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ELIZABETH ENTERPRISE PRECINCT

Noise and Vibration Impact Assessment

17 October 2024

Mirvac Projects Pty Ltd

TM130-01F02 Noise & Vibration Assessment (r9)

40 YEARS 1982-2022 ACOUSTIC ENGINEERING EXCELLENCE
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1 Introduction

1.1 Overview and purpose of report

Renzo Tonin & Associates was engaged by Mirvac Projects Pty Ltd (Mirvac) to prepare a noise and vibration impact assessment (NVIA) for the proposed Elizabeth Enterprise Precinct – Stage 1 Concept Masterplan (the Proposal) located at 1669-1723 and 1669A Elizabeth Drive, Badgerys Creek. The Proposal is considered to be a State Significant Development (SSD-19618251).

This report assesses noise and vibration impacts during the construction and operational stages of the Proposal, including mitigation and management measures to reduce impacts during the construction and operational phases. This report has been prepared to address the Planning Secretary's environmental assessment requirements (SEARs) specific to noise and vibration, as issued by the Department of Planning, Housing and Infrastructure (DPHI).

The noise and vibration assessment has been carried out in accordance with the policies, guidelines and standards presented in Section 3 of this report, addressing construction and operational noise and vibration impacts.

1.2 Secretary's environmental assessment requirements

The noise and vibration requirements addressed in this report are presented in the SEARs (ref. SSD-19618251, dated 31 August 2022) issued for the Proposal and are outlined in Table 1-1.

Table 1-1 – Secretary's environmental assessment requirements – noise and vibration

Secretary's environmental assessment requirements	Where addressed
Noise and vibration	
– a quantitative noise and vibration impact assessment for construction and operation of the development, including traffic noise, undertaken by a suitably qualified person in accordance with the relevant Environment Protection Authority guidelines and including an assessment of nearby sensitive receivers;	This report
– cumulative impacts of other existing and proposed developments;	Section 5.7
– consideration of potential impacts from the airport on the development including any sensitive land uses; and	Section 5.1
– details of the proposed noise mitigation, management and monitoring measures.	Section 4.5.2 – Construction noise Section 4.6.3 – Construction vibration Section 4.7 – Complaints management Section 5.6 – Operational noise

1.3 Proposal description

The EEP Stage 1 Concept Masterplan includes seven (7) warehouse buildings across Lots 1, 2, 4, 5, 6, 7 and 8. The Concept Masterplan seeks consent for warehouse and distribution centre and general industry uses.

More specifically, the Proposal will involve the following:

- The Concept Masterplan for the Elizabeth Enterprise Precinct Stage 1 comprising of seven (7) industrial buildings, internal road network layout, building locations, car parking, concept landscaping, building heights, setbacks and built form parameters
- Site preparation works comprising:
  - Demolition and removal of existing rural structures
  - Heritage salvage works (if applicable)
  - Creation of roads and access infrastructure, including connectivity to a signalised intersection with Elizabeth Drive
  - Clearing of existing vegetation on the subject site and associated dam dewatering and decommissioning
  - On-site bulk earthworks including any required ground dewatering
  - Importation, placement and compaction of soil material
  - Construction of boundary retaining walls
  - Delivery catchment level stormwater infrastructure, trunk service connections, utility infrastructure
- Construction and fit out of warehouses 1, 2, 4, 5, 6, 7 and 8 which will operate 24 hours per day, seven days per week including associated site grading and infrastructure integration
- Boundary stormwater management, fencing and landscaping
- Subdivision
- Signage.

1.4 Assessment objectives

The assessment objectives are to determine the potential levels of noise and vibration impacts at sensitive receivers located near the Proposal and determine the levels of mitigation that would be required to enable compliance with the current NSW requirements.

As part of preparing this assessment and in accordance with the SEARS, the following policies, guidelines and standards have been considered:

- Australian Standard AS 1055:2018 *Acoustics—Description and measurement of environmental noise*
- NSW *Noise Policy for Industry* (NPfI) (EPA 2016)
- NSW *Road Noise Policy* (RNP) (DECCW July 2011)
- *Noise Criteria Guideline* (NCG) (RMS 2015)
- *Noise Mitigation Guideline* (NMG) (RMS 2015)
- NSW *Interim Construction Noise Guideline* (ICNG) (DECC 2009)
- NSW *Assessing Vibration – A Technical Guideline* (AVTG) (DEC 2006)
- NSW *Environmental Criteria for Road Traffic Noise* (ECRTN) (EPA 1999)
- *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration* (ANZECC 1990)
- British Standard BS 6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting*
- NSW *Noise Guide for Local Government* (NGLG) (EPA 2013).

In undertaking the assessment, a three-dimensional noise modelling software package was used to create a noise model of the Proposal in order to predict noise levels at the nominated sensitive receivers and assess the need for noise mitigation.

1.5 Nearby noise and vibration sensitive receivers

Scattered rural-residential receivers largely occupy the land use surrounding the Proposal site. While a few commercial and industrial receivers occupy the area to the east and west of the Proposal site.

It is noted that as part of the Western Sydney Aerotropolis State Environmental Planning Policy (now known as State Environmental Planning Policy (Precincts—Western Parkland City) 2021), the land use surrounding the Proposal site have been zoned as 'Enterprise', which will only include commercial and industrial uses. Residential and other noise sensitive uses will not be permitted in Enterprise zones. Nevertheless, for the purpose of the assessment and the benefit of existing residences surrounding the Proposal site, the current residential areas surrounding the Proposal site will be assessed accordingly.

The nearest residential receivers are located along Elizabeth Drive to the east, south and west, and along Clifton Avenue to the northeast. The nearby noise sensitive receivers are presented in Figure 1-1 and described below:

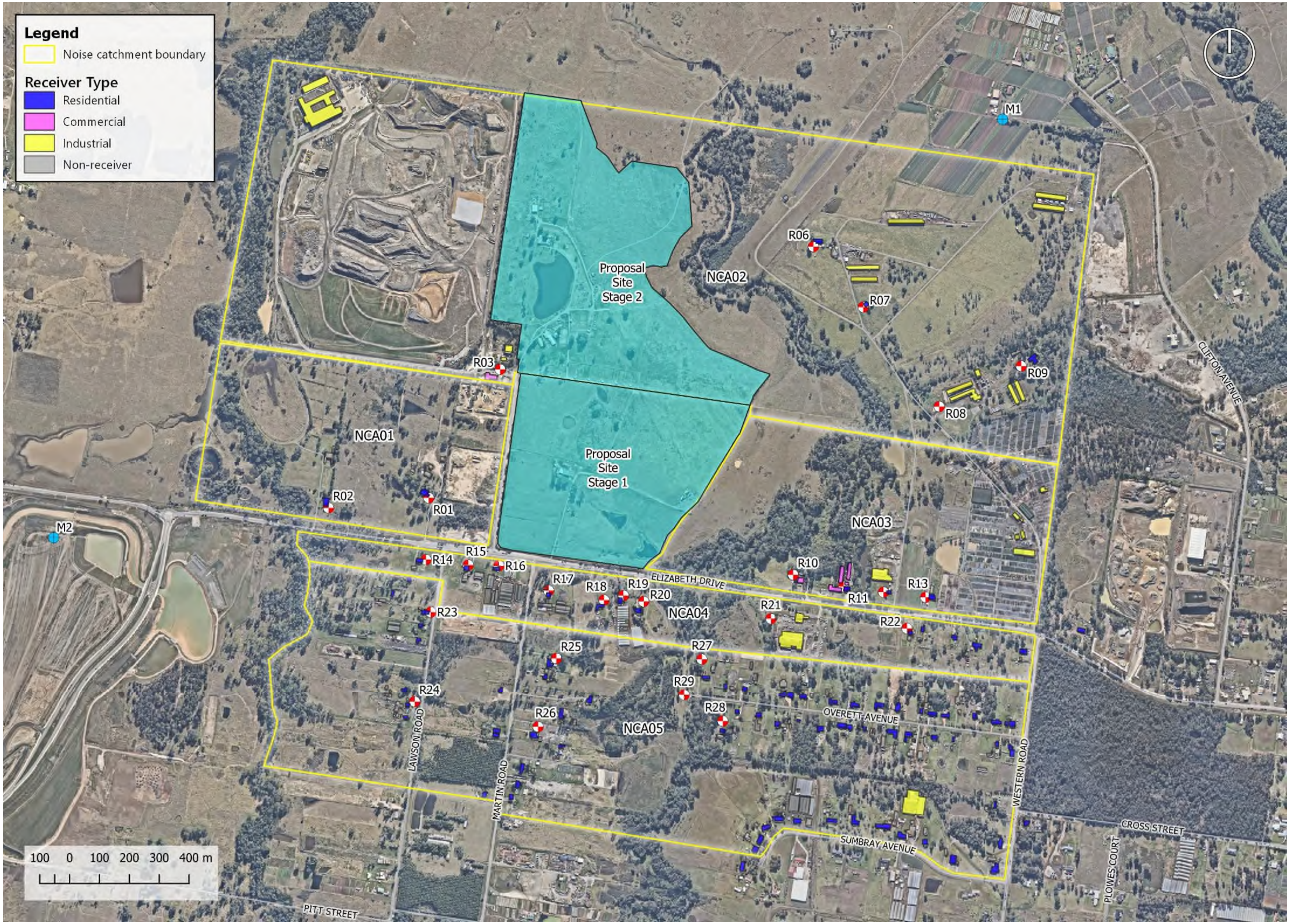
- Residential properties north, south, east and west of the site (blue shaded buildings)
- Suez Kemps Creek Resource Recovery Centre (industrial facility) to the northwest (yellow and pink shaded buildings)
- Kingsfield Stud farm (commercial facility) to the north (pink shaded buildings)
- West Sydney Sand and Soil (industrial facility) to the west
- Animal Welfare League NSW animal shelter (commercial facility) to the east (pink shaded buildings)
- Roladuct Spiral Tubing Group (industrial facility) to the southeast (yellow shaded building).

The extent of receiver buildings that have been included in the assessment modelling for the NPfI assessment is presented in Figure 1-1. Given the large extent of the assessment area, a set of representative receiver locations have been selected and are presented in APPENDIX B.

Additionally, as the existing acoustic environment varies at the nearby residential receivers, these residential receivers have been grouped into Noise Catchment Areas (NCAs) based upon areas with similar acoustic environments. This has been done to logically group the receivers to assist with the assessment and allocate the appropriate project noise trigger levels or management levels to each receiver. Generally, the first row of lots along Elizabeth Drive have been allocated to one NCA and the lots beyond the first row have been allocated to another NCA.

The location of these noise catchment area boundaries are also shown in Figure 1-1.

Figure 1-1 – Site location, nearby noise sensitive receivers, land uses and NCAs



1.5.1 Representative receivers

Noise levels have been modelled to all neighbouring noise sensitive receiver locations as well as additional representative receiver locations set-back further away from the Proposal site. The results from 27 representative receiver points (nearest and set-back receivers) are presented to provide an indication of the range of predicted noise levels around the Proposal during each of the assessment scenarios. The 27 receivers and their corresponding NCAs are as follows:

- R01 to R02 are residential receivers on the west side of the Proposal, within NCA01
- R06, R07 and R09 are residential receivers on the north side of the Proposal, within NCA02
- R11 to R13 are residential receivers on the east side of the Proposal, within NCA03
- R14 to R20 and R22 are residential receivers on the south side of the Proposal, within NCA04
- R23 to R28 are residential receivers to the south of the Proposal, within NCA05
- The remaining receivers are other non-residential (e.g. commercial, industrial and recreational), potentially impacted receivers.

The locations of the representative receiver points for the noise and vibration assessment are presented in Table 1-2, and a map of these locations is presented in APPENDIX B.

Table 1-2 – Representative receiver locations

Receiver ID	Address / location	Receiver type	Noise catchment area (NCA)	Approx. distance to the Proposal, (metres)
R01	1745 Elizabeth Drive, Badgerys Creek	Residential	NCA01	245
R02	1783-1789 Elizabeth Drive, Badgerys Creek	Residential	NCA01	575
R03	1725A Elizabeth Drive, Badgerys Creek	Commercial	NCA02	70
R06	146B Clifton Avenue, Kemps Creek	Residential	NCA02	570
R07	146B Clifton Avenue, Kemps Creek	Residential	NCA02	500
R08	1541A Elizabeth Drive, Kemps Creek	Industrial	NCA02	635
R09	1541A Elizabeth Drive, Kemps Creek	Residential	NCA02	915
R10	1605-1667 Elizabeth Drive, Kemps Creek	Commercial	NCA03	400
R11	1605-1667 Elizabeth Drive, Kemps Creek	Residential	NCA03	565
R12	1589 Elizabeth Drive, Kemps Creek	Residential	NCA03	690
R13	1569-1587 Elizabeth Drive, Kemps Creek	Residential	NCA03	820
R14	5 Lawson Road, Badgerys Creek	Residential	NCA04	245
R15	1990 Elizabeth Drive, Badgerys Creek	Residential	NCA04	120
R16	1970 Elizabeth Drive, Badgerys Creek	Residential	NCA04	60
R17	10 Martin Road, Badgerys Creek	Residential	NCA04	115
R18	1930 Elizabeth Drive, Badgerys Creek	Residential	NCA04	120
R19	1920 Elizabeth Drive, Badgerys Creek	Residential	NCA04	100
R20	1910 Elizabeth Drive, Badgerys Creek	Residential	NCA04	110

Receiver ID	Address / location	Receiver type	Noise catchment area (NCA)	Approx. distance to the Proposal, (metres)
R21	1820 Elizabeth Drive, Badgerys Creek	Industrial	NCA04	435
R22	1745 Elizabeth Drive, Badgerys Creek	Residential	NCA04	820
R23	35 Lawson Road, Badgerys Creek	Residential	NCA05	320
R24	83-87 Lawson Road, Badgerys Creek	Residential	NCA05	590
R25	30 Martin Road, Badgerys Creek	Residential	NCA05	340
R26	70 Martin Road, Badgerys Creek	Residential	NCA05	575
R27	155 Overett Avenue, Kemps Creek	Residential	NCA05	360
R28	150 Overett Avenue, Kemps Creek	Residential	NCA05	575
R29	Overett Reserve - 165 Overett Avenue, Kemps Creek	Recreational	NCA05	445

1.6 Acoustic terms & quality

This report is technical in nature and uses acoustic terminology throughout. A summary and explanation of the common acoustic terms that have been used in this report is presented in APPENDIX A, Sections A.1 and A.2. Some of the key acoustic concepts used in this report are outlined in APPENDIX A, Section A.3.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

2 Existing noise environment

Criteria for the assessment of operational and construction noise are usually derived from the existing noise environment of an area, excluding noise from the subject development.

As the noise environment of an area almost always varies over time, background and ambient noise levels need to be determined for the operational times of the proposed development. Background noise varies over the course of any 24-hour period, typically from a minimum at 3:00am in the morning to a maximum during morning and afternoon traffic peak hours. Therefore, the NSW Environment Protection Authority (EPA) *Noise Policy for Industry* (NPfI) (EPA 2017) requires that the level of background and ambient noise be assessed separately for the daytime, evening and night-time periods. Fact Sheet B of the NPfI outlines the methods for determining the background noise level of an area.

The NPfI also outlines methods for assessing 'shoulder periods' being shorter periods on either side of a standard period, where the standard period noise levels are not well represented. For example, a 'shoulder period' may be warranted for 5:00am-7:00am or 10:00pm-12:00am during which the night-time period background noise level is not well represented. Fact Sheet A, Section A3 of the NPfI outlines suitable methods to determine the shoulder period background noise level. Because of the nearby arterial road (Elizabeth Drive) which has increased traffic during the early morning period and existing background noise levels steadily rising in these early morning hours, a shoulder period has been established between 5:00am and 7:00am for the assessment.

The time periods established for the assessment in accordance with the NPfI are as follows:

- **Day** is defined as 7:00am to 6:00pm, Monday to Saturday and 8:00am to 6:00pm Sundays & Public Holidays.
- **Evening** is defined as 6:00pm to 10:00pm, Monday to Sunday & Public Holidays.
- **Night** is defined as 10:00pm to 5:00am, Monday to Sunday & Public Holidays.
- **Morning shoulder** is defined as 5:00am to 7:00am, Monday to Saturday and 5:00am to 8:00am Sundays & Public Holidays.

2.1 Existing background noise levels

The Western Sydney Airport is currently under construction directly to the southwest of the Proposal site, which is understood to occasionally include out of hours work (OOHW). Additionally, the construction of the M12 Motorway to the north of the Proposal site is also currently underway and includes OOHW. As such, current background noise levels may be influenced by these noise sources.

Therefore, a review of recently approved State Significant Developments in the area suggested that noise monitoring conducted as part of the EIS prepared for the M12 Motorway, located to the north of the Proposal, would provide a good reference for measured background noise levels in the surrounding area, as the results would not have been influenced by any construction activities from the Western Sydney Airport or the M12 Motorway sites.

Appendix K of the M12 Motorway EIS (October 2019) presents the noise and vibration assessment report. Section 2.2, Figure 2-1 and Annexure B of the M12 Motorway EIS noise and vibration report presents the noise monitoring locations and survey results.

For the purposes of this noise and vibration assessment for the Proposal, the following monitoring locations from the M12 Motorway EIS have been selected to represent the sensitive areas surrounding the Proposal.

Table 2-1 – Noise monitoring locations

Location ID	Address	Description
M1	203 Clifton Avenue, Kemps Creek	Long-term unattended noise monitoring location northeast of the Proposal site and in the free-field (i.e. away from buildings). Noise environment dominated by wildlife noise (i.e. farm animals and birds) and is considered to be representative of the receivers surrounding the Proposal site and located away from any major noise sources (e.g. major roads), namely NCA02 and NCA 05. It Is noted that this location was presented as Location L06 in the M12 Motorway EIS. Noise monitoring was conducted from 22 June to 4 July 2017.
M2	2160 Elizabeth Drive, Badgerys Creek	Long-term unattended noise monitoring location south of the Proposal site, approximately 145m south of Elizabeth Drive and in the free-field (i.e. away from buildings). Noise environment dominated by traffic noise from Elizabeth Drive, light aircraft and wildlife (i.e. birds) and is considered to be representative of receivers adjacent to Elizabeth Drive, namely NCA01, NCA03 and NCA04. It is noted that this location was presented as Location L12, 2300 Elizabeth Drive in the M12 Motorway EIS. However, through a review of photos presented in Annexure B of Appendix K of the EIS, it was confirmed that the monitoring location was at 2160 Elizabeth Drive. Noise monitoring was conducted from 19 June to 3 July 2017.

The measured background noise levels at the monitoring locations are presented in Table 2-2 below and the noise monitoring locations are shown in APPENDIX B.

Table 2-2 – Measured rating background noise levels (RBL), dB(A)

Monitoring Location ID	Location description	Rating background noise levels (RBL), $L_{A90,\ 15\ minute}$			
		Day[1]	Evening[2]	Night[3]	Morning shoulder[4]
Location M1	203 Clifton Avenue, Kemps Creek	35 (34[5])	34 (35[6])	31	34 (43[7])
Location M2	2160 Elizabeth Drive, Badgerys Creek[8]	40	37	30	40 (50[7])

Notes:
1. Day: 7.00am to 6.00pm Monday to Saturday and 8.00am to 6.00pm Sundays & Public Holidays
2. Evening: 6.00pm to 10.00pm Monday to Sunday & Public Holidays
3. Night: 10.00pm to 5.00am Monday to Sunday & Public Holidays
4. Morning shoulder: 5.00am to 7.00am Monday to Saturday and 5:00am to 8:00am Sundays & Public Holidays. Note that the M12 Motorway EIS presents the morning shoulder period between 6.00am to 7.00am. For this assessment, the shoulder period has been extended to include the period between 5.00am to 7.00am as the noise monitoring graphs show evidence of noise levels steadily rising from 5.00am in the early morning period. As per Note 7, the day period RBL has been adopted as the morning shoulder RBL. The M12 EIS noise monitoring graphs show that this would be conservatively representative of the 5.00am to 7.00am morning shoulder period.
5. Number in brackets represents the measured (actual) Day RBL value, which is below the minimum RBL value of 35 dB(A) during the day period, as per Table 2.1 of the NPfI. Therefore, an RBL of 35 dB(A) has been used for assessment purposes
6. Number in brackets represents the measured (actual) Evening RBL value, which is greater than the measured Day RBL. As per the NPfI, if Evening RBL > Day RBL, then Day RBL has been used for assessment purposes
7. Number in brackets represents the measured (actual) morning shoulder RBL value, which is greater than the measured Day RBL. As per the NPfI, if shoulder period RBL > Day RBL, then Day RBL has been used for assessment purposes
8. Presented as 2300 Elizabeth Drive, Badgerys Creek in the M12 motorway EIS.

2.2 Measured road traffic noise levels

The existing traffic noise levels along Elizabeth Drive were monitored at Location M2 as part of the M12 Motorway EIS noise and vibration assessment and the results are summarised in Table 2-3.

Table 2-3 – Measured road traffic noise levels

Monitoring location ID	Address	Measured road traffic noise level, dB(A)	
		$L_{Aeq,15hour}$ (7:00am to 10:00pm)	$L_{Aeq,9hour}$ (10:00pm to 7:00am)
Location M2	2160 Elizabeth Drive, Badgerys Creek[1]	49	48

Notes: 1. Presented as 2300 Elizabeth Drive, Badgerys Creek in the M12 motorway EIS.

2.3 Attended noise measurements

Noise measurements of truck movements were conducted on 14 July 2021 at a similar industrial estate to provide the noise source levels used in this assessment. The industrial estate was the Mirvac Calibre Estate in Eastern Creek.

The activity noise source measurements conducted at the estate were as follows:

1. A-double truck
    a) Truck pass-by at speed on internal access road (approximately 40km/h)
    b) Truck entering warehouse hardstand
    c) Truck exiting warehouse hardstand

2. B-double truck
    a) Truck pass-by at speed on internal access road (approximately 40km/h)
    b) Truck entering warehouse hardstand
    c) Truck exiting warehouse hardstand
3. Single articulated (6-axle) truck (semi-trailer)
    a) Truck pass-by at speed on internal access road (approximately 40km/h)
    b) Truck entering warehouse hardstand
    c) Truck exiting warehouse hardstand
4. Loading dock activities
    a) Reach stacker (model Kalmar Eco) loading / unloading shipping containers from trucks

Additional truck noise data was sourced from measurements undertaken previously by Renzo Tonin & Associates at three distribution facilities including rigid heavy vehicles and prime movers.

The measurement results were used to derive a range of noise source levels for the assessment of the Proposal and are presented in Section 5.3.1.

Measurements of the noise source levels from the key noise generating activities were undertaken at similar facilities with a sufficient duration to capture the total activity noise level (i.e. arrival and departure manoeuvre, pass-by, etc), and all relevant statistical measurement parameters (L_{Amax}, $L_{A1,T}$, $L_{A10,T}$, $L_{A90,T}$, L_{Amin}) were recorded in accordance with AS1055:2018. For the trucks moving onsite, maximum pass-by noise levels were used to derive conservatively high sound power levels for the assessment. A summary of the measured noise levels for the key activities are presented in Table 2-4 and Table 2-5.

Table 2-4 – Attended noise measurement results – steady sound activities

Noise source / noise generating operation	Measured noise level, dB(A)			Comments on measured noise levels
	L_{Amax}	$L_{Aeq,t}$	$L_{A90,t}$	
Prime mover idling – no trailer[1]	68	67	66	Measurement distance @ 8m [2]

Notes: 1. Measurements at distribution centre, Minchinbury on 1 April 2021
2. Loudest location presented; derived source level based upon multiple measurement locations.

