Noise and Vibration Impact Assessment

49 – 61 Stephen Road, Banksmeadow

ESR Australia

Level 24, 88 Phillip Street, Sydney NSW 2000

Prepared by:

SLR Consulting Australia

SLR Project No.: 610.031103.00004

17 April 2026

Revision: 1.1

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
v1.0	30 March 2026	Brandon Nguyen Khuong	Steven Luzuriaga	Steven Luzuriaga
v1.1	17 April 2026	Brandon Nguyen Khuong	Aaron McKenzie	Aaron McKenzie

Basis of Report

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

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

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

Table of Contents

Tables

Figures

Appendices

1.0 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by ESR Developments (Australia) Pty Ltd (ESR) to undertake a noise and vibration impact assessment (NVIA) in support of a State Significant Development Application (SSDA) for the construction and operation of a two-storey warehouse and distribution centre development located at 49 – 61 Stephen Road, Banksmeadow (the Project).

This report has been prepared in response to the requirements contained within the Secretary's Environmental Assessment Requirements (**SEARs**) dated 30 January 2024 and issued for the SSDA (**SSD-65924461**) and agency advice received after the exhibition of the previous scheme from DPHI and Bayside Council.

SLR is suitably qualified to produce this noise impact assessment. 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 results of ambient noise measurements undertaken at the site and assesses the potential operational noise impacts associated with the project.

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

1.1 Project Description

The site is identified as 49 – 61 Stephen Road, Banksmeadow within the Bayside Council Local Government Area (LGA).

Specifically, the project comprises:

- Demolition of all existing built form
- Site preparation works, bulk earthworks and infrastructure and service provisions and/or augmentation.
- Extensive remediation of the site.
- Construction and operation of two two-storey warehouse and distribution centre buildings including the following key components:
- Approximately 45,896 m2 of total GLF comprising:
    - 41,702 m2 of warehouse area.
    - 4,024 m2 of office area.
- Two warehouse buildings of two storeys containing:
    - 6 units in Warehouse 1 – two levels.
    - 4 units in Warehouse 2 – two levels.
- 240 car spaces
- 16 motorbike parking spaces.
- End of trip facilities.
- Site landscaping works totalling 5,566.1 m2 (10.2% of the site), and
- Provision of building and business identification signage

1.1.1 Nearest Receivers

The Project site is bound by the following receivers:

- Industrial receivers north, east and south of the site
- Educational receiver (Banksmeadow Public School) south-west of the site
- Residential receivers west of the site

All identified noise sensitive receivers surrounding the Project site have been grouped into Noise Catchment Areas (NCAs) that reflect the ambient noise environment of that area, as well as the noise and vibration sensitivity of the surrounding land uses to assist in summarising the potential impacts. The study area was chosen to include all surrounding receivers with potential noise and/or vibration impacts from the project.

The NCAs and nearest identified receivers are shown in **Figure 1**. The proposed warehouse floor plans (GL and L1) are shown in **Figure 2** and **Figure 3** respectively.

1.2 Secretary's Environmental Assessment Requirements

The Secretary's Environmental Assessment Requirements (SEARs) were issued by the Department of Planning, Housing and Infrastructure (DPHI) on 30 January 2024 in SSD-65924461. The requirements relevant to noise and vibration are shown in **Table 1**.

Table 1 Secretary's Environmental Assessment Requirements

Noise and Vibration	Where Addressed
Noise and Vibration – a quantitative noise and vibration impact assessment undertaken by a suitably qualified acoustic consultant in accordance with the relevant Environment Protection Authority guidelines and Australian Standards which includes:	This report
- The identification of impacts associated with construction, site emission and traffic generation at noise affected sensitive receivers, including the provision of operational noise contours and a detailed sleep disturbance assessment.	**Section 4.0** **Section 5.0** **Appendix B**
- Details of noise monitoring survey, background noise levels, noise source inventory and 'worst case' noise emission scenarios.	**Section 2.0** **Section 4.0**
- Consideration of noise generated from a potential café onsite	**No longer applicable due to redesign**
- Consideration of annoying characteristics of noise and prevailing meteorological conditions in the study area	**Section 4.2.2** **Section 4.2.5**
- Consideration of vehicle's usage of ramps	**Section 4.2.1**
- A cumulative impact assessment inclusive of impacts from other developments	**Section 3.3.2** **Section 6.0**
- Details and analysis of the effectiveness of proposed management and mitigation measures to adequately manage identified impacts, including a clear identification of residual noise and vibration following application of mitigation these measures and details of any proposed compliance monitoring programs.	**Section 7.0**

Figure 1 Site Location, Surrounding Receivers and Noise Monitoring Locations

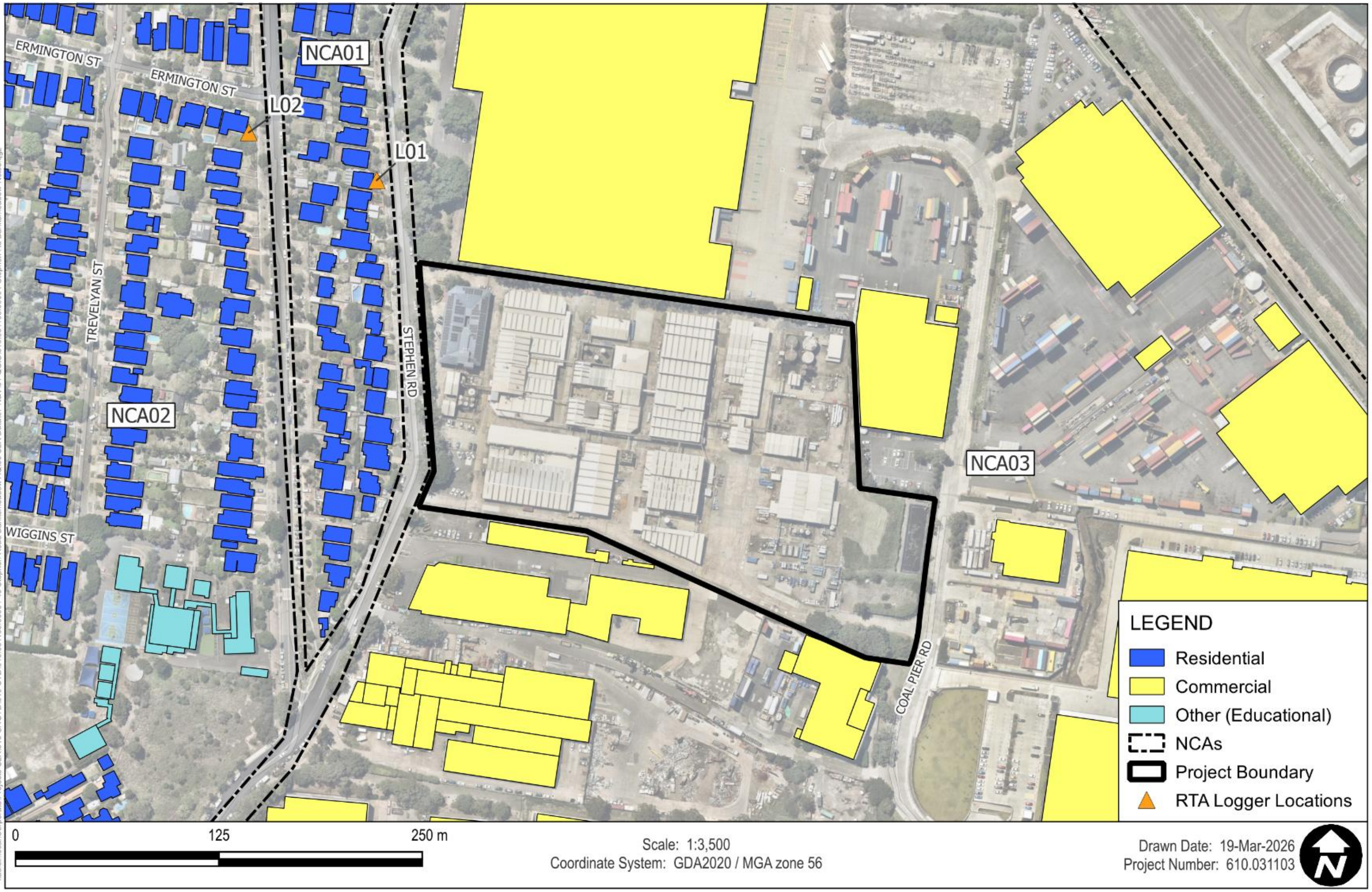


Figure 2 Warehouse Site Plan (GF)

