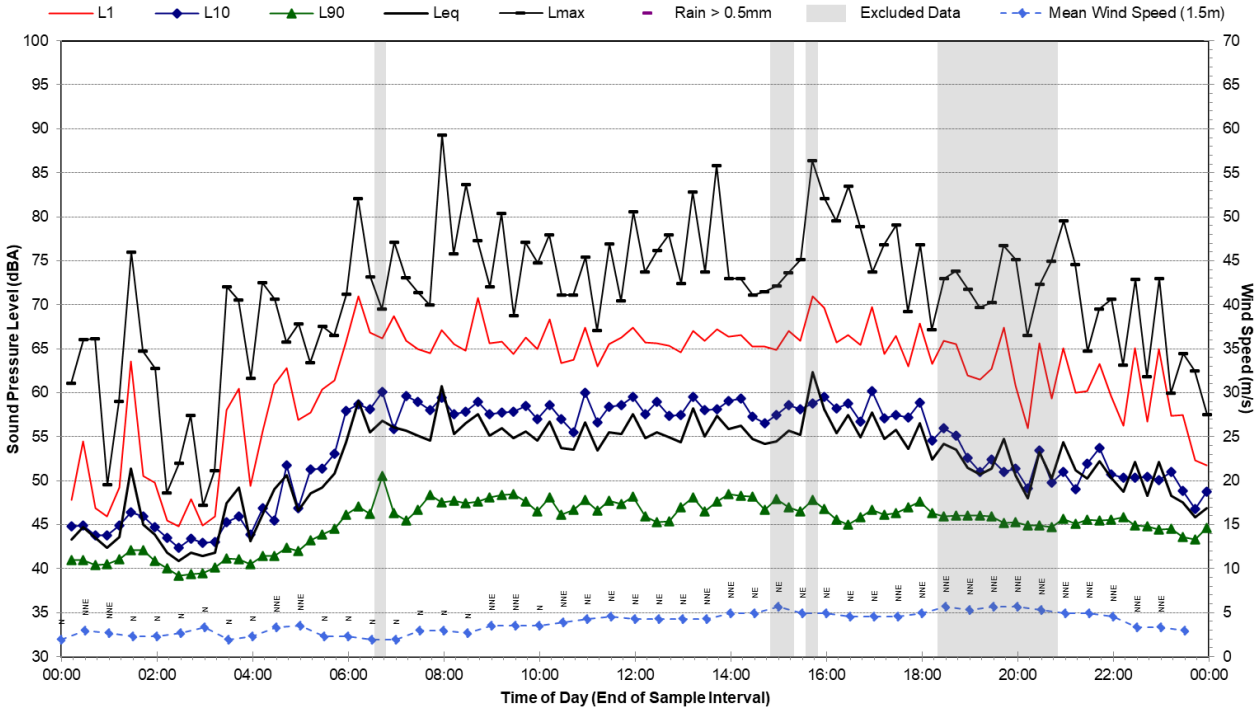
Statistical Ambient Noise Levels

L01 - 15 McCauley Street, Matraville - Tuesday, 2 November 2021



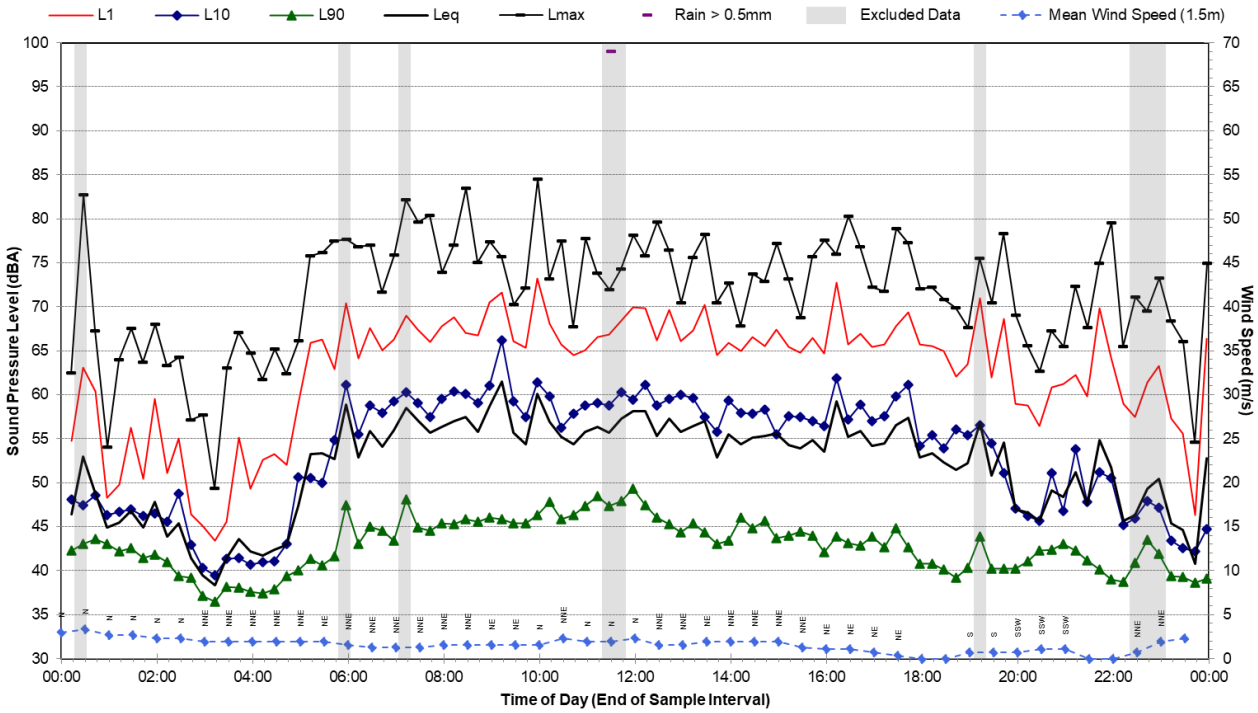
Statistical Ambient Noise Levels

L01 - 15 McCauley Street, Matraville - Wednesday, 3 November 2021



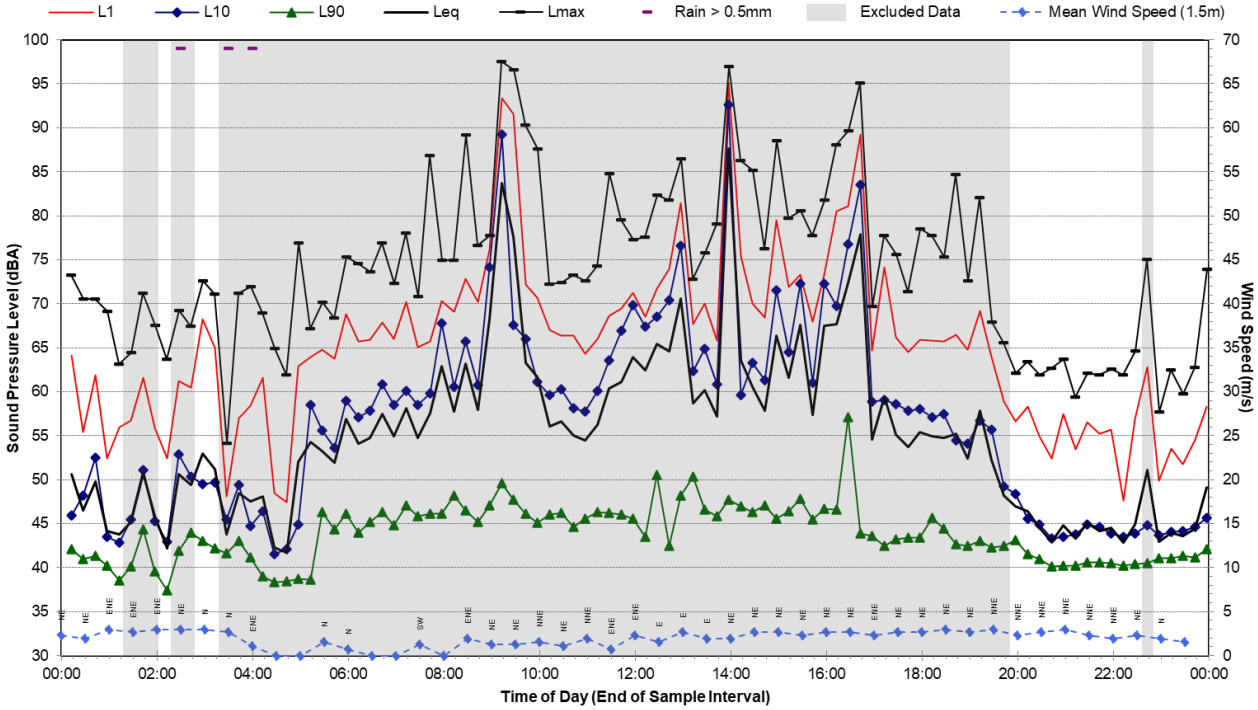
Statistical Ambient Noise Levels