Table 2-5 – Attended noise measurement results – non-steady sound activities

Noise source / noise generating operation	Measured noise level, dB(A)					Comments on measured noise levels
	L_{Amax}	$L_{A1,t}$	$L_{A10,t}$	$L_{Aeq,t}$	$L_{A90,t}$	
Prime mover – accelerating from stationary [1]	82	82	80	75	63	Moving source, closest measurement distance @ 7.5m
Prime mover with trailer – reversing (tonal) beeper (operating during reversing) [2]	76	74	74	73	72	Source distance varied from 11m to 23m
A-double – pass-by [3]	82	82	77	72	60	Moving source, closest measurement distance @ 8m [4]
A-double – site entry (decelerating) [3]	81	81	80	75	68	Moving source, closest measurement distance @ 10m [4]
A-double – site exit (accelerating) [3]	75	75	73	69	64	Moving source, closest measurement distance @ 15m [4]
B-double – pass-by [3]	80	80	76	71	60	Moving source, closest measurement distance @ 8m [4]
B-double – site entry (decelerating) [3]	71	71	71	68	63	Moving source, closest measurement distance @ 11m [4]
B-double – site exit (accelerating) [3]	85	85	85	80	68	Moving source, closest measurement distance @ 4m [4]
Semi-trailer (6 axle) – pass-by [3]	77	77	76	71	63	Moving source, closest measurement distance @ 12m [4]
Semi-trailer (6 axle) – site entry (decelerating) [3]	72	71	70	67	63	Moving source, closest measurement distance @ 8m [4]
Semi-trailer (6 axle) – site exit (accelerating) [3]	73	73	73	70	62	Moving source, closest measurement distance @ 12m [4]
Airbrake event [3]	81	81	80	75	59	Measurement distance @ 30m [4]
Truck 'bang' coming off site exit crossover [3]	82	82	82	80	77	Measurement distance @ 25m [4]
Reach stacker loading activity [3]	70	70	69	67	63	Moving source, closest measurement distance @ 50m [4]
Shipping container 'bang' from loading onto truck [3]	75	75	75	72	68	Moving source, closest measurement distance @ 60m [4]

Notes:
1. Based on measurements at a distribution centre in Hoxton Park on 3 March 2021
2. Based on measurements at a distribution centre in Brookvale on 16 March 2021
3. Based on measurements at Mirvac Calibre Estate, Eastern Creek on 14 July 2021
4. Representative measurement presented; derived source level based upon multiple measurements.

2.4 Meteorological factors

The NPfI recommends that project noise criteria are to apply under weather conditions characteristic of an area. These may include standard meteorological conditions (i.e. calm) and noise-enhancing meteorological conditions (i.e. winds and temperature inversions). In this regard, the increase in noise that results from atmospheric temperature inversions and winds may need to be assessed. The noise levels predicted under characteristic meteorological conditions for each receiver are then compared with the criteria, to establish whether the meteorological effects will cause a significant impact.

The NPfI permits two approaches for assessing these effects – use of default parameters and use of site-specific parameters. For the purpose of the noise assessment for the Proposal, default parameters have been used for a conservative assessment. By using default parameters, general meteorological values are used to predict noise levels, foregoing detailed analyses of site-specific meteorological data. This approach assumes that meteorological effects are conservative, in that it is likely to predict the upper range of increases in noise levels. Actual noise levels may be less than predicted.

In accordance with Table D1 of the NPfI, the following default parameters have been used when modelling under meteorological conditions.

Table 2-6 – Default parameters for meteorological conditions

Meteorological conditions	Default parameters	Assessment periods
Standard conditions	• Stability Category D • 0.5m/s wind speeds	• Day (7am to 6pm) • Evening (6pm to 10pm) • Night (10pm to 5am) • Morning shoulder (5am to 7am)
Noise-enhancing conditions	Wind • Stability Category D • 3m/s wind speeds	• Day (7am to 6pm) • Evening (6pm to 10pm) • Night (10pm to 5am) • Morning shoulder (5am to 7am)
	Temperature Inversions • Stability Category F • 2m/s wind speeds	• Night (10pm to 5am) • Morning shoulder (5am to 7am)

3 Noise and vibration objectives

3.1 Construction noise objectives

3.1.1 Noise management levels (NMLs)

The NSW *Interim Construction Noise Guideline* (ICNG, 2009) provides guidelines for assessing noise generated during the construction phase of developments.

The key components of the guideline that are incorporated into this assessment include:

- Use of L_{Aeq} as the descriptor for measuring and assessing construction noise.
- Application of reasonable and feasible noise mitigation measures.
- As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice and is practical to build given the project constraints.
- Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

The ICNG provides two methods described for the assessment of construction noise, being either a quantitative or a qualitative assessment. A quantitative assessment is recommended for major construction projects of significant duration and involves the measurement and prediction of noise levels and assessment against set criteria. A qualitative assessment is recommended for small projects with duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification. Given the scale and duration of the construction works proposed, a quantitative assessment is carried out herein, consistent with the ICNG requirements.

Table 3-1 reproduced from the ICNG, sets out the airborne noise management levels and how they are to be applied for residential receivers.

Table 3-1 – Noise management levels at residential receivers

<table>
<tr><th>Time of day</th><th>Management level $L_{Aeq\ (15\ min)}$ *</th><th>How to apply</th></tr>
<tr><td rowspan="2">Recommended standard hours:
Monday to Friday
7am to 6pm
Saturday 8am to 1pm
No work on Sundays or public holidays</td><td>Noise affected
RBL + 10 dB</td><td>The noise affected level represents the point above which there may be some community reaction to noise.
• Where the predicted or measured $L_{Aeq\ (15\ min)}$ 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.</td></tr>
<tr><td>Highly noise affected
75 dB(A)</td><td>The highly noise affected 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 restricting the hours that the very noisy activities can occur, taking into account:
1. times identified by the community when they are less sensitive to noise (such as before/ after school for works near schools, or mid-morning or mid-afternoon for works near residences
2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.</td></tr>
<tr><td>Outside recommended standard hours</td><td>Noise affected
RBL + 5 dB</td><td>• 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 practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community.
• For guidance on negotiating agreements see ICNG section 7.2.2.</td></tr>
</table>

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 metres above ground level. If the property boundary is more than 30 metres from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 metres of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Table 3-2 sets out the ICNG noise management levels for the other noise sensitive receiver locations near the Proposal site, namely commercial and industrial premises.

Table 3-2 – Noise management levels at other noise sensitive land uses

Land use	Time of day	Where objective applies	Management level $L_{Aeq\ (15\ min)}$
Commercial premises	When in use	Outdoor noise level	70 dB(A)
Industrial premises	When in use	Outdoor noise level	75 dB(A)

3.1.2 Summary of construction noise management levels

Construction works for the Proposal are proposed to take place during the ICNG standard construction hours. Table 3-3 presents the construction noise management levels established for the nearest noise sensitive receivers based upon the noise monitoring outlined in Section 2. The assessment locations and nearby sensitive receivers for the construction assessment are identified in Section 4.3.

Table 3-3 – Construction noise management levels (Standard construction hours)

Receiver ID	NCA	Receiver type	Noise Management Level $L_{Aeq(15min)}$ [1,2]
R01	NCA01	Residential premises	50
R03	NCA02	Commercial premises	70[3]
R04	NCA02	Commercial premises	70[3]
R05	NCA02	Residential premises	45
R06	NCA02	Residential premises	45
R07	NCA02	Residential premises	45
R08	NCA02	Industrial premises	75[3]
R10	NCA03	Commercial premises	70[3]
R11	NCA03	Residential premises	50
R14	NCA04	Residential premises	50
R15	NCA04	Residential premises	50
R16	NCA04	Residential premises	50
R17	NCA04	Residential premises	50
R18	NCA04	Residential premises	50
R19	NCA04	Residential premises	50
R20	NCA04	Residential premises	50
R21	NCA04	Industrial premises	75[3]
R23	NCA05	Residential premises	45
R25	NCA05	Residential premises	45
R27	NCA05	Residential premises	45

Notes:
1. Applicable during standard construction hours; i.e. Monday to Fridays (7:00am to 6:00pm) & Saturdays (8:00am to 1:00pm)
2. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.
3. Noise management levels apply when receiver areas are in use only.

3.2 Construction vibration objectives

Construction vibration is associated with three main types of impact:

- disturbance to building occupants
- potential damage to buildings, and
- potential damage to sensitive equipment in a building.

Generally, if disturbance to building occupants is controlled, there is limited potential for structural damage to buildings.

Vibration amplitude may be measured as displacement, velocity, or acceleration.

- Displacement (x) measurement is the distance or amplitude displaced from a resting position. The International System of Units (SI unit) for distance is the metre (m), although common industrial standards include mm.
- Velocity ($v = \Delta x / \Delta t$) is the rate of change of displacement with respect to change in time. The SI unit for velocity is metres per second (m/s), although common industrial standards include mm/s. The Peak Particle Velocity (PPV) is the greatest instantaneous particle velocity during a given time interval. If measurements are made in 3-axis (x, y, and z) then the resultant PPV is the vector sum (i.e. the square root of the summed squares of the maximum velocities) regardless of when in the time history those occur.
- Acceleration ($a = \Delta v / \Delta t$) is the rate of change of velocity with respect to change in time. The SI unit for acceleration is metres per second squared (m/s^2). Construction vibration goals are summarised below.

Construction vibration goals are summarised below.

3.2.1 Disturbance to buildings occupants

The acceptable vibration values to assess the potential for human annoyance from vibration are set out in the NSW '*Environmental Noise Management Assessing Vibration: A Technical Guideline*' (AVTG).

To assess the potential for vibration impact on human comfort, an initial screening test will be done based on peak velocity units, as this metric is also used for the cosmetic damage vibration assessment. The screening test is based on the continuous vibration velocity (i.e. vibration that continues uninterrupted for a defined period). If the vibration level exceeds the initial screening test, the total estimated Vibration Dose Value (i.e. eVDV) will be determined based on the level and duration of the vibration event causing exceedance.

The initial screening test values and VDVs recommended in BS 6472-1992 for which various levels of adverse comment from occupants may be expected, are presented in Table 3-4 for the type of receivers surrounding the Proposal site. The 'Low probability of adverse comment eVDV' represents the preferred and maximum values presented in the AVTG.

Table 3-4 – Vibration management levels for disturbance to building occupants

Place and Time	Initial screening test Velocity, PEAK, mm/s (>8Hz)	Low probability of adverse comment eVDV $m/s^{1.75}$	Adverse comment possible eVDV $m/s^{1.75}$	Adverse comment probable eVDV $m/s^{1.75}$
Residential buildings – Day[1]	0.56	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – Night[1]	0.40	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8
Offices, schools, educational institutions and places of worship (day or night)	1.10	0.4 to 0.8	0.8 to 1.6	1.6 to 2.4
Workshops (day or night)	2.20	0.8 to 1.6	1.6 to 3.2	3.2 to 6.4

Notes: 1. Daytime is 7am to 10pm and night-time is 10pm to 7am

3.2.2 Building damage

Potential structural damage of buildings as a result of vibration is typically managed by ensuring vibration induced into the structure does not exceed certain limits and standards, such as British Standard 7385 Part 2 and German Standard DIN4150-3. Currently there is no existing Australian Standard for assessment of structural building damage caused by vibration energy.

It is noted that vibration levels required to cause minor cosmetic damage are typically 10 times higher than levels that will cause disturbance to building occupants. Many building occupants assume that building damage is occurring when they feel vibration or observe rattling of loose objects; however, the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that can cause damage to structures.

Within British Standard 7385 Part 1, different levels of structural damage are defined:

- **Cosmetic –** The formation of hairline cracks on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick/concrete block construction.
- **Minor –** The formation of large cracks or loosening of plaster or drywall surfaces, or cracks through bricks/concrete blocks.
- **Major –** Damage to structural elements of the building, cracks in supporting columns, loosening of joints, splaying of masonry cracks, etc.

The vibration limits in Table 1 of British Standard 7385 Part 2 are for the protection against cosmetic damage; however, guidance on limits for minor and major damage is provided in Section 7.4.2 of the Standard:

> "*7.4.2 Guide values for transient vibration relating to cosmetic damage*
>
> *Limits for transient vibration, above which cosmetic damage could occur are given numerically in Table 1 and graphically in Figure 1. In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for the building types corresponding to line 2 are reduced. Below a frequency of 4 Hz, where a high displacement is associated with a relatively low peak component particle velocity value a maximum displacement of 0.6 mm (zero to peak) should be used.*
>
> *Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 1, and major damage to a building structure may occur at values greater than four times the tabulated values.*"

Within DIN4150-3, damage is defined as "*any permanent consequence of an action that reduces the serviceability of a structure or one of its components*" (p.4). The Standard also outlines:

> *"For buildings as in lines 2 and 3 of Tables 1, 4 or B.1, the serviceability is considered to have been reduced if, for example*
>
> – *cracks form in plastered or rendered surfaces of walls;*
>
> – *existing cracks in a structure are enlarged;*
>
> – *partitions become detached from load-bearing walls or floor slabs.*
>
> *These effects are deemed 'minor damage'. " (DIN4150.3:2016, p.6)*

While the DIN Standard defines the above damage as 'minor', based on the definitions provided in BS7385, the DIN standard is considered to deal with cosmetic issues rather than major structural failures.

British Standard

British Standard 7385: Part 2 '*Evaluation and measurement of vibration in buildings*', can be used as a guide to assess the likelihood of building damage from ground vibration. BS7385 suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur.

The cosmetic damage levels set by BS 7385 are considered 'safe limits' up to which no damage due to vibration effects has been observed for certain particular building types. Damage comprises minor non-structural effects such as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks and separation of partitions or intermediate walls from load bearing walls. 'Minor' damage is considered possible at vibration magnitudes which are twice those given and 'major' damage to a building structure may occur at levels greater than four times those values.

BS7385 is based on peak particle velocity and specifies damage criteria for frequencies within the range 4Hz to 250Hz, being the range usually encountered in buildings. At frequencies below 4Hz, a maximum displacement value is recommended. The values set in the Standard relate to transient vibrations and to low-rise buildings. Continuous vibration can give rise to dynamic magnifications due to resonances and may need to be reduced by up to 50%. Table 3-5 sets out the BS7385 criteria for cosmetic, minor and major damage.

Regarding heritage buildings, British Standard 7385 Part 2 (1993) notes that "*a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive*" (p.5).

Table 3-5 – BS 7385 structural damage criteria

Group	Type of structure	Damage level	Peak component particle velocity[1], mm/s		
			4Hz to 15Hz	15Hz to 40Hz	40Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	Cosmetic	50		
		Minor [2]	100		
		Major [2]	200		
2	Un-reinforced or light framed structures Residential or light commercial type buildings	Cosmetic	15 to 20	20 to 50	50
		Minor [2]	30 to 40	40 to 100	100
		Major [2]	60 to 80	80 to 200	200

Notes: 1. Peak Component Particle Velocity is the maximum Peak particle velocity in any one direction (x, y, z) as measured by a tri-axial vibration transducer

2. Minor and major damage criteria established based on British Standard 7385 Part 2 (1993) Section 7.4.2.

German Standard

German Standard DIN 4150 - Part 3 (2016) '*Vibration in buildings - Effects on Structures*' (DIN 4150-3:2016), also provides recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are generally recognised to be conservative.

DIN 4150-3:2016 presents the recommended maximum limits over a range of frequencies (Hz), measured at the foundations, in the plane of the uppermost floor of a building or structure or vertically on floor slabs. The vibration limits at the foundations increase as the frequency content of the vibration increases. The criteria are presented in Table 3-6.

Table 3-6 – DIN 4150-3:2016 structural damage criteria

Group	Type of structure	Vibration velocity, mm/s				
		At foundation in all directions at frequency of			Plane of floor uppermost storey in horizontal direction	Floor slabs, vertical direction
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz	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 under Groups 1 and 2 <u>and</u> are of great intrinsic value (eg listed buildings)	3	3 to 8	8 to 10	8	20

3.2.3 Damage to buried services

Section 5.3 of DIN 4150-3:2016 also sets out guideline values for vibration velocity to be used when evaluating the effects of vibration on buried pipework. These values, which apply at the wall of the pipe, are reproduced and presented in Table 3-7 below.

Table 3-7 – DIN 4150-3:1999 Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on buried pipework

Line	Pipe Material	Guideline values for vibration velocity measured on the pipe, mm/s
1	Steel (including welded pipes)	100
2	Vitrified clay, concrete, reinforced concrete, prestressed concrete, metal (with or without flange)	80
3	Masonry, plastics	50

For long-term vibration the guideline levels presented in Table 3-7 should be halved.

Recommended vibration goals for electrical cables and telecommunication services such as fibre optic cables range from between 50 mm/s and 100 mm/s. It is noted however that although the cables may sustain these vibration levels, the services they are connected to, such as transformers and switch blocks, may not. It is recommended that should such equipment be encountered during the construction process an individual vibration assessment should be carried out. This may include a specific vibration impact statement addressing impact on the utility and consultation with the utility provider to confirm specific vibration requirements.

3.3 Operational noise

This assessment aims to quantify the potential operational noise emissions from the Proposal in accordance with the NPfI. The assessment procedure has two components:

- Controlling intrusive noise impacts in the short-term for residences; and
- Maintaining noise level amenity for residences and other land uses.

In accordance with the NPfI, noise impact should be assessed against the project noise trigger level which is the lower value of the project intrusiveness noise levels and project amenity noise levels.

3.3.1 Project intrusive noise levels

According to the NPfI, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the $L_{Aeq,15min}$ descriptor) does not exceed the background noise level measured in the absence of the source by more than 5 dB(A). The project intrusiveness noise level, which is only applicable to residential receivers, is determined as follows:

- **$L_{Aeq,15min}$ Intrusiveness noise level = Rating Background Level ('RBL') plus 5 dB(A)**

For the purposes of assessing operational noise impacts, rating background noise levels representative of the nearby affected residential receivers were described and presented in Section 2.1. The intrusiveness noise levels for the residential receivers surrounding the Proposal site are reproduced in Table 3-8 below.

Table 3-8 – Intrusiveness noise levels

NCAs	Intrusiveness noise level, $L_{Aeq,15min}$			
	Day	Evening	Night	Shoulder period (5:00am to 7:00am)[4]
NCA01 (West)	40 + 5 = 45	37 + 5 = 42	30 + 5 = 35	40 (50)[6] + 5 = 45
NCA02 (North)	35 (34)[5] + 5 = 40	34 (35)[6] + 5 = 39	31 + 5 = 36	34 (43)[6] + 5 = 39
NCA03 (East)	40 + 5 = 45	37 + 5 = 42	30 + 5 = 35	40 (50)[6] + 5 = 45
NCA04 (South)	40 + 5 = 45	37 + 5 = 42	30 + 5 = 35	40 (50)[6] + 5 = 45
NCA05 (South – set back)	35 (34)[5] + 5 = 40	34 (35)[6] + 5 = 39	31 + 5 = 36	34 (43)[6] + 5 = 39

Notes:
1. Day: 7.00am to 6.00pm Monday to Saturday and 8.00am to 6.00pm Sundays & Public Holidays
2. Evening: 6.00pm to 10.00pm Monday to Sunday & Public Holidays
3. Night: 10.00pm to 5.00am Monday to Sunday
4. Shoulder period 5:00am to 7:00am Monday to Saturday and 5:00am to 8:00am Sundays & Public Holidays
5. Consistent with Section 2.3 and Table 2.1 of the NPfI, the project intrusiveness noise level for the day is set at the minimum
6. Consistent with Section 2.3 of the NPfI, the project intrusiveness noise level for the evening and shoulder is set no greater than for daytime.

3.3.2 Amenity noise levels

The amenity noise levels for different time periods of the day are determined in accordance with Section 2.4 of the NPfI. The NPfI recommends amenity noise levels ($L_{Aeq,period}$) for various receivers including residential, commercial, industrial receivers and sensitive receivers such as schools, hotels, hospitals, churches and parks. These “recommended amenity noise levels” represent the objective for total industrial noise experienced at a receiver location. However, when assessing a single industrial development and its impact on an area then “project amenity noise levels” apply.

The recommended amenity noise levels applicable for the receivers surrounding the Proposal site are reproduced from the NPfI in Table 3-9 below.

Table 3-9 – Recommended amenity noise levels

Type of receiver	Noise amenity area	Time of day	Recommended amenity noise level, $L_{Aeq,}$ dB(A)
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Passive recreation	All	When in use	50
Commercial premises	All	When in use	65
Industrial premises	All	When in use	70

Notes:
1. Day: 7.00am to 6.00pm; Evening: 6.00pm to 10.00pm; Night: 10.00pm to 7.00am
2. On Sundays and Public Holidays, Day: 8.00am to 6.00pm; Evening: 6.00pm to 10.00pm; Night: 10.00pm to 8.00am.
3. The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.
4. The recommended amenity noise levels refer only to noise from industrial sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

As discussed previously, the land uses surrounding the Proposal site have been rezoned as 'Enterprise', which will only include commercial and industrial uses and no residential or other noise sensitive uses. Nevertheless, for the purpose of the assessment and the benefit of existing residences surrounding the Proposal site, the current residential areas surrounding the Proposal site have been considered as rural-residential and the 'Rural' amenity noise levels would be applied.

Furthermore, as stated in Section 1.3 the Proposal involves the construction of eight warehouses / premises. Section 2.4.2 of the NPfI, which addresses greenfield developments where there are multiple new noise-generating premises proposed, provides the following approach in determining the project amenity noise level due to multiple premises within a site:

> **Individual project amenity noise level = 10Log (10$^{(ANL - 5\ dB/10)}$/N)**
> *where:*
> *ANL = relevant recommended amenity noise level from Table 3-9*
> *N = number of proposed additional premises.*

Based on the Proposal concept masterplan, there are a total of eight (8) premises proposed of varying lot sizes (i.e. 'N' in the formula above).

Furthermore, given that the intrusiveness noise level is based on a 15 minute assessment period and the project amenity noise level is based on day, evening and night assessment periods, the NPfI provides the following guidance on adjusting the $L_{Aeq,period}$ level to a representative $L_{Aeq,15minute}$ level in order to standardise the time periods.

$$L_{Aeq,15min} = L_{Aeq,period} + 3dB(A)$$

Therefore, the individual project amenity noise levels ($L_{Aeq,15min}$) applied for each of the seven (7) individual warehouses / premises of the Proposal are reproduced in Table 3-10 below.

Table 3-10 – Individual warehouses / premises amenity noise levels

Type of receiver	Noise amenity area	Time of day[1]	Individual warehouses / premises amenity noise level, dB(A)	
			$L_{Aeq,Period}$[2]	$L_{Aeq,15min}$
Residence	Rural	Day	36	36 + 3 = **39**
		Evening	31	31 + 3 = **34**
		Night	26	26 + 3 = **29**
		Morning shoulder[4]	36[4]	36 + 3 = **39**
Passive recreation	All	When in use	36	36 + 3 = **39**
Commercial premises	All	When in use	51	51 + 3 = **54**
Industrial premises	All	When in use	56	56 + 3 = **59**

Notes:
1. Daytime 7.00am to 6.00pm; Evening 6.00pm to 10.00pm; Night-time 10.00pm to 5.00am Monday to Saturday. On Sundays and Public Holidays, Daytime 8.00am to 6.00pm; Evening 6.00pm to 10.00pm; Night-time 10.00pm to 5.00am.
2. Calculated using Equation 1 from the NPfI for determining the individual project amenity noise levels of new multiple industrial premises.
3. The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.
4. Based upon recently clarifications from the NSW Environmental Protection Authority (EPA) in the Acoustic Australia journal (Vol. 50, No. 3, September 2022), the NSW EPA expects that where a morning shoulder period has been justified that the corresponding day-time period amenity level would be applicable.

The individual project amenity noise levels presented in the table above (Table 3-10) are applicable for each of the eight individual warehouses / premises of the Proposal. Given that the Proposal assessed in this report is for the combined operation of all eight warehouses (i.e. warehouses 1, 2, 4, 5, 6, 7 and 8), the applicable project amenity noise levels for the operation of the Proposal as a whole is presented in Table 3-11 below.

Table 3-11 – Project amenity noise levels for the Proposal

Type of receiver	Noise amenity area	Time of day	$L_{Aeq,15min}$ Project amenity noise level, dB(A)[1]
Residence	Rural	Day	48
		Evening	43
		Night[1]	38
		Morning shoulder[2]	48
Passive recreation	All	When in use	48
Commercial premises	All	When in use	63
Industrial premises	All	When in use	68

Notes:
1. Project amenity noise levels based on operation of all eight premises (warehouses 1, 2, 4, 5, 6, 7 and 8)
2. Based upon recently clarifications from the NSW Environmental Protection Authority (EPA) in the Acoustic Australia journal (Vol. 50, No. 3, September 2022), the NSW EPA expects that where a morning shoulder period has been justified that the corresponding day-time period amenity level would be applicable.

3.3.3 Project noise trigger levels

The project noise trigger levels have been determined based on the $L_{Aeq15min}$ intrusive and project amenity trigger levels presented in Table 3-12.