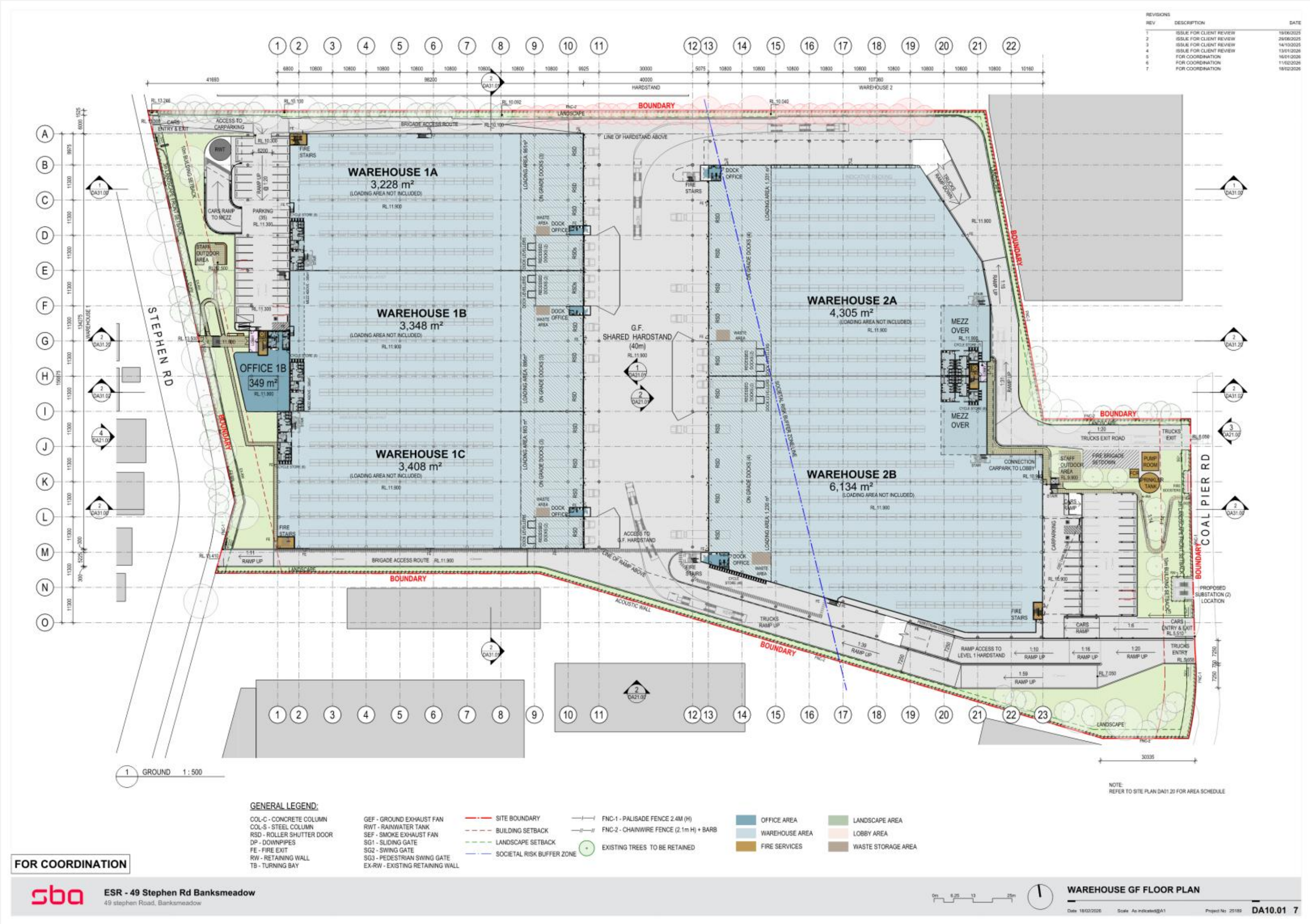
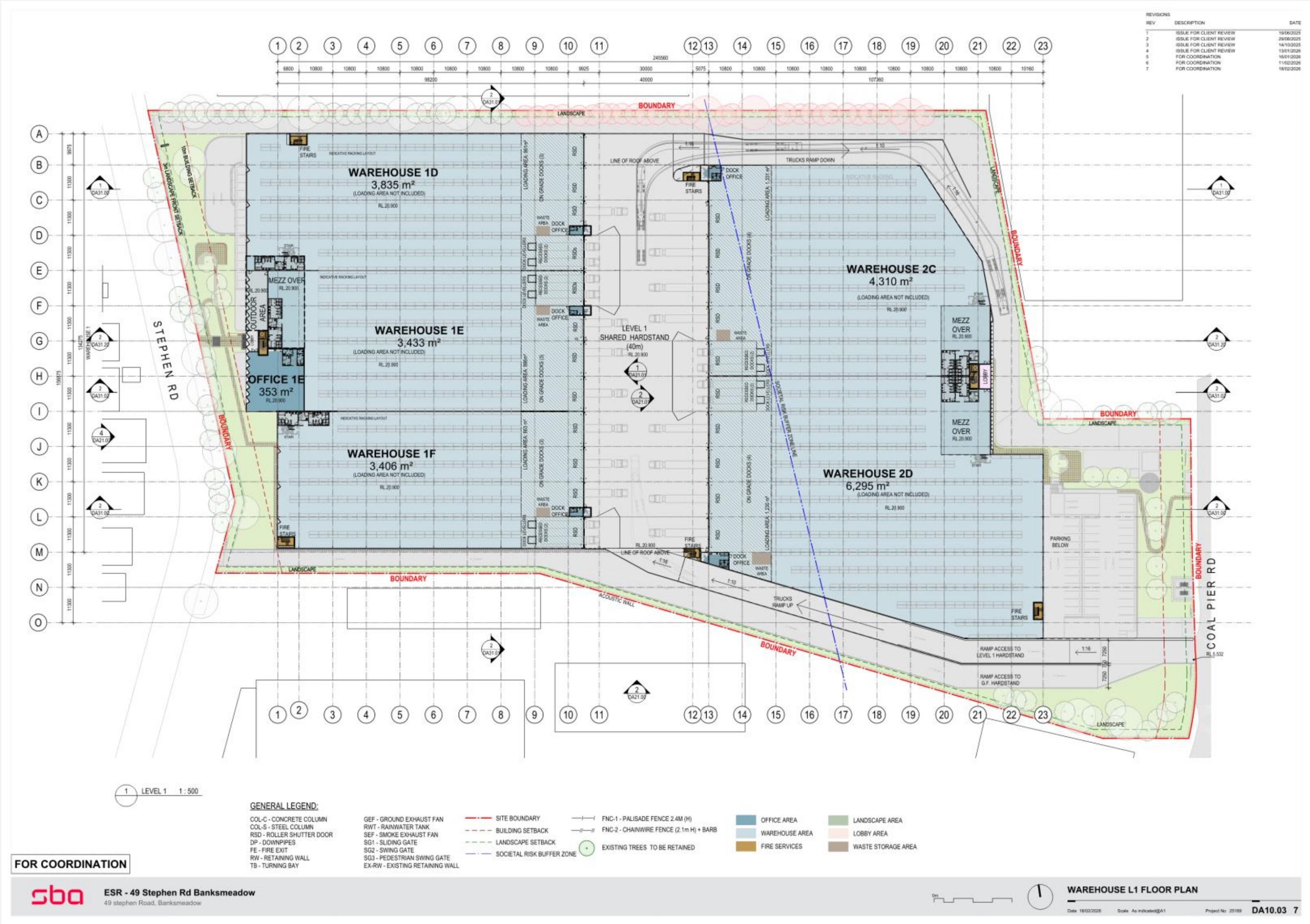


Figure 3 Warehouse Site Plan (L1)



2.0 Existing Noise Environment

This assessment refers to the noise impact assessment prepared by Renzo Tonin & Associates (TN139-01F01 49 – 61 Stephen Road, Banksmeadow SSD NVIA (r3), dated 9/12/2024) (RTA NVIA) to establish the existing noise environment.

2.1 Unattended Noise Monitoring

Unattended noise monitoring was undertaken by RTA at two residential locations shown in **Figure 1**. Details including methodology of unattended noise monitoring and daily measured noise graphs and meteorological conditions are included in the RTA NVIA.

Consistent with the RTA NVIA, a morning shoulder period has been adopted due to the steady increase in existing ambient noise between 5am – 7am. The NPfI defines a morning shoulder period as follows:

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

As outlined in the RTA NVIA, the existing noise environment is dominated by road traffic and industrial noise with steadily rising noise levels in the early morning 5 am to 7 am period.

A summary of the unattended noise monitoring data is detailed in **Table 2**.

Table 2 Summary of Unattended Noise Monitoring Results (RTA NVIA)

ID	Address	Measured Noise Levels (dBA)							
		Background Noise (RBL)				Average Noise (L_{Aeq})			
		Day[1]	Evening[1]	Night[1]	Morning Shoulder[2]	Day[1]	Evening[1]	Night[1]	Morning Shoulder[2]
L01	46 Stephen Road, Botany	47	47	45	45[3]	62	61	57	61
L02	17 Ermington Street, Botany	44	46 (44)[4]	43	43[3]	53	52	49	51

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

Note 2: Morning Shoulder period has been adopted as per the approach undertaken in the RTA NVIA.

Note 3: Night-time RBL has conservatively been adopted to derive the morning shoulder period RBL as per the approach from the RTA NVIA.

Note 4: Evening RBL reduced to match the daytime RBL for determining project noise trigger levels, as outlined in the NPfI.

2.2 Attended Noise Monitoring

Short-term attended noise monitoring was conducted by RTA at the noise monitoring locations and at other surrounding receivers. The general consensus from the noise survey demonstrated the existing environment is predominantly industrial activities within the Banksmeadow industrial precinct and nearby traffic along Stephen Road.

For additional information regarding methodology and instrumentation, refer to Section 2.2 of the RTA NVIA.

3.0 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 3**.

Table 3 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: o 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 o If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Standard Construction Hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours • The proponent should apply all feasible and reasonable work practices to meet the noise affected level • Where all feasible and reasonable practises have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

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

3.1.1.2 Other Sensitive' Land Uses

The ICNG NMLs for 'other sensitive' non-residential land uses are shown in **Table 4**.

Table 4 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]
Commercial	n/a	70
Industrial	n/a	75

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

3.1.1.3 NML Summary

The construction NMLs are summarised in **Table 5**. Out of hours NMLs would be applicable to works undertaken outside the ICNG standard construction hours.

Table 5 Construction Noise Management Levels

NCA	Receiver Type	Mon. Location	Measured RBL[1] – dBA			NML ($L_{Aeq(15minute)}$ – dBA)				Sleep Disturbance Screening Level[2] (L_{Amax} dBA)
						Standard Construction Hours (RBL+10dB)	Out of Hours (RBL+5dB)			
			Day	Eve.	Night	Day	Day	Eve.	Night	Night
NCA01	Residential	L01	47	47	45	57	52	52	50	60
NCA02	Residential	L02	44	44[3]	43	54	49	49	48	58
All	Industrial	n/a				75 when in use				n/a
All	Educational	n/a				External noise level 55 when in use				n/a

Note 1: RBL = Rating Background Level.
Note 2: Sleep disturbance screening level is RBL+15 dB or 52 dBA, whichever is higher.
Note 3: The evening RBL has been reduced to match the daytime RBL for determining NMLs, as outlined in the NPfI.

3.2 Construction Vibration Guidelines

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

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

3.2.1 Human Comfort Vibration

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

Vibration from construction works tends to be intermittent in nature and the EPA's *Assessing Vibration: a technical guideline* (2006) provides criteria for intermittent vibration based on the Vibration Dose Value (VDV). The 'preferred' and 'maximum' VDVs for human comfort impacts are shown in **Table 6**.

Table 6 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 7**.

Table 7 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 8**.

Table 8 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 Transport for NSW *Construction Noise and Vibration Guideline* (CNVG) and are shown in **Table 9**. 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 9 Recommended Minimum Working Distances from Vibration Intensive Equipment

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

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

3.3 Operational Noise Criteria

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.

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 10**.

Table 10 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.

An assessment to determine the suitable amenity noise categories for the surrounding receivers have been determined with reference to the RTA NVIA. A summary of outcomes are shown in **Table 11**.

Table 11 Residential Receiver Amenity Category Assessment

NCA	Land Use Zoning	Existing Background Noise Levels RBL (dBA)			Resulting Amenity Classification	Discussion
		Day	Eve	Night		
NCA01	Low-density residential (R2)	47	47	45	Urban	The surrounding area is zoned as R2. R2 zoning is considered suburban as per the NPfI as shown in **Table 10**. However, considering the context of receivers in close-proximity to Stephen Road and the Banksmeadow industrial precinct, existing elevated noise levels due to traffic and industrial activities have resulted in an acoustic amenity better defined as 'urban' in accordance with the definition provided by the NPfI summarised in **Table 10**. This is consistent with the approach undertaken in the RTA NVIA and has been retained for this assessment.
NCA02	Low-density residential (R2)	44	46	43	Urban	
NCA03	IN1	-	-	-	General Industrial	The surrounding land use within the Banksmeadow precinct is approved for General Industrial. Therefore, receivers within this zone are assumed as 'Industrial' receivers in accordance with the NPfI.