L01 - 15 McCauley Street, Matraville - Thursday, 4 November 2021



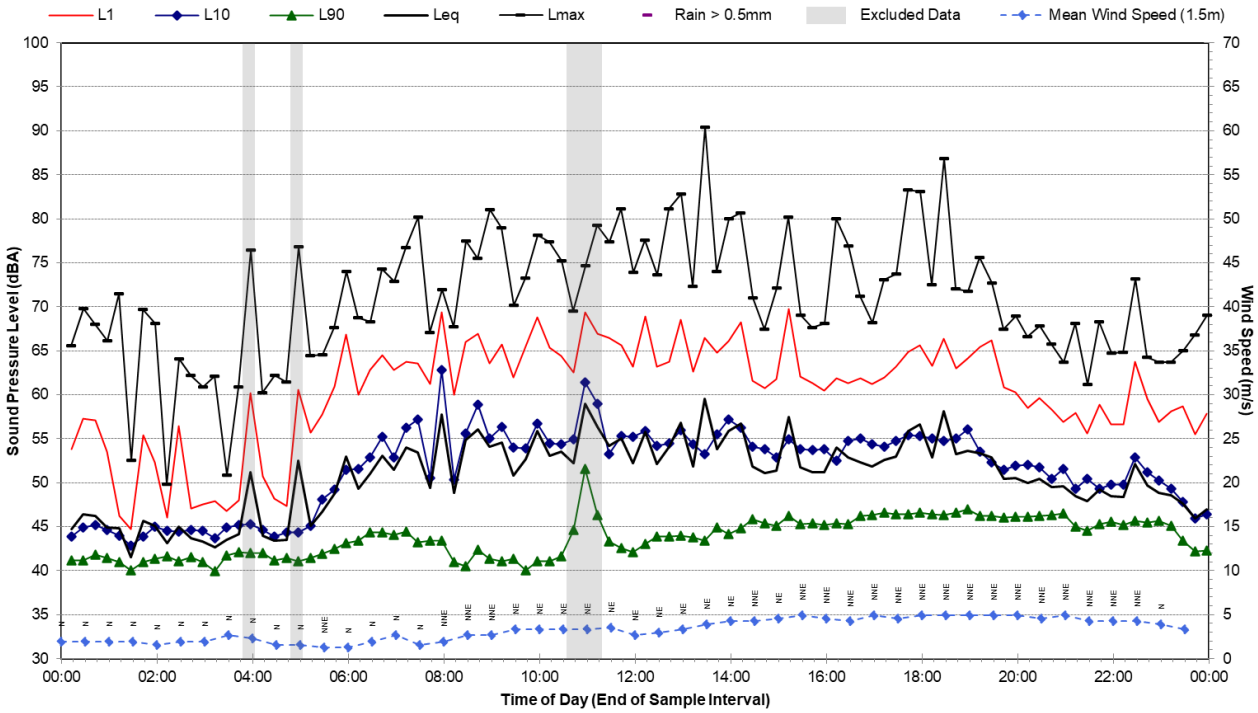
Statistical Ambient Noise Levels

L01 - 15 McCauley Street, Matraville - Friday, 5 November 2021



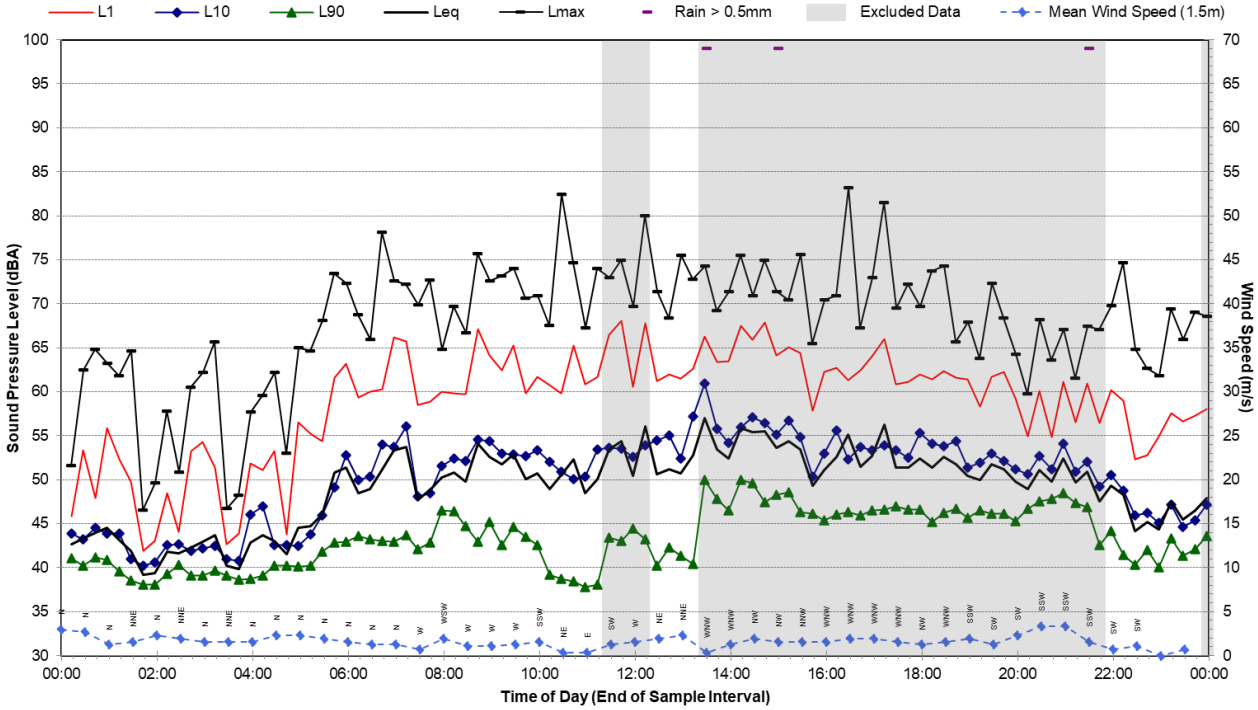
Statistical Ambient Noise Levels

L01 - 15 McCauley Street, Matraville - Saturday, 6 November 2021



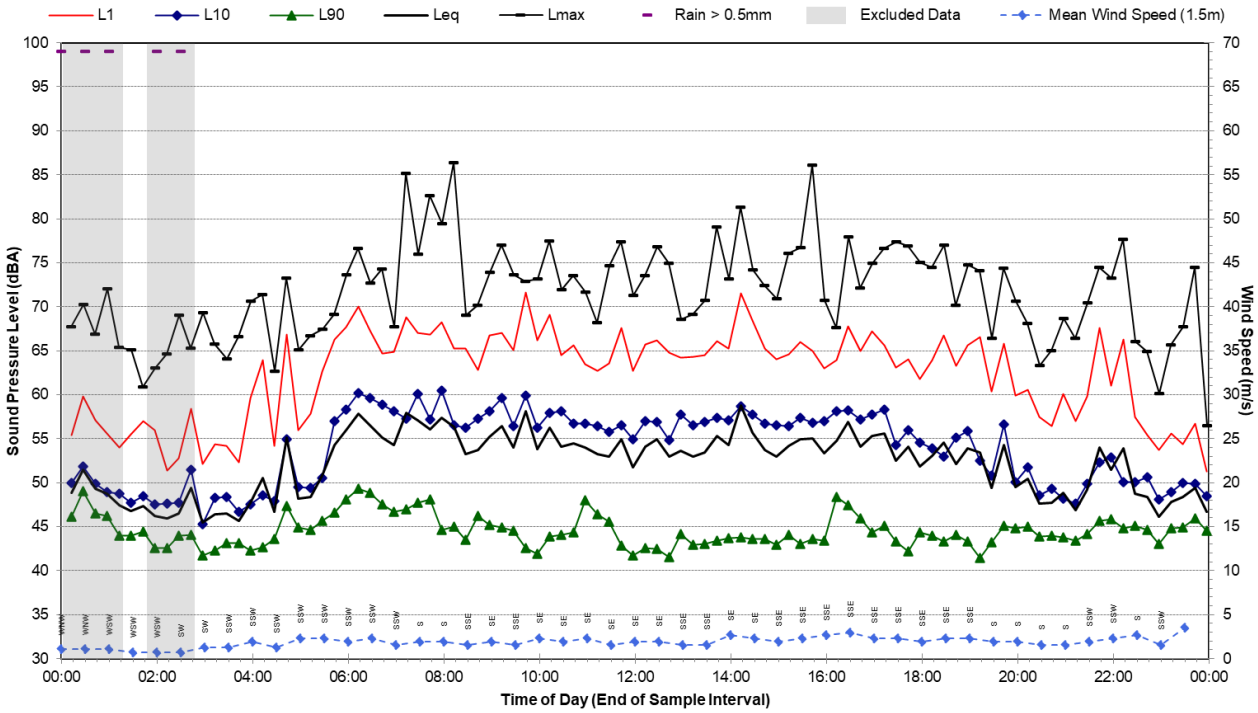