Table 3-12 – Intrusive and amenity trigger levels for residential receivers

Receiver location	Day		Evening		Night		Morning shoulder period (5:00am to 7:00am)[1]	
	Intrusive	Amenity	Intrusive	Amenity	Intrusive	Amenity	Intrusive[2]	Amenity
NCA01	**45**	48	**42**	43	**35**	38	**45**	48
NCA02	**40**	48	**39**	43	**36**	38	**39**	48
NCA03	**45**	48	**42**	43	**35**	38	**45**	48
NCA04	**45**	48	**42**	43	**35**	38	**45**	48
NCA05	**40**	48	**39**	43	**36**	38	**39**	48

Notes:
1. The shoulder period has been established as the background noise levels are steadily rising during these early morning hours. As noted in the NPfI Section A3 the objectives have been based upon the intrusiveness noise level only, based upon the guidance in NPfI Section A3.
2. As per Section 2.3 of the NPfI, the project intrusiveness noise level for the shoulder period is set no greater than the project intrusiveness noise level for the daytime
3. Project amenity noise levels based on the operation of two (out of eight) premises of the Proposal
4. **Bold** font indicates the controlling project noise trigger level.

In accordance with the NPfI the project noise trigger levels, which are the lower of the intrusive or amenity trigger levels, are presented in Table 3-13 below.

Table 3-13 – Summary of project noise trigger levels

Receiver location	$L_{Aeq,15min}$ Project noise trigger levels, dB(A)			
	Day	Evening	Night	Morning shoulder period
Residential receivers[1]				
NCA01 (West)	45	42	35	45
NCA02 (North)	40	39	36	39
NCA03 (East)	45	42	35	45
NCA04 (South)	45	42	35	45
NCA05 (South – set back)	40	39	36	39
Other sensitive receivers[2]				
Passive recreation	48[3]			
Commercial	63[3]			
Industrial	68[3]			

Notes:
1. For a residence, the project noise trigger level is to be assessed at the reasonably most-affected point on or within the residential property boundary
2. For commercial or industrial premises, the noise level is to be assessed at the reasonably most-affected point on or within the property boundary
3. Project noise trigger level is only applicable when the receiver type is in use.

3.3.4 Cumulative industrial noise

The management of cumulative operational noise is required by the NPfI. By addressing cumulative noise impacts consistent with the NPfI, this will also sufficiently address cumulative impacts in accordance with the DPIE guideline "*Cumulative Impact Assessment Guidelines for State Significant Projects*" (DPIE, 2021) as detailed in Section 3.5 of that document.

As stated in Section 2.1 of the NPfI "*The project intrusiveness noise level aims to protect against significant changes in noise levels, whilst the project amenity noise level seeks to protect against cumulative noise impacts from industry and maintain amenity for particular land uses.*".

The NPfI amenity noise criteria derived in Section 3.3.2 aims to control the total industrial noise level (existing plus new) with the aim for it to remain within the recommended amenity noise levels for the area. As such, the potential cumulative noise impacts as a result of the development has been considered in the assessment through the derivation of criteria in accordance with the NPfI, and assessment against these levels.

As the Proposal contains multiple warehouse tenancies that would be undertaking operations separately from each other, there is potential cumulative noise from all operating tenancies which should be considered. Conservatively, the noise emissions assessed in Section 5 consider all potential tenancies operating cumulatively, to demonstrate that the Proposal can manage overall cumulative noise emissions from the facility through the recommended mitigation and management measures.

While individual project amenity noise levels ($L_{Aeq,15min}$) applied for each of the eight individual warehouses / premises of the Proposal are presented in Table 3-10. As there are multiple warehouse tenancies, potential management approaches to achieve the overall project noise trigger levels should be incorporated into future management of the site and consideration of future tenants, including aiming to achieve the limits presented in in Table 3-10. Consideration of the elements detailed in NPfI Section 2.8 ('Noise management precinct') can be used for this management. As there are many different ways to manage these potential cumulative noise emissions, this should be considered as part of the Operational Noise Management Plan developed for the Proposal.

3.3.5 Sleep disturbance noise levels

NSW Noise Policy for Industry

The potential for sleep disturbance from maximum noise level events from the Proposal site during the night-time period is to be considered. In accordance with the NPfI, a detailed maximum noise level event assessment should be undertaken where the night-time noise levels from the subject development at a residential location exceed the following noise trigger levels:

- $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
- L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater.

The sleep disturbance noise trigger levels for the Proposal are presented in Table 3-14.

Table 3-14 – NPfI Sleep disturbance assessment trigger levels

Receiver type	Night (10:00pm to 5:00am)		Morning shoulder period (5:00am to 7:00am)	
	Assessment level $L_{Aeq,15min}$	Assessment level L_{AFmax}	Assessment level $L_{Aeq,15min}$	Assessment level L_{AFmax}
NCA01 (West)	40[1]	52[2]	40 + 5 = 45	40 + 15 = 55
NCA02 (North)	40[1]	52[2]	40[1]	52[2]
NCA03 (East)	40[1]	52[2]	40 + 5 = 45	40 + 15 = 55
NCA04 (South)	40[1]	52[2]	40 + 5 = 45	40 + 15 = 55
NCA05 (South – set back)	40[1]	52[2]	40[1]	52[2]

Notes:
1. As per NPfI Section 2.5, minimum screening level is the greater of $L_{Aeq,15min}$ 40 dB(A) or RBL + 5dB. In this case RBL+5 is less than 40dB(A)
2. As per NPfI Section 2.5, minimum screening level is the greater of L_{AFmax} 52 dB(A) or RBL + 15dB. In this case RBL+15 is less than 52dB(A)

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

- how often high noise events will occur
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the subject development
- whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods)
- current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

Maximum noise level event assessments should be based on the L_{AFmax} descriptor on an event basis under 'fast' time response.

The detailed assessment should consider all feasible and reasonable noise mitigation and management measures with a goal of achieving the sleep disturbance noise trigger levels. The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the NSW Road Noise Policy as presented below.

NSW Road Noise Policy

In relation to maximum noise level events, the NSW Road Noise Policy (RNP) identifies in its summary on sleep disturbance research to date that:

1. *Maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep*
2. *One or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.*

The above references identify that internal noise levels of 50 to 55 dB(A), are unlikely to cause awakenings. On the assumption that there is a 10 dB(A) outside-to-inside noise loss through an open window (see Section 2.6 of the NPfI, p15), this indicates that external noise levels of L_{Amax} 60 to 65 dB(A) are unlikely to cause awakening reactions. Therefore, based on the RNP a noise level of L_{Amax} 65 dB(A) has then been used as the assessment level to determine the potential for awakening reactions.

World Health Organisation reports

As stated in the NPfI, other factors that may be important in assessing the extent of impacts on sleep, includes current scientific literature regarding the impact of maximum noise level events at night. The international organisation that reports on the current scientific literature pertaining to night-time impacts on sleep is the World Health Organisation (WHO).

The latest guidelines produced by the WHO relating to night-time impacts on sleep, were produced in 2009 and 2018. These reports mainly focus on sleep disturbance from transportation noise sources, such as aircraft, road and rail, with the 2018 guideline also providing recommendations for wind turbine and leisure noise sources. As stated in the later report, it does not provide specific recommendations for industrial activity noise due to lack of information and data.

However, given that some of the proposed operations of the Proposal, may have a similar nature and character of noise to road traffic noise, guidance and limits relating to road traffic noise are referred to in this noise and vibration impact assessment to assess potential sleep disturbance from site operations and activities.

Following the publication of community noise guidelines in 1999, the WHO released the *Night Noise Guidelines for Europe (WHO 2009)* in 2009, which uses $L_{night\ (outside)}$ as a primary measure of night-time noise. The $L_{night\ (outside)}$ is an A-weighted noise level at the most exposed facade outdoors over all night periods determined as a long-term average over a year, and is roughly equivalent to the external $L_{Aeq,9hour}$ night-time descriptor.

The report recommends a long-term $L_{night\ (outside)}$ noise guideline level of 40 dB(A), with an interim $L_{night\ (outside)}$ target level of 55 dB(A). The interim target is only intended as an intermediate step in localised situations as health impacts, particularly on vulnerable groups, are apparent at this noise level.

The report notes:

1. For $L_{Aeq(9hour)}$ (external) levels above 55 dB(A), adverse health effects occur frequently, and a sizeable proportion of the population is highly annoyed and sleep disturbed.

2. For $L_{Aeq(9hour)}$ (external) levels between 40 dB(A) and 55 dB(A), adverse health effects are observed and vulnerable groups are more severely affected.

The WHO released the latest research into sleep in 2018 as the *Environmental Noise Guidelines for the European Region: A systematic Review on Environmental Noise and Effects on Sleep* (WHO 2018). The WHO 2018 guideline recommends reducing noise levels produced by road traffic during the night-time to be below $L_{night\ (outside)}$ 45 dB(A), as night-time road traffic noise above this level is associated with adverse effects on sleep.

The WHO 2018 guideline does not recommend criteria in terms of single-event noise indicators or maximum sound pressure levels (e.g. L_{Amax}), because the assessment of the relationship between different types of single-event noise indicators and long-term health outcomes at the population level remains tentative. The WHO guideline therefore makes no recommendations for single-event noise indicators. Thus, the WHO guideline is restricted to long-term health effects during the night time and therefore, only includes recommendations about average noise indicators; e.g. $L_{night\ (outside)}$.

Sleep disturbance assessment noise levels

In accordance with the NPfI and current scientific literature, the sleep disturbance project assessment noise levels, are presented in Table 3-15 below.

Table 3-15 – Sleep disturbance project assessment noise levels

Receiver location	Sleep disturbance project assessment noise levels, dB(A)					
	EPA NPfI sleep disturbance assessment levels, L_{Amax}		Awakening reaction[2], L_{Amax}	EPA NPfI sleep disturbance assessment levels, $L_{Aeq,15min}$		WHO 2018 $L_{Aeq,15min}$[3]
	Night[1]	Morning shoulder period[1]		Night[1]	Morning shoulder period[1]	
NCA01 (West)	52	55	65	40	45	48
NCA02 (North)	52	52	65	40	40	48
NCA03 (East)	52	55	65	40	45	48
NCA04 (South)	52	55	65	40	45	48
NCA05 (South – set back)	52	52	65	40	40	48

Notes:
1. Night-time 10:00pm to 5:00am. The morning shoulder period is 5:00am to 7:00am
2. As per the NSW RNP
3. As per Section 2.2 of the NPfI, the WHO 45 dB(A) $L_{night\ (outside)}$ has been converted to a $L_{Aeq,15minute}$ level by adding 3 dB(A).

3.4 Road traffic noise

Noise impacts from the potential increase in traffic on the surrounding road network due to construction and operational activities from the Proposal is assessed in accordance with the RNP. The

RNP sets out criteria to be applied to particular types of road and land uses. These noise criteria are to be applied when assessing noise impact and determining mitigation measures for sensitive receivers that are potentially affected by road traffic noise associated with the construction and operation of the subject site, with the aim of preserving the amenity appropriate to the land use.

The Proposal will be utilising Elizabeth Drive, which is classified as an arterial road. Therefore, for existing residences affected by additional traffic on existing arterial roads generated by land use developments, the following RNP road traffic noise criteria would apply.

Table 3-16 – RNP Road traffic noise criteria, dB(A)

Road Category	Type of Project/Land Use	Assessment Criteria, dB(A)	
		Day 7am – 10pm	Night 10pm – 7am
Freeway/arterial/sub-arterial roads	3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,(15 hour)}$ 60 (external)	$L_{Aeq,(9 hour)}$ 55 (external)

Further to the above, the RNP states the following for land use developments generating additional traffic:

> *"For existing residences and other sensitive land uses affected by* ***additional traffic on existing roads generated by land use development,*** *any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'."*

The RNP states that in assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

Further to the above, it is understood that the ownership of the future internal roads of the precinct, which form part of the Proposal, will be vested with Council and will be public roads. With this in mind, the future internal roads are public roads and as such, are assessed under the RNP. However, given that there will be no residences or sensitive land uses along these future roads, an assessment of traffic noise impacts from these roads will not be required.

4 Construction noise and vibration assessment

4.1 Background

Construction activities associated with the Proposal has the potential to increase noise levels during construction hours. The works to be undertaken consist of a mixture of both high and low noise activities. This assessment identifies potentially noisy activities, their impacts on surrounding receivers and outlines management strategies to control the impacts of noise and vibration during the construction stages of the Proposal.

4.2 Construction hours

Construction works for the Proposal are proposed to take place during the ICNG standard construction hours as follows:

- 7:00am to 6:00pm Monday to Friday
- 8:00am to 1:00pm on Saturday
- No work performed on Sunday and Public Holidays.

4.3 Receiver locations

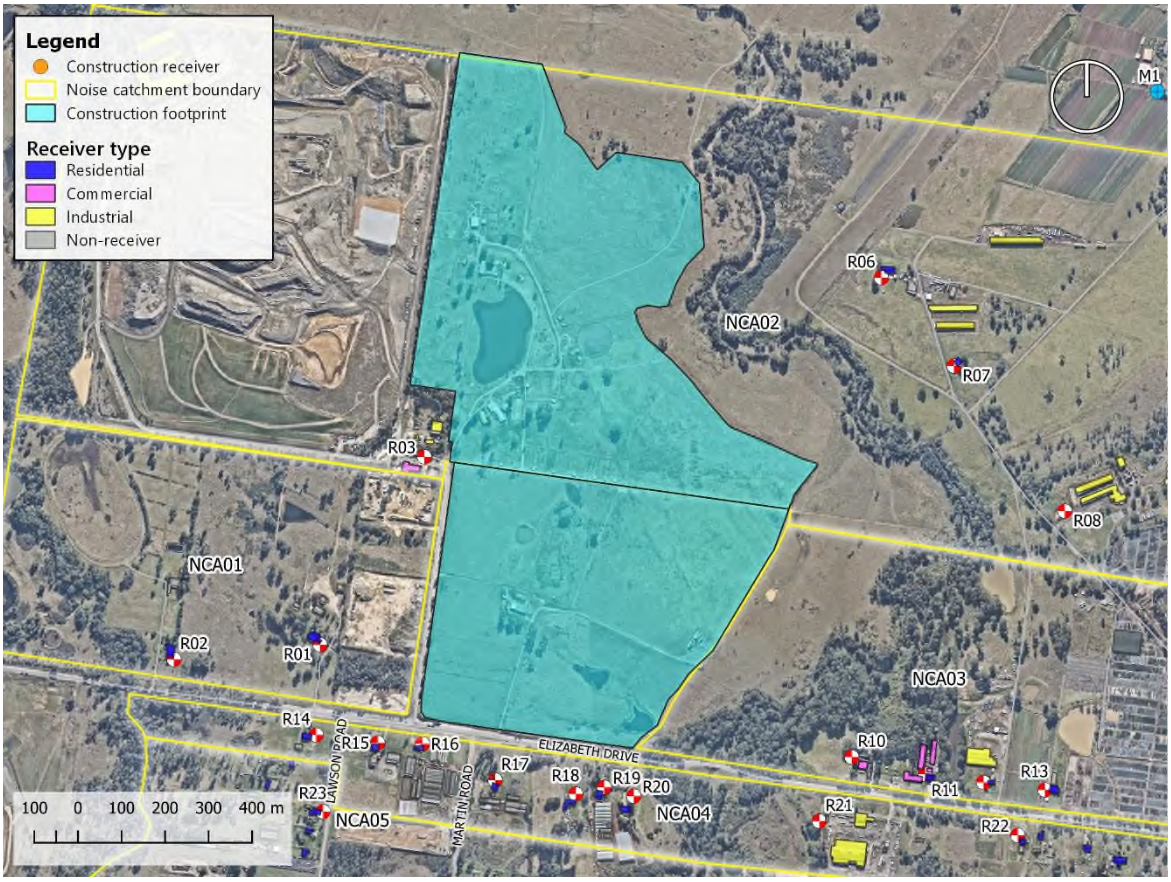
The identified nearest affected receiver locations are outlined in Table 4-1 and shown on Figure 4-1. It is noted that the receiver IDs are in line with those presented in Table 1-2 and is a subset of that table.

Table 4-1 – Receiver Locations

Receiver ID	Address	Description
R01	1745 Elizabeth Drive, Badgerys Creek	Residential property located approximately 245m west of the site boundary.
R03	1725A Elizabeth Drive, Badgerys Creek	Commercial property located approximately 70m west of the site boundary.
R06	146B Clifton Avenue, Kemps Creek	Residential property located approximately 570m northeast of the site boundary.
R07	146B Clifton Avenue, Kemps Creek	Residential property located approximately 500m northeast of the site boundary.
R08	1541A Elizabeth Drive, Kemps Creek	Industrial property located approximately 635m east of the site boundary.
R10	1605-1667 Elizabeth Drive, Kemps Creek	Commercial property located approximately 400m east of the site boundary.
R11	1605-1667 Elizabeth Drive, Kemps Creek	Residential property located approximately 565m east of the site boundary.
R14	5 Lawson Road, Badgerys Creek	Residential property located approximately 245m southwest of the site boundary.
R15	1990 Elizabeth Drive, Badgerys Creek	Residential property located approximately 120m southwest of the site boundary.
R16	1970 Elizabeth Drive, Badgerys Creek	Residential property located approximately 60m south of the site boundary.

Receiver ID	Address	Description
R17	10 Martin Road, Badgerys Creek	Residential property located approximately 115 south of the site boundary.
R18	1930 Elizabeth Drive, Badgerys Creek	Residential property located approximately 120m south of the site boundary.
R19	1920 Elizabeth Drive, Badgerys Creek	Residential property located approximately 100m south of the site boundary.
R20	1910 Elizabeth Drive, Badgerys Creek	Residential property located approximately 110m south of the site boundary.
R21	1820 Elizabeth Drive, Badgerys Creek	Industrial property located approximately 435m southeast of the site boundary.
R23	35 Lawson Road, Badgerys Creek	Residential property located approximately 320m southwest of the site boundary.
R25	30 Martin Road, Badgerys Creek	Residential property located approximately 340m south of the site boundary.
R27	155 Overett Avenue, Kemps Creek	Residential property located approximately 360m southeast of the site boundary.

Figure 4-1 – Proposal site and construction receiver locations



4.4 Construction noise and vibration activities and assumptions

4.4.1 Construction works and activities

An assessment of the potential level of construction noise and vibration impact has been carried out to determine whether mitigation would be required and to determine appropriate management controls, where required. Specific construction equipment requirements are not yet known. The type and number of plant and equipment associated with the proposed works was assumed based upon experience with similar developments.

Prior to the commencement of construction, the final construction details should be reviewed against the assumptions in this report to ensure that the mitigation and management measures that will be implemented remain consistent with these assumptions, and appropriate for the project.

For the construction of Stage 1 the staging considers site establishment, demolition and removal of existing structures, vegetation clearing and am dewatering, excavator/civil, road and intersection works, and building construction. In addition there will be construction of an earth bund within Stage 2 lands to form an interim evaporative storage basin. The basin will capture and store surface water runoff from the Stage 1 development area (via the proposed OSD basin), as well as local catchment runoff from the Stage 2 land to the west. The basin is one of several measures that have been incorporated into the stormwater management strategy to satisfy stormwater quality and flow volume controls for the EEP Stage 1 development.

The approximate phases and duration of works are presented in Table 4-2.

Table 4-2 – Approximate construction phases and duration of works

Stage / Description	Details	Time frame
Stage 1 Construction		
Site establishment	Initial site setup and establishment	Months 1 – 3
Demolition and removal of existing structures	Demolish and remove existing structures	Months 1 – 3
Vegetation clearing and dam dewatering	Vegetation clearing, tree removal and dam dewatering	Months 1 – 3
Excavation/civil	Estate bulk earthworks, construction of retaining walls and utility works	Months 4 – 16
Road and intersection works	Construction of internal estate roads and signalised intersection with Elizabeth Drive	Months 4 – 16
Building construction	Construction of the main building structures for all eight warehouses	Months 7 – 55
Stage 2 Construction of Temporary Bund and Basin		
Site establishment	Initial site setup and establishment	Months 1 – 3

Stage / Description	Details	Time frame
Demolition and removal of existing structures	Demolish and remove existing structures	Months 1 – 3
Vegetation clearing and dam dewatering	Vegetation clearing, tree removal and dam dewatering	Months 1 – 3
Excavation/civil	Estate bulk earthworks, construction of retaining walls and utility works	Months 4 – 16

4.4.2 Construction traffic

The worksite will generate additional traffic movements in the form of:

- Light vehicle movements generated by construction personnel travelling to and from work
- Heavy vehicle movements generated by:
  - Trucks removing spoil from the site
  - Delivery vehicles bringing raw materials, plant and equipment to the site.

Construction traffic on the site is included as part of the construction noise assessment of the work activities identified in Section 4.4.1. For construction related traffic movements on the public road network, a different noise assessment methodology is applicable as vehicle movements would be regarded as additional road traffic on public roads rather than as part of the construction site's activities.

Access to the site will be from Elizabeth Drive. The estimated daily number of heavy vehicles accessing the site will be up to 50 trucks per day during peak periods or an average of 5 trucks per hour, over a standard 10 hour work day. It is noted that the construction traffic movements provided are indicative only based on similar sized industrial estates as referenced throughout Western Sydney. The actual construction vehicle numbers and types will be subject to the appointed Principal contractors programme, selected staging and construction methodology. A Construction Noise and Vibration Management Plan (CNVMP) with further detail in relation to selected construction staging, vehicle types, vehicle numbers and mitigation strategies is proposed to form part of the Construction Environmental Management Plan (CEMP) to be prepared and approved prior to the commencement of construction.

Nevertheless, this volume of heavy vehicle traffic is not expected to significantly add to the existing traffic noise along Elizabeth Drive (see Section 5.2 for existing traffic levels on Elizabeth Drive). Therefore, construction traffic from the site on the public roads is predicted not to be a significant noise impact and is not further addressed in this report.

4.4.3 Construction noise sources

The schedule of items of plant and equipment likely to be used during the construction phases of the Proposal is presented in Table 4-3 below.

Table 4-3 – Typical construction equipment & sound power levels, dB(A) re 1pW

Plant item	Plant description	Estimated no. of Items	$L_{Aeq(15min)}$ sound power levels, dB(A) re 1pW
Stage 1 Construction			
Site establishment			
1	5-tonne excavator with hydraulic hammer	2 x 5-tonne excavators in total	118
2	5-tonne excavator with saw		116
3	Truck and dog	4 per hour	108
4	Powered hand tool	Various	107
5	5-tonne excavator with claw/bucket	2 x 5-tonne excavators in total	103
6	Bobcat	2	102
7	Non-powered hand tools	Various	98
Demolition and removal of existing structures			
1	20-tonne excavator with hydraulic hammer	2 x 20-tonne excavators in total	121
2	20-tonne excavator with saw		119
3	Truck and dog	4 per hour	108
4	Powered hand tool	Various	107
5	20-tonne excavator with claw/bucket	2 x 20-tonne excavators in total	103
Vegetation clearing and dam dewatering			
1	Tub grinder / mulcher	1	116
2	Chainsaw	2	114
3	D1 dozer	2	110
4	Truck and dog	4 per hour	108
5	Pump	2	106
6	20-tonne excavator with claw/bucket	2 x 20-tonne excavators in total	103
Excavation / civil works			
1	20-tonne excavator with hydraulic hammer	2 x 20-tonne excavators in total	121
2	D10 dozer	1	116
3	Grader	3	113
4	D6 dozer	2	111
5	Scraper	3	110
6	Vibratory roller	3	109
7	Truck and dog (30-42 tonne payload)	6 per hour	108
8	Concrete truck	4 per hour (peak)	108
9	Delivery truck (HR)	4 per hour	108
10	Powered hand tools	Various	107
11	Water cart	3	107
12	20-tonne excavator with claw/bucket	2 x 20-tonne excavators in total	103
13	Concrete Pump	1	102
14	Concrete vibrator	1	100

Plant item	Plant description	Estimated no. of Items	$L_{Aeq(15min)}$ sound power levels, dB(A) re 1pW
Road and intersection works			
1	Pavement laying machine	1	114
2	Vibratory roller	1	109
3	Truck and dog	4 per hour	108
4	Concrete truck	4 per hour	108
5	Delivery truck	4 per hour	108
6	Line marking truck	1	108
7	Asphalt truck & sprayer	1	103
8	Franna crane	1	98
9	Scissor lift	1	98
Buildings works			
1	Mobile / tower crane	1	110
2	Concrete truck	4 per hour	108
3	Delivery truck	4 per hour	108
4	Powered hand tools	Various	107
5	Concrete Pump	2	102
6	Bobcat	2	102
7	Concrete vibrator	8	100
8	Scissor lift	2	98
9	Non-powered hand tools	Various	98
Stage 2 Construction of Temporary Bund and Basin			
Site establishment			
1	5-tonne excavator with hydraulic hammer	2 x 5-tonne excavators in total	118
2	5-tonne excavator with saw		116
3	Truck and dog	4 per hour	108
4	Powered hand tool	Various	107
5	5-tonne excavator with claw/bucket	2 x 5-tonne excavators in total	103
6	Bobcat	2	102
7	Non-powered hand tools	Various	98
Vegetation clearing and dam dewatering			
1	Tub grinder / mulcher	1	116
2	Chainsaw	2	114
3	D1 dozer	2	110
4	Truck and dog	4 per hour	108
5	Pump	2	106
6	20-tonne excavator with claw/bucket	2 x 20-tonne excavators in total	103
Excavation / civil works			
1	20-tonne excavator with hydraulic hammer	2 x 20-tonne excavators in total	121
2	D10 dozer	1	116

Plant item	Plant description	Estimated no. of Items	$L_{Aeq(15min)}$ sound power levels, dB(A) re 1pW
3	Grader	3	113
4	D6 dozer	2	111
5	Scraper	3	110
6	Vibratory roller	3	109
7	Truck and dog (30-42 tonne payload)	6 per hour	108
8	Concrete truck	4 per hour (peak)	108
9	Delivery truck (HR)	4 per hour	108
10	Powered hand tools	Various	107
11	Water cart	3	107
12	20-tonne excavator with claw/bucket	2 x 20-tonne excavators in total	103
13	Concrete Pump	1	102
14	Concrete vibrator	1	100

The sound power levels for the majority of construction plant and equipment presented in the above table are based on maximum noise levels given in Table A1 of Australian Standard 2436 - 2010 'Guide to Noise Control on Construction, Demolition and Maintenance Sites', the NSW Interim Construction Noise Guideline (ICNG) reference documents, Transport for NSW (TfNSW) Construction Noise and Vibration Strategy (2019) (DMS-ST-157, Revision 4.1), information from past projects and/or information held in our library files.