3.3.1 Project Noise Trigger Levels

The trigger levels for industrial noise from the proposal are summarised in **Table 12**. The Project Noise Trigger Levels (PNTL) are the most stringent of the intrusiveness and amenity trigger level for each period.

Table 12 Project Noise Trigger Levels

NCA	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]
Residential	NCA01	Day	60	47	62	**52**	58
		Evening	50	47	61	52	**48**
		Night	45	45	57	50	**43**
		Shoulder	60	45	61	**50**	58
	NCA02	Day	60	44	53	**49**	58
		Evening	50	44	52	49	**48**
		Night	45	43	49	48	**43**
		Shoulder	60	43	51	**48**	58
Educational	NCA02	When in use	40[4] $L_{Aeq\ (1hr)}$ (internal)	-	-	-	**48** [4,5]
Industrial	NCA03	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.

Note 4: In the case where existing schools are affected by noise from existing industrial noise sources, the acceptable L_{Aeq} noise level may be increased to 40 dB $L_{Aeq(1hr)}$.

Note 5: Assume a 10 dB reduction through an open window to determine the criteria at the façade.

3.3.2 Cumulative Noise Impacts

The NPfI aims to limit continuing increases in industrial noise through the application of amenity noise levels. The project amenity noise levels are reduced by 5 dB relative to the recommended amenity levels to allow for other sources of industrial noise in the area (existing and new). By doing this, the policy accounts for potential cumulative impacts by lowering the criteria for each individual development. The NPfI states that *"where the project amenity noise level applies and it can be met, no additional consideration of cumulative industrial noise is required."*

3.3.3 Sleep Disturbance

The potential for sleep disturbance from maximum noise level events during the night-time period from the proposal is required to be considered. This is applicable only to residential receivers.

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 proposal are shown in **Table 13**.

Table 13 Sleep Disturbance Screening Levels

Location	Noise Level (dBA)	
	Measured Prevailing Night-time Background Level	Sleep Disturbance Screening Level[1]
NCA01	45	60
NCA02	43	58

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.

3.3.4 Corrections for Annoying Noise Characteristics

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

Table 14 NPfI Modifying Factor Corrections

Factor	Assessment/ Measurement	When to Apply	Correction[1]
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by the levels defined in the NPfI.	5 dB[2]
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements	Measure/assess source contribution C and A weighted $L_{eq,t}$ 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.	5 dB[3]

Factor	Assessment/ Measurement	When to Apply	Correction[1]
		The EPA has confirmed[4] that the intermittent correction does not apply to short-term events that emerge above the general industrial noise level and is therefore not applicable to industrial or commercial sites that have vehicle or plant movements at night, including audible reversing alarms. The intermittency correction is not intended to be applied to changes in noise level due to meteorology.	
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.

Note 4: How to Apply the Noise Policy for Industry Intermittent Modifying Factor Corrections, NSW Environment Protection Authority, Acoustics Australia Vol. 50, No. 3, September 2022.

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

3.3.5 Residual Impacts

The NPfI defines residual noise impacts as exceedances of the Project Noise Trigger Levels which remain after all feasible and reasonable source and pathway mitigation measures have been considered.

The significance of residual noise impacts, as defined in the NPfI, is shown in **Table 15**. Examples of receiver-based treatments that can be used to mitigate residual impacts are shown in **Table 16**.

Table 15 NPfI Significance of Residual Noise Impacts

If the Predicted Noise Level minus the Project Noise Trigger Level is:	And the Total Cumulative Industrial Noise Levels is:	Then the Significance of the Residual Noise Level is:
≤ 2 dBA	Not applicable	Negligible
≥ 3 but ≤ 5 dBA	< recommended amenity noise level or > recommended amenity noise level, but the increase in total cumulative industrial noise level resulting from the development is less than or equal to 1dB	Marginal
≥ 3 but ≤ 5 dBA	> recommended amenity noise level and the increase in total cumulative industrial noise level resulting from the development is more than 1 dB	Moderate
> 5 dBA	≤ recommended amenity noise level	Moderate
	> recommended amenity noise level	Significant

Table 16 NPfI Examples of Receiver based Treatments to Mitigate Residual Noise Impacts

Significance of Residual Noise Impact	Example of Potential Treatment
Negligible	The exceedances would not be discernible by the average listener and therefore would not warrant receiver-based treatments or controls.
Marginal	Provide mechanical ventilation/comfort condition systems to enable windows to be closed without compromising internal air quality/amenity.
Moderate	As for ‘marginal’, but also upgraded facade elements, such as windows, doors or roof insulation, to further increase the ability of the building facade to reduce noise levels.
Significant	May include suitable commercial agreements where considered feasible and reasonable.

3.3.6 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 17**.

Table 17 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)

4.0 Assessment Methodology

4.1 Construction Noise and Vibration

A noise model of the study area has been used to predict noise levels from the proposed construction work to all surrounding receivers. The construction noise model uses the ISO 9613 algorithm 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 18**.

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 18 Construction Scenarios and Equipment

Scenario	Works Activity	Equipment
W.001	Site Establishment	• Truck (flatbed) • Elevated Work Platform • Hand tools • Dump Truck (15-25T) • Excavator - Tracked (20 tonne) • Front End Loader • Water Cart
W.002	Demolition of Existing Structures	• Dozer (CAT D9) • Dump Truck (15-25T) • Excavator - Tracked (20 tonne) • Front End Loader • Excavator 20-30T + hydraulic Hammer • Jackhammer • Water Cart
W.003	Earthworks	• Dozer (CAT D9) • Dump Truck (15-25T) • Grader • Excavator - Tracked (20 tonne) • Front End Loader • Roller - Vibratory • Water Cart
W.004	Construction of pads and hardstands	• Concrete agitator truck • Concrete pump truck • Concrete pencil vibrator • Hand tools • Truck - Medium Rigid (20 tonne) • Excavator - Tracked (20 tonne)
W.005	Construction of structures	• Elevated Work Platform • Truck (flatbed) • Hand tools • Truck - road truck/ truck & dog (30 tonne) • Crane (mobile)

Scenario	Works Activity	Equipment
W.006	Building Fit-out	• Elevated Work Platform • Truck (flatbed) • Hand tools • Crane (mobile)

4.1.2 Hours of Construction

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

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

4.2 Operational Noise Assessment

The potential operational noise levels from the proposal have been predicted to the surrounding receivers using the ISO 9613-2 industrial noise algorithm in SoundPLAN. The model includes ground topography, ground type and absorption, 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

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

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

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 provided by ESR and corrected for warehouse GFA. The worst-case 15-minute traffic data for each assessment period are summarised in **Table 19**.

The volumes are representative of the expected worst-case 15-minute period for the daytime, evening, night-time and morning shoulder period. 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 and morning shoulder period.

Heavy vehicle deliveries to the warehouses would be via a range of freight vehicles including medium trucks (ie rigid trucks) and heavy trucks (ie. articulated semi-trailers) accessing the site via entry/exit ramps located on ground level (GL) to L1.

Table 19 Vehicle Traffic Data – Worse Case 15 Minute Period

Warehouse	Vehicle Type	Number of Vehicles in Worst-case 15-minute Period[1]			
		Daytime (7am to 6pm)	Evening (6pm to 10pm)	Night-time (10pm to 5am)	Morning Shoulder (5am – 7am)
Ground Level					
WH1	Heavy trucks	1	1	1	1
	Medium trucks	2	1	1	1
	Light vehicles	10	2	9	10
WH2	Heavy trucks	1	1	1	1
	Medium trucks	2	2	1	2
	Light vehicles	11	2	11	11
Level 1					
WH1	Heavy trucks	1	1	1	1
	Medium trucks	2	1	1	1
	Light vehicles	10	2	9	10
WH2	Heavy trucks	1	1	1	1
	Medium trucks	2	2	1	2
	Light vehicles	11	2	11	11

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

Table 20 Vehicle Sound Power Levels

Vehicle	Movement	Sound Power Level (dBA)	Vehicle Speed (km/h)
Heavy trucks	Hardstands and access routes	108[1]	10
Medium trucks	Hardstands and access routes	97[2]	10
Light vehicles	Car park and access routes	90[3]	20

Note 1: 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 and is representative of trucks with three or more axles. Sound power levels taken from the Federal Highway Administration's Traffic Noise Model.

Note 2: Sound power level for medium trucks based on measurement data. Based on 95 dBA for trucks at slow speed for 80% of the time and 100 dBA for trucks accelerating for 20% of the time.

Note 3: Sound power level based on SLR measurement data.

Hardstands and Loading Docks

Details of the hardstand and loading dock noise sources are shown in **Table 21**. The various sources have been modelled in the hardstand areas (see **Figure 4**) based on the corresponding number of heavy vehicle movements in the worst-case 15-minute periods (see **Table 19**).

Table 21 Typical Hardstand and Loading Dock Noise Sources

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

Note 1: Sound power levels based on measurement data, where appropriate.

Note 2: Sound power level based on assumption of use of broadband reversing alarms.

Note 3: Sound power level includes a -3 dB reduction due to alarms being discrete events.

Internal Activities

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

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

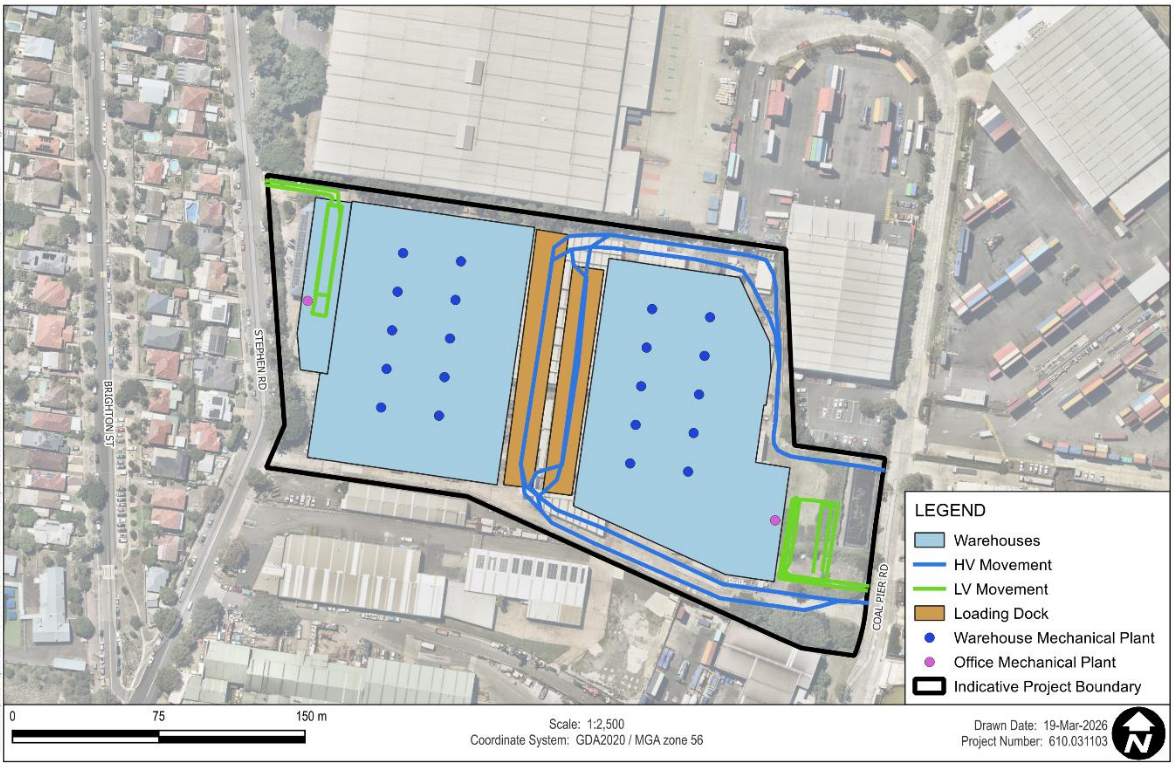
Mechanical Plant

At this early stage of the development the specific mechanical plant requirements for each warehouse have not been determined. Indicative external mechanical plant types, sound power levels, number of units and locations have been assumed based on the requirements of similar warehouse developments and are detailed in **Table 22**. The locations of the sources are shown in **Figure 4**.