Statistical Ambient Noise Levels

L01 - 15 McCauley Street, Matraville - Sunday, 7 November 2021



Statistical Ambient Noise Levels

L01 - 15 McCauley Street, Matraville - Monday, 8 November 2021



Statistical Ambient Noise Levels

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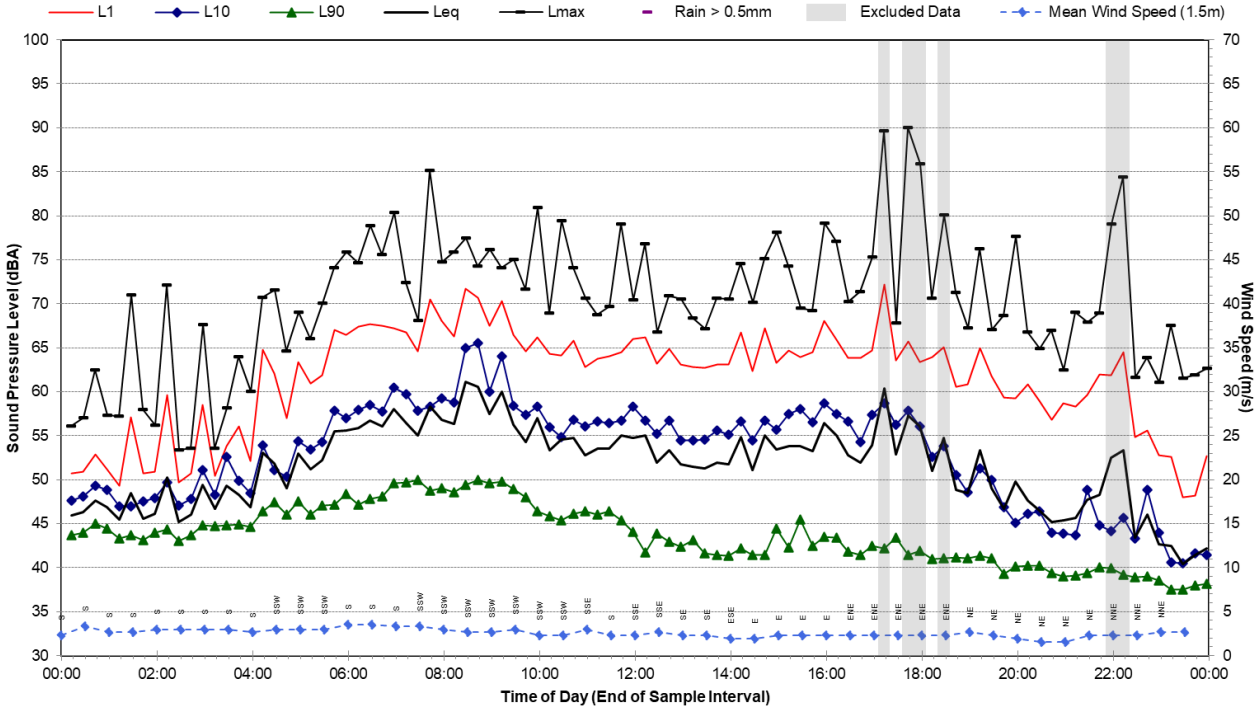
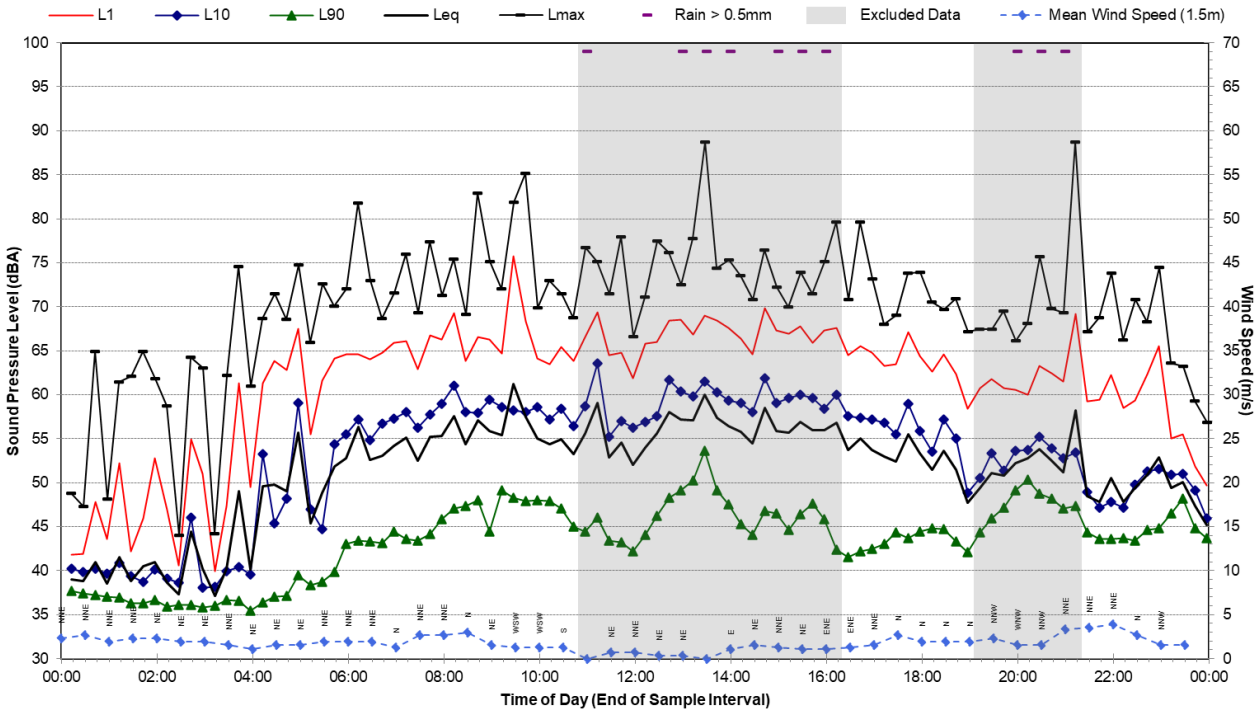