4.5 Construction noise assessment

4.5.1 Predicted noise levels

Noise levels at any receiver location resulting from construction works would depend on the location of the receiver with respect to the area of construction, shielding from intervening topography and structures, and the type and duration of construction being undertaken. Furthermore, noise levels at receivers would vary significantly over the total construction program due to the transient nature and large range of plant and equipment that could be used.

Noise emissions were determined by modelling the noise sources, receiver locations and operating activities, based on the information presented in in the previous sections. In accordance with the ICNG, a 5 dB(A) penalty has been factored into the noise modelling levels, where applicable, to allow for particularly annoying activities, such as rock breaking, saw cutting and tree removal.

Table 4-4 presents noise levels likely to be experienced at the nearby affected receivers based on the construction activities and plant and equipment associated with the Proposal site. The noise level range presented represents the plant item operating at a location furthest from the receiver and a location closest to the receiver. Noise levels were calculated taking into consideration attenuation due to distance between the construction works and the receiver locations and any intervening structures.

The worst affected receivers are typically in the first row of houses back from the Proposal site, with direct line-of-sight to the construction work area. Receivers in the next row of houses back from the Proposal, or receivers without direct line-of-sight to the construction area would typically be exposed to construction noise levels 5 to 10 dB(A) lower than the levels predicted for the worst affected receivers.

Table 4-4 – Stage 1 Construction – Predicted $L_{Aeq(15min)}$ noise levels for typical construction plant and equipment, dB(A)

Plant Item	Plant description	Predicted $L_{Aeq(15min)}$ construction noise levels																	
		R01	R03	R06	R07	R08	R10	R11	R14	R15	R16	R17	R18	R19	R20	R21	R23	R25	R27
Noise management level (external) – Standard construction hours (Mon-Fri – 7:00am to 5:00pm; Sat – 8:00am to 1:00pm)		50	70	45	45	75	70	50	50	50	50	50	50	50	50	75	45	45	45
1	5-tonne excavator with hydraulic hammer	42 - 58	46 - 72	40 - 55	40 - 56	40 - 51	43 - 58	41 - 55	42 - 59	43 - 67	44 - 75	46 - 70	46 - 68	46 - 69	46 - 68	42 - 57	40 - 56	43 - 56	43 - 59
2	5-tonne excavator with saw	40 - 56	44 - 70	38 - 53	38 - 54	38 - 49	41 - 56	39 - 53	40 - 57	41 - 65	42 - 73	44 - 68	44 - 66	44 - 67	44 - 66	40 - 55	38 - 54	41 - 54	41 - 57
3	Truck and dog	<30 - 43	31 - 57	<30 - 40	<30 - 41	<30 - 36	<30 - 43	<30 - 40	<30 - 44	<30 - 52	<30 - 60	31 - 55	31 - 53	31 - 54	31 - 53	<30 - 42	<30 - 41	<30 - 41	<30 - 44
4	Powered hand tool	<30 - 42	30 - 56	<30 - 39	<30 - 40	<30 - 35	<30 - 42	<30 - 39	<30 - 43	<30 - 51	<30 - 59	30 - 54	30 - 52	30 - 53	30 - 52	<30 - 41	<30 - 40	<30 - 40	<30 - 43
5	5-tonne excavator with claw/bucket	<30 - 38	<30 - 52	<30 - 35	<30 - 36	<30 - 31	<30 - 38	<30 - 35	<30 - 39	<30 - 47	<30 - 55	<30 - 50	<30 - 48	<30 - 49	<30 - 48	<30 - 37	<30 - 36	<30 - 36	<30 - 39
6	Bobcat	<30 - 37	<30 - 51	<30 - 34	<30 - 35	<30 - 30	<30 - 37	<30 - 34	<30 - 38	<30 - 46	<30 - 54	<30 - 49	<30 - 47	<30 - 48	<30 - 47	<30 - 36	<30 - 35	<30 - 35	<30 - 38
7	Non-powered hand tools	<30 - 33	<30 - 47	<30 - 30	<30 - 31	<30	<30 - 33	<30 - 30	<30 - 34	<30 - 42	<30 - 50	<30 - 45	<30 - 43	<30 - 44	<30 - 43	<30 - 32	<30 - 31	<30 - 31	<30 - 34
Up to 3 (noisiest) plant operating concurrently		45 - 61	48 - 74	42 - 57	42 - 59	42 - 54	45 - 60	44 - 57	44 - 61	45 - 69	46 - **77**	48 - 72	49 - 70	48 - 72	48 - 70	45 - 59	42 - 58	45 - 58	45 - 61
Up to 3 (noisiest) plant operating concurrently excluding excavator with hammer or saw attachment		31 - 47	34 - 60	<30 - 43	<30 - 45	<30 - 40	31 - 46	30 - 43	30 - 47	31 - 55	32 - 63	34 - 58	35 - 56	34 - 58	34 - 56	31 - 45	<30 - 44	31 - 44	31 - 47
1	20-tonne excavator with hydraulic hammer	46 - 55	52 - 62	45 - 52	45 - 52	45 - 51	48 - 55	46 - 53	51 - 56	53 - 59	54 - 61	54 - 63	53 - 63	53 - 63	52 - 58	48 - 55	45 - 54	50 - 55	49 - 56
2	20-tonne excavator with saw	44 - 53	50 - 60	43 - 50	43 - 50	43 - 49	46 - 53	44 - 51	49 - 54	51 - 57	52 - 59	52 - 61	51 - 61	51 - 61	50 - 56	46 - 53	43 - 52	48 - 53	47 - 54
3	Truck and dog	<30 - 37	34 - 44	<30 - 34	<30 - 34	<30 - 33	30 - 37	<30 - 35	33 - 38	35 - 41	36 - 43	36 - 45	35 - 45	35 - 45	34 - 40	30 - 37	<30 - 36	32 - 37	31 - 38
4	Powered hand tool	<30 - 36	33 - 43	<30 - 33	<30 - 33	<30 - 32	<30 - 36	<30 - 34	32 - 37	34 - 40	35 - 42	35 - 44	34 - 44	34 - 44	33 - 39	<30 - 36	<30 - 35	31 - 36	30 - 37
5	20-tonne excavator with claw/bucket	<30 - 32	<30 - 39	<30	<30	<30	<30 - 32	<30 - 30	<30 - 33	30 - 36	31 - 38	31 - 40	30 - 40	30 - 40	<30 - 35	<30 - 32	<30 - 31	<30 - 32	<30 - 33
Up to 3 (noisiest) plant operating concurrently		48 - 57	54 - 64	47 - 54	48 - 54	47 - 53	50 - 57	49 - 55	53 - 58	55 - 61	56 - 63	56 - 65	55 - 65	55 - 65	54 - 61	50 - 58	47 - 56	52 - 57	51 - 59
Up to 3 (noisiest) plant operating concurrently excluding excavator with hammer or saw attachment		32 - 40	38 - 48	31 - 37	31 - 37	30 - 36	34 - 41	32 - 38	36 - 41	38 - 44	39 - 46	39 - 49	38 - 48	38 - 48	37 - 44	33 - 41	30 - 39	36 - 40	34 - 42
1	Tub grinder / mulcher	40 - 56	44 - 70	38 - 53	38 - 54	38 - 49	41 - 56	39 - 53	40 - 57	41 - 65	42 - 73	44 - 68	44 - 66	44 - 67	44 - 66	40 - 55	38 - 54	41 - 54	41 - 57
2	Chainsaw	38 - 54	42 - 68	36 - 51	36 - 52	36 - 47	39 - 54	37 - 51	38 - 55	39 - 63	40 - 71	42 - 66	42 - 64	42 - 65	42 - 64	38 - 53	36 - 52	39 - 52	39 - 55
3	D1 dozer	<30 - 45	33 - 59	<30 - 42	<30 - 43	<30 - 38	30 - 45	<30 - 42	<30 - 46	30 - 54	31 - 62	33 - 57	33 - 55	33 - 56	33 - 55	<30 - 44	<30 - 43	30 - 43	30 - 46
4	Truck and dog	<30 - 43	31 - 57	<30 - 40	<30 - 41	<30 - 36	<30 - 43	<30 - 40	<30 - 44	<30 - 52	<30 - 60	31 - 55	31 - 53	31 - 54	31 - 53	<30 - 42	<30 - 41	<30 - 41	<30 - 44
5	Pump	<30 - 41	<30 - 55	<30 - 38	<30 - 39	<30 - 34	<30 - 41	<30 - 38	<30 - 42	<30 - 50	<30 - 58	<30 - 53	<30 - 51	<30 - 52	<30 - 51	<30 - 40	<30 - 39	<30 - 39	<30 - 42
6	20-tonne excavator with claw/bucket	<30 - 38	<30 - 52	<30 - 35	<30 - 36	<30 - 31	<30 - 38	<30 - 35	<30 - 39	<30 - 47	<30 - 55	<30 - 50	<30 - 48	<30 - 49	<30 - 48	<30 - 37	<30 - 36	<30 - 36	<30 - 39
Up to 3 (noisiest) plant operating concurrently		43 - 59	46 - 73	40 - 56	40 - 57	40 - 52	43 - 58	42 - 55	42 - 60	43 - 67	45 - 75	46 - 70	47 - 68	47 - 70	46 - 68	43 - 57	40 - 56	44 - 56	43 - 59
1	20-tonne excavator with hydraulic hammer	45 - 61	49 - 75	43 - 58	43 - 59	43 - 54	46 - 61	44 - 58	45 - 62	46 - 70	47 - **78**	49 - 73	49 - 71	49 - 72	49 - 71	45 - 60	43 - 59	46 - 59	46 - 62
2	D10 dozer	35 - 51	39 - 65	33 - 48	33 - 49	33 - 44	36 - 51	34 - 48	35 - 52	36 - 60	37 - 68	39 - 63	39 - 61	39 - 62	39 - 61	35 - 50	33 - 49	36 - 49	36 - 52
3	Grader	32 - 48	36 - 62	30 - 45	30 - 46	30 - 41	33 - 48	31 - 45	32 - 49	33 - 57	34 - 65	36 - 60	36 - 58	36 - 59	36 - 58	32 - 47	30 - 46	33 - 46	33 - 49
4	D6 dozer	30 - 46	34 - 60	<30 - 43	<30 - 44	<30 - 39	31 - 46	<30 - 43	30 - 47	31 - 55	32 - 63	34 - 58	34 - 56	34 - 57	34 - 56	30 - 45	<30 - 44	31 - 44	31 - 47
5	Scraper	<30 - 45	33 - 59	<30 - 42	<30 - 43	<30 - 38	30 - 45	<30 - 42	<30 - 46	30 - 54	31 - 62	33 - 57	33 - 55	33 - 56	33 - 55	<30 - 44	<30 - 43	30 - 43	30 - 46
6	Vibratory roller	<30 - 44	32 - 58	<30 - 41	<30 - 42	<30 - 37	<30 - 44	<30 - 41	<30 - 45	<30 - 53	30 - 61	32 - 56	32 - 54	32 - 55	32 - 54	<30 - 43	<30 - 42	<30 - 42	<30 - 45
7	Truck and dog (30-42 tonne payload)	<30 - 43	31 - 57	<30 - 40	<30 - 41	<30 - 36	<30 - 43	<30 - 40	<30 - 44	<30 - 52	<30 - 60	31 - 55	31 - 53	31 - 54	31 - 53	<30 - 42	<30 - 41	<30 - 41	<30 - 44
8	Concrete truck	<30 - 43	31 - 57	<30 - 40	<30 - 41	<30 - 36	<30 - 43	<30 - 40	<30 - 44	<30 - 52	<30 - 60	31 - 55	31 - 53	31 - 54	31 - 53	<30 - 42	<30 - 41	<30 - 41	<30 - 44
9	Delivery truck (HR)	<30 - 43	31 - 57	<30 - 40	<30 - 41	<30 - 36	<30 - 43	<30 - 40	<30 - 44	<30 - 52	<30 - 60	31 - 55	31 - 53	31 - 54	31 - 53	<30 - 42	<30 - 41	<30 - 41	<30 - 44
10	Powered hand tools	<30 - 42	30 - 56	<30 - 39	<30 - 40	<30 - 35	<30 - 42	<30 - 39	<30 - 43	<30 - 51	<30 - 59	30 - 54	30 - 52	30 - 53	30 - 52	<30 - 41	<30 - 40	<30 - 40	<30 - 43
11	Water cart	<30 - 42	30 - 56	<30 - 39	<30 - 40	<30 - 35	<30 - 42	<30 - 39	<30 - 43	<30 - 51	<30 - 59	30 - 54	30 - 52	30 - 53	30 - 52	<30 - 41	<30 - 40	<30 - 40	<30 - 43
12	20-tonne excavator with claw/bucket	<30 - 38	<30 - 52	<30 - 35	<30 - 36	<30 - 31	<30 - 38	<30 - 35	<30 - 39	<30 - 47	<30 - 55	<30 - 50	<30 - 48	<30 - 49	<30 - 48	<30 - 37	<30 - 36	<30 - 36	<30 - 39
13	Concrete Pump	<30 - 37	<30 - 51	<30 - 34	<30 - 35	<30 - 30	<30 - 37	<30 - 34	<30 - 38	<30 - 46	<30 - 54	<30 - 49	<30 - 47	<30 - 48	<30 - 47	<30 - 36	<30 - 35	<30 - 35	<30 - 38
14	Concrete vibrator	<30 - 35	<30 - 49	<30 - 32	<30 - 33	<30	<30 - 35	<30 - 32	<30 - 36	<30 - 44	<30 - 52	<30 - 47	<30 - 45	<30 - 46	<30 - 45	<30 - 34	<30 - 33	<30 - 33	<30 - 36
Up to 3 (noisiest) plant operating concurrently		46 - 62	50 - 76	43 - 59	44 - 60	43 - 55	46 - 61	45 - 58	46 - 63	47 - 71	48 - **79**	50 - 73	50 - 71	50 - 73	49 - 71	46 - 61	43 - 60	47 - 59	46 - 62

Plant Item	Plant description	Predicted $L_{Aeq(15min)}$ construction noise levels																	
		R01	R03	R06	R07	R08	R10	R11	R14	R15	R16	R17	R18	R19	R20	R21	R23	R25	R27
Up to 3 (noisiest) plant operating concurrently excluding excavator with hammer or saw attachment		38 - 54	42 - 68	35 - 51	35 - 52	35 - 47	38 - 53	37 - 50	38 - 55	39 - 63	40 - 71	42 - 65	42 - 63	42 - 65	41 - 63	38 - 53	35 - 51	39 - 51	38 - 54
1	Pavement laying machine	32 - 49	38 - 65	31 - 45	31 - 45	30 - 40	34 - 47	32 - 44	34 - 55	36 - 64	36 - **77**	38 - 63	38 - 58	38 - 56	37 - 53	34 - 47	30 - 48	35 - 48	34 - 47
2	Vibratory roller	<30 - 44	33 - 60	<30 - 40	<30 - 40	<30 - 35	<30 - 42	<30 - 39	<30 - 50	31 - 59	31 - 72	33 - 58	33 - 53	33 - 51	32 - 48	<30 - 42	<30 - 43	30 - 43	<30 - 42
3	Truck and dog	<30 - 43	32 - 59	<30 - 39	<30 - 39	<30 - 34	<30 - 41	<30 - 38	<30 - 49	30 - 58	30 - 71	32 - 57	32 - 52	32 - 50	31 - 47	<30 - 41	<30 - 42	<30 - 42	<30 - 41
4	Concrete truck	<30 - 43	32 - 59	<30 - 39	<30 - 39	<30 - 34	<30 - 41	<30 - 38	<30 - 49	30 - 58	30 - 71	32 - 57	32 - 52	32 - 50	31 - 47	<30 - 41	<30 - 42	<30 - 42	<30 - 41
5	Delivery truck	<30 - 43	32 - 59	<30 - 39	<30 - 39	<30 - 34	<30 - 41	<30 - 38	<30 - 49	30 - 58	30 - 71	32 - 57	32 - 52	32 - 50	31 - 47	<30 - 41	<30 - 42	<30 - 42	<30 - 41
6	Line marking truck	<30 - 43	32 - 59	<30 - 39	<30 - 39	<30 - 34	<30 - 41	<30 - 38	<30 - 49	30 - 58	30 - 71	32 - 57	32 - 52	32 - 50	31 - 47	<30 - 41	<30 - 42	<30 - 42	<30 - 41
7	Asphalt truck & sprayer	<30 - 38	<30 - 54	<30 - 34	<30 - 34	<30	<30 - 36	<30 - 33	<30 - 44	<30 - 53	<30 - 66	<30 - 52	<30 - 47	<30 - 45	<30 - 42	<30 - 36	<30 - 37	<30 - 37	<30 - 36
8	Franna crane	<30 - 33	<30 - 49	<30	<30	<30	<30 - 31	<30	<30 - 39	<30 - 48	<30 - 61	<30 - 47	<30 - 42	<30 - 40	<30 - 37	<30 - 31	<30 - 32	<30 - 32	<30 - 31
9	Scissor lift	<30 - 33	<30 - 49	<30	<30	<30	<30 - 31	<30	<30 - 39	<30 - 48	<30 - 61	<30 - 47	<30 - 42	<30 - 40	<30 - 37	<30 - 31	<30 - 32	<30 - 32	<30 - 31
Up to 3 (noisiest) plant operating concurrently		34 - 50	40 - 67	32 - 47	33 - 47	32 - 42	36 - 49	34 - 46	36 - 56	37 - 65	38 - **79**	39 - 65	40 - 60	40 - 58	39 - 55	35 - 49	32 - 50	37 - 50	36 - 49
1	Mobile / tower crane	30 - 46	31 - 52	<30 - 40	<30 - 41	<30 - 38	31 - 44	<30 - 41	30 - 49	32 - 55	33 - 57	34 - 53	35 - 53	35 - 54	34 - 51	30 - 43	<30 - 43	32 - 41	31 - 44
2	Concrete truck	<30 - 44	<30 - 50	<30 - 38	<30 - 39	<30 - 36	<30 - 42	<30 - 39	<30 - 47	30 - 53	31 - 55	32 - 51	33 - 51	33 - 52	32 - 49	<30 - 41	<30 - 41	30 - 39	<30 - 42
3	Delivery truck	<30 - 44	<30 - 50	<30 - 38	<30 - 39	<30 - 36	<30 - 42	<30 - 39	<30 - 47	30 - 53	31 - 55	32 - 51	33 - 51	33 - 52	32 - 49	<30 - 41	<30 - 41	30 - 39	<30 - 42
4	Powered hand tools	<30 - 43	<30 - 49	<30 - 37	<30 - 38	<30 - 35	<30 - 41	<30 - 38	<30 - 46	<30 - 52	30 - 54	31 - 50	32 - 50	32 - 51	31 - 48	<30 - 40	<30 - 40	<30 - 38	<30 - 41
5	Concrete Pump	<30 - 38	<30 - 44	<30 - 32	<30 - 33	<30 - 30	<30 - 36	<30 - 33	<30 - 41	<30 - 47	<30 - 49	<30 - 45	<30 - 45	<30 - 46	<30 - 43	<30 - 35	<30 - 35	<30 - 33	<30 - 36
6	Bobcat	<30 - 38	<30 - 44	<30 - 32	<30 - 33	<30 - 30	<30 - 36	<30 - 33	<30 - 41	<30 - 47	<30 - 49	<30 - 45	<30 - 45	<30 - 46	<30 - 43	<30 - 35	<30 - 35	<30 - 33	<30 - 36
7	Concrete vibrator	<30 - 36	<30 - 42	<30 - 30	<30 - 31	<30	<30 - 34	<30 - 31	<30 - 39	<30 - 45	<30 - 47	<30 - 43	<30 - 43	<30 - 44	<30 - 41	<30 - 33	<30 - 33	<30 - 31	<30 - 34
8	Scissor lift	<30 - 34	<30 - 40	<30	<30	<30	<30 - 32	<30	<30 - 37	<30 - 43	<30 - 45	<30 - 41	<30 - 41	<30 - 42	<30 - 39	<30 - 31	<30 - 31	<30	<30 - 32
9	Non-powered hand tools	<30 - 34	<30 - 40	<30	<30	<30	<30 - 32	<30	<30 - 37	<30 - 43	<30 - 45	<30 - 41	<30 - 41	<30 - 42	<30 - 39	<30 - 31	<30 - 31	<30	<30 - 32
Up to 3 (noisiest) plant operating concurrently		33 - 50	34 - 55	31 - 44	31 - 44	30 - 41	34 - 48	32 - 45	34 - 53	35 - 58	36 - 61	37 - 57	38 - 56	38 - 58	38 - 54	34 - 47	<30 - 46	35 - 45	35 - 48

Notes: 1. Red font represents exceedance of the relevant NML

2. **Bold** font represents receiver that is highly noise affected [i.e. >75dB(A)] and only applicable to residential receivers, as per Table 2 of the ICNG

Table 4-5 – Stage 2 Demoliton and Construction of Temporary Bund and Basin– Predicted $L_{Aeq(15min)}$ noise levels for typical construction plant and equipment, dB(A)