Table 22 Mechanical Plant

Noise Source	Sound Power Level (dBA)	Indicative Locations
Office air-conditioning	85 per unit	One unit on the roof above each office – conservatively assumed to operate 24 hours a day.
Warehouse roof fans	85 per unit	Ten units on each warehouse roof – conservatively assumed to operate 24 hours a day.

Figure 4 Modelled Noise Sources



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

4.2.3 Noise Sources with Potential for Sleep Disturbance

As the development is proposed to operate 24-hours a day, noise emissions during the night-time require assessment for potential sleep disturbance at the nearest residential receivers. The details of typical activities with the potential to cause sleep disturbance are shown in **Table 23**. The various sources have been modelled in the hardstand areas (see **Figure 4**) with truck movement modelled in the truck access.

Table 23 Sleep Disturbance Noise Events – L_{Amax} Sound Power Levels

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

4.2.4 Off-Site Road Traffic

The potential noise impacts from additional traffic on public roads have been assessed based on the proposed increase in traffic volumes. Existing traffic volumes on surrounding roadways are based on the reported volumes detailed in the RTA NVIA. The proposed site related traffic volumes provided by ESR have also been included and are shown in **Table** 24.

Table 24 Traffic Volumes – Existing and Development Related

Road	Existing Traffic volumes[1]				Development Related Traffic Volumes			
	Daytime (7am to 10pm)		Night-time (10pm to 7am)		Daytime (7am to 10pm)		Night-time (10pm to 7am)	
	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
Stephen Road (between Proposal site and Swinbourne Street)	3651	275	445	39	142[2]	33	109[2]	12
Stephen Road (between Proposal site and Brighton Street)	3597	271	469	35	142[2]	33	109[2]	12
Botany Road (between Hill Street and Dent Street)	7527	1225	1236	271	418	132	347	46

Note 1: Existing traffic count sourced from Table 6-17 from the RTA NVIA.

Note 2: Assumes light vehicle traffic along Stephen Road are evenly split heading towards Swinbourne Street and Brighton Street.

4.2.5 Weather Conditions

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

The nearest sensitive residential receivers are within 250 m of the proposal site and the effects of weather on noise levels are expected to be minimal. Notwithstanding, the noise prediction modelling uses ISO 9613-2 algorithms which include noise-enhancing weather conditions including downwind propagation, or equivalently, propagation under a well-developed moderate ground-based temperature inversion.

5.0 Assessment of Impacts

5.1 Construction Noise

The predicted construction noise levels at the most-affected sensitive receivers surrounding the site are shown in **Table 26**.

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

The assessment shows the predicted impacts based on the exceedance of the management levels, as per the categories in **Table 25**.

Table 25 Exceedance Bands and Impact Colouring

Exceedance of Management Level	Impact Colouring
No exceedance	
1 to 10 dB	
11 dB to 20 dB	
21 dB to 30 dB	
>30 dB	

Note 1: The subjective response would vary and depends on the period in which the impacts occur (ie people are generally more sensitive to impacts during the evening and night-time).

Table 26 Predicted Construction Noise Levels

NCA	Receiver Type	Noise Management Levels (dBA) $L_{Aeq(15 minute)}$				Predicted Noise Levels (dBA) $L_{Aeq(15 minute)}$					
		Standard Hours (SH)	Out-of-hours (OOH)			W.001	W.002	W.003	W.004	W.005	W.006
			Day	Evening	Night	SH	SH	SH	SH	SH	SH
NCA01	Residential	57	52	52	50	70	82	76	72	65	62
NCA02	Residential	54	49	49	48	60	72	66	62	54	52
NCA02	Education	55 (external - when in use)				50	62	55	51	44	41
NCA03	Industrial	75 (external - when in use)				79	92	86	82	74	72

The predicted construction noise levels above show the following:

- Noise levels are expected to exceed the NMLs during noisy works at most surrounding residential receivers.
    - The main impacts are predicted to occur in NCA01 at the closest sensitive receivers where exceedances range from 5 – 25 dB depending on work scenarios. The worst-case impacts are expected to occur during W.002.
    - Exceedances of the NML at residential receivers set further back from the site in NCA02 are expected to be lower in magnitude, ranging from 6 – 18 dB depending on work scenarios. Similarly, the worst-case impacts are expected to occur during W.002.
        - Predicted noise levels in NCA02 are expected to be lower than the NML during W.005 and W.006.

- Educational receiver set further back from the site is expected to comply with the NML during all work scenarios except W.002 where exceedances of up to 7 dB are expected to occur.
- Industrial receivers surrounding the site are expected to exceed the NML during W.001 – W.004. Worst-case exceedances are expected to occur during W.002
    - The main impacts are predicted to occur at the closest sensitive receivers where exceedances range from 4 – 17 dB depending on work scenarios. The worst-case impacts are expected to occur during W.002.

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

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

5.2 Construction Vibration

The major potential sources of vibration from the proposed construction activities would likely be during:

- W.002 (Demolition of Existing Structures) – Large hydraulic hammers
- W.003 (Earthworks) – Vibratory rollers

Vibration offset distances have been determined from the CNVG minimum working distances for cosmetic damage and human comfort (see **Table 9**) during W.002 and W.003 and the assessment is summarised in **Figure 5** and **Figure 6** respectively.

Figure 5 W.002 – Construction Vibration Minimum Working Distances

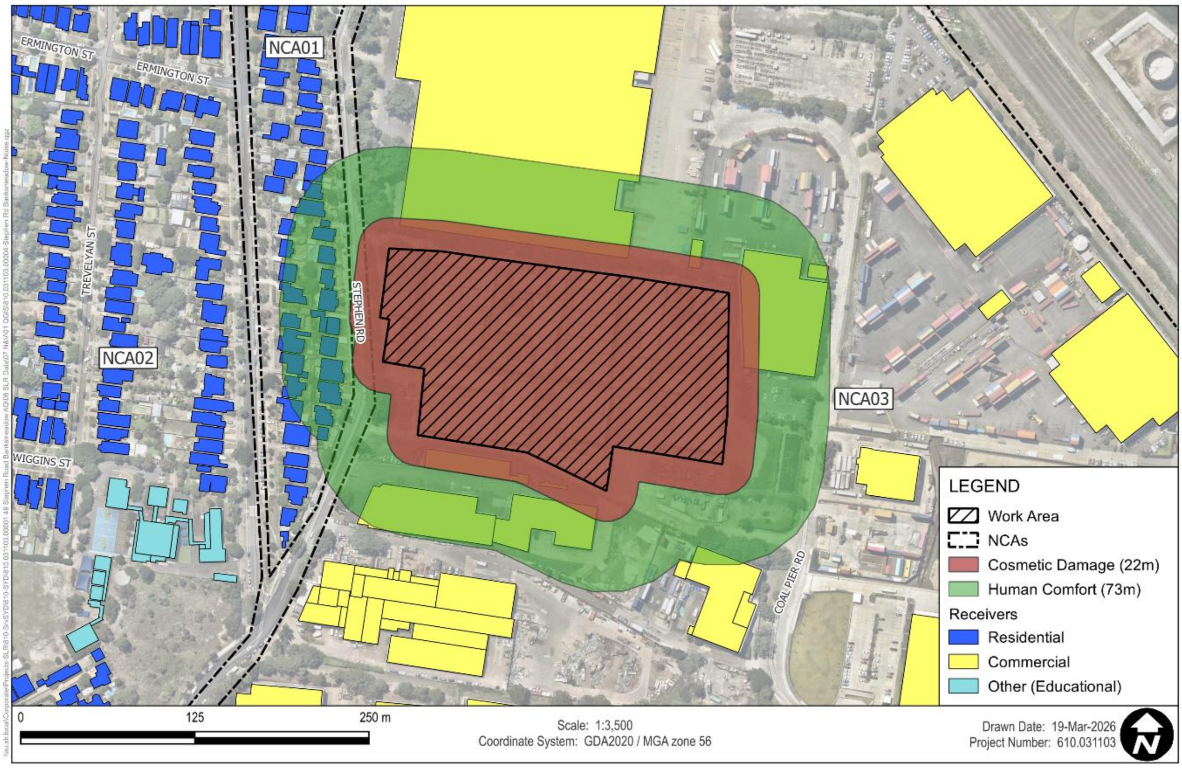
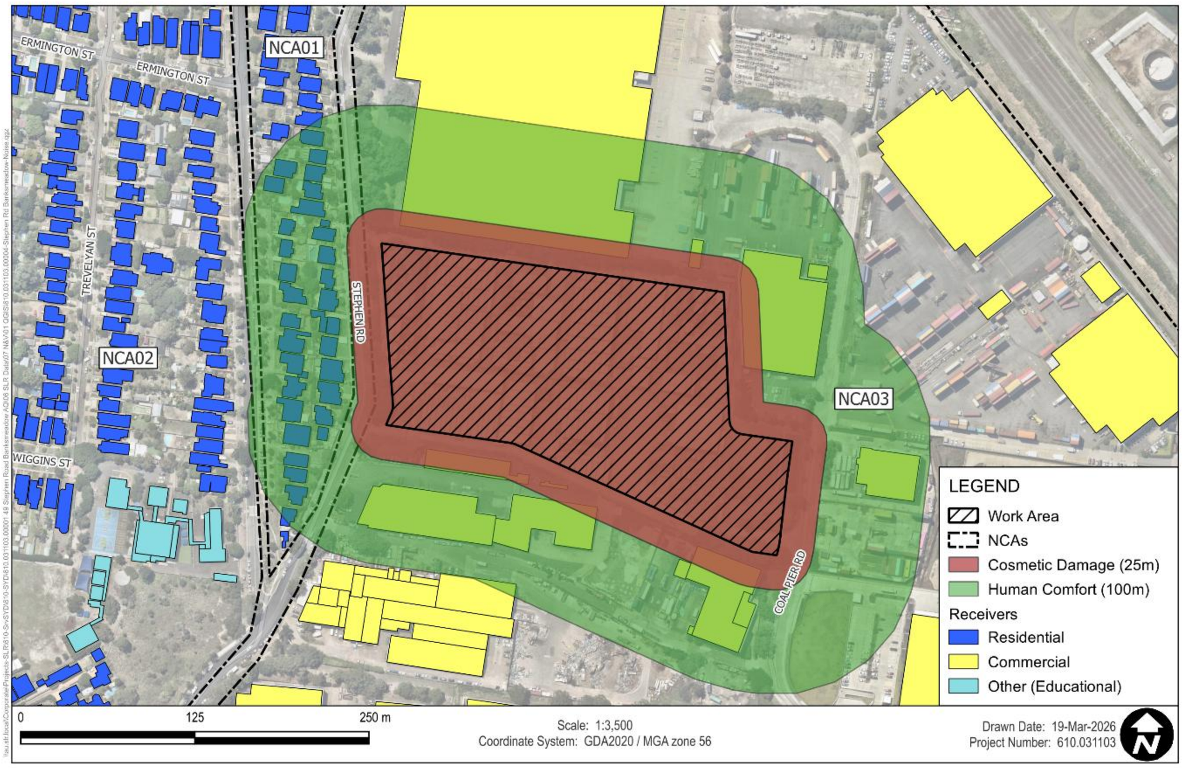