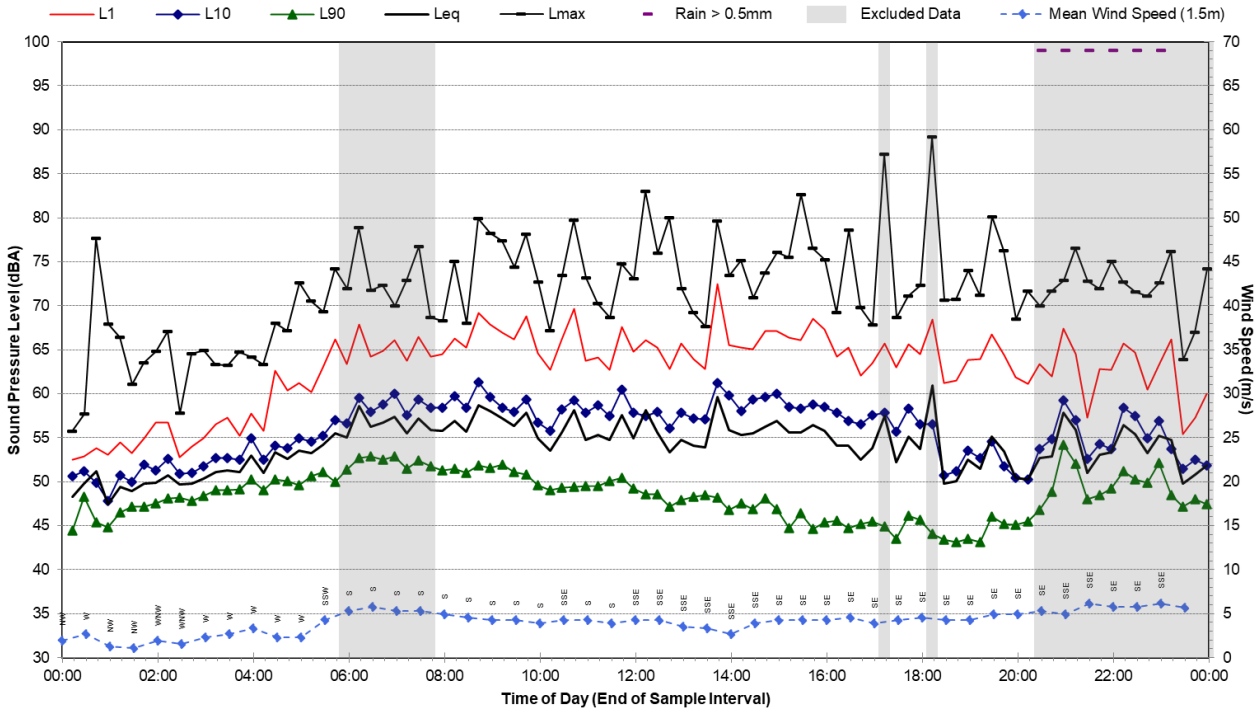
Statistical Ambient Noise Levels

L01 - 15 McCauley Street, Matraville - Wednesday, 10 November 2021



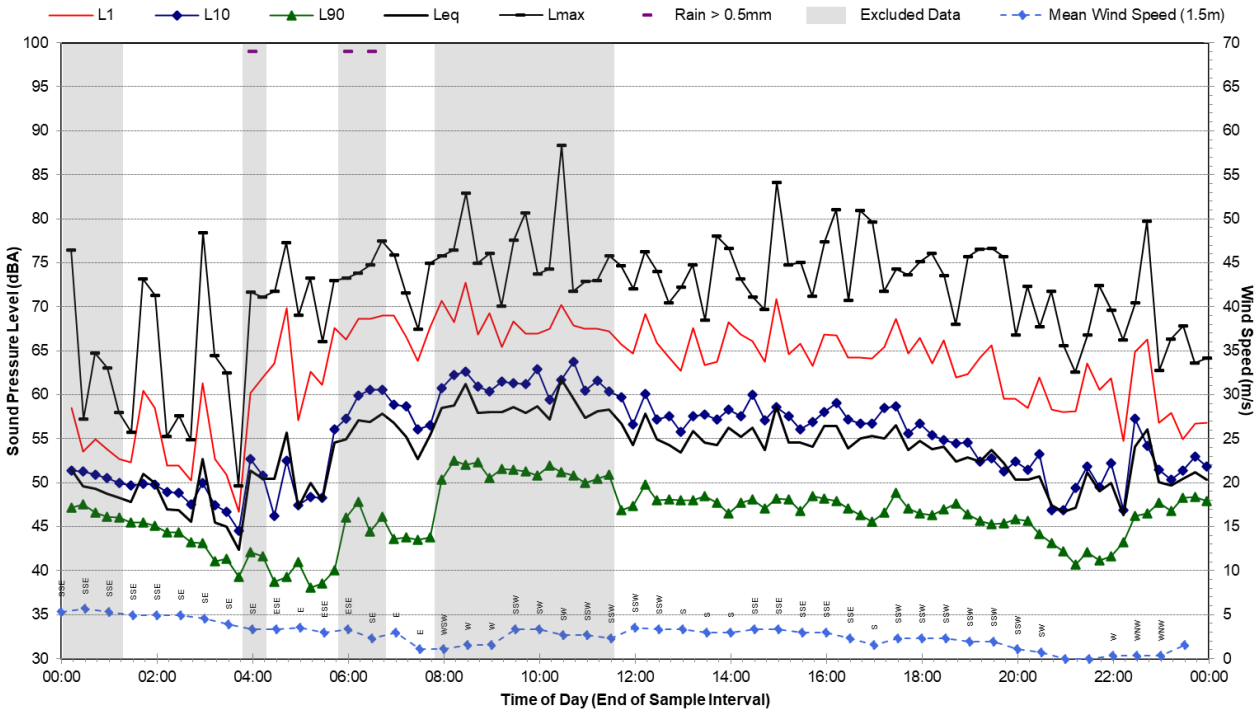
Statistical Ambient Noise Levels

L01 - 15 McCauley Street, Matraville - Thursday, 11 November 2021



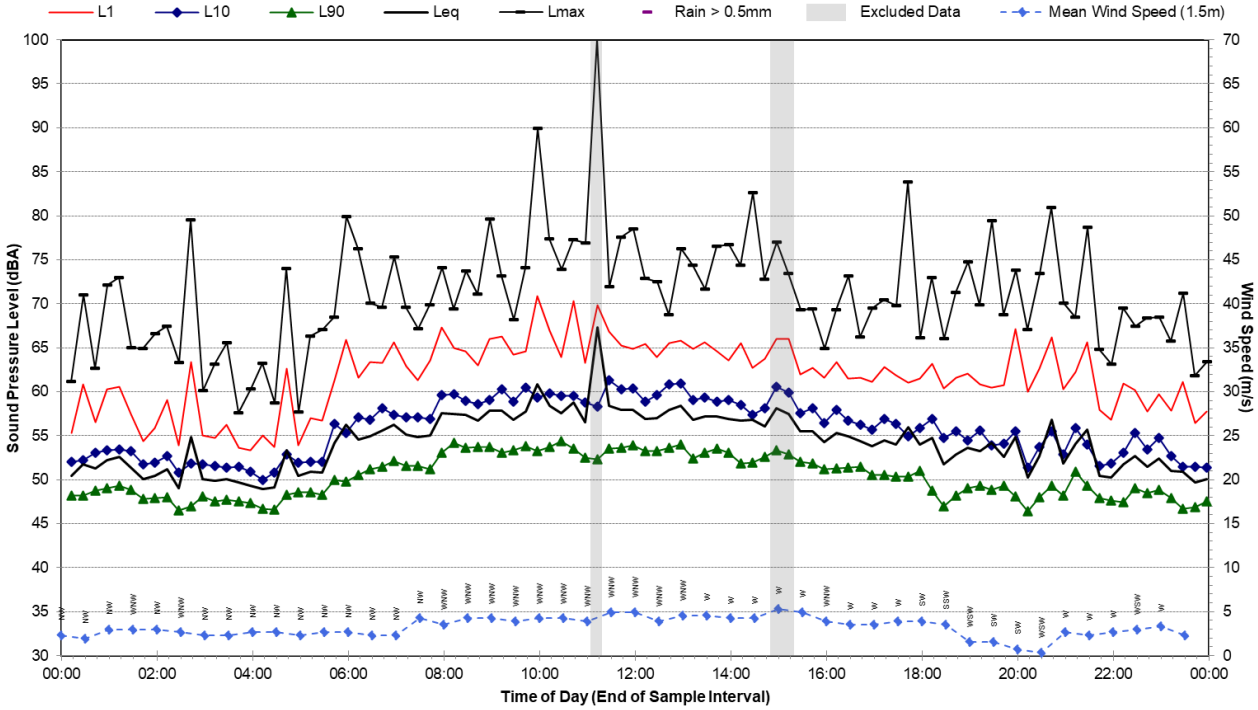
Statistical Ambient Noise Levels

L01 - 15 McCauley Street, Matraville - Friday, 12 November 2021



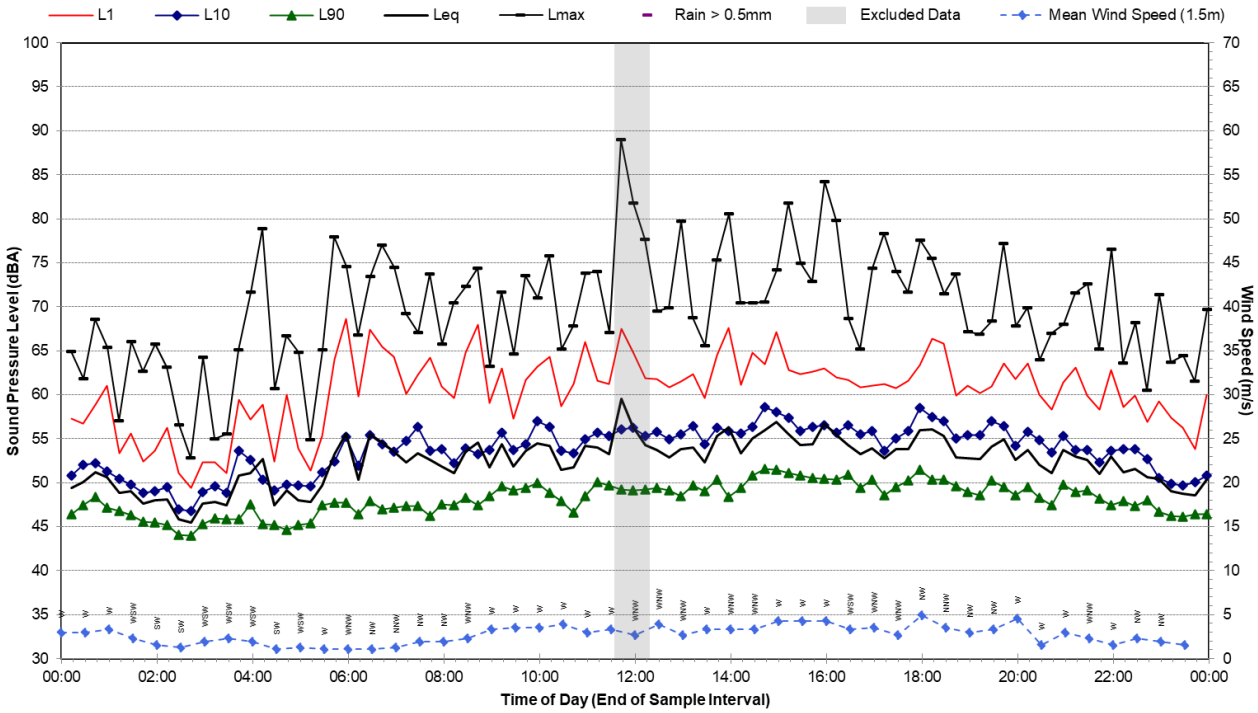
Statistical Ambient Noise Levels

L01 - 15 McCauley Street, Matraville - Saturday, 13 November 2021