Plant Item	Plant description	Predicted $L_{Aeq(15min)}$ construction noise levels																	
		R01	R03	R06	R07	R08	R10	R11	R14	R15	R16	R17	R18	R19	R20	R21	R23	R25	R27
Noise management level (external) – Standard construction hours (Mon-Fri – 7:00am to 5:00pm; Sat – 8:00am to 1:00pm)		50	70	45	45	75	70	50	50	50	50	50	50	50	50	75	45	45	45
1	5-tonne excavator with hydraulic hammer	33 - 45	41 - 52	48 - 57	44 - 58	39 - 51	37 - 54	36 - 47	38 - 44	39 - 45	39 - 45	38 - 50	38 - 51	38 - 52	38 - 52	37 - 49	37 - 42	37 - 44	36 - 46
2	5-tonne excavator with saw	31 - 43	39 - 50	46 - 55	42 - 56	37 - 49	35 - 52	34 - 45	36 - 42	37 - 43	37 - 43	36 - 48	36 - 49	36 - 50	36 - 50	35 - 47	35 - 40	35 - 42	34 - 44
3	Truck and dog	<30 - 30	<30 - 37	33 - 42	<30 - 43	<30 - 36	<30 - 39	<30 - 32	<30	<30 - 30	<30 - 30	<30 - 35	<30 - 36	<30 - 37	<30 - 37	<30 - 34	<30	<30	<30 - 31
4	Powered hand tool	<30	<30 - 36	32 - 41	<30 - 42	<30 - 35	<30 - 38	<30 - 31	<30	<30	<30	<30 - 34	<30 - 35	<30 - 36	<30 - 36	<30 - 33	<30	<30	<30 - 30
5	5-tonne excavator with claw/bucket	<30	<30 - 32	<30 - 37	<30 - 38	<30 - 31	<30 - 34	<30	<30	<30	<30	<30 - 30	<30 - 31	<30 - 32	<30 - 32	<30	<30	<30	<30
6	Bobcat	<30	<30 - 31	<30 - 36	<30 - 37	<30 - 30	<30 - 33	<30	<30	<30	<30	<30	<30 - 30	<30 - 31	<30 - 31	<30	<30	<30	<30
7	Non-powered hand tools	<30	<30	<30 - 32	<30 - 33	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Up to 3 (noisiest) plant operating concurrently		36 - 48	43 - 54	51 - 59	46 - 60	41 - 53	40 - 56	39 - 50	41 - 46	41 - 47	41 - 48	40 - 52	40 - 53	40 - 54	40 - 54	39 - 51	39 - 44	39 - 46	38 - 48
Up to 3 (noisiest) plant operating concurrently excluding excavator with hammer or saw attachment		<30 - 34	<30 - 40	37 - 45	32 - 46	<30 - 39	<30 - 42	<30 - 36	<30 - 32	<30 - 33	<30 - 34	<30 - 38	<30 - 39	<30 - 40	<30 - 40	<30 - 37	<30 - 30	<30 - 32	<30 - 34
1	20-tonne excavator with hydraulic hammer	39 - 52	44 - 64	43 - 55	43 - 53	41 - 46	42 - 51	35 - 49	38 - 50	38 - 50	45 - 51	42 - 50	42 - 49	42 - 49	42 - 49	41 - 50	36 - 48	37 - 47	41 - 46
2	20-tonne excavator with saw	37 - 50	42 - 62	41 - 53	41 - 51	39 - 44	40 - 49	33 - 47	36 - 48	36 - 48	43 - 49	40 - 48	40 - 47	40 - 47	40 - 47	39 - 48	34 - 46	35 - 45	39 - 44
3	Truck and dog	<30 - 34	<30 - 46	<30 - 37	<30 - 35	<30	<30 - 33	<30 - 31	<30 - 32	<30 - 32	<30 - 33	<30 - 32	<30 - 31	<30 - 31	<30 - 31	<30 - 32	<30 - 30	<30	<30
4	Powered hand tool	<30 - 33	<30 - 45	<30 - 36	<30 - 34	<30	<30 - 32	<30 - 30	<30 - 31	<30 - 31	<30 - 32	<30 - 31	<30 - 30	<30 - 30	<30 - 30	<30 - 31	<30	<30	<30
5	20-tonne excavator with claw/bucket	<30	<30 - 41	<30 - 32	<30 - 30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Up to 3 (noisiest) plant operating concurrently		41 - 54	46 - 66	45 - 57	45 - 56	43 - 48	44 - 53	37 - 51	40 - 52	40 - 53	47 - 53	44 - 52	45 - 51	44 - 51	45 - 51	44 - 52	38 - 50	39 - 49	43 - 48
Up to 3 (noisiest) plant operating concurrently excluding excavator with hammer or saw attachment		<30 - 38	30 - 49	<30 - 41	<30 - 39	<30 - 32	<30 - 36	<30 - 34	<30 - 35	<30 - 36	30 - 36	<30 - 35	<30 - 34	<30 - 34	<30 - 34	<30 - 36	<30 - 33	<30 - 32	<30 - 31
Vegetation clearing and dam dewatering																			
1	Tub grinder / mulcher	31 - 43	39 - 50	46 - 55	42 - 56	37 - 49	35 - 52	34 - 45	36 - 42	37 - 43	37 - 43	36 - 48	36 - 49	36 - 50	36 - 50	35 - 47	35 - 40	35 - 42	34 - 44
2	Chainsaw	<30 - 41	37 - 48	44 - 53	40 - 54	35 - 47	33 - 50	32 - 43	34 - 40	35 - 41	35 - 41	34 - 46	34 - 47	34 - 48	34 - 48	33 - 45	33 - 38	33 - 40	32 - 42
3	D1 dozer	<30 - 32	<30 - 39	35 - 44	31 - 45	<30 - 38	<30 - 41	<30 - 34	<30 - 31	<30 - 32	<30 - 32	<30 - 37	<30 - 38	<30 - 39	<30 - 39	<30 - 36	<30	<30 - 31	<30 - 33
4	Truck and dog	<30 - 30	<30 - 37	33 - 42	<30 - 43	<30 - 36	<30 - 39	<30 - 32	<30	<30 - 30	<30 - 30	<30 - 35	<30 - 36	<30 - 37	<30 - 37	<30 - 34	<30	<30	<30 - 31
5	Pump	<30	<30 - 35	31 - 40	<30 - 41	<30 - 34	<30 - 37	<30 - 30	<30	<30	<30	<30 - 33	<30 - 34	<30 - 35	<30 - 35	<30 - 32	<30	<30	<30
6	20-tonne excavator with claw/bucket	<30	<30 - 32	<30 - 37	<30 - 38	<30 - 31	<30 - 34	<30	<30	<30	<30	<30 - 30	<30 - 31	<30 - 32	<30 - 32	<30	<30	<30	<30
Up to 3 (noisiest) plant operating concurrently		34 - 46	41 - 52	49 - 57	44 - 59	39 - 51	38 - 54	37 - 48	39 - 44	39 - 45	39 - 46	39 - 50	38 - 52	38 - 52	38 - 52	37 - 49	37 - 42	37 - 44	36 - 46
1	20-tonne excavator with hydraulic hammer	36 - 48	44 - 55	51 - 60	47 - 61	42 - 54	40 - 57	39 - 50	41 - 47	42 - 48	42 - 48	41 - 53	41 - 54	41 - 55	41 - 55	40 - 52	40 - 45	40 - 47	39 - 49
2	D10 dozer	<30 - 38	34 - 45	41 - 50	37 - 51	32 - 44	30 - 47	<30 - 40	31 - 37	32 - 38	32 - 38	31 - 43	31 - 44	31 - 45	31 - 45	30 - 42	30 - 35	30 - 37	<30 - 39
3	Grader	<30 - 35	31 - 42	38 - 47	34 - 48	<30 - 41	<30 - 44	<30 - 37	<30 - 34	<30 - 35	<30 - 35	<30 - 40	<30 - 41	<30 - 42	<30 - 42	<30 - 39	<30 - 32	<30 - 34	<30 - 36
4	D6 dozer	<30 - 33	<30 - 40	36 - 45	32 - 46	<30 - 39	<30 - 42	<30 - 35	<30 - 32	<30 - 33	<30 - 33	<30 - 38	<30 - 39	<30 - 40	<30 - 40	<30 - 37	<30 - 30	<30 - 32	<30 - 34
5	Scraper	<30 - 32	<30 - 39	35 - 44	31 - 45	<30 - 38	<30 - 41	<30 - 34	<30 - 31	<30 - 32	<30 - 32	<30 - 37	<30 - 38	<30 - 39	<30 - 39	<30 - 36	<30	<30 - 31	<30 - 33
6	Vibratory roller	<30 - 31	<30 - 38	34 - 43	30 - 44	<30 - 37	<30 - 40	<30 - 33	<30 - 30	<30 - 31	<30 - 31	<30 - 36	<30 - 37	<30 - 38	<30 - 38	<30 - 35	<30	<30 - 30	<30 - 32
7	Truck and dog (30-42 tonne payload)	<30 - 30	<30 - 37	33 - 42	<30 - 43	<30 - 36	<30 - 39	<30 - 32	<30	<30 - 30	<30 - 30	<30 - 35	<30 - 36	<30 - 37	<30 - 37	<30 - 34	<30	<30	<30 - 31
8	Concrete truck	<30 - 30	<30 - 37	33 - 42	<30 - 43	<30 - 36	<30 - 39	<30 - 32	<30	<30 - 30	<30 - 30	<30 - 35	<30 - 36	<30 - 37	<30 - 37	<30 - 34	<30	<30	<30 - 31
9	Delivery truck (HR)	<30 - 30	<30 - 37	33 - 42	<30 - 43	<30 - 36	<30 - 39	<30 - 32	<30	<30 - 30	<30 - 30	<30 - 35	<30 - 36	<30 - 37	<30 - 37	<30 - 34	<30	<30	<30 - 31
10	Powered hand tools	<30	<30 - 36	32 - 41	<30 - 42	<30 - 35	<30 - 38	<30 - 31	<30	<30	<30	<30 - 34	<30 - 35	<30 - 36	<30 - 36	<30 - 33	<30	<30	<30 - 30
11	Water cart	<30	<30 - 36	32 - 41	<30 - 42	<30 - 35	<30 - 38	<30 - 31	<30	<30	<30	<30 - 34	<30 - 35	<30 - 36	<30 - 36	<30 - 33	<30	<30	<30 - 30
12	20-tonne excavator with claw/bucket	<30	<30 - 32	<30 - 37	<30 - 38	<30 - 31	<30 - 34	<30	<30	<30	<30	<30 - 30	<30 - 31	<30 - 32	<30 - 32	<30	<30	<30	<30
13	Concrete Pump	<30	<30 - 31	<30 - 36	<30 - 37	<30 - 30	<30 - 33	<30	<30	<30	<30	<30	<30 - 30	<30 - 31	<30 - 31	<30	<30	<30	<30
14	Concrete vibrator	<30	<30	<30 - 34	<30 - 35	<30	<30 - 31	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30

Plant Item	Plant description	Predicted $L_{Aeq(15min)}$ construction noise levels																	
		R01	R03	R06	R07	R08	R10	R11	R14	R15	R16	R17	R18	R19	R20	R21	R23	R25	R27
Up to 3 (noisiest) plant operating concurrently		37 - 49	45 - 55	52 - 60	48 - 62	42 - 54	41 - 58	40 - 51	42 - 47	42 - 48	42 - 49	42 - 54	42 - 55	42 - 55	41 - 56	40 - 52	41 - 46	40 - 48	40 - 50
Up to 3 (noisiest) plant operating concurrently excluding excavator with hammer or saw attachment		<30 - 41	37 - 47	44 - 52	40 - 54	34 - 46	33 - 50	32 - 43	34 - 39	34 - 40	34 - 41	34 - 46	33 - 47	34 - 47	33 - 47	32 - 44	33 - 38	32 - 40	32 - 42

Notes: 1. Red font represents exceedance of the relevant NML

2. **Bold** font represents receiver that is highly noise affected [i.e. >75dB(A)] and only applicable to residential receivers, as per Table 2 of the ICNG

The predicted construction noise levels presented above indicate that during site establishment, demolition and vegetation clearing the NMLs at the residential receivers may be exceeded when construction works are conducted within close proximity to the receiver locations. In particular, the exceedances are greatest when rock hammering, saw cutting, mulching and chain sawing is undertaken near the boundary of the site, closest to each respective receiver location. Receiver R16 has been predicted to be highly noise affected [i.e. exposed to noise levels greater than 75 dB(A)] when rock hammering, pavement laying machines and other equipment are used concurrently near this receiver location.

During excavation and civil works, the NMLs are exceeded at all residential and one commercial receivers (R03). The exceedances are likely to occur while rock hammering or a number of concurrent construction activities is undertaken near each corresponding receiver location. Receiver R16 has been predicted to be highly noise affected when rock hammering is undertaken near this receiver location.

The NMLs have been predicted to be exceeded at several residential receivers during road works. In particular, the NMLs at residential receivers R14 to R20 are exceeded when intersection works are undertaken at the site entry on Elizabeth Drive. Receiver R16 located closest to the intersection is predicted to be highly noise affected while the pavement laying machine is operated in close proximity to this receiver location.

Minor exceedances of the NML at residential receivers may occur during building works when several construction activities are undertaken concurrently near each affected residential receiver location.

In general, the exceedances at the upper range of the predicted construction noise levels occur during construction activities that involve the use of noise intensive equipment in close proximity to each respective receiver location. It would be expected that these works would exceed the respective NMLs for a relatively short duration as works progress across the site and noise intensive equipment is used on a transient basis.

Considering the predicted noise levels above, it is recommended that a feasible and reasonable approach towards noise mitigation measures be applied to reduce noise levels as much as possible to mitigate the impact from construction noise. Further details on construction noise mitigation and management measures are provided in Section 4.5.2 below.

4.5.2 Construction noise mitigation measures

General engineering noise controls

Implementation of noise control measures, such as those suggested in Australian Standard 2436-2010 'Guide to Noise Control on Construction, Demolition and Maintenance Sites', are expected to reduce predicted construction noise levels.

Reference to Australian Standard 2436-2010, Appendix C, Table C1 suggests possible remedies and alternatives to reduce noise emission levels from typical construction equipment. Table C2 in Appendix

C presents typical examples of noise reductions achievable after treatment of various noise sources. Table C3 in Appendix C presents the relative effectiveness of various forms of noise control treatment.

Table 4-6 below presents noise control methods, practical examples and expected noise reductions according to AS2436 and according to Renzo Tonin & Associates' opinion based on experience with past projects.

Table 4-6 – Relative effectiveness of various forms of noise control

Noise control method	Practical examples	Typical noise reduction possible in practice, dB(A)		Maximum noise reduction possible in practice, dB(A)	
		AS 2436	Renzo Tonin & Assoc.	AS 2436	Renzo Tonin & Assoc.
Distance	Doubling of distance between source and receiver	6	6	6	6
Screening	Acoustic barriers such as temporary or permanent noise barriers where barrier breaks line-of-sight between the source and receiver	5 to 10	5 to 10	15	15
Acoustic enclosures	Engine casing lagged with acoustic insulation and plywood	15 to 25	10 to 20	50	30
Engine Silencing	Residential class mufflers	5 to 10	5 to 10	20	20
Substitution by alternative process	Use electric motors in preference to diesel or petrol	-	15 to 25	-	40

The Renzo Tonin & Associates' listed noise reductions are conservatively low and should be referred to in preference to those of AS2436.

Table 4-7 below identifies possible noise control measures, which are applicable on the construction plant likely to be used on site.

Table 4-7 – Possible noise control measures for likely construction plant

Plant Description	Screening	Acoustic enclosures	Silencing	Alternative process
Excavator with hammer/saw	✔	✖	✔	✔
Tub grinder	✔	✔	✔	✖
Chainsaw	✔	✖	✔	✖
Dozer	✔	✖	✔	✖
Roller	✔	✖	✔	✖
Grader	✔	✖	✔	✖
Pavement laying machine	✔	✔	✔	✖
Bobcat	✔	✖	✔	✖
Concrete truck	✔	✖	✔	✖
Delivery trucks	✔	✖	✔	✖
Water cart	✔	✖	✔	✖

Plant Description	Screening	Acoustic enclosures	Silencing	Alternative process
Line marking truck	✔	✖	✔	✖
Mobile crane	✔	✖	✔	✖
Concrete vibrator	✔	✔	✔	✔
Concrete pump	✔	✔	✔	✔
Scissor lift	✔	✖	✔	✔
Hand tools	✔	✖	✔	✖

Noise management measures

The following recommendations provide feasible and reasonable noise control solutions to reduce noise impacts to sensitive receivers. A strong justification must be provided for not implementing the proposed measures if they are later determined on-site not to be feasible or reasonable.

The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

General noise management measures

The following general noise management measures are recommended for all receiver locations:

- Use less noisy plant and equipment, where feasible and reasonable.
- Plant and equipment must be properly maintained.
- Provide special attention to the use and maintenance of 'noise control' or 'silencing' kits fitted to machines to ensure they perform as intended.
- Strategically position plant on site to reduce the emission of noise to the surrounding neighbourhood and to site personnel.
- Avoid any unnecessary noise when carrying out manual operations and when operating plant.
- Any equipment not in use for extended periods during construction work must be switched off.
- Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be limited/avoided where possible.
- The offset distance between noisy plant and adjacent sensitive receivers is to be maximised where practicable.
- Plant used intermittently to be throttled down or shut down when not in use where practicable.
- Noise-emitting plant to be directed away from sensitive receivers where possible.

- Staging of construction works so as to erect solid external walls first and utilising them to provide noise shielding to the noise sensitive receivers. However, the structural integrity of the external walls should be investigated prior to implementing this measure and should be prioritised over the noise benefits.
- In addition to the noise mitigation measures outlined above, a management procedure will need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint will need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits.
- Good relations with people living and working in the vicinity of a construction site should be established at the beginning of a project and be maintained throughout the project, as this is of paramount importance. Keeping people informed of progress and taking complaints seriously and dealing with them expeditiously is critical. The person selected to liaise with the community must be adequately trained and experienced in such matters.

Additional measures to be considered

Other potential mitigation measures include:

- Use of broadband "quacker" type of reverse/movement alarms instead of the tonal 'beeping" type.
- Relocatable noise screens / enclosures constructed of the EchoBarrier or Acoustifence Sound Barrier Material mounted to temporary steel fencing may be utilised to provide additional screening, such as during concrete saw activity, where reasonable and feasible. The relocatable noise screen would need to be installed to completely break line of site to receivers to ensure it works as an effective noise barrier. The noise screen should be located as close as practical to the works to ensure good acoustic performance.
- A respite period can be agreed upon with the neighbouring premises if the residences / tenants occupy the surrounding premises during the construction periods.
- All employees, contractors and subcontractors are to receive site induction and toolbox talks and ongoing training so that the above noise management measures are implemented accordingly. Content within toolboxes will include location of nearest sensitive receivers; relevant project specific and standard noise and vibration mitigation measures; permissible hours of work, truck route and truck loading restrictions and construction employee parking areas.

Noise monitoring

The following approach could be adopted with regard to noise monitoring procedures during the construction works.

- Where potential noise impacts are predicted to be up to 10 dB(A) above the noise criteria, all feasible and reasonable noise reduction measures must be investigated, where necessary.
- Where potential noise impacts are predicted to be more than 10 dB(A) above the noise criteria, the potential construction noise nuisance is considered to be moderate. In the event of a compliant, noise monitoring may be carried out to confirm predicted noise impacts. Reasonable and feasible noise reduction measures must be investigated, where necessary.

4.6 Construction vibration assessment

4.6.1 Minimum working distances

The vibration generated from construction works will vary depending on the level and type of activity carried out at each stage. During site establishment, demolition, excavation and road works, there are vibration intensive plant and equipment involved in the construction schedule including excavators, rock breakers and vibratory rollers. However, considering the distances to sensitive receiver buildings there is generally considered low to negligible risk of vibration impact, depending on the location of the construction works. This assessment only covers the closest vibration sensitive receivers for this reason.

The pattern of vibration radiation is very different to the pattern of airborne noise radiation and is very site specific as final vibration levels are dependent on many factors including the actual plant used, its operation and the intervening geology between the activity and the receiver. Potential vibration generated at receivers for this project will be dependent on separation distances, the intervening soil and rock strata, dominant frequencies of vibration and the receiver building's construction and structure.

The recommended minimum working distances for vibration intensive plant are presented in Table 4-8.

Table 4-8 – Recommended minimum working distances for vibration intensive equipment

Plant item	Rating / description	Minimum working distance	
		Cosmetic damage	Human response
Vibratory roller[3]	< 50 kN (typically 1-2 tonnes)	5 m	15m – 20 m
	< 100 kN (typically 2-4 tonnes)	6 m	20 m
	< 200 kN (typically 4-6 tonnes)	12 m	40 m
	< 300 kN (typically 7-13 tonnes)	15 m	100 m
	> 300 kN (typically 13-18 tonnes)	20 m	100 m
	> 300 kN (typically > 18 tonnes)	25 m	100 m
Dozer[1]	(D810) with ripper	2 m (nominal)	10 m
Excavators[2]	< 30 tonne (travelling/ digging)	10 m	15 m

Plant item	Rating / description	Minimum working distance	
		Cosmetic damage	Human response
Grader[1]	<= 20 tonne	2 m (nominal)	10 m
Small hydraulic hammer[3]	300kg (5-12 tonne excavator)	2 m	7 m
Medium hydraulic hammer[3]	900kg (12-18 tonne excavator)	7 m	23 m
Large hydraulic hammer[3]	1600kg (18-34 tonne excavator)	22 m	73 m
Jackhammer[3]	Hand held	1 m (nominal)	Avoid contact with structure
Truck movements[2]	-	-	10 m

Notes: 1. TCA Construction Noise Strategy (Rail Projects) November 2011
2. Renzo Tonin & Associates project files, databases & library.
3. TfNSW Construction Noise and Vibration Strategy (2019) (DMS-ST-157, Revision 4.1) (Appendix D)

Site specific buffer distances for vibration significant plant items should be measured on site where plant and equipment are likely to operate close to or within the minimum working distances for cosmetic damage.

As previously identified, unlike noise, vibration cannot be 'predicted' due to many variables from site to site, for example soil type and conditions; sub surface rock; building types and foundations; and actual plant on site. The data relied upon in this assessment (tabulated above) is taken from a database of vibration levels measured at various sites or obtained from other sources (eg. BS 5228-2:2009). They are not specific to this project as final vibration levels are dependent on many factors including the actual plant used, its operation and the intervening geology between the activity and the receiver.

4.6.2 Potential vibration impacts

Based on the proposed plant items presented, vibration generated by construction plant was estimated and potential vibration impacts are summarised in Table 4-9 below. The assessment is relevant to the nearest affected buildings and other similar type structures in the project area and has been assessed against the vibration limits presented in the German Standard DIN 4150-3:2016 (see Section 3.2.2).

Table 4-9 – Potential vibration for residential and commercial properties

Receiver location	Approx. distance to nearest buildings from works (m)	Group classification in accordance with Table 3-6	Assessment on potential vibration impacts		
			Structural damage risk	Human disturbance	Vibration monitoring
R03	25	Group 1 (commercial /industrial)	Low risk of structural damage from construction works	Low risk of adverse comment as a result of construction works	Vibration monitoring not required
R15	70	Group 2 (residential dwelling)	Low risk of structural damage from construction works	Low risk of adverse comment as a result of construction works	Vibration monitoring not required
R16	25	Group 2 (residential dwelling)	Low risk of structural damage from construction works	Medium risk of adverse comment as a result of construction works	Vibration monitoring conducted where required

Receiver location	Approx. distance to nearest buildings from works (m)	Group classification in accordance with Table 3-6	Assessment on potential vibration impacts		
			Structural damage risk	Human disturbance	Vibration monitoring
R17	90	Group 2 (residential dwelling)	Low risk of structural damage from construction works	Low risk of adverse comment as a result of construction works	Vibration monitoring not required
R19	100	Group 2 (residential dwelling)	Low risk of structural damage from construction works	Low risk of adverse comment as a result of construction works	Vibration monitoring not required

Note: 1. The source of vibration levels is an 18 tonne vibratory roller, considered to be the highest vibration producing plant item

Based on the above assessment for the receivers surrounding the site, Receiver R16 would be most at risk from vibration impacts if vibration intensive equipment are required to be used (i.e. 18 tonne vibratory roller or excavator with hydraulic hammer), particularly for human disturbance. However, the closest distance at which vibration intensive equipment would be used is greater than or equal to the recommended minimum working distance. Hence, there is low to negligible risk of structural / cosmetic damage, depending on the location of the construction works.

Site specific buffer distances should be determined once vibration emission levels are measured from each plant item prior to the commencement of their regular use on site in close proximity to vibration sensitive structures. Where construction activity occurs in close proximity to sensitive receivers, minimum buffer distances for building damage should be determined by site measurements and maintained.

4.6.3 Vibration mitigation measures

The following vibration management measures are provided to minimise vibration impact from construction activities to the nearest affected receivers and to meet the relevant human comfort and building damage vibration limits:

1. A management procedure should be implemented to deal with vibration complaints. Each complaint should be investigated and where vibration levels are established as exceeding the set limits, appropriate amelioration measures should be put in place to mitigate future occurrences.

2. Where vibration is found to be excessive, management measures should be implemented to ensure vibration compliance is achieved. Management measures may include modification of construction methods such as using smaller equipment, establishment of safe buffer zones as mentioned above, and if necessary, time restrictions for the most excessive vibration activities. Time restrictions are to be negotiated with affected receivers.

3. Where construction activity occurs in close proximity to sensitive receivers, vibration testing of actual equipment on site would be carried out prior to their commencement of site operation to determine acceptable buffer distances to the nearest affected receiver locations.