Figure 6 W.003 – Construction Vibration Minimum Working Distances



5.2.1 Cosmetic Damage Assessment

The above figure shows that the nearest industrial buildings surrounding the site may potentially be within the cosmetic damage minimum working distance for vibration intensive equipment. However, it should be noted that the cosmetic damage buffer shown above assumes light frame structures which may not be applicable in this circumstance due to the typical construction of warehouses and other industrial buildings.

The minimum working distance from reinforced/industrial structures would be 12 m for large vibratory rollers (>18t) and 11 m for large hydraulic hammers (1,600kg).

Where structures are shown within the cosmetic damage buffer above, this would only be when vibration intensive equipment is being used at the site boundary, near to adjacent sensitive receivers. Work in other more distant areas of the site would be outside the minimum working distances.

No residential buildings have been identified within the cosmetic damage buffer.

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

5.2.2 Human Comfort Vibration Assessment

The above figures show that numerous residential and industrial receivers, in NCA01 and NCA03 respectively, closest to the site are likely within the human comfort minimum working distance and occupants of these buildings may be able to perceive vibration impacts at times when vibration intensive equipment are in use nearby. Where impacts are perceptible, they would likely only be apparent for relatively short durations when vibration intensive equipment is in use.

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

5.3 Operational Noise

5.3.1 Predicted Noise Levels

A summary of the worst-case operational noise assessment at the most affected receivers within each NCA surrounding the proposal is shown in **Table 27**. Noise levels have been predicted at all floors of the nearest receivers and the highest noise level reported. 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 B**.

Feasible and reasonable mitigation measures have been investigated for the development with the aim of reducing noise levels to the PNTLs. A detailed investigation of all potential feasible and reasonable mitigation measures is provided in **Section 7.2**. The following predictions include the recommended mitigation measures, where appropriate.

Table 27 Operational Noise Assessment – Worst-case Affected Receivers

NCA	Type	Period	Noise Level $L_{Aeq(15minute)}$ (dBA)			Compliance
			Noise Criteria	Predicted	Exceedance	
NCA01	Residential	Day	52	50	-	Yes
		Evening	48	48	-	Yes
		Night	43	44	1	No[1]
		Morning Shoulder	50	48	-	Yes
NCA02	Residential	Day	49	45	-	Yes
		Evening	48	44	-	Yes
		Night	43	41	-	Yes
		Morning Shoulder	48	44	-	Yes
	Educational	When in use	48	45	-	Yes
NCA03	Industrial	When in use	70	62	-	Yes

Note 1: A 1 dB residual exceedance is considered negligible in accordance with Section 4.2 NPfI and is further discussed in **Section 7.2.2**.

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. A residual 1 dB exceedance during the night-time period was identified at several receivers within NCA01. Further discussion relating to residual exceedance is included in **Section 7.2.2**.

5.3.2 Sleep Disturbance

The predicted night-time maximum noise levels at the nearest residential receivers are shown in **Table 28**. Impacts have been predicted at all floors of the nearest receivers and the highest noise level has been reported.

The predictions include noise-enhancing weather conditions as discussed in **Section 4.2.6**. The various sources have been modelled within the site boundary (see **Figure 4**).

Table 28 Sleep Disturbance Assessment

NCA	Source	Maximum Noise Level LAmax (dBA)			Below Screening Level
		Sleep Dist. Screening Level	Predicted	Exceedance	
NCA01	Light Vehicle Movements	60	48	-	Yes
	Truck movements		61	1	**No**
	Truck airbrake		67	7	**No**
	Truck reversing alarm		61	1	**No**
	Forklift reversing alarm		56	-	Yes
	Roller door		44	-	Yes
NCA02	Truck movements	58	55	-	Yes
	Truck airbrake		61	3	**No**
	Truck reversing alarm		55	-	Yes
	Forklift reversing alarm		50	-	Yes
	Roller door		39	-	Yes

The assessment indicates that maximum noise events from the proposal are predicted to exceed the sleep disturbance screening level for the most-affected receivers within NCA01 and NCA02. The main events that are expected to result in this exceedance are from heavy vehicle manoeuvring (airbrake, vehicle movement and reverse alarms).

The NPfI requires a detailed maximum noise level assessment to be completed where night-time noise levels exceed the screening level which is included in **Section 5.3.2.1**.

5.3.2.1 Detailed Maximum Noise Level Assessment

The detailed maximum noise level assessment is summarised in **Table 29** for the worst-affected receivers in each NCA.

Table 29 Detailed Maximum Noise Level Assessment

NCA	Maximum Noise Level LAmax (dBA)					Comments
	Sleep Disturbance Goals (dBA)		Development Related Maximum Noise Events		Existing Maximum Noise Levels[3]	
	Awakening Response[1]	Good Sleep[2]	Predicted	Frequency of Occurrence		
NCA01	65	Around 55 (10 to 15 times per night)	Up to 67	> 15 events	65 – 75 dBA	**Awakening Response:** maximum noise levels are predicted to exceed the 'awakening response' due to truck airbrake. **Good Sleep:** maximum noise levels are predicted to exceed the 'good sleep' noise level goal due to truck movement, truck airbrake, truck reverse alarms and forklift reverse alarms. **Existing maximum noise levels:** the unattended noise monitoring showed that existing maximum noise levels were measured to frequently be in the range of: • 70 – 75 dB(A) As per the RTA NVIA, existing maximum noise events are typically attributed to vehicle pass by along Stephen Road and industrial activities including material handling from freight sites adjacent to Coal Pier Road.
NCA02			Up to 61		55 – 65 dBA	**Awakening Response:** maximum noise levels are predicted to be below the 'awakening response'. **Good Sleep:** maximum noise levels are predicted to exceed the 'good sleep' noise level goal due to truck airbrake. **Existing maximum noise levels:** the unattended noise monitoring showed that

NCA	Maximum Noise Level LAmax (dBA)					Comments
	Sleep Disturbance Goals (dBA)		Development Related Maximum Noise Events		Existing Maximum Noise Levels[3]	
	Awakening Response[1]	Good Sleep[2]	Predicted	Frequency of Occurrence		
						existing maximum noise levels were measured to frequently be in the range of: • 55 – 65 dB(A) Maximum noise events are attributed to vehicle pass by along Brighton Street and industrial activities from the Banksmeadow Industrial Precinct.

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

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

Note 3: As per unattended noise monitoring results detailed in Appendix B RTA NVIA

The assessment detailed in **Table 29** shows predicted noise level due to heavy vehicle airbrakes from the proposed site will marginally exceed the awakening response and good sleep criteria at the most affected receiver in NCA01 whilst windows are opened to allow for natural ventilation.

However, when considering the existing maximum noise levels based on long-term unattended noise monitoring, the site related maximum noise events are expected to be within the typical range of the existing environment and is not expected to negatively affect the acoustic amenity of the immediate surrounding area within NCA01.

In relation to the worst-affected receiver further back from the site in NCA02, the predicted maximum noise events are expected to comply with the sleep awakening response criteria whilst exceeding the good sleep criteria with windows opened to allow for natural ventilation.

Similarly, the predicted maximum noise events from the site are expected to be within the range of existing maximum noise events based on long-term unattended noise monitoring and is not expected to negatively affect the acoustic amenity for receivers set further back within NCA02.

Based on the above assessment, predicted maximum noise events are within the existing maximum noise range for the surrounding area and is not expected to adversely impact the amenity. Hence, no further mitigation measures are required.

5.4 Off Site Traffic Assessment

The potential noise impacts from additional traffic on public roads have been assessed based on the proposed increase in traffic volumes shown in **Section 4.2.4**. The results of the off-site traffic noise assessment are shown in **Table 30**.

Table 30 Traffic Noise Assessment

Location	RNP Increase Criterion (dB)	Predicted Increase (dB)	
		Day	Night
Stephen Road (between Proposal site and Swinbourne Street)	2.0	0.3	1.0
Stephen Road (between Proposal site and Brighton Street)		0.3	1.1
Botany Road (between Hill Street and Dent Street)		0.4	0.8

Note 1: Exceedances of the RNP increase criterion shown in bold.

The above assessment shows that the predicted increase in noise from development related vehicles using Stephen Road and Botany Road (via Coal Pier Road) are expected to be below 2.0 dB during both the daytime and night-time periods.

Increases of less than 2.0 dB are considered negligible and represent a minor change that is considered barely perceptible to the average person. As such, impacts are not expected and there is no requirement to consider noise mitigation or management measures.

6.0 Cumulative Impacts

The NSW Government *Cumulative Impact Assessment Guidelines for State Significant Projects* requires that the potential combined effect of cumulative impacts on all nearby industrial developments to be considered when assessing potential noise impacts from state significant projects. Cumulative impacts can be caused by the compounding effects of multiple projects in an area, and by the accumulation of effects from past, current and future activities as they arise.

6.1 Construction Noise

Cumulative construction noise impacts can occur where multiple work activities are being completed near to a particular receiver at the same time.

The site is surrounded by existing industrial sites. Currently, there are no other identified SSDAs proposed within the Banksmeadow precinct. However, there are multiple DAs submitted to Bayside Council which may result in future site redevelopments. This could result in multiple construction sites operating concurrently.