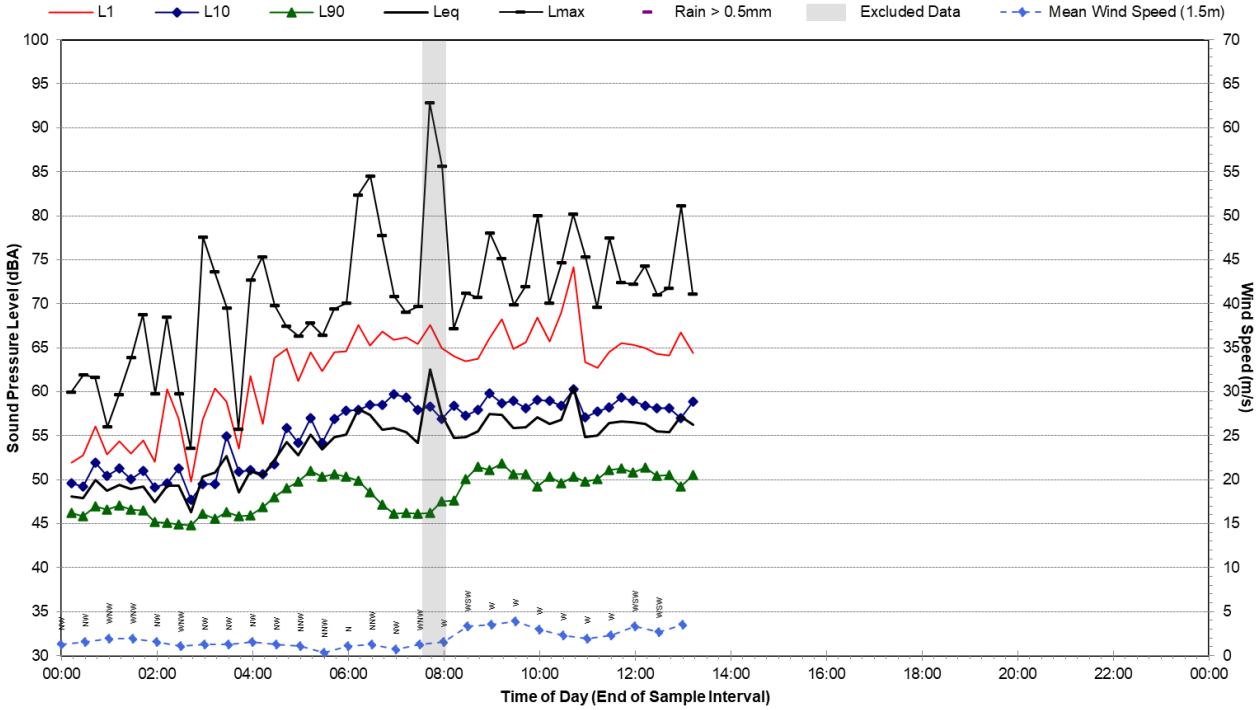
Statistical Ambient Noise Levels

L01 - 15 McCauley Street, Matraville - Sunday, 14 November 2021



Statistical Ambient Noise Levels

L01 - 15 McCauley Street, Matraville - Monday, 15 November 2021



APPENDIX C

Construction Noise Sources

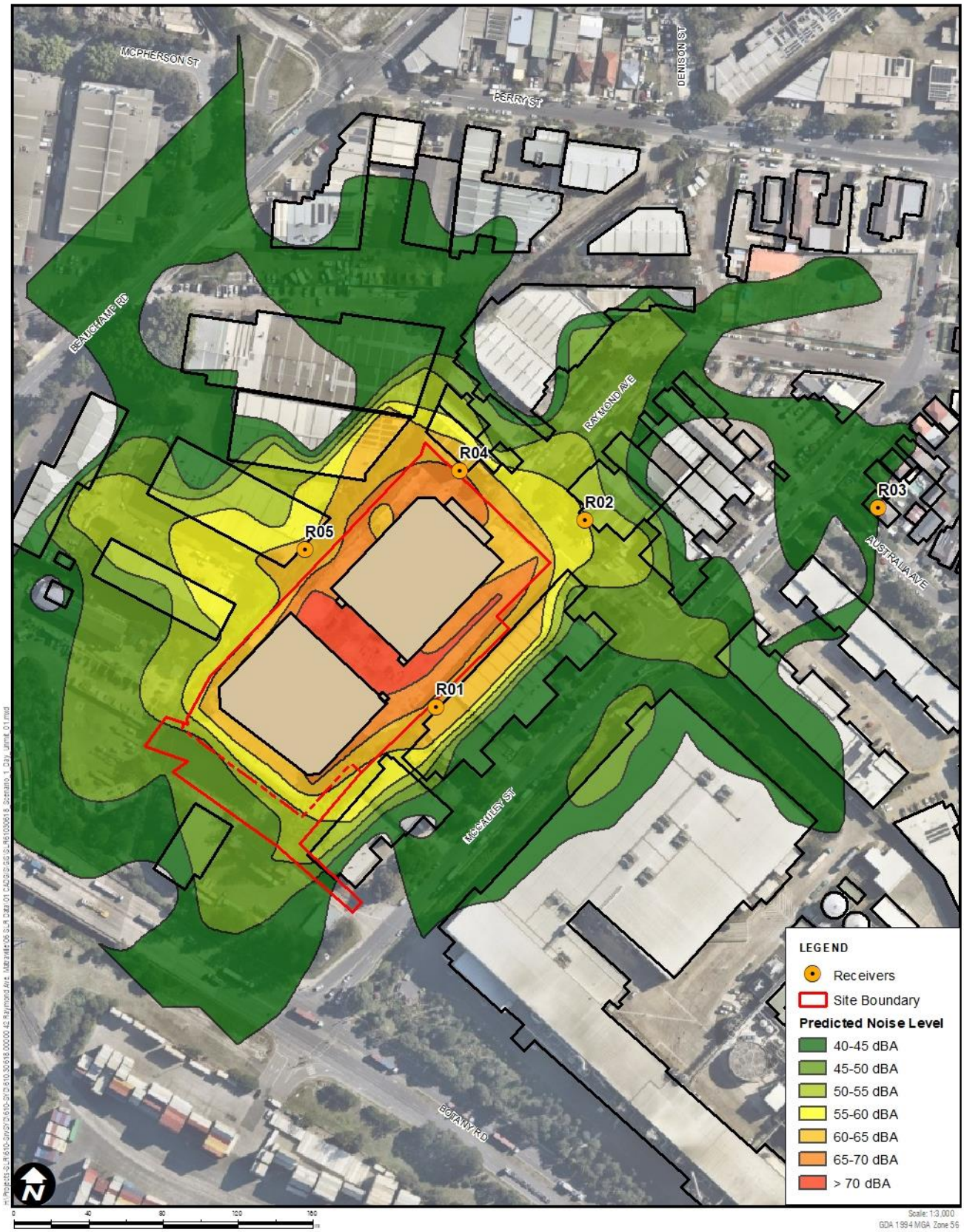
Scenario	Concrete Mixer Truck	Concrete Pump	Elevated Working Platform	Excavator (30t)	Excavator (15 t)	Forklift	Hand Tools	Mobile Crane - Franna	Mobile Crane (100 t)	Piling Rig - Bored	Roller (20 t)	