4. Dilapidation surveys should be conducted at all residential and other sensitive receivers within 50 metres of the construction site. Notification by letterbox drop would be carried out

for all occupied buildings within 100m of the construction site. These measures are to address potential community concerns that perceived vibration may cause damage to property.

4.7 Complaints management

Noise and vibration levels generated by construction activities associated with the construction of the development must aim to comply with the noise and vibration goals set by the relevant regulations and guidelines.

The contractor is responsible for ensuring that all reasonable and feasible mitigation and management measures are implemented such as the provision of a Noise and Vibration Complaints Program, to minimise the generation of excessive noise and/or vibration levels from the site to nearby sensitive areas.

Owners and occupants of nearby affected properties are to be informed by direct mail of a direct telephone line and contact person where any noise and/or vibration complaints related to the construction activities are to be reported.

All noise and/or vibration complaints associated with the construction works shall be investigated in accordance with the Noise / Vibration Complaint Management Procedure identified in APPENDIX D.

5 Operational noise assessment

5.1 Airport noise impacts

Noise and vibration impacts from aircraft flights and ground-based operations of the Western Sydney Airport were assessed and presented in the Western Sydney Airport Environmental Impact Statement (EIS), dated September 2016. The following technical reports specific to noise and vibration were included in the EIS:

- Volume 4, Appendix E1 Aircraft overflight noise – 'Aircraft overflight & operational noise', Wilkinson Murray, Report no. 14168, Version E, dated August 2016
- Volume 4, Appendix E2 Airport ground-based noise and vibration – 'Assessment of ground-based noise', Wilkinson Murray, Report no. 14168-1, Version I, dated August 2016

A review of the above technical reports indicate that noise impacts were not assessed for future commercial and industrial developments surrounding the airport site. The reason for this may be due to the rezoning of the areas surrounding the airport site to Enterprise zones occurring in 2020, while in 2016 when the assessments and reports were prepared, the surrounding areas were zoned residential.

Nevertheless, given that the technical reports assessed the surrounding areas as residential, which would result in a more stringent assessment compared to commercial and industrial uses, any noise impacts to the Proposal would have been accounted for in the noise and vibration assessments prepared for the Western Sydney Airport.

Furthermore, it is not expected that the Proposal would accommodate any sensitive land uses (eg. places of worship, childcare centres, schools, hospitals).

Additionally, reference is made to the 'State Environmental Planning Policy (Western Sydney Aerotropolis) 2020'. Part 3, Clause 19 restricts development consent of any noise sensitive development if the development is to be located on land that is in an ANEF contour of 20 or greater. Given that the Proposal is not expected to accommodate any sensitive land uses as defined in Section 6 of same clause (e.g. places of worship, childcare centres, schools, hospitals), the restriction would not be applicable.

5.2 Operational road traffic

5.2.1 Existing traffic

As stated previously, COVID safe measures and restrictions were issued by the NSW Government were in place during the initial preparation of this noise and vibration impact assessment and report. As a result, traffic surveys to determine existing traffic volumes could not be undertaken, considering both the restrictions in place and the reduced traffic volumes as a result. The M12 Motorway EIS presents 2017 traffic volumes at a traffic counting location on Elizabeth Drive and near the Proposal site. Given that the presented traffic counts were undertaken in 2017, it would be expected that traffic volumes would have increased in the following years due to major developments occurring in the surrounding area. Therefore, existing traffic volumes as presented in the M12 Motorway EIS would form a conservative assumption for the basis of this traffic noise impact assessment.

Additionally, to further inform the traffic classification volumes (i.e. breakup of vehicle classes) on Elizabeth Drive, the traffic classification survey carried out by Matrix Traffic and Transport Pty Ltd (ref. N3351) in June 2017 on Elizabeth Drive, east of Mamre Road was analysed to determine the likely percentage of medium and heavy trucks along the section of Elizabeth Drive adjacent to the Proposal site.

The existing traffic volumes and classifications are presented in Table 5-1.

Table 5-1 – Existing (2023) traffic volumes

Road	Direction	Day (15 hour) 7.00am – 10.00pm				Night (9 hour) 10.00pm – 7.00am			
		Total Vehicles[1]	Heavy Vehicle %[2]		Speed[3] (km/h)	Total Vehicles[1]	Heavy Vehicle %[2]		Speed[3] (km/h)
			Medium	Heavy			Medium	Heavy	
Elizabeth Drive (between Luddenham Rd and Devonshire Rd)	Eastbnd	6,111	12.1%	9.3%	76	1,265	12.2%	9.9%	78
	Westbnd	9,079	10.7%	9.1%	75	1,879	10.3%	7.3%	75

Notes: 1. Based on 2023 peak hour traffic counts at Elizabeth Drive and Martins Road intersection and scaled for day (15 hour) and night (9 hour) volumes based on 2017 traffic classification survey undertaken by Matrix Traffic and Transport Pty Ltd on Elizabeth Drive (east of Mamre Road)

2. Percentage determined based on 2017 traffic classification survey undertaken by Matrix Traffic and Transport Pty Ltd on Elizabeth Drive (east of Mamre Road)

3. Based on 2017 traffic survey as presented in the M12 Motorway EIS

5.2.2 Proposed vehicle movements

Future internal roads

As mentioned previously, the ownership of the future internal roads of the precinct will be vested with Council and will be public road. Therefore, noise impacts from the future internal roads are assessed under the requirements of the RNP, rather than the NPfI. However, given that there will be no residences or sensitive land uses along these future roads, an assessment of traffic noise impacts from these roads against the RNP will not be required.

Heavy vehicle routes

Heavy vehicle movements for operational traffic to and from the Proposal site will be along Elizabeth Drive. Traffic accessing the Proposal site would travel along Elizabeth Drive via the M7 Motorway from the east and via The Northern Road from the west. However, to present a conservative assessment, it has been assumed that all vehicle movements generated by the Proposal would access and depart the Proposal site via Elizabeth Drive, east of Martin Road.

To determine the potential change in road traffic noise levels as a result of additional traffic generated by the Proposal on Elizabeth Drive, the existing traffic data has been based upon the traffic volumes and vehicle classifications presented in Table 5-1.

Vehicle traffic volumes and composition

Table 5-2 presents a summary of the forecasted vehicle movements during the operation of the Proposal, as provided by the project team.

Table 5-2 – Predicted hourly vehicle volumes and compositions

Time	Light vehicle, movements	Heavy vehicle (HV), movements					All vehicle, movements[1]
		Rigid	Semi-trailer	B-double	A-double	Total HV	
12:00 AM	24	7	1	0	3	10	34
1:00 AM	20	7	1	0	3	10	30
2:00 AM	22	7	1	0	3	11	32
3:00 AM	28	6	1	0	2	9	36
4:00 AM	95	13	1	0	5	20	115
5:00 AM	176	29	3	1	11	44	219
6:00 AM	235	41	4	1	16	61	297
7:00 AM	221	48	5	1	19	73	294
8:00 AM	188	56	6	1	21	84	272
9:00 AM	144	61	6	2	23	92	236
10:00 AM	132	59	6	2	23	89	221
11:00 AM	141	60	6	2	23	91	232
12:00 PM	171	54	6	1	21	82	253
1:00 PM	221	55	6	1	21	83	304
2:00 PM	257	49	5	1	19	74	331
3:00 PM	218	43	4	1	17	65	283
4:00 PM	183	35	4	1	13	52	235
5:00 PM	150	29	3	1	11	44	194
6:00 PM	85	20	2	1	8	31	116
7:00 PM	50	12	1	0	5	19	69
8:00 PM	36	10	1	0	4	15	51
9:00 PM	55	7	1	0	3	11	66
10:00 PM	71	9	1	0	3	13	85
11:00 PM	48	8	1	0	3	12	60
Daily Total	**2,973**	**724**	**74**	**19**	**278**	**1,094**	**4,067**

Notes:
1. Traffic volumes represent the total vehicles movements (i.e. 1 inbound movement or 1 outbound movement)
2. Traffic volumes predicted based on the operation of all warehouses
3. Traffic volume data provided by project team (traffic consultant)

Table 5-2 shows that for the day period, the highest hourly heavy vehicle movements occur between 9:00am and 12:00pm; for the evening period between 6:00pm and 7:00pm; for the night period between 4:00am and 5:00am; and for the morning shoulder period between 6:00am and 7:00am.

Carpark activities

Noise generated by car park activities includes vehicle doors closing, vehicle engines starting, vehicles accelerating and vehicles moving. To assess this noise, the $L_{Aeq\ 15\text{-}minute}$ noise level at the nearest affected residential receivers was determined for each relevant period based on the number of light vehicle movements expected to occur during that period. For this assessment, the predicted hourly light vehicle movements as presented in Table 5-2 have been reviewed to determine the maximum number of car movements within the carpark areas during each assessment period. The carpark activity has been distributed across 13 carpark areas located alongside each of the warehouse buildings, where each warehouse building will have two carpark areas, except for Warehouse 5, which would have one carpark area.

The carpark vehicle movements assumed for this assessment is summarised in Table 5-3 for the highest one-hour period for the day, evening, night and morning shoulder periods.

Table 5-3 – Car parking activity distribution

Assessment period	Highest number of car movement activities per hour (using carpark and public roads)	Time period these are expected to occur
Daytime	257	2:00pm to 3:00pm
Evening	85	6:00pm to 7:00pm
Night	95	4:00am to 5:00am
Morning shoulder	235	6:00am to 7:00am

For assessing the vehicles on public roads, it has been assumed that a total of 3,160 vehicle movements are generated by the proposal for the daytime period (7:00am to 10:00pm) and a total of 907 vehicle movements are generated for the night period (10:00pm to 7:00am).

5.2.3 Predicted road traffic noise changes on arterial roads

The potential increase in road traffic noise levels has been calculated using the 'Federal Highway Administration Model' (FHWA) 2004 (TNM 2.5) model to determine the potential change in traffic noise levels at residential receivers adjacent to the arterial roads (eg. Elizabeth Drive) that will be used by vehicles associated with the Proposal.

This model has been selected as it is identified in Appendix B4 of the RNP as a suitable road traffic noise model that has been validated under specific Australian conditions, while also allowing for a greater level of break-down and categorisation of heavy vehicle types, compared with the relatively simplistic corrections for the percentage of heavy vehicles in the 'Calculation of Road Traffic Noise' (1988) (CoRTN88) method. Considering the number of heavy vehicle movements per day as part of the Proposal, adopting an approach with a greater level of accuracy and consideration for heavy vehicles is appropriate. It has conservatively been assumed that all heavy vehicles associated with the Proposal are classified as heavy trucks for the purposes of the TNM 2.5 model inputs.

The results of the road traffic noise predictions are presented in Table 5-4.

Table 5-4 – Predicted increase in road traffic noise levels along Elizabeth Drive, dB(A)

Period	Existing[1]			Future[1]			Predicted increase, dB(A)	Comply?
	Traffic Volume	% Medium	% Heavy	Traffic Volume	% Medium	% Heavy		
Day (15 hour) 7:00am to 10:00pm	15,190	11.3%	9.2%	18,349	9.3%	12.5%	1.5	Yes
Night (9 hour) 10:00pm to 7:00am	3,144	11.0%	8.3%	4,051	8.6%	11.1%	1.5	Yes

Notes: 1. Based upon combined two-way traffic volumes

From the above table, it can be seen that road traffic noise level contributions from the vehicle movements associated with the Proposal are not expected to increase the existing traffic noise levels by more than 2.0 dB(A) at noise sensitive receivers along Elizabeth Drive. Therefore, traffic noise levels as a result of the operational traffic from the Proposal on public roads would meet the RNP requirements.

5.3 Operations noise sources

As discussed in Section 1.3, as part of the Proposal warehouse buildings in Lots 1, 2, 4, 5, 6, 7 and 8 (i.e. Warehouses 1, 2, 4, 5, 6, 7 and 8, respectively) will be constructed as part of the Proposal. Therefore, the assessment of operational noise in the following sections will be based on the operational activities associated with Warehouses 1, 2, 4, 5, 6, 7 and 8 only.

The noise sources associated with the operation of the Proposal are as follows:

- truck movements within each warehouse site
- passenger vehicle movements and activities within the designated car parking areas
- loading dock activities in hardstand areas
- fixed mechanical plant and equipment.

The following sections detail the key noise generating plant and equipment that will operate as part of typical operations associated with Warehouses 1, 2, 4, 5, 6, 7 and 8.

5.3.1 Description of operational assumptions

Truck movements within warehouse lots

The proposed number of trucks and the composition of these vehicles that are proposed to move through the Proposal site were presented Section 5.2.2.

Over the day period up to 829 trucks are expected to move through the facility, varying between 44 per hour to 92 per hour. The peak hour period for truck movements has been predicted to occur during 9:00am to 10:00am, where up to 92 trucks per hour could move through the precinct into the warehouse lots. In a 15-minute period, a maximum of 32 trucks are expected to move through the precinct into each warehouse site. During other periods fewer trucks are expected.

Based upon the heavy vehicle composition as presented in Table 5-2 and the above potential maximum reasonable worst case 15-minute period movement assumptions, the following truck movements into each warehouse site have been modelled for the reasonable worst case 15-minute period assessment.

Table 5-5 – Reasonable worst case 15-minute period truck movements – truck type breakdown

Trucks	Day	Evening	Night	Shoulder
Representative period with maximum movements	*9:00am-10:00am*	*6:00pm-7:00pm*	*4:00am-5:00am*	*6:00am-7:00am*
Warehouse 1				
Rigid truck	2	1	1	1
Semi-trailer	1	0	0	0
B-double	0	0	0	0
A-double	1	1	1	1
TOTAL	**4**	**2**	**2**	**2**
Warehouse 2				
Rigid truck	2	1	1	2
Semi-trailer	1	0	0	1
B-double	0	0	0	0
A-double	1	1	0	1
TOTAL	**4**	**2**	**1**	**4**
Warehouse 4				
Rigid truck	1	1	1	1
Semi-trailer	0	0	0	0
B-double	0	0	0	0
A-double	1	1	0	1
TOTAL	**2**	**2**	**1**	**2**
Warehouse 5				
Rigid truck	1	1	1	1
Semi-trailer	0	0	0	0
B-double	0	0	0	0
A-double	1	0	0	1
TOTAL	**2**	**1**	**1**	**2**

Trucks	Day	Evening	Night	Shoulder
Representative period with maximum movements	*9:00am-10:00am*	*6:00pm-7:00pm*	*4:00am-5:00am*	*6:00am-7:00am*
Warehouse 6				
Rigid truck	4	2	1	2
Semi-trailer	1	1	0	1
B-double	2	1	0	1
A-double	2	1	1	2
TOTAL	**9**	**5**	**2**	**6**
Warehouse 7				
Rigid truck	4	2	1	2
Semi-trailer	1	1	0	1
B-double	0	0	0	0
A-double	2	1	1	2
TOTAL	**7**	**4**	**2**	**5**
Warehouse 8				
Rigid truck	2	2	2	2
Semi-trailer	0	0	0	0
B-double	0	0	0	0
A-double	2	2	0	2
TOTAL	**4**	**4**	**2**	**4**

Notes: 1. One movement represents one inbound or one outbound movement

The noise levels for heavy vehicles moving within each warehouse site (i.e. hardstand areas) were based upon the noise measurements undertaken at other similar facilities, as presented in Section 2.3. The noise modelling of truck movements within each warehouse site has been based on the sound power levels presented in Table 5-6.

Table 5-6 – Summary of sound power levels for truck movements within warehouse lots

Truck type	Noise source / noise generating operation	Individual source/activity sound power level (L_w re. 1pW), $L_{Aeq,t}$, dB(A)	Modelled source height above local ground level (m)
11 metre rigid[2, 3]	Moving within site boundary (internal site roads (~40km/h) / hardstand (~10km/h))[1]	106[1]	1.5
6 axle semi-trailer	Moving within site boundary (internal site roads (~40km/h) / hardstand (~10km/h))	109	1.5
	Decelerating - internal road to hardstand (to ~10km/h)	99	1.5
	Accelerating - hardstand to internal road (from ~10km/h)	104	1.5
B-double	Moving within site boundary (internal site roads (~40km/h) / hardstand (~10km/h))	107	1.5
	Decelerating - internal road to hardstand (to ~10km/h)	102	1.5
	Accelerating - hardstand to internal road (from ~10km/h)	107	1.5

Truck type	Noise source / noise generating operation	Individual source/activity sound power level (L_w re. 1pW), $L_{Aeq,t}$, dB(A)	Modelled source height above local ground level (m)
A-double	Moving within site boundary (internal site roads (~40km/h) / hardstand (~10km/h))	109	1.5
	Decelerating - internal road to hardstand (to ~10km/h)	109	1.5
	Accelerating - hardstand to internal road (from ~10km/h)	107	1.5
Used for all truck types	Airbrake (when stop at dock) (L_{Amax})	120	1.5
	Airbrake (when stop at dock) ($L_{Aeq, 15min}$)	90	1.5
	'Bang' from truck coming off site exit cross over (L_{Amax})	117	0.5
	'Bang' from truck coming off site exit cross over ($L_{Aeq, 15min}$)	90	0.5
	Truck reversing into dock with reversing beeper (operating during reversing at 5km/h)[4]	105	1.5

Notes: 1. Based on previously measured 11m rigid trucks. The loudest of a number of rigid truck types were adopted for the typical pass-by noise levels
2. Conservative assumption based upon a rigid truck with a refrigeration unit
3. Accelerating / decelerating assumptions based upon 6 axle semi-trailer
4. Measurements were with a tonal reversing beeper.

Loading dock activities

Trucks would arrive and enter the warehouse lots via the internal roads to access the loading dock areas. Loading dock activities would include trucks reversing into the loading dock, a reach stacker unloading / loading shipping containers from / onto trucks and forklifts. It is expected that trucks including A-doubles and B-doubles would typically enter and exit each warehouse in a forward direction and may potentially reverse into a loading dock. Some rigid trucks and semi-trailers may also reverse into the loading dock, and so this has been included in the modelling.

Modelling of loading dock operations were based upon the sound power levels presented in Table 5-7, which have been measured for the project at similar facilities as described in Section 2.3 and/or sourced from the Renzo Tonin & Associates database of previous measured levels.

Table 5-7 – Summary of sound power levels for loading dock area activities

Noise source / noise generating operation	Individual source/activity sound power level (L_w re. 1pW), $L_{Aeq,t}$, dB(A)	Modelled source height above local ground level (m)
Prime mover idling – no trailer	96	1.5
Truck reversing into dock with reversing beeper (at ~5km/h)[1]	105	1.5
Reach stacker unloading / loading shipping container	112	2.0
'Bang' from loading shipping container onto truck (L_{Amax})	120	3.6
'Bang' from loading shipping container onto truck ($L_{Aeq, 15min}$)	93	3.6
Forklift moving pallets	90	1.5

Notes: 1. Measurements were with a tonal reversing beeper.

Staff vehicle movements and car parking

The proposed carpark movement assumptions are detailed in Section 5.2.2.

The sound power levels generated by carpark activities on site are presented in the following table sourced from the Renzo Tonin & Associates database.

Table 5-8 – Carpark activity sound power levels

Activity	Metric	Individual source/activity sound power level (L_w re. 1pW), $L_{Aeq,t}$, dB(A)
Vehicle moving (10km/h)	Passby L_W	79
Door slam	L_W+10log(t)	86
Engine start	L_W+10log(t)	92

Building services and mechanical plant

The specific type of mechanical plant and their location on site are yet to be finalised at this early development approval stage of the project. However, office condenser units are likely to be located on the rooves of the offices. Table 5-9 details the mechanical plant source sound power level assumed as part of the modelling for this assessment.

Table 5-9 – Assumed mechanical plant noise sound power levels

Noise source	Warehouse	Number of units[1]	Sound power level, dB(A) re. 1pW	Location
Office condenser units	Warehouse 1	2	70 (each)	On top of office roof
	Warehouse 2	4		
	Warehouse 4	3		
	Warehouse 5	2		
	Warehouse 6	4		
	Warehouse 7	4		
	Warehouse 8	4		

Notes: 1. One (1) condenser unit per office

Emergency plant and equipment

The following noise generating emergency plant are likely to be included in the Proposal:

1. Sprinkler pumps, located within a dedicated plant room
2. Emergency backup generator.

Due to the infrequent and non-typical operating nature of these emergency plant and equipment items, they do not operate as part of normal reasonable worst-case operations as they are for emergency and stand-by usage only. For this reason and in the absence of any directly relevant NSW guideline or specific guidance for emergency and stand-by equipment, they do not form part of the reasonable worst case 15-minute scenario modelling.

However, feasible and reasonable mitigation and management should be implemented in accordance with the NPfI in order to minimise the potential noise impacts on nearby sensitive receivers. The project trigger levels presented in Section 3.3.3 are not directly suitable or applicable for the stand-by and emergency plant but can serve as a guide for reviewing selections and feasible and reasonable mitigation and management measures at detailed design.

As such, the following recommendations should be considered as a minimum:

a) For selection and installation of the sprinkler pumps, they should be located within an enclosure, to minimise noise impacts at the nearest residential receivers

b) All emergency plant and equipment are to be tested and maintained during the daytime weekday period (7:00 am to 6:00 pm)

c) All noise mitigation and management measures should generally be selected to not substantially increase the cumulative site noise emissions during testing

d) The design of noise levels from emergency plant and equipment should consider the internal noise level requirements during emergencies detailed in Section 4.6 of AS/NZS 1668:2015.

5.3.2 Reasonable worst-case intrusiveness scenario (15-minute period)

Based upon the above assumptions and in addition to observations of the activities that take place at similar industrial facilities, reasonable worst-case operational assessment scenarios have been developed for assessing noise emissions from the Proposal for each assessment period (i.e. day, evening, night and morning shoulder).

The operational noise source levels, assumptions and reasonable worst-case operational assessment scenarios have been gleaned largely from the Mirvac Calibre Estate, Eastern Creek facility, which was identified as similar in parts to the Proposal's operation.

Table 5-10 details the 'reasonable' worst-case scenarios (15-minute period) for the day, evening, night and morning shoulder periods, covering the noise intensive periods for the main areas of noise generation across the Proposal site.

As discussed previously, the ownership of the future internal roads of the Proposal will be vested with Council and will be public roads, and so moving vehicles sources outside of the lot boundaries are not included in the operational noise assessment for the Proposal as they are assessed by the RNP as per Section 5.2.

Table 5-10 – Representative 'reasonable' worst-case 15-minute intrusive assessment scenarios

Activity	Daytime (7:00am to 6:00pm)	Evening (6:00pm to 10:00pm)	Night (10:00pm to 5:00am	Morning shoulder (5:00am to 7:00am)
Representative period	*9:00am-10:00am*	*6:00pm-7:00pm*	*4:00am-5:00am*	*6:00am-7:00am*
Heavy vehicle movements within each warehouse site				
A-double	Refer to Table 5-5			
B-double				
Semi-trailer				
Rigid				
Loading dock activities				
Prime mover	1 idling waiting at each warehouse			
Reach stacker	1 stack reacher at each warehouse operating for 30 sec per truck movement			
Truck reversing with tonal reversing beepers	Trucks reversing with tonal beepers for 30 sec per truck movement			
Airbrake	Refer to Table 5-6 and Table 5-7 for the heavy vehicle numbers. Includes each of these activity noise sources for each truck arriving/departing the site.			
'Bang' from truck coming off driveway crossover				
'Bang from loading truck with shipping container				
Forklift	2 operating at each warehouse from the warehouse to the hardstand	2 operating at each warehouse from the warehouse to the hardstand	2 operating at each warehouse from the warehouse to the hardstand (warehouse 6 only)	2 operating at each warehouse from the warehouse to the hardstand
Staff vehicle movements and car parking (based on Table 5-3)				
Light vehicle movements	Based on Table 5-3, where light vehicle movements and carpark activities are distributed across all car parks of the Proposal			
Car park activities				
Mechanical plant				
Office condenser units	Refer to Table 5-9			

5.4 Noise prediction methodology

5.4.1 Modelling overview

Modelling and assessment of airborne noise impacts from the Proposal were undertaken by modelling the noise sources, receiver locations and topographical features, and possible noise mitigation measures using a 3D noise modelling software package, CadnaA (Version 2021 MR 2). Noise modelling algorithms were used to calculate the contribution of each noise source at each identified sensitive receiver location and to predict the total noise from the site for the various reasonable worst-case scenarios developed for the Proposal.