Since construction scenarios and equipment for other possible nearby projects would generally require similar items of equipment to the proposal, concurrent construction work could theoretically increase the worst-case noise levels from the proposal by around 3 dB (ie the logarithmic addition of two sources of noise at the same level). The likelihood of worst-case noise levels being generated by works on different projects at the same time is, however, considered low.

As such, cumulative construction impacts are not considered likely to significantly alter the predictions from the proposal and no specific mitigation to address cumulative impacts is expected to be required. The potential cumulative impacts from the proposal and other projects would continue to be considered as the project progresses when detailed construction planning is developed as part of preparation of the site's Construction Environmental Management Plans (CEMPs).

6.2 Operational Noise

The *Noise Policy for Industry* states that it aims to limit continuing increases in cumulative industrial noise through by setting out procedures for assessing the existing acoustic environment and the application of amenity noise levels for sensitive receivers, which are applicable to all industrial noise sources in an area.

The policy accounts for potential cumulative impacts by lowering the criteria for each individual development to ensure that the ambient noise level within an area from all industrial noise sources combined remains below the recommended amenity noise levels, where feasible and reasonable.

As such (as discussed in **Section 3.3.2**), the potential cumulative operational impacts from the proposal and other potential sources of industrial noise in the area are accounted for in the proposal-specific PNTLs and, therefore, do not require further consideration.

7.0 Mitigation and Management Measures

7.1 Construction Impacts

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

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

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

7.2 Operational Impacts

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

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

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

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

Table 31 Operational Noise Mitigation Options

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

Ref.	Mitigation Option	Noise Impact/Benefit	Reasonable and Feasible to Apply
S3	Hardstand/external equipment use	Minimising the concurrent use of forklifts or other mobile plant outside the warehouses and/or limiting their use to the less sensitive day and evening periods. In practice, this would occur naturally across the estate due to operational requirements of the different tenants.	No – placing restrictions on allowable external use of forklifts and equipment across the different tenancies is unlikely to be feasible and reasonable.
S4	Quieter mobile plant and equipment	Use of quieter mobile plant and equipment options, such as electric forklifts instead of gas forklifts.	Yes – quieter electric forklifts will be used on the hardstand.
S5	Use broadband and/or ambient sensing alarms on trucks and forklifts where they are required to reverse during the night-time.	Reduce potential for annoying noise emissions during the night-time from forklifts and trucks.	Yes – use broadband and/or ambient sensing alarms on forklifts and trucks where they are required to reverse during the night-time.
S6	Appropriate specification and location of mechanical plant during detailed design.	If noise impacts from mechanical plant are identified during detailed design, quieter plant could be selected, or the plant could be relocated to a location screened from view of the nearest receivers, where appropriate.	Yes – impacts from mechanical plant were not identified during this assessment. Noise impacts from mechanical plant would be investigated further during detailed design or construction certificate stages when specific plant requirements are identified.
S7	Appropriate design of warehouses during detailed design.	Appropriate warehouse materials to minimise noise break-out from internal activities would be selected during detailed design. Where it is identified that noisier equipment is required to be used within the warehouse buildings than currently assumed (eg manufacturing equipment instead of standard warehousing and distribution equipment), facade and roof construction can use materials that provide a greater acoustic benefit.	Potentially – noise impacts from internal equipment would be investigated further during construction certificate stages if tenants require manufacturing plant or other noisy equipment.
S8	Roller doors kept closed when loading/unloading is not occurring to minimise noise breakout.	Use of roller doors to minimise internal noise breakout.	Yes – roller doors should be kept closed when not in use for loading/unloading trucks.
S9	Appropriate design of site layout to minimise the need for trucks to stop or brake outside of loading docks with line of sight to noise sensitive receivers.	Minimise noise emissions, particularly from truck airbrakes.	Yes – applied during design of the warehouse layout.

Ref.	Mitigation Option	Noise Impact/Benefit	Reasonable and Feasible to Apply
S10	Production of an Operational Noise Management Plan.	This would detail the measures that could be used by the various tenants to minimise general noise emissions from the site. Reference can be made to the Best Management Practice (BMP) and Best Available Technology Economically Available (BATEA) measures listed in the NPfI (see **Appendix E**).	Yes, would be completed during later stages of the project, where necessary
Path Control			
P1	Noise barriers	Construction of noise barriers along boundary fence locations or other strategic locations could be used to reduce noise levels where plant or equipment are in line of sight of the nearest receivers.	Yes – see **Section 7.2.1**.
Receiver Control			
R1	At-property treatments	The NPfI notes that noise mitigation at a residence may be required to be considered where the residual impact exceeds the PNTLs by ≥3 dB. At-property treatments typically include mechanical ventilation to allow windows to be closed as a noise mitigation measure, together with upgraded facade elements such as windows, doors and acoustic seals.	All predicted residual receivers are ≤2 dB and are considered negligible. These exceedances would not be discernible by the average listener and therefore would not warrant receiver-based treatments or controls
Verification Monitoring			
V1	Noise monitoring	Verify post-construction operational noise levels are in-line with predictions and the mitigation is working as intended.	Yes

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

7.2.1 Proposed Barrier Location

Modelled noise levels have incorporated proposed barriers at the following locations:

- Solid façade enclosing the western light vehicle carpark
- 2m solid parapets to all entry/exit ramps across the site
- 3m barriers along the ground level hardstand along the northwestern and southwestern perimeter.

The proposed western carpark enclosure and hardstand barriers are depicted in **Figure 7**.

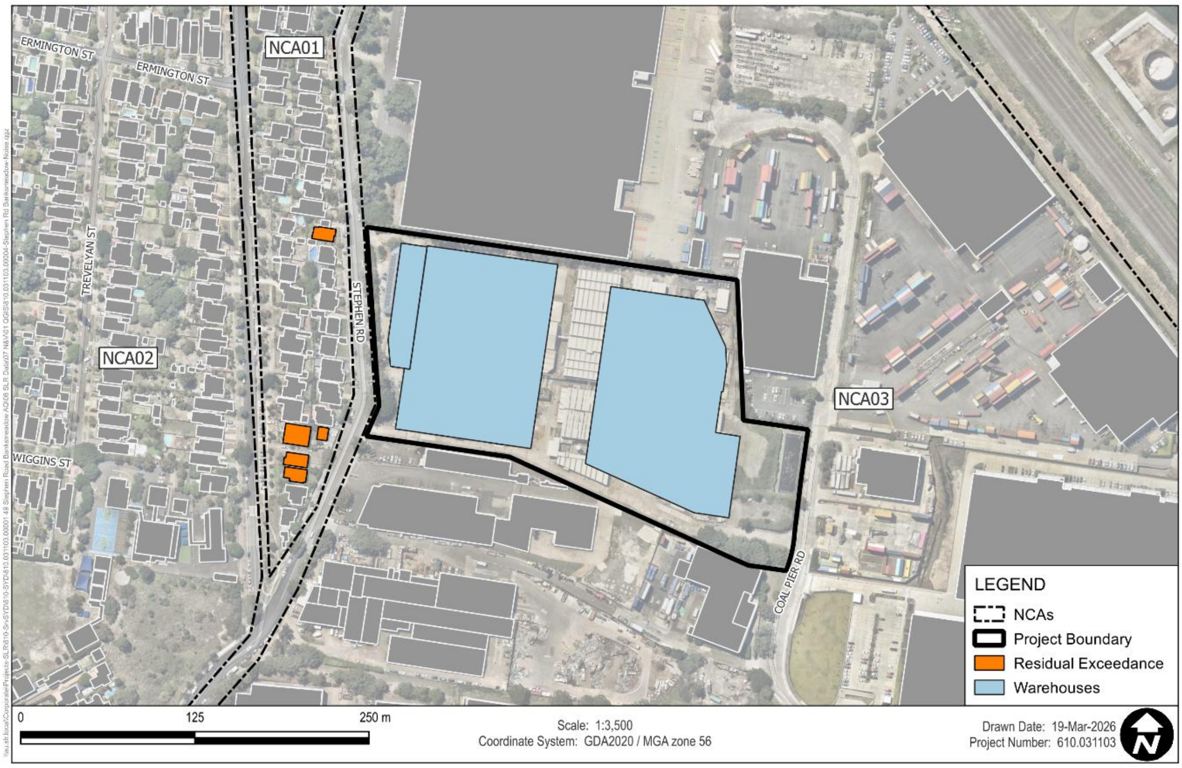
Figure 7 Proposed Barrier Locations

7.2.2 Residual Impacts

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

The predicted residual impacts from the development are limited to a total of five receivers located within NCA01. These receivers are shown in **Figure 8**. All predicted residual receivers are ≤2 dB and are considered negligible (see **Table 15** and **Table 16**). These exceedances would not be discernible by the average listener and therefore would not warrant receiver-based treatments or controls.

Figure 8 Residual Exceedances of PNTLs



7.3 Comparison with EIS Noise and Vibration Assessment

The previous site design detailed in the RTA NVIA demonstrated noise breakout concerns due to the orientation of the site's hardstands and buildings enabling line of sight with sensitive residents along Stephen Road and other residents set further back from the site. This resulted in noise emission impacts from the site due to vehicle movement and loading dock activities located within the hardstand areas. Additionally, the heavy vehicle entry/exit ramp designs would result in vehicle movements being brought to the edge of the site closest to the sensitive receivers along Stephen Road. Therefore, extensive mitigation measures were necessitated to minimise noise impacts (see Table 6-11 RTA NVIA).

Conversely, the redesigned site layout allowed the warehouses to provide natural attenuation, removing line of sight to the majority of sensitive receivers whilst also offsetting heavy vehicle entry/exit ramps further back from the residents along Stephen Road. This resulted in all receivers achieving compliance with the project noise criteria(see **Section 5.3** and **Section 7.2.2**) whilst reducing the extent of noise mitigation required (see **Section 7.2.1**).

8.0 Conclusion

SLR has been engaged to assess the potential operational noise emissions from the proposed development at 49 – 61 Stephen Road, Banksmeadow. The proposal includes the operation of two multi-level warehouses, which would be in use 24/7.

Construction noise levels are predicted to exceed noise management levels at the nearest receivers during worst-case construction scenarios, however, this would only be expected to occur when noisy work is being completed close to the site boundary nearest to these receivers. Construction activities for the proposal would only be undertaken during standard daytime construction hours.

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

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

Operational noise emissions from the proposal have been predicted to the surrounding receivers in the immediate vicinity and set further back from the site. Noise levels are generally expected to comply with the trigger levels with the inclusion of the specified mitigation measures at all receivers during all time periods. Five residual exceedances are predicted, however these are considered negligible and would not be discernible by the average listener. Therefore receiver-based treatments or controls are not warranted.