Roller (7 t)	Scissor Lift	Tipper Truck	Articulated Dump Truck (30 t)	HIAB Truck	Truck and Dog	Water Cart
SWL	103	106	97	109	97	101	94	98	100	111	107	109	92	97	109	98	107	107
Civil Works				X								X			X			X
Piling	X				X			X		X								X
Structural Steel			X				X	X	X							X		X
Fitout (Internal)	X	X	X			X	X	X					X					
Stormwater and Pavements	X				X	X	X				X	X		X			X	X

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

APPENDIX D

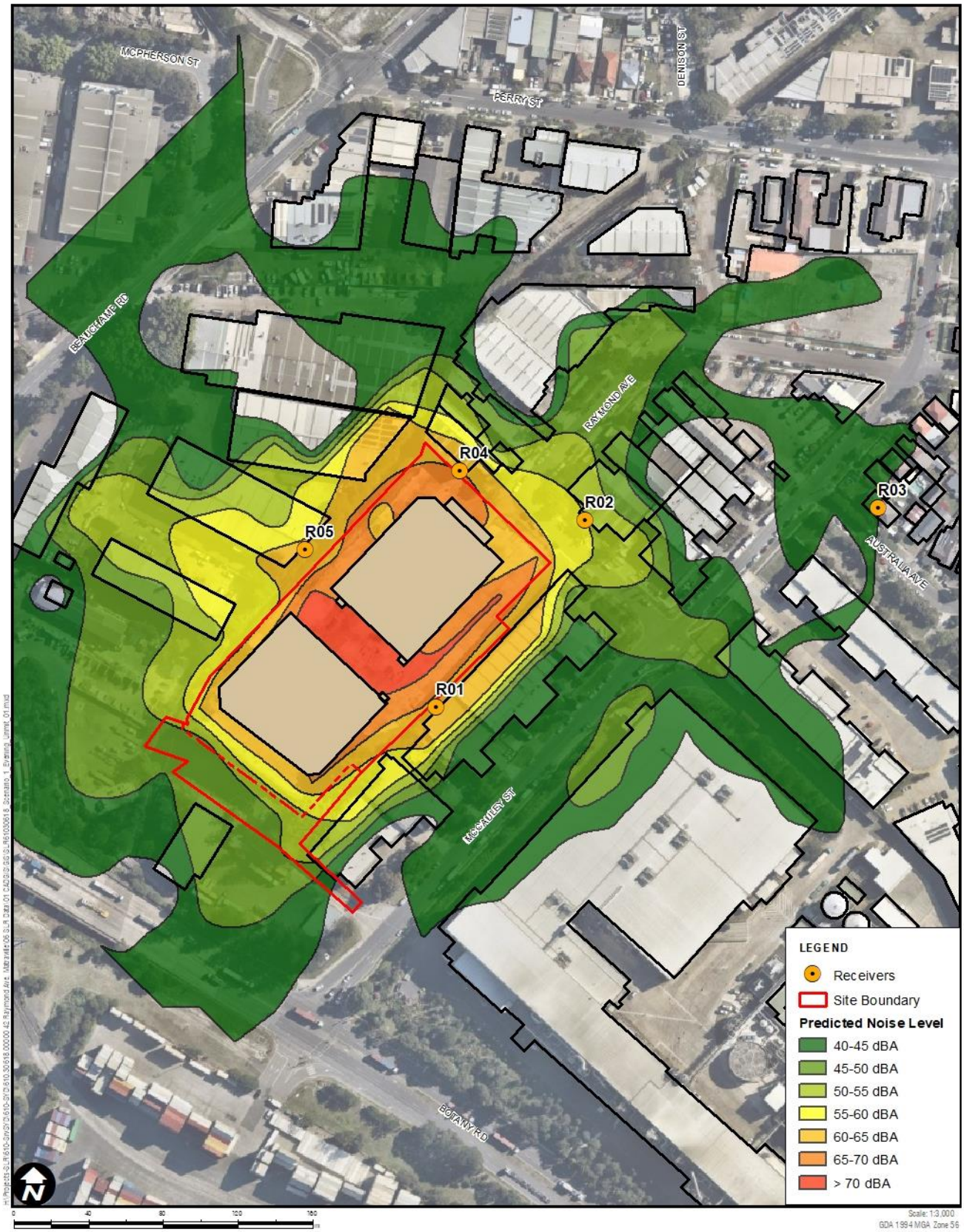
Operational Noise Contours

Site Operations – Day (Unmitigated)