The noise prediction model considers:

- Location of noise sources and sensitive receiver locations

- Heights of sources and receivers referenced to digital ground contours (1m contour intervals)
- The results in Section 5.5 present the levels at representative receiver locations; however, all nearby and potentially impacted noise sensitive receivers have been evaluated
- Noise source levels of individual plant and equipment
- Separation distances between sources and receivers
- Ground type and reflections between sources and receivers (ground absorption value of 0 for the site and roads, and 0.75 for grassed and suburban areas).
- Attenuation from barriers, buildings and structures (natural terrain and purpose built)
- Atmospheric losses and meteorological conditions.

The CONCAWE noise propagation algorithm was implemented for modelling potential noise impacts due to the following:

- As the potentially nearest residential receivers are located typically at distances greater than 100 metres from the Proposal, this algorithm allows for prevailing noise enhancing meteorological conditions, as presented in Fact Sheet D of the NPfI and reproduced in Section 2.4, to be directly considered and included in the assessment.
- The adoption of the CONCAWE algorithm for assessing receivers at the distances relevant to this assessment provides for a conservative assessment.

5.4.2 Meteorological conditions

As discussed in Section 2.4, the default parameters for standard and noise enhancing meteorological conditions, such as wind and temperature inversions in accordance with the NPfI Fact Sheet D, have been considered in the noise modelling using the CONCAWE noise modelling algorithm.

5.5 Noise predictions

5.5.1 Predicted operational noise levels

To assess operational noise emissions from the Proposal, operational assessment scenarios have been developed to capture the reasonable worst-case 15-minute noise emissions from the operations during the day, evening, night and morning shoulder periods, as detailed in Section 0.

As operations take place during the night period, there is also the potential for sleep disturbance noise impacts to occur from high noise event activities within the warehouse areas (i.e. airbrake releases), and so these have also been assessed.

The reasonable worst-case operating scenarios are considered conservative and are based on the assumption that all the noisiest activities would take place simultaneously during the day, evening, night and morning shoulder periods. However, where all the activities do not occur simultaneously during the same 15-minute period, then noise levels are likely to be lower than those predicted.

Predicted noise levels have been assessed to all the nearby representative receivers, and a summary of these results are presented in Table 5-11 and Table 5-12 for standard and noise enhancing meteorological conditions, respectively. Noise contour maps at 1.5m above the local ground level for each of the scenarios assessed are presented in APPENDIX C.

Table 5-11 – Predicted $L_{Aeq(15min)}$ operational noise levels – standard meteorological conditions

Assessment period			**Daytime**			**Evening**			**Night**			**Morning shoulder**		
Representative period			***9:00am-10:00am***			***6:00pm-7:00pm***			***4:00am-5:00am***			***6:00am-7:00am***		
Rec. ID	**Receiver type**	**NCA**	**PNTL**	**Predicted noise level, dB(A)**	**Exceedance**	**PNTL**	**Predicted noise level, dB(A)**	**Exceedance**	**PNTL**	**Predicted noise level, dB(A)**	**Exceedance**	**PNTL**	**Predicted noise level, dB(A)**	**Exceedance**
R01	Residential	NCA01	*45*	32	–	*42*	31	–	*35*	31	–	*45*	31	–
R02	Residential	NCA01	*45*	22	–	*42*	21	–	*35*	21	–	*45*	22	–
R03	Industrial	NCA02	*68*	31	–	*68*	30	–	*–*[1]	–	–	*–*[1]	–	–
R06	Residential	NCA02	*40*	25	–	*39*	24	–	*36*	23	–	*39*	25	–
R07	Residential	NCA02	*40*	24	–	*39*	23	–	*36*	22	–	*39*	24	–
R08	Industrial	NCA02	*68*	24	–	*68*	22	–	*–*[1]	–	–	*–*[1]	–	–
R09	Residential	NCA02	*40*	22	–	*39*	21	–	*36*	20	–	*39*	22	–
R10	Commercial	NCA03	*63*	31	–	*63*	29	–	*–*[1]	–	–	*–*[1]	–	–
R11	Residential	NCA03	*45*	28	–	*42*	27	–	*35*	26	–	*45*	28	–
R12	Residential	NCA03	*45*	27	–	*42*	26	–	*35*	25	–	*45*	27	–
R13	Residential	NCA03	*45*	25	–	*42*	24	–	*35*	23	–	*45*	25	–
R14	Residential	NCA04	*45*	27	–	*42*	26	–	*35*	26	–	*45*	27	–
R15	Residential	NCA04	*45*	30	–	*42*	29	–	*35*	29	–	*45*	30	–
R16	Residential	NCA04	*45*	34	–	*42*	33	–	*35*	33	–	*45*	34	–
R17	Residential	NCA04	*45*	37	–	*42*	36	–	*35*	35	–	*45*	37	–
R18	Residential	NCA04	*45*	39	–	*42*	37	–	*35*	35	–	*45*	38	–
R19	Residential	NCA04	*45*	37	–	*42*	36	–	*35*	35	–	*45*	37	–
R20	Residential	NCA04	*45*	36	–	*42*	35	–	*35*	34	–	*45*	36	–
R21	Industrial	NCA04	*68*	28	–	*68*	27	–	*–*[1]	–	–	*–*[1]	–	–
R22	Residential	NCA04	*45*	25	–	*42*	24	–	*35*	23	–	*45*	25	–
R23	Residential	NCA05	*40*	23	–	*39*	22	–	*36*	21	–	*39*	23	–
R24	Residential	NCA05	*40*	20	–	*39*	18	–	*36*	17	–	*39*	19	–
R25	Residential	NCA05	*40*	30	–	*39*	29	–	*36*	27	–	*39*	29	–
R26	Residential	NCA05	*40*	26	–	*39*	25	–	*36*	23	–	*39*	26	–
R27	Residential	NCA05	*40*	27	–	*39*	27	–	*36*	26	–	*39*	27	–
R28	Residential	NCA05	*40*	25	–	*39*	24	–	*36*	23	–	*39*	24	–

Assessment period			Daytime			Evening			Night			Morning shoulder		
Representative period			*9:00am-10:00am*			*6:00pm-7:00pm*			*4:00am-5:00am*			*6:00am-7:00am*		
Rec. ID	Receiver type	NCA	PNTL	Predicted noise level, dB(A)	Exceedance	PNTL	Predicted noise level, dB(A)	Exceedance	PNTL	Predicted noise level, dB(A)	Exceedance	PNTL	Predicted noise level, dB(A)	Exceedance
R29	Recreational	NCA05	*48*	27	–	*48*	27	–	–[1]	–	–	–[1]	–	–

Notes:
1. Project specific noise limits only applicable when in use
2. Receiver locations shown in APPENDIX B
3. Standard meteorological conditions – Stability Category D and 0.5m/s wind speeds
4. PNTL = Project Noise Trigger Levels

Table 5-12 – Predicted $L_{Aeq(15min)}$ operational noise levels – noise enhancing meteorological conditions

Assessment period			Daytime[1]			Evening[1]			Night[2]			Morning shoulder[2]		
Representative period			*9:00am-10:00am*			*6:00pm-7:00pm*			*4:00am-5:00am*			*6:00am-7:00am*		
Rec. ID	Receiver type	NCA	PTNL	Predicted noise level, dB(A)	Exceedance	PTNL	Predicted noise level, dB(A)	Exceedance	PTNL	Predicted noise level, dB(A)	Exceedance	PTNL	Predicted noise level, dB(A)	Exceedance
R01	Residential	NCA01	*45*	33	–	*42*	32	–	*35*	32	–	*45*	32	–
R02	Residential	NCA01	*45*	23	–	*42*	22	–	*35*	22	–	*45*	23	–
R03	Industrial	NCA02	*68*	32	–	*68*	31	–	–[3]	–	–	–[3]	–	–
R06	Residential	NCA02	*40*	26	–	*39*	24	–	*36*	23	–	*39*	26	–
R07	Residential	NCA02	*40*	25	–	*39*	24	–	*36*	23	–	*39*	25	–
R08	Industrial	NCA02	*68*	25	–	*68*	23	–	–[3]	–	–	–[3]	–	–
R09	Residential	NCA02	*40*	23	–	*39*	21	–	*36*	20	–	*39*	22	–
R10	Commercial	NCA03	*63*	32	–	*63*	30	–	–[3]	–	–	–[3]	–	–
R11	Residential	NCA03	*45*	29	–	*42*	28	–	*35*	27	–	*45*	29	–
R12	Residential	NCA03	*45*	28	–	*42*	26	–	*35*	26	–	*45*	27	–
R13	Residential	NCA03	*45*	26	–	*42*	24	–	*35*	24	–	*45*	26	–
R14	Residential	NCA04	*45*	28	–	*42*	27	–	*35*	27	–	*45*	28	–
R15	Residential	NCA04	*45*	31	–	*42*	30	–	*35*	29	–	*45*	31	–
R16	Residential	NCA04	*45*	35	–	*42*	34	–	*35*	34	–	*45*	35	–
R17	Residential	NCA04	*45*	38	–	*42*	37	–	*35*	36	**1**	*45*	38	–
R18	Residential	NCA04	*45*	40	–	*42*	38	–	*35*	36	**1**	*45*	39	–
R19	Residential	NCA04	*45*	38	–	*42*	37	–	*35*	36	**1**	*45*	38	–
R20	Residential	NCA04	*45*	37	–	*42*	36	–	*35*	35	–	*45*	37	–
R21	Industrial	NCA04	*68*	29	–	*68*	28	–	–[3]	–	–	–[3]	–	–
R22	Residential	NCA04	*45*	26	–	*42*	25	–	*35*	24	–	*45*	26	–
R23	Residential	NCA05	*40*	24	–	*39*	23	–	*36*	22	–	*39*	24	–
R24	Residential	NCA05	*40*	20	–	*39*	19	–	*36*	18	–	*39*	20	–
R25	Residential	NCA05	*40*	31	–	*39*	30	–	*36*	28	–	*39*	30	–

Assessment period			Daytime[1]			Evening[1]			Night[2]			Morning shoulder[2]		
Representative period			*9:00am-10:00am*			*6:00pm-7:00pm*			*4:00am-5:00am*			*6:00am-7:00am*		
Rec. ID	Receiver type	NCA	PTNL	Predicted noise level, dB(A)	Exceedance	PTNL	Predicted noise level, dB(A)	Exceedance	PTNL	Predicted noise level, dB(A)	Exceedance	PTNL	Predicted noise level, dB(A)	Exceedance
R26	Residential	NCA05	*40*	27	–	*39*	26	–	*36*	24	–	*39*	26	–
R27	Residential	NCA05	*40*	28	–	*39*	28	–	*36*	27	–	*39*	28	–
R28	Residential	NCA05	*40*	25	–	*39*	25	–	*36*	24	–	*39*	25	–
R29	Recreational	NCA05	*48*	28	–	*48*	27	–	–[3]	–	–	–[3]	–	–

Notes:
1. Default noise enhancing meteorological conditions – Stability Category D and 3m/s wind speeds (adverse winds)
2. Default noise enhancing meteorological conditions – Stability Category F and 2m/s wind speeds (temperature inversion)
3. Project specific noise limits only applicable when in use
4. Receiver locations shown in APPENDIX B
5. PNTL = Project Noise Trigger Levels
6. **Bold** font represents exceedance of the PNTL

From the above tables, the predicted operational noise levels comply with the established project noise trigger levels for all the nominated receiver locations during standard meteorological conditions. Under noise enhancing meteorological conditions, compliance is predicted at all nominated receiver locations, except for a 1 dB(A) exceedance at Receiver R17, R18 and R19 during the night time period.

Reference is made to Tables 4.1 and 4.2 of the NPfI, which states that a residual impact of up to 2 dB(A) is considered negligible and this exceedance would not be discernible by the average person. Therefore, as this residual impacts at Receiver R17, R18 and R19 are only predicted under noise enhancing meteorological conditions during the night period, and as a result of cumulative warehouse operational noise emissions, the predicted levels are considered acceptable and manageable within the applicable criteria and no further acoustic mitigation and management measures are required.

5.5.2 Annoying noise characteristic adjustments

Where the character of the industrial noise is assessed as particularly annoying at a receiver location (i.e. if the resulting noise level at a receiver location is tonal, has a low frequency component or is intermittent at night), then an adjustment would be added to penalise the predicted noise for its potential increase in annoyance. Fact Sheet C of the NPfI provides definitive procedures for determining whether a modifying factor should be applied, which will be assessed as part of the Proposal. The corrections are to be added to the predicted noise levels at the receiver/s before comparison with the project noise trigger levels.

Measurements of the noise source levels from the key noise generating plant / equipment were undertaken at three similar facilities with a sufficient duration to capture the total activity noise level, and all relevant statistical measurement parameters (L_{Amax}, $L_{A1,T}$, $L_{A10,T}$, $L_{A90,T}$, L_{Amin}) were recorded in accordance with AS1055:2018. The measured noise data were used in determining whether annoying noise characteristic adjustments were required as part of the noise assessment.

Tonal noise

One noise source was identified as being tonal at the source and therefore, having the potential to be tonal at the nearby receivers. This being the tonal reversing alarms used on heavy vehicles.

The NPfI details that a correction for tonal noise is to be applied when:

> *"the level of one-third octave band exceeds the level of the adjacent band on both sides by:*
>
> - *5 dB or more if the centre frequency of the band containing the tone is in the range 500 – 10000 Hz*
> - *8 dB or more if the centre frequency of the band containing the tone is in the range 160 – 400 Hz*
> - *15 dB or more if the centre frequency of the band containing the tone is in the range 25 – 125 Hz.*"

A one-third octave band frequency analysis of the predicted noise levels at the nominated receiver locations was undertaken as per the NPfI. The results of the analysis confirmed that a correction for tonal noise was not applicable as the predicted noise levels at all receiver locations achieve the requirements detailed in Fact Sheet C of the NPfI. The main reason that the requirements are achieved are due to the relatively large distances between the noise source and receiver locations.

Intermittent noise

The NPfI provides the following test for intermittent noise that applies during the night time period:

- "*The source noise heard at the receiver varies by more than 5 dB(A) and the intermittent nature of the noise is clearly audible.*" and
- *"…where the level suddenly drops/increases several times during the assessment period…*".

During the environmental assessment phase it is not possible to listen and subjectively assess the noise at the receiver as required by the policy. Nevertheless, for assessment purposes, only where all of the following tests are met shall a penalty be applicable to the predicted noise level at the relevant receiver location:

- the noise level fluctuates / cycles by more than 5 dB(A)
- this difference relates to a 'sudden' drop / increase in the activity noise level
- this activity may occur multiple times during a 15-minute assessment period
- the predicted noise level from the subject source at a receiver is clearly audible over the ambient noise environment.

The only noise source which potentially exhibits intermittent characteristics, such as cycling on and off, would be the reversing alarms fitted to the heavy vehicles that would operate throughout the facility.

However, reference is made to a recent publication issued by the NSW Environmental Protection Authority (EPA) in the Acoustic Australia journal (Vol. 50, No. 3, September 2022), titled "*How to Apply the Noise Policy for Industry Intermittent Modifying Factor Correction*". The paper states the following relating to reversing alarms:

> "*Industrial or commercial sites that have vehicle or plant movements at night, including audible reversing alarms, would not normally attract the intermittent noise modifying factor correction. However, these movements and other activities that may generate short term excursions above the general industrial noise should be assessed against the maximum noise level event assessment approach and be included in any calculation or measurement of LAeq noise levels.*"

Based on the EPA's clarification stated above, noise from reversing alarms is not required to be assessed for intermittent noise. Instead, noise from reversing alarms is considered in the assessment of general operational noise from the site and sleep disturbance. It is confirmed that noise from reversing alarms have been considered in the assessment of operational noise presented in Section 5.5.1 and sleep disturbance in Section 5.5.3.

Therefore, no intermittent noise modifying factor correction is required.

Impulsiveness noise

Following the review / consultation process of the *Draft Industrial Noise Guidelines Technical Background Paper* (EPA, 2015), where the views of acoustical practitioners was sought, the NSW *EPA draft Industrial Noise Guideline* (draft ING) did not include the assessment of impulsiveness. Subsequently, impulsiveness was not included in the NPfI when released by the EPA in 2017.

Alternatively, Australian Standard AS1055-2018 describes how potentially annoying characteristics, such as impulsiveness, may be considered and determined. Section 6.7.4 of AS1055-2018 states the following regarding impulse adjustment:

> *"If impulsiveness is a significant characteristic of the sound within a measurement time interval, an adjustment shall be made over this time interval."*

Also, Appendix E of AS1055-2018 provides an objective method for the application of an impulse adjustment to the measured noise levels at receivers, where deemed necessary. Impulsive noise is defined in this standard as a sound with a sudden onset. The definition includes only the onset of a sound, not the sound as a whole. Onset is defined in the standard as a sound having a positive slope time history where the gradient exceeds 10 dB/s.

Section E9 *'Care in the use of methods'* of AS1055-2018 also states that:

> *"It is recommended that the impulse method only be applied where the occurrence of impulsive sounds caused by a subject source are identified audibly to occur at the receiver locations by attended monitoring."*

Although the standard states that the presence of impulsive noise is identified through noise measurements at the impacted receiver locations, a review of the measured noise source data has been undertaken to provide an early understanding of any potential impulsive noise characteristics at the nominated receiver locations. Two noise sources have been identified as potentially exhibiting impulsive characteristics at the source. These include:

- Truck park brake full system air release events
- Shipping container loading

These operations would typically occur in the hardstand areas and the entrances and exits to the warehouse lots. A screening test was carried out as per Appendix E of AS1055-2018 using predicted noise levels to determine the contribution of these sources at the nearby residential receivers. As the location of these activities are typically located at relatively large distances from the nearby receiver locations and/or potentially shielded by the warehouse buildings, the contributions from individual instantaneous noise source levels are substantially attenuated.

The screening test reviewed the instantaneous contributions at nearby receiver locations from these sources. Results of the test indicated that even though noise sources may exhibit a 10dB(A) increase per second at the source, when considering the noise environment at the receivers the prominence of these events is unlikely to require further adjustment for impulsiveness as per Appendix E of AS1055-2018.

5.5.3 Sleep disturbance assessment

This section assesses the potential for sleep disturbance impacts at residential receivers, specifically looking at the maximum noise levels (L_{AFmax}) associated with on-site truck movements including release of truck airbrakes and shipping container loading events.

For the assessment of sleep disturbance against $L_{Aeq15\ minute}$ noise levels, reference is made to the predicted $L_{Aeq15\ minute}$ noise levels presented in Section 5.5.1 and compared against the NPfI $L_{Aeq15\ minute}$ sleep disturbance assessment levels.

In regards to the WHO 2018 sleep disturbance project assessment noise level of 48 dB(A) $L_{Aeq15\ minute}$ [equivalent to 45 dB(A) $L_{night\ (outside)}$, see Section 3.3.4], the highest predicted night period noise level is 36 dB(A) $L_{Aeq15\ minute}$ and morning shoulder period noise level is 39 dB(A) $L_{Aeq15\ minute}$ under noise enhancing meteorological conditions, and as such comply with the WHO 2018 recommended noise level.

Predicted L_{Amax} noise levels at nearby representative receiver locations during the operation of the Proposal in the night period are presented in Table 5-13. Noise contour maps at 1.5m above the local ground level for the reasonable worst-case scenario for standard and noise enhancing meteorological conditions, are presented in APPENDIX C.

Table 5-13 – L_{Amax} Sleep disturbance assessment, dB(A)

Representative receiver	L_{AFmax} Screening level		Awakening reaction	Standard meteorological conditions				Noise enhancing meteorological conditions			
				Predicted L_{AFmax} noise level	Exceedance			Predicted L_{AFmax} noise level	Exceedance		
	Night (10pm - 5am)	Morning shoulder (5am - 7am)			Screening level (Night)	Screening level (Morning shoulder)	Awakening reaction		Screening level (Night)	Screening level (Morning shoulder)	Awakening reaction
R01	*52*	*55*	*65*	45	–	–	–	47	–	–	–
R02	*52*	*55*	*65*	32	–	–	–	34	–	–	–
R06	*52*	*52*	*65*	44	–	–	–	46	–	–	–
R07	*52*	*52*	*65*	44	–	–	–	45	–	–	–
R09	*52*	*52*	*65*	34	–	–	–	35	–	–	–
R11	*52*	*55*	*65*	45	–	–	–	46	–	–	–
R12	*52*	*55*	*65*	43	–	–	–	44	–	–	–
R13	*52*	*55*	*65*	40	–	–	–	41	–	–	–
R14	*52*	*55*	*65*	45	–	–	–	47	–	–	–
R15	*52*	*55*	*65*	44	–	–	–	46	–	–	–
R16	*52*	*55*	*65*	59	7	4	–	61	9	6	–
R17	*52*	*55*	*65*	59	7	4	–	61	9	6	–
R18	*52*	*55*	*65*	57	5	2	–	59	7	4	–
R19	*52*	*55*	*65*	54	2	–	–	56	4	1	–
R20	*52*	*55*	*65*	59	7	4	–	61	9	6	–
R22	*52*	*55*	*65*	40	–	–	–	42	–	–	–
R23	*52*	*52*	*65*	35	–	–	–	36	–	–	–
R24	*52*	*52*	*65*	30	–	–	–	32	–	–	–
R25	*52*	*52*	*65*	43	–	–	–	45	–	–	–
R26	*52*	*52*	*65*	39	–	–	–	41	–	–	–
R27	*52*	*52*	*65*	47	–	–	–	48	–	–	–
R28	*52*	*52*	*65*	43	–	–	–	45	–	–	–

Notes: 1. Sleep disturbance assessment based on L_{Amax} noise source of a truck releasing airbrake
2. **Bold** font indicates exceedance

The maximum noise levels associated activities at the warehouse lots may potentially cause sleep disturbance at nearby residential receivers (i.e. Receivers R16 to R20) to the south of the Proposal site should airbrakes be used, which is the loudest potential L_{Amax} noise event that could occur within the Proposal. These events have the potential for instantaneous L_{Amax} noise levels to be above the sleep disturbance screening levels particularly if trucks were to stop and release their airbrakes near the entrances / exits to the warehouses. However, trucks may be more likely to stop at the docks within the hardstand areas where there may be some additional shielding provided by the warehouse buildings, which may result in noise levels lower than those presented in the above tables.

Attended noise measurements undertaken at noise monitoring Location M2 as part of the M12 Motorway EIS indicated L_{Amax} noise events from road traffic on Elizabeth Drive to range between 55 to 59 dB(A). Given that the monitoring location was approximately 145m from Elizabeth Drive while the impacted receiver locations are much closer to Elizabeth Drive, it would be expected that the L_{Amax} noise levels from road traffic on Elizabeth Drive at the impacted receiver locations would be louder than the L_{Amax} noise levels measured during the attended noise measurements. As such, the L_{Amax} noise levels associated with airbrake events at the Proposal site are expected to be similar to or less than the L_{Amax} noise levels from road traffic on Elizabeth Drive.

Truck noise source levels as presented in Table 5-6 shows that airbrake events could have a maximum sound power level of L_{Amax} 120 dB(A). However, several measurements of airbrake events were undertaken with a variety of different truck types which indicated that airbrake events could have maximum sound power levels as low as L_{Amax} 113dB(A). Additionally, rigid heavy vehicles make up the majority of heavy vehicle movements generated by the Proposal during the night time period, which in general have lower L_{Amax} noise levels than articulated heavy vehicles. Given the variability in maximum noise levels of these events, it is likely that there would be a reduced number of L_{Amax} noise events.

Section 5.2.1 presents existing traffic volumes on Elizabeth Drive which indicates there are 488 heavy vehicle movements during the night time period. The Proposal would generate up to 189 heavy vehicle movements over the night time period as presented in Section 5.2.2. Thus, considering the existing high volume of heavy vehicles on Elizabeth Drive and the varying potential L_{Amax} noise events due to the Proposal, it is concluded that the number of L_{Amax} events from airbrakes and other onsite activities would not add significantly to the number of existing L_{Amax} events from road traffic on Elizabeth Drive at the impacted receiver locations.

Furthermore, although maximum noise levels may be above the screening levels, they are below the sleep disturbance 'awakening reaction' level of 55 dB(A) L_{Amax} (internal) or 65 dB(A) L_{Amax} (external) assuming windows open. Therefore, the sleep disturbance impacts are considered minimal.

Nonetheless, these activities will be managed by minimising the requirement for trucks to stop and release airbrakes, in order to prevent noise levels exceeding the sleep disturbance assessment trigger level from occurring.