A sleep disturbance assessment has been undertaken to determine the risk of operational noise impacts from the site to the surrounding receivers. Maximum noise events due to the operation of the site were deemed suitable when considering proposed noise from the site are predicted to be within the expected range of the existing environment and will not adversely impact the acoustic amenity.

A qualitative comparative assessment was undertaken against the RTA NVIA to highlight the key design changes incorporated in the updated site layout that enabled noise emission compliance with the relevant standards to be achieved whilst reducing the required mitigation measures. This was achieved by reorientating the site to introduce shielding and moving vehicle sources away from sensitive receivers.

Off-site traffic noise impacts are below the 2.0 dB Road Noise Policy increase criterion and no further assessment is warranted.

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

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

Appendix A Acoustic Terminology

Noise and Vibration Impact Assessment

49 – 61 Stephen Road, Banksmeadow

ESR Australia

SLR Project No.: 610.031103.00004

17 April 2026

1. Sound Level or Noise Level

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

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

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

2. 'A' Weighted Sound Pressure Level

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

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

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

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

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

3. Sound Power Level

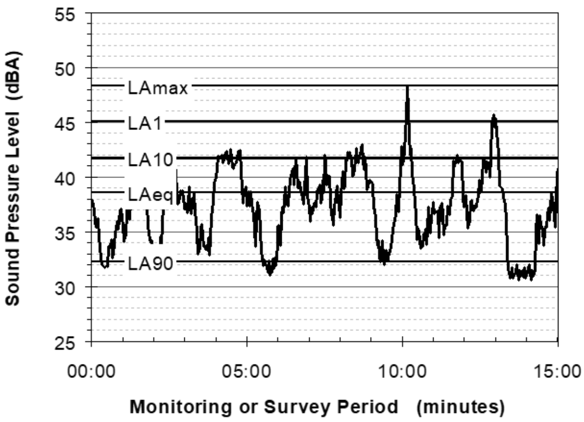
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

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

4. Statistical Noise Levels

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

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



Of particular relevance, are:

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

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

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

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

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

5. Frequency Analysis

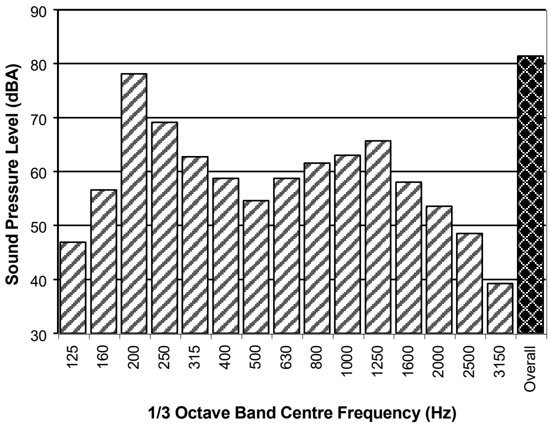
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

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

Frequency analysis can be in:

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

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



6. Annoying Noise (Special Audible Characteristics)

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

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

7. Vibration

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

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

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

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

8. Human Perception of Vibration

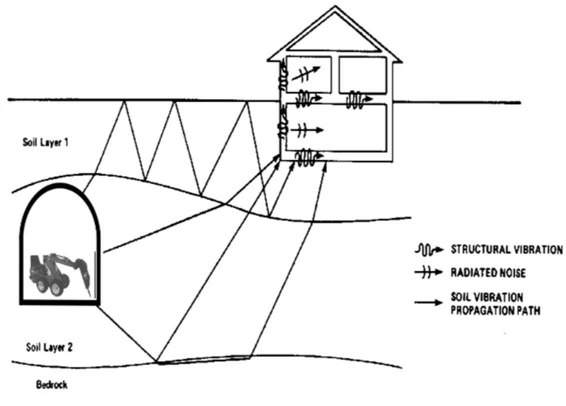
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience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