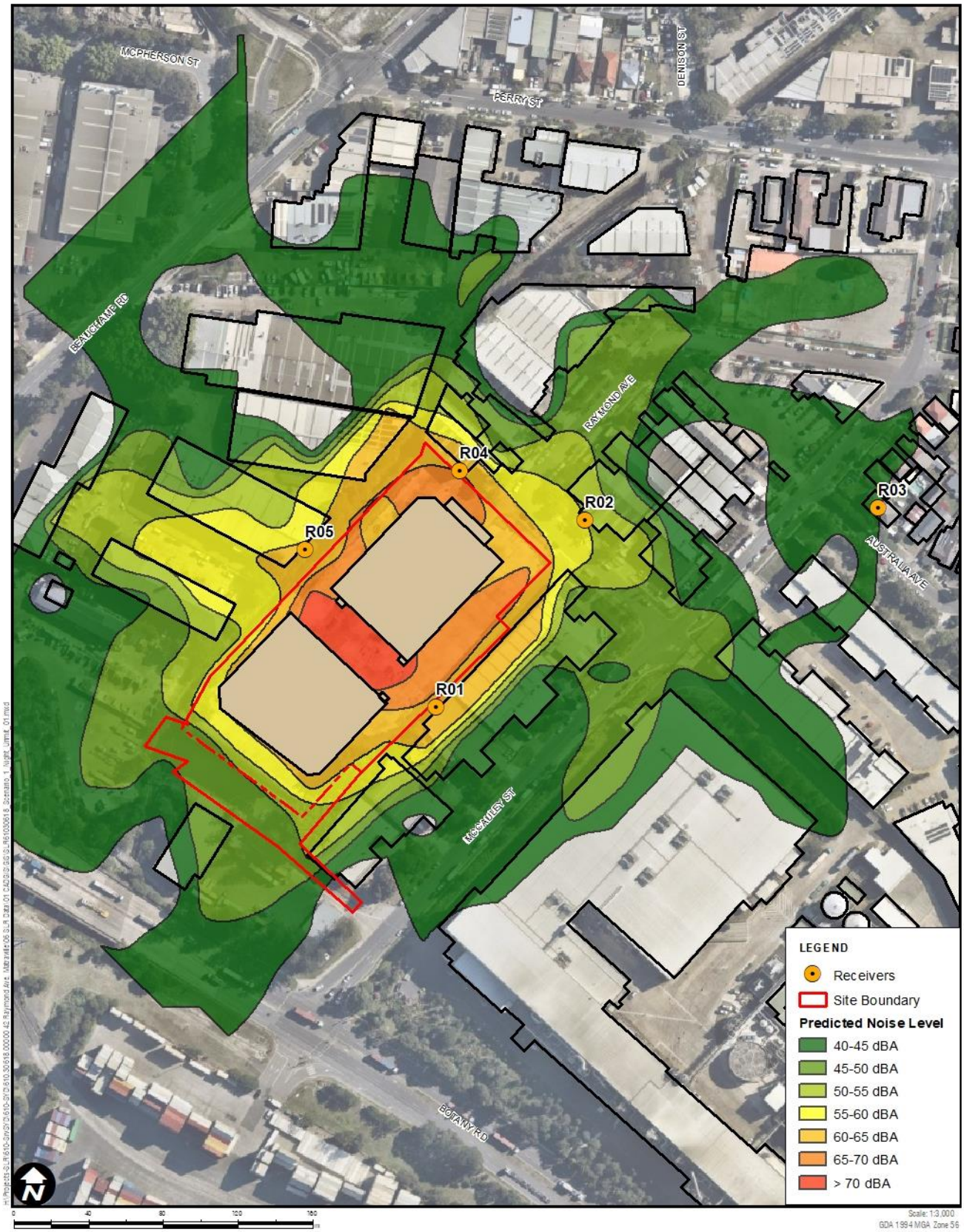
Note 1: Noise contours are at a height of 1.5 m and are free field.

Site Operations – Evening (Unmitigated)



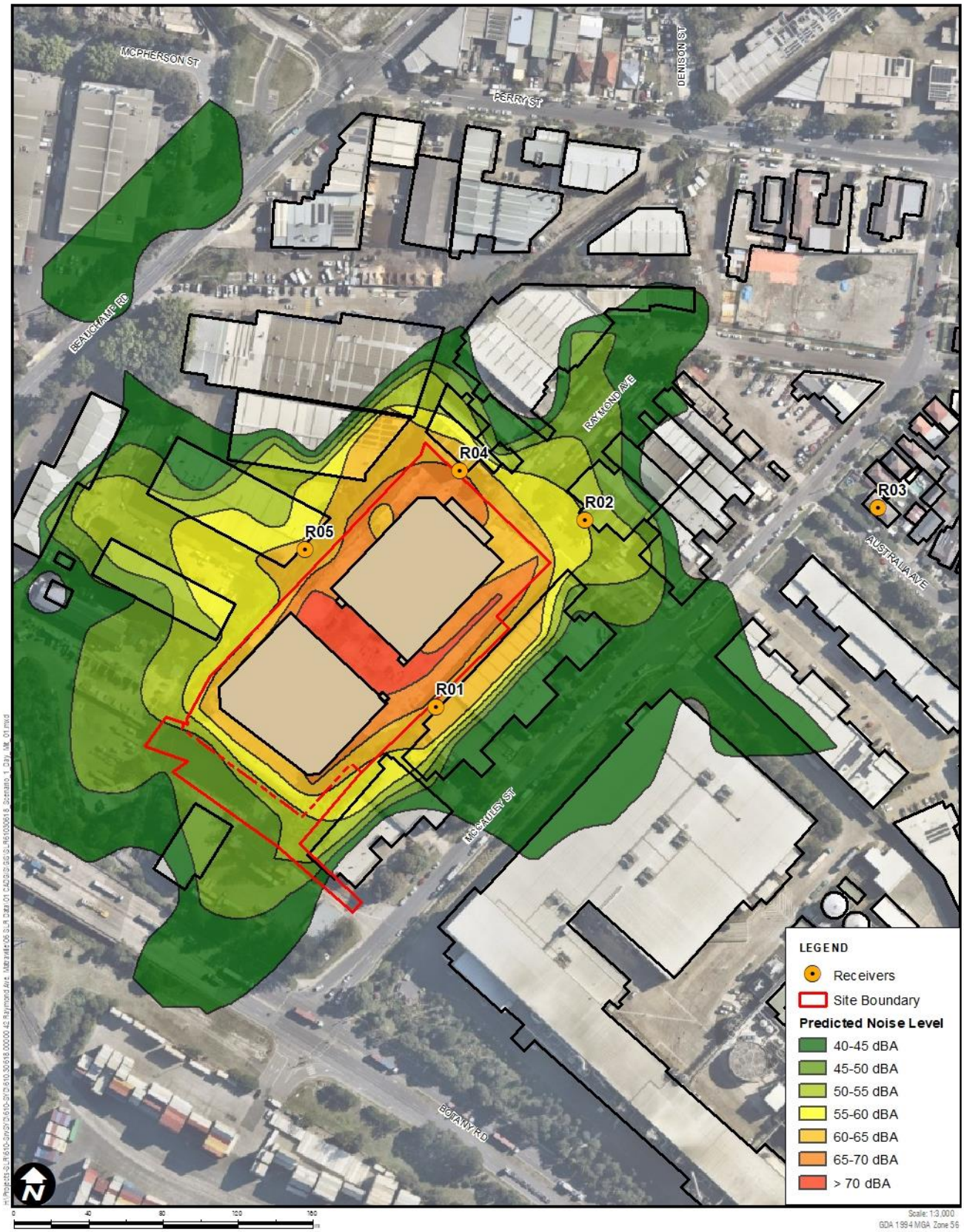
Note 1: Noise contours are at a height of 1.5 m and are free field.