5.6 Acoustic mitigation and management review

One receiver (Receiver R18) located across the Proposal site along Elizabeth Drive has been predicted to exceed the applicable noise criteria by 1 dB(A) during noise enhancing meteorological conditions. As discussed, a 1 dB(A) exceedance only under noise-enhancing meteorological conditions is considered to be negligible in accordance with the NPfI.

Therefore, it is not reasonable to provide further noise mitigation measures to reduce the negligible impacts.

5.6.1 Consideration of changing acoustic environment and zoning

The noise assessment has been based on background and ambient noise levels measured in 2017. Since then, background noise levels may have increased due to increasing activity in the surrounding area largely due to works associated with the construction of the Western Sydney Airport.

The background and ambient noise levels are likely to continue increasing as the Proposal site and surrounding areas are developed as part of the Western Sydney Aerotropolis. The Western Sydney Aerotropolis encompasses plans to develop an extensive area around Western Sydney Airport into Sydney's third major business area. The development of Western Sydney Aerotropolis would result in significant changes to the acoustic environment with likely increased background and ambient noise levels.

Furthermore, Western Sydney Airport is expected to be operating in a 24 hour, 7 days a week capacity when it opens in 2026. The Proposal site is located directly to the north-east of Western Sydney Airport. Thus, it would be expected that the sensitive receivers impacted by the Proposal would also be impacted by aircraft flyovers given the proximity of the airport to the identified sensitive receivers.

In addition to the changing acoustic environment, the land zoning has significantly changed as part of the Western Sydney Aerotropolis Planning Policy (2020). As a result of the recent rezoning, the identified sensitive residential receivers are now located in 'Enterprise' and 'Environment and Recreation' zones which prohibits residential land uses in these areas. Thus, it is likely that the existing primarily residential and agricultural land uses will change to commercial or industrial land uses.

When evaluating the reasonableness and feasibleness of noise mitigation measures, consideration should be given to the changing land use and associated acoustic environment of the impacted sensitive receivers.

5.6.2 Mechanical plant and equipment

Building services and mechanical plant and equipment associated with the development has the potential to impact on nearby noise sensitive properties if not designed or selected correctly. To carry out a quantitative assessment of mechanical equipment, a complete specification of equipment is required. At this stage of the project appropriate detail for mechanical plant is not typically available, and so indicative plant and equipment has been assumed as part of the assessment as detailed in

Section 5.3.1. The following in-principle noise management measures should be considered during detailed design:

- Acoustic assessment of mechanical services equipment should be undertaken during the detailed design phase of the development to ensure that the cumulative noise of all equipment does not exceed the applicable noise criteria. This includes the detailed specification and location of mechanical plant (e.g. air handling equipment, emergency plant and equipment, etc) on site.
- Noise control treatment can affect the operation of the mechanical services system. An acoustic engineer should be consulted during the initial design phase of mechanical services system to reduce potential redesign of the mechanical system.
- Mechanical plant noise emission can be controlled by appropriate mechanical system design and implementation of common engineering methods, which may include:
  - procurement of 'quiet' plant
  - strategic positioning of plant away from sensitive neighbouring premises to maximise intervening acoustic shielding between the plant and sensitive neighbouring premises
  - commercially available acoustic attenuators for air discharge and air intakes of plant
  - acoustically lined and lagged ductwork
  - acoustic barriers between plant and sensitive neighbouring premises
  - partial or complete acoustic enclosures over plant
- The specification and location of mechanical plant should be confirmed prior to installation on site.
- Fans shall be mounted on vibration isolators and balanced in accordance with Australian Standard 2625 '*Rotating and Reciprocating Machinery – Mechanical Vibration*'.

5.6.3 Operational noise management measures

Although noise mitigation measures are not required given the predicted negligible impacts, operational noise management measures could be considered to further reduce noise at the source. The NPfI presents the implementation of 'best management practice' (BMP) which is the adoption of operational procedures that minimise noise while retaining productive efficiency. Application of BMP can include the following types of practice:

- Reducing peak 15-minute heavy vehicles movements across the site by staggering delivery / pickup times
- Minimising concurrent use of mobile plant outside warehouses and/or limiting their use to the less sensitive daytime and evening periods
- Minimising use of reversing alarms by providing forward manoeuvring where practicable

- Switching vehicles and plant off when not in use
- Keeping equipment well-maintained and operating it in a proper and efficient manner
- Training staff and drivers on the effects of noise and the use of quiet work practices (eg. informing drivers of the noise impacts from sudden braking or accelerating, bangs and clangs, etc).

In conjunction with BMP, the NPfI refers to ‘best available technology economically achievable’ (BATEA) with which equipment and plant incorporate the most advanced and affordable technology to minimise noise output. Examples of uses of BATEA include:

- Use of broadband reversing alarms “quackers” on permanent on site mobile plant (eg. reach stacker and forklift)
- The use of quieter mobile plant, such as electric forklifts instead of gas-powered forklifts.
- Using equipment with efficient muffler design
- Fitting and maintaining noise reduction packages on plant and equipment
- Ensure hardstand surfaces, roadways and vehicular access points are smooth as to not result in jolting of the truck
- Damping or lining metal trays or bins.

It is recommended that noise compliance measurements are conducted once operations commence, to determine that noise emissions are consistent with those documented in this assessment, and to determine that the management measures are effective. The method for measuring the performance and/or noise compliance of the Proposal should be undertaken in accordance with Section 7 ‘Monitoring performance’ of the NPfI.

As part of the site’s Operational Noise Management Plan, there should also be regular reviews of on-site noise mitigation and management practices to incorporate and capture opportunities for reductions of site noise emissions, with considerations of the following:

- Review of noise reduction opportunities during changes or refinements of site noise generating activities
- Reviewing noise levels of plant, equipment and activities, during both ongoing compliance checks and in response to complaints
- Improvements in Best Management Practice (BMP)
- Improvements in Best Available Technology Economically Achievable (BATEA).

The above recommendations provide in-principle solutions to address project acoustic requirements. This information is presented for the purpose of the consent authority approvals process and for preliminary cost planning. It shall not be used for detailed design and construction purposes without approval in writing by the acoustic consultant. Assistance of the acoustic consultant must be sought during the detailed design phase of the project to confirm all details, material quantities and performance specifications.

5.7 Cumulative noise

The potential for cumulative noise impacts as a result of the Proposal and other nearby industrial developments (both the future warehouses as part of future project stages in addition to industrial activities external to the project) was considered as part of deriving the amenity noise levels presented in Section 3.3.2. The criteria were established with the aim of ensuring that the total industrial noise level (existing plus new) remain within the recommended amenity noise levels for each area, and so addressing the potential for cumulative noise impacts on receivers nearby to the Proposal.

6 Conclusion

Renzo Tonin & Associates was engaged by Mirvac Projects Pty Ltd to prepare a noise and vibration impact assessment for the proposed Elizabeth Enterprise Precinct – Stage 1 Concept Masterplan development located at 1669-1723 Elizabeth Drive, Badgerys Creek as part of the submission for the State Significant Development (SSD-19618251).

This report assesses noise and vibration impacts during the construction and operational stages for the Proposal. Mitigation and management measures to reduce noise and/or vibration impacts during the construction and operation phases of the Proposal have been recommended. This report has been prepared to address the Planning Secretary's environmental assessment requirements (SEARs) specific to noise and vibration.

6.1 Construction noise and vibration assessment

An assessment of potential construction noise and vibration impacts from the site establishment, demolition, excavation and construction stages of the Proposal has been undertaken.

The expected construction noise levels have been predicted and presented in Section 4.5.1. Construction noise mitigation and management measures have been presented in Section 4.5.2 to aid in providing additional noise reduction benefits where exceedance of the construction noise management levels occur.

During the site establishment, demolition, excavation and road works phases vibration intensive plant and equipment are proposed to be used as part of the construction works. As a result, management measures have been presented in Section 4.6.3 to aid in minimising any potential vibration impacts.

The noise impact of construction traffic on the existing road network has been reviewed and is considered not to be significant.

6.2 Operational noise assessment

Operational noise impacts from the proposed warehouse facilities for Warehouses 1, 2, 4, 5, 6, 7 and 8 have been assessed and predicted operational noise levels generally comply with the established project noise trigger levels at all receiver locations. Three receivers (Receiver R17, R18 and R19) were predicted to exceed the nominated noise criteria by 1 dB(A) under noise enhancing meteorological conditions during the night period. However, in accordance with the NPfI, a 1 dB(A) exceedance is considered to be negligible. Therefore, it would not be reasonable to provide noise mitigation measures.

Due to construction activities in the surrounding area as part of the Western Sydney Airport and M12 Motorway, the assessment has reviewed noise monitoring results from the M12 Motorway EIS to establish the applicable ambient noise environment and the noise emission objectives were determined in accordance with the NSW Noise Policy for Industry (NPfI) (EPA 2016).

A review of the potential noise generating activities that will likely take place as part of operations of the Proposal was undertaken, and noise measurements for a range of these activities at another similar industrial estate were conducted to provide additional confidence for the assessment inputs.

The assessment has predicted potential noise impacts at the nearest receiver locations under both standard meteorological conditions and noise-enhancing meteorological conditions during the operation of the Proposal. There is also the potential for exceedance of the sleep disturbance screening levels for the nearest residential receivers along Elizabeth Drive. However, the occurrence of these events would not be significant considering the existing high volumes and similar noise levels from heavy vehicles on Elizabeth Drive.

It is recommended to consider the changing acoustic environment and rezoning associated with the development of the Western Sydney Aerotropolis when assessing the reasonableness and feasibleness of any noise mitigation measures. The existing residential receivers surrounding the Proposal are located in areas that have been rezoned for enterprise use, which would likely result in the redevelopment of these residential areas into commercial and/or industrial facilities. Therefore, any noise mitigation and management measures, including at-property treatments, should be considered on a case-by-case basis during the detailed design stage of the Proposal.

Potential increases in road traffic noise as a result of heavy vehicles generated by the Proposal on public roads have been reviewed. The road traffic noise level contributions from the vehicle movements associated with the Proposal are not expected to increase the existing traffic noise levels at the residential receivers along Elizabeth Drive by more than 2 dB(A). As such, the traffic noise levels as a result of the operational traffic from the Proposal would meet the relevant RNP requirements.

Furthermore, the ownership of the future internal roads within the Proposal site are to be vested with Council once the development is completed. This will result in the internal roads being listed as public roads once operational and therefore, are assessed under the requirements of the RNP. However, given that there are no residential or noise sensitive receivers located along these future internal roads, in accordance with the RNP, traffic noise impacts are not assessed.

References

1. Downey G. and Marsh C. *How to Apply the Noise Policy for Industry Intermittent Modifying Factor Correction*, Acoustics Australia, vol. 50, no. 3, September 2022

2. Downey G. and Marsh C. *Determining the Noise Policy for Industry noise amenity category for residential receivers*, Acoustics Australia, vol. 50, no. 3, September 2022

3. Manning C.J. (1981), *The Propagation of Noise from Petroleum and Petrochemical Complexes to Neighbouring Communities*, CONCAWE report 4/81

4. NSW Department of Climate Change and Water (2011), *Road Noise Policy* (RNP)

5. NSW Department of Environment and Climate Change (2009), *Interim Construction Noise Guideline* (ICNG)

6. NSW Department of Planning, Industry and Environment (2020), *Western Sydney Aerotropolis Plan*

7. NSW Environment Protection Authority (2017), *Noise Policy for Industry* (NPfI)

8. NSW Environment Protection Authority (2015*), Draft Industrial Noise Guideline Technical Background Paper*

9. NSW Transport for NSW (formerly Roads and Maritime Services) (October 2019), *M12 Motorway Environmental Impact Assessment*

10. Standards Australia (2016), *Guide to Noise Control on Construction, Demolition and Maintenance Sites*, AS 2436:2010 (R2016)

11. Standards Australia (2018), *Acoustics—Description and measurement of environmental noise,* AS1055:2018

12. UK Department of Transport 1988, *Calculation of Road Traffic Noise* (CORTN)

13. United States Department of Transportation (Federal Highway Administration) (2004), *Traffic Noise Model Version 2.5*

14. World Health Organisation (2009), *Night Noise Guidelines for Europe*

15. World Health Organisation (2018), *Environmental Noise Guidelines for the European Region: A systematic Review on Environmental Noise and Effects on Sleep*

APPENDIX A Technical terms and concepts

A.1 Glossary of terminology – Noise

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Absorption Coefficient α	The absorption coefficient of a material, usually measured for each octave or third-octave band and ranging between zero and one. For example, a value of 0.85 for an octave band means that 85% of the sound energy within that octave band is absorbed on coming into contact with the material. Conversely, a low value below about 0.1 means the material is acoustically reflective.
Adverse weather	Weather effects that enhance noise (particularly wind and temperature inversions) occurring at a site for a significant period of time. In the NSW INP this occurs when wind occurs for more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of nights in winter.
Air-borne noise	Noise which is fundamentally transmitted by way of the air and can be attenuated by the use of barriers and walls placed physically between the noise source and receiver.
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Amenity	A desirable or useful feature or facility of a building or place.
AS	Australian Standard
Assessment period	The time period in which an assessment is made. e.g. Day 7am-10pm & Night 10pm-7am.
Assessment Point	A location at which a noise or vibration measurement is taken or estimated.
Attenuation	The reduction in the level of sound or vibration.
Audible Range	The limits of frequency which are audible or heard as sound. The normal hearing in young adults detects ranges from 20 Hz to 20 kHz, although some people can detect sound with frequencies outside these limits.
A-weighting	A filter applied to the sound recording made by a microphone to approximate the response of the human ear.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the LA90 noise level if measured as an overall level or an L90 noise level when measured in octave or third-octave bands.
Barrier (Noise)	A natural or constructed physical barrier which impedes the propagation of sound and includes fences, walls, earth mounds or berms and buildings.
Berm	Earth or overburden mound.
Buffer	An area of land between a source and a noise-sensitive receiver and may be an open space or a noise-tolerant land use.
Bund	A bund is an embankment or wall of brick, stone, concrete or other impervious material, which may form part or all of the perimeter of a compound.
BS	British Standard
CoRTN	United Kingdom Department of Environment entitled "Calculation of Road Traffic Noise (1988)"

Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of common sounds in our environment:		
	threshold of hearing	0 dB	The faintest sound we can hear, defined as 20 micro Pascal
		10 dB	Human breathing
	almost silent	20 dB	
		30 dB	Quiet bedroom or in a quiet national park location
	generally quiet	40 dB	Library
		50 dB	Typical office space or ambience in the city at night
	moderately loud	60 dB	CBD mall at lunch time
		70 dB	The sound of a car passing on the street
	loud	80 dB	Loud music played at home
		90 dB	The sound of a truck passing on the street
	very loud	100 dB	Indoor rock band concert
		110 dB	Operating a chainsaw or jackhammer
	extremely loud	120 dB	Jet plane take-off at 100m away
	threshold of pain	130 dB	
		140 dB	Military jet take-off at 25m away
dB(A)	A-weighted decibel. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter is denoted as dB(A). Practically all noise is measured using the A filter.		
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies. The dB(C) level is not widely used but has some applications.		
Deemed-to-Satisfy Provisions	The Deemed-to-Satisfy Provisions are an optional means of achieving compliance with the mandatory Performance Requirements of the National Construction Code. (also see Alternate Solution)		
Diffraction	The distortion of sound waves caused when passing tangentially around solid objects.		
DIN	German Standard		
ECRTN	Environmental Criteria for Road Traffic Noise, NSW, 1999		
ENMM	Environmental Noise Management Manual, Roads and Maritime Services (Transport for NSW)		
EPA	Environment Protection Authority		
Field Test	A test of the sound insulation performance in-situ. See also 'Laboratory Test' The sound insulation performance between building spaces can be measured by conducting a field test, for example, early during the construction stage or on completion. A field test is conducted in a non-ideal acoustic environment. It is generally not possible to measure the performance of an individual building element accurately as the results can be affected by numerous field conditions.		
Flanking	Flanking is the transfer of sound through paths around a building element rather than through the building element material directly. For example, sound travelling through a gap underneath a door or a gap at the top of a wall.		
Fluctuating Noise	Noise that varies continuously to an appreciable extent over the period of observation.		

Free-field	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Ground-borne noise	Vibration propagated through the ground and then radiated as noise by vibrating building elements such as wall and floor surfaces. This noise is more noticeable in rooms that are well insulated from other airborne noise. An example would be vibration transmitted from an underground rail line radiating as sound in a bedroom of a building located above.
Habitable Area	Includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom. Excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.
Heavy Vehicle	A truck, transporter or other vehicle with a gross weight above a specified level (for example: over 8 tonnes).
IGANRIP	Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects, NSW DEC 2007
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
INP	NSW Industrial Noise Policy, EPA 1999
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
Intrusive noise	Refers to noise that intrudes above the background level by more than 5 dB(A).
ISEPP	State Environmental Planning Policy (Infrastructure), NSW, 2007
ISEPP Guideline	Development Near Rail Corridors and Busy Roads - Interim Guideline, NSW Department of Planning, December 2008
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L10(1hr)	The L10 level measured over a 1 hour period.
L10(18hr)	The arithmetic average of the L10(1hr) levels for the 18 hour period between 6am and 12 midnight on a normal working day.
L90	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
LAeq or Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time, which would produce the same energy as a fluctuating sound level. When A-weighted, this is written as the LAeq.
LAeq(1hr)	The LAeq noise level for a one-hour period. In the context of the NSW EPA's Road Noise Policy it represents the highest tenth percentile hourly A-weighted Leq during the period 7am to 10pm, or 10pm to 7am (whichever is relevant).
LAeq(8hr)	The LAeq noise level for the period 10pm to 6am.
LAeq(9hr)	The LAeq noise level for the period 10pm to 7am.
LAeq(15hr)	The LAeq noise level for the period 7am to 10pm.
LAeq (24hr)	The LAeq noise level during a 24 hour period, usually from midnight to midnight.
Lmax	The maximum sound pressure level measured over a given period. When A-weighted, this is usually written as the LAmax.

Lmin	The minimum sound pressure level measured over a given period. When A-weighted, this is usually written as the LAmin.
Ln,w	Weighted Normalised Impact Sound Pressure Level A measure of the sound level transmitted from impacts on a floor to a tenancy below. It is measured in very controlled conditions in a laboratory and is characterised by how much sound reaches the receiving room from a standard tapping machine. A lower value indicates a better performing floor.
LnT,w	Weighted Standardised Field Impact Sound Pressure Level As for Ln,w but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement. The equivalent measurement in a laboratory is the Ln,w. A lower value indicates a better performing floor.
Laboratory Test	The performance of a building element when measured in a laboratory. The sound insulation performance of a building element installed in a building however can differ from its laboratory performance for many reasons including the quality of workmanship, the size and shape of the space in which the measurement is conducted, flanking paths and the specific characteristics of the material used which may vary from batch to batch.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on. That is, the sound of 85 dB is four times or 400% the loudness of a sound of 65 dB.
Microphone	An electro-acoustic transducer which receives an acoustic signal and delivers a corresponding electric signal.
NCA	Noise Catchment Area. An area of study within which the noise environment is substantially similar.
NCG	Noise Criteria Guideline, Roads and Maritime Services (Transport for NSW)
NMG	Noise Mitigation Guideline, Roads and Maritime Services (Transport for NSW)
Noise	Unwanted sound
Normalised	A method of adjusting the measured noise indices in a laboratory so that they are independent of the measuring space. The noise level in a room is affected by reverberation in the room. For example, the Ln,w impact sound pressure level measured in a laboratory is dependent upon the amount of absorptive material in the receiving room. The value is adjusted to what would be measured if the sound absorption in the receiving room is set at 10m2. This enables all laboratories to report the same value when measured under slightly different conditions. See also 'Standardised'.
Pre-construction	Work in respect of the proposed project that includes design, survey, acquisitions, fencing, investigative drilling or excavation, building/road dilapidation surveys, minor clearing (except where threatened species, populations or ecological communities would be affected), establishing ancillary facilities such as site compounds, or other relevant activities determined to have minimal environmental impact (e.g. minor access roads).
RBL	Rating Background Level is the representative LA90 background noise level for a period, as defined in the NSW EPA's noise policies.
Reflection	Sound wave reflected from a solid object obscuring its path.
RING	Rail Infrastructure Noise Guideline, NSW, May 2013
rms	Root Mean Square value representing the average value of a signal.
Rw	Weighted Sound Reduction Index A measure of the sound insulation performance of a building element. It is measured in very controlled conditions in a laboratory. The term supersedes the value STC which was used in older versions of the Building Code of Australia. Rw is measured and calculated using the procedure in ISO 717-1. The related field measurement is the DnT,w. The higher the value the better the acoustic performance of the building element.

R'w	Weighted Apparent Sound Reduction Index. As for Rw but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement. The higher the value the better the acoustic performance of the building element.
RNP	Road Noise Policy, NSW, March 2011
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sole-occupancy Unit	An area within a building for the exclusive use of the owner or occupier.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy by conversion to thermal energy.
Sound Insulation	Sound insulation refers to the ability of a construction or building element to limit noise transmission through the building element. The sound insulation of a material can be described by the Rw and the sound insulation between two rooms can be described by the DnT,w.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 pico watt.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone referenced to 20 mico Pascal.
Spoil	Soil or materials arising from excavation activities.
Standardised	A method of adjusting the measured noise indices in-situ so that they are independent of the measuring space. The noise level in a room is affected by reverberation in the room. For example, the L'n,w impact sound pressure level measured in a room is dependent upon the amount of absorptive material in the receiving room. The value is adjusted to what would be measured if the reverberation time in the receiving room is set at 0.5 seconds. This enables the same value to be reported independent of whether the room contains carpet and furnishings and the like. See also 'Normalised'.
STC	Sound Transmission Class A measure of the sound insulation performance of a building element. It is measured in controlled conditions in a laboratory. The term has been superseded by Rw.
Structure-borne Noise	Audible noise generated by vibration induced in the ground and/or a structure. Vibration can be generated by impact or by solid contact with a vibrating machine. Structure-borne noise cannot be attenuated by barriers or walls but requires the isolation of the vibration source itself. This can be achieved using a resilient element placed between the vibration source and its support such as rubber, neoprene or springs or by physical separation (using an air gap for example). Examples of structure-borne noise include the noise of trains in underground tunnels heard to a listener above the ground, the sound of footsteps on the floor above a listener and the sound of a lift car passing in a shaft. See also 'Impact Noise'.
Tonal Noise	Sound containing a prominent frequency and characterised by a definite pitch.
Transmission Loss	The sound level difference between one room or area and another, usually of sound transmitted through an intervening partition or wall. Also, the vibration level difference between one point and another. For example, if the sound level on one side of a wall is 100dB and 65dB on the other side, it is said that the transmission loss of the wall is 35dB. If the transmission loss is normalised or standardised, it then becomes the Rw or R'w or DnT,w.

A.2 Glossary of terminology – Vibration

The following is a brief description of the technical terms used to describe vibration to assist in understanding the technical issues presented.

Acceleration	The rate of change of velocity, often measured in m/s^2 or g's. 1 g = 9.81 m/s^2. Commonly used to assess human response to vibration and for machine condition monitoring.
Accelerometer	A vibration transducer sensor that is used to measure acceleration.
ANC	The Association of Noise Consultants, UK.
Ambient vibration	The all-encompassing vibration occurring at a given location, at a given time, composed of all vibration sources near and far.
Amplification	Vibration amplification refers to an increase in vibration. Amplification may occur due to resonance, when an object or structure is excited at its natural frequency.
Attenuation	Attenuation refers to a reduction in vibration. This may occur due to damping of a vibration system, the inclusion of attenuating devices or, in the case of ground vibration, during propagation through the ground. Ground attenuation is determined by the dynamic properties of the site's soil and rock.
AVTG	Assessing Vibration: A Technical Guideline. NSW Department of Environment and Conservation's (DEC) 2006 guideline for assessing human responses to vibration. Based on BS 6472–1992.
Axis	A fixed reference line for the measurement for the measurement of vibration in a particular direction. Vibration is commonly measured in transverse (T), longitudinal (L) and vertical (V) axes (or X, Y and Z).
Background vibration	The underlying level of vibration present in the ambient environment, measured in the absence of the vibration sources of interest.
Blasting	Excavation or demolition using explosives.
Borehole transducer	A geophone transducer rigidly mounted at the bottom of a borehole (either permanently or temporarily) to measure underground vibration.
Broadband vibration	The overall vibration level which encompasses a wide range of frequencies. As opposed to vibration levels for specific frequency bands (see Octave) or narrowband