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

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

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

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



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

Appendix B Operational Noise Contours

Noise and Vibration Impact Assessment

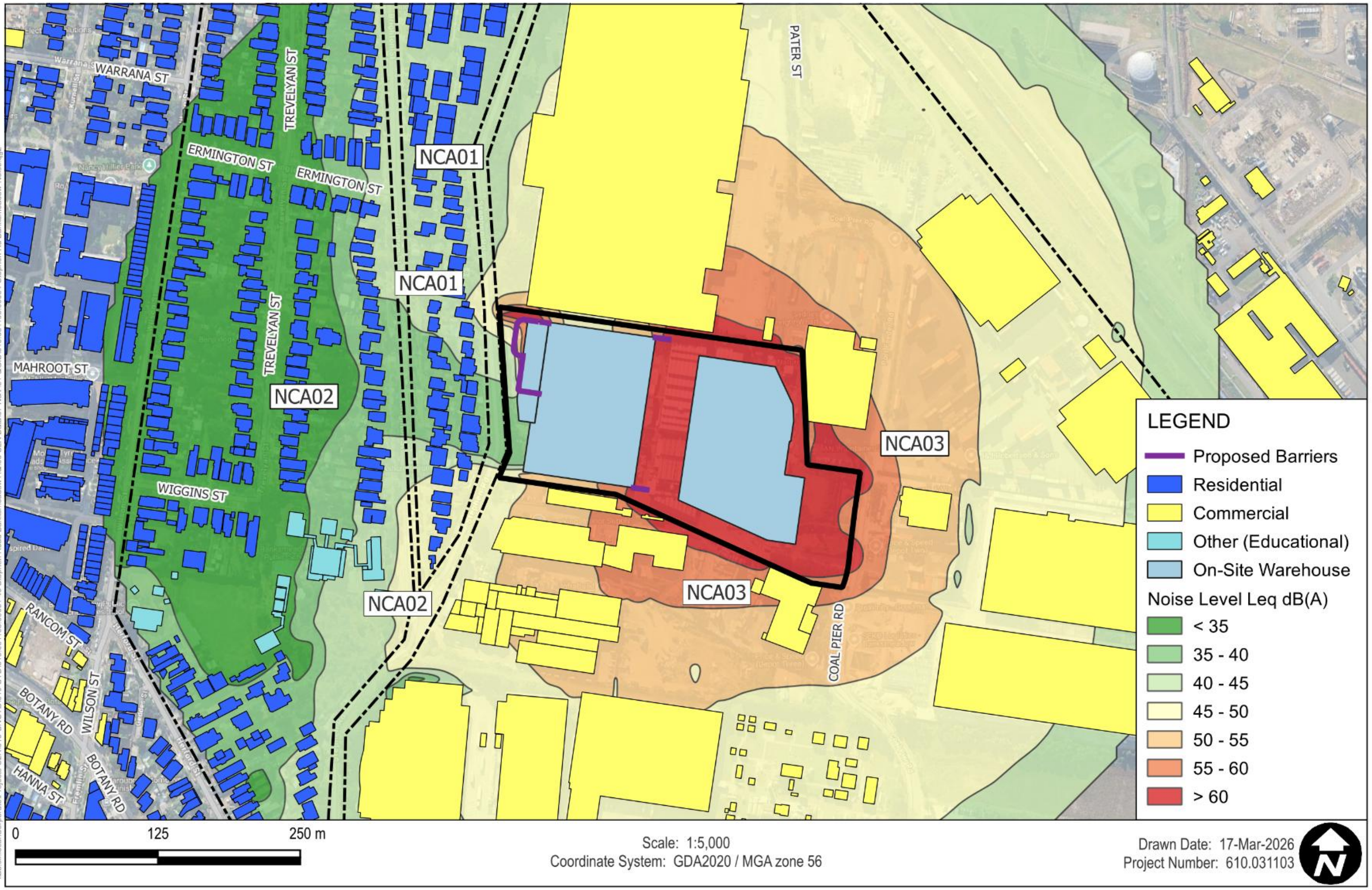
49 – 61 Stephen Road, Banksmeadow

ESR Australia

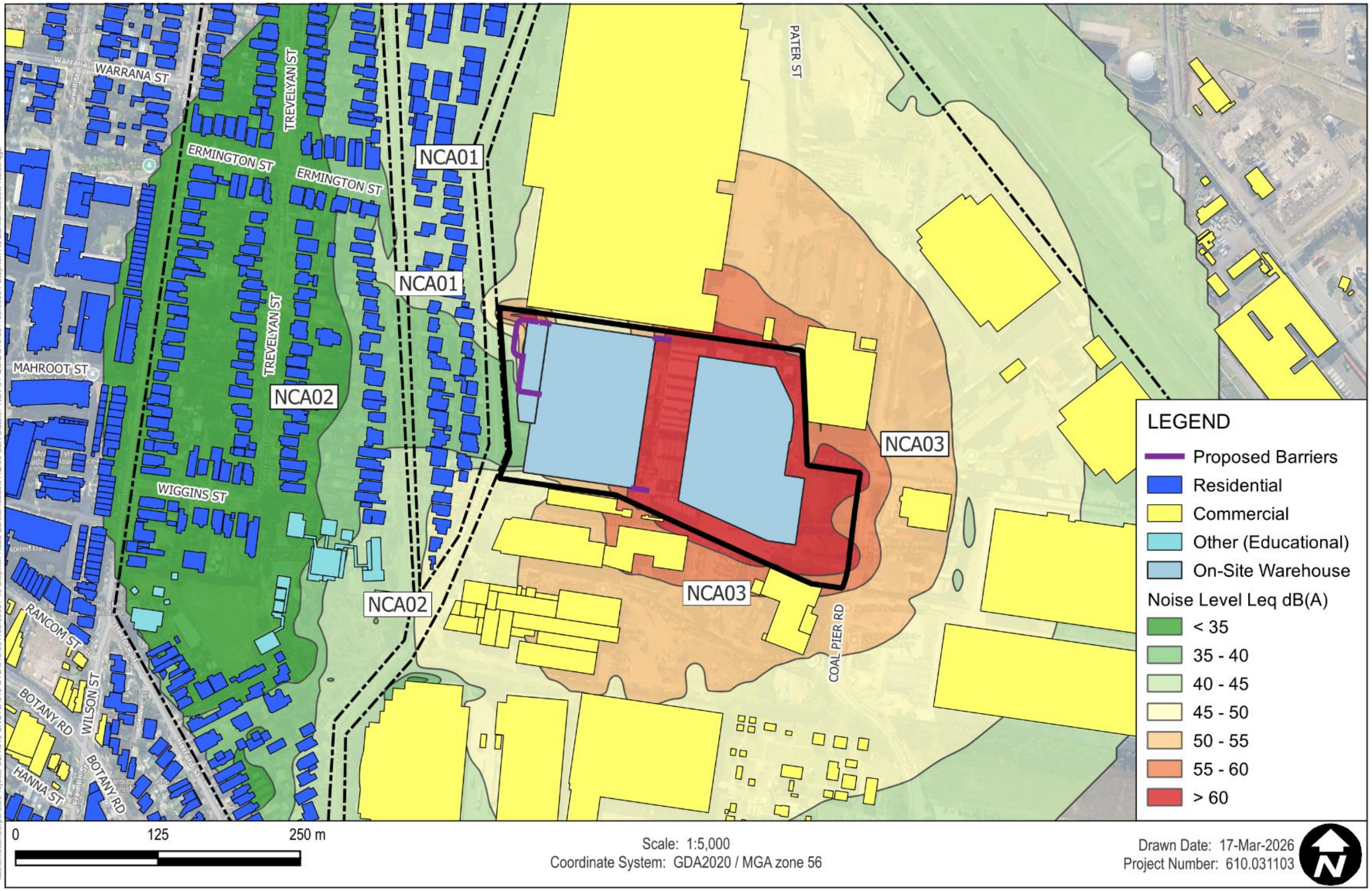
SLR Project No.: 610.031103.00004

17 April 2026

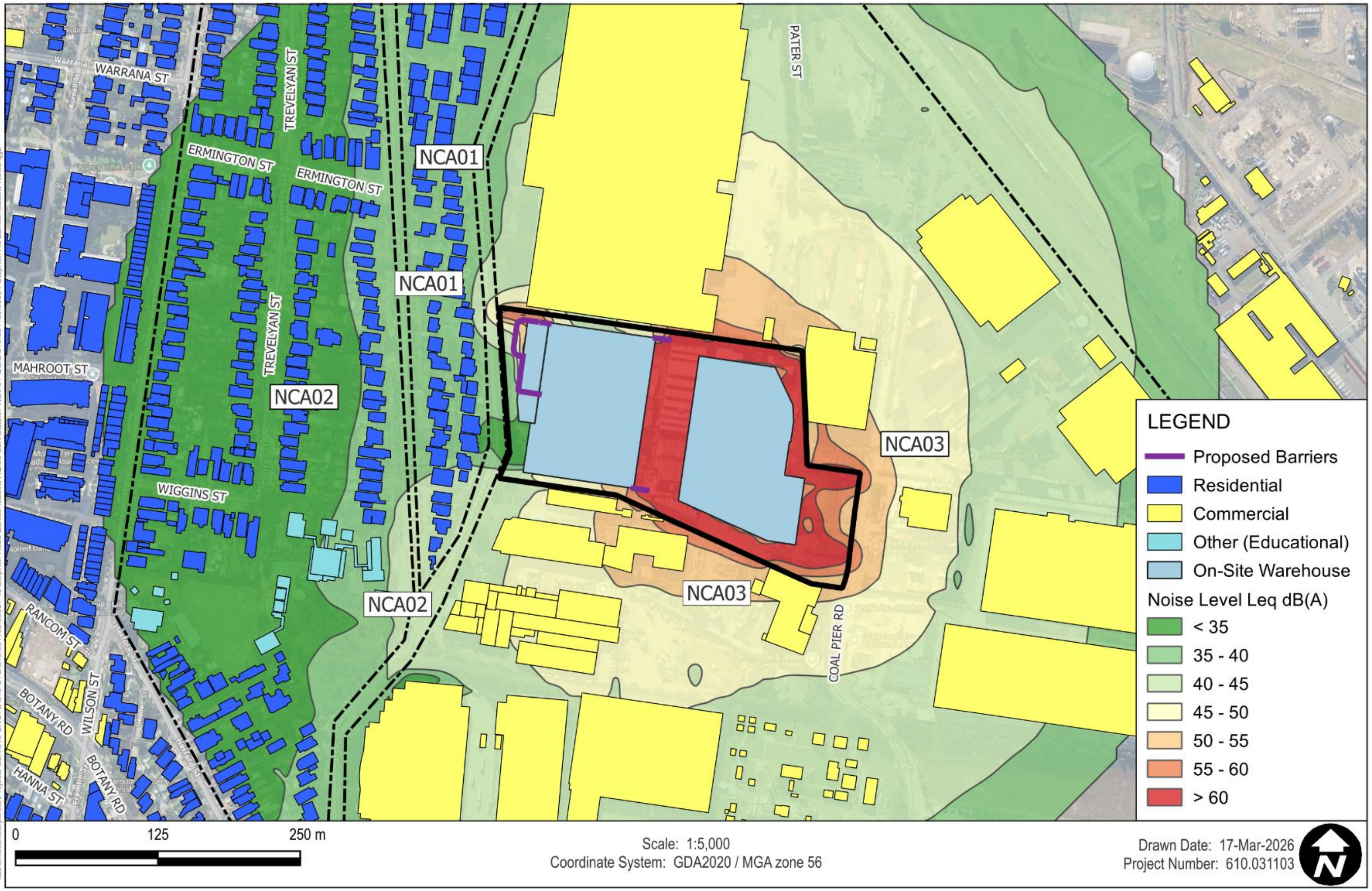
B.1 Operational Noise Contour – Day



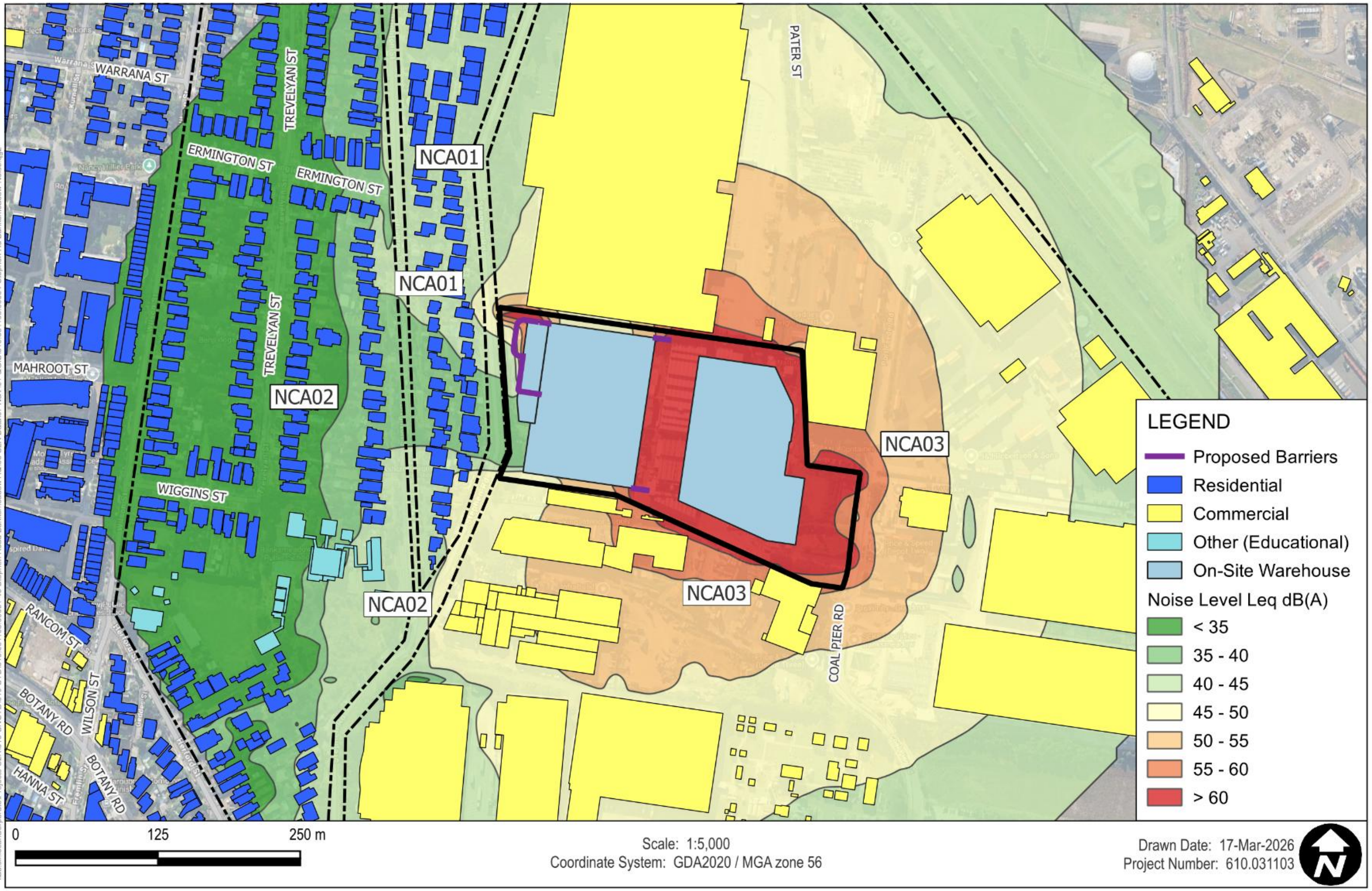
B.2 Operational Noise Contour – Evening



B.3 Operational Noise Contour – Night



B.4 Operational Noise Contour – Morning Shoulder



Appendix C Construction Noise Sources

Noise and Vibration Impact Assessment

49 – 61 Stephen Road, Banksmeadow

ESR Australia

SLR Project No.: 610.031103.00004

17 April 2026

	Equipment	Total Lw (dBA)	Concrete agitator truck	Concrete pencil vibrator	Concrete pump truck	Crane (mobile)	Dozer (CAT D9)	Dump Truck (15-25T)	Elevated Work Platform	Excavator - Tracked (20 tonne)	Excavator 20-30T + hydraulic Hammer[1]	Front End Loader	Grader	Hand tools	Jackhammer[1]	Roller - Vibratory[1]	Truck - Medium Rigid (20 tonne)	Truck - road truck/ truck & dog (30 tonne)	Truck (flatbed)	Water Cart
	Sound Power Level (Lw)[2]		109	103	108	104	116	98	97	105	122	113	110	102	113	109	103	108	95	107
	Estimated utilisation in 15-min assessment period (%)		100	100	100	30	50	25	25	50	30	50	50	75	30	50	25	25	25	75
ID	**Construction Scenario**																			
W.001	Site Establishment	**112**						X	X	X		X		X					X	X
W.002	Demolition of Existing Structures	**123**					X	X		X	X	X			X					X
W.003	Earthworks	**117**					X	X		X		X	X			X				X
W.004	Construction of pads and hardstands	**113**	X	X	X					X				X			X			
W.005	Construction of structures	**106**				X			X					X				X	X	
W.006	Building Fit-out	**103**				X			X					X					X	

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

Note 2: 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 CNVG Mitigation Measures

Noise and Vibration Impact Assessment

49 – 61 Stephen Road, Banksmeadow

ESR Australia

SLR Project No.: 610.031103.00004

17 April 2026

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 Transport 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.
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.

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

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

Appendix E NPfI Mitigation Measures

Noise and Vibration Impact Assessment

49 – 61 Stephen Road, Banksmeadow

ESR Australia

SLR Project No.: 610.031103.00004

17 April 2026

Best Management Practice (BMP)

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

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

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

Best Available Technology Economically Achievable (BATEA)

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

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

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

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

Making Sustainability Happen