Site Operations – Night (Unmitigated)



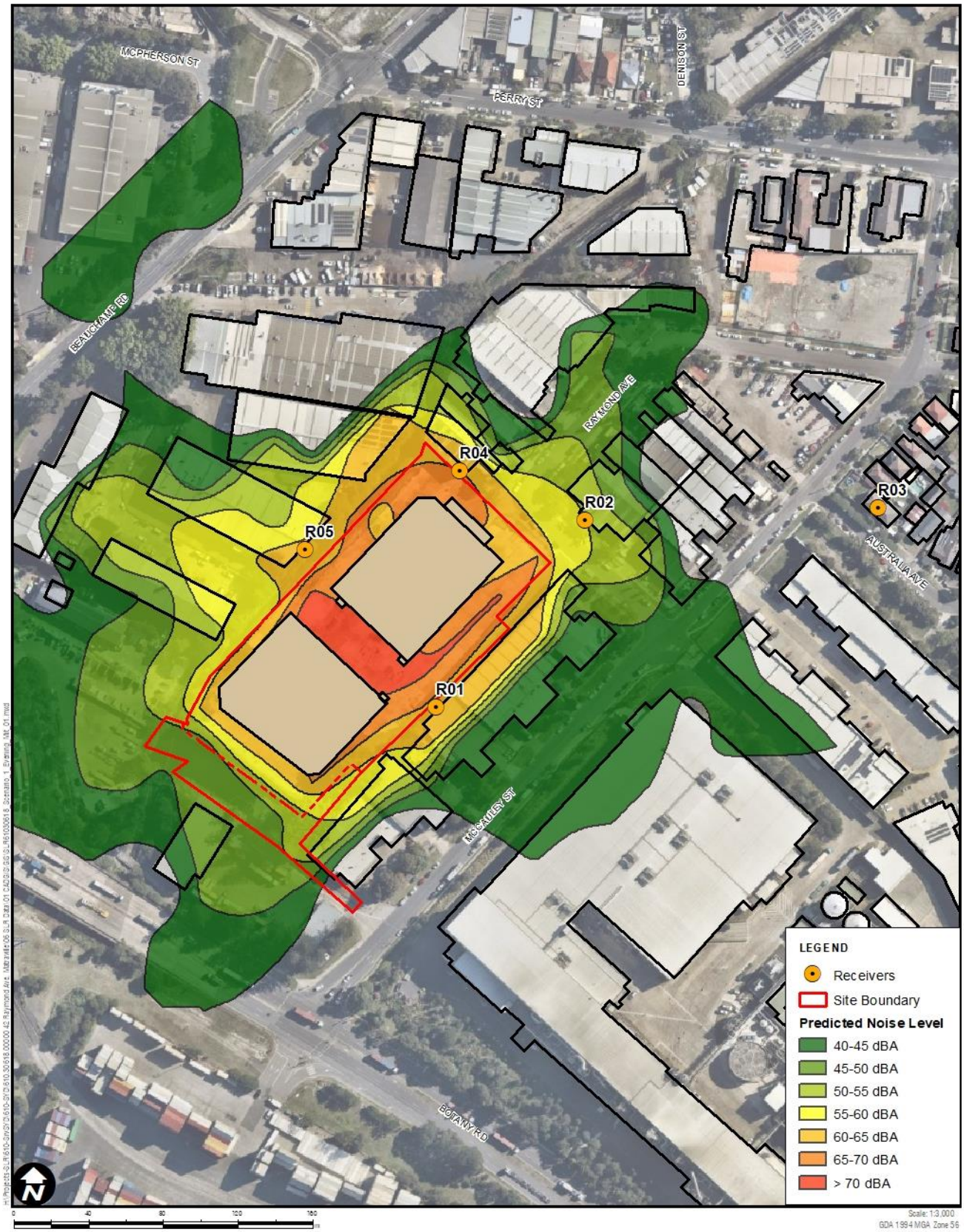
Note 1: Noise contours are at a height of 1.5 m and are free field.

Site Operations – Day (Mitigated)



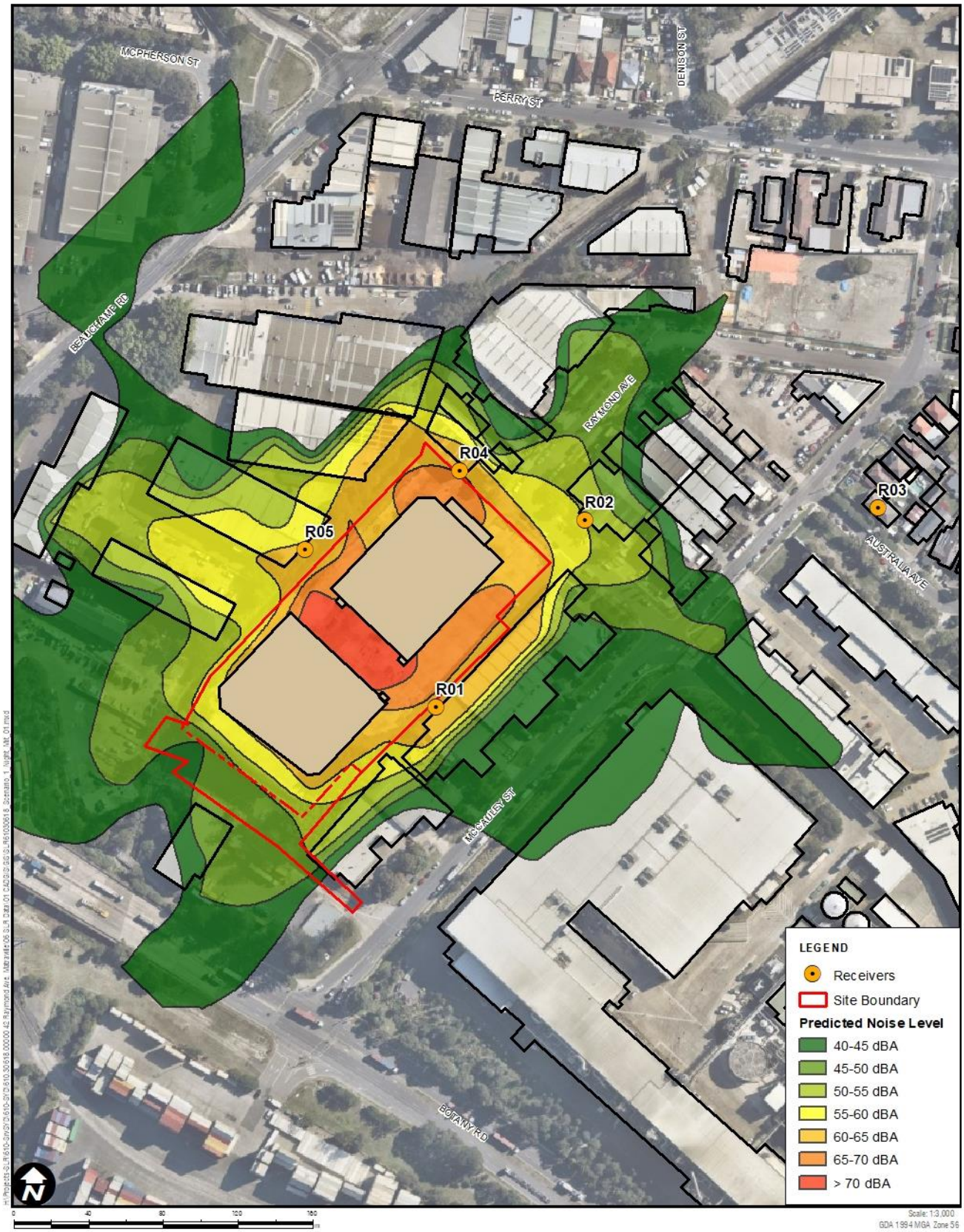
Note 1: Noise contours are at a height of 1.5 m and are free field.

Site Operations – Evening (Mitigated)



Note 1: Noise contours are at a height of 1.5 m and are free field.

Site Operations – Night (Mitigated)



Note 1: Noise contours are at a height of 1.5 m and are free field.

APPENDIX E

CNVG Mitigation Measures

CNVG Standard Mitigation and Management Measures

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

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

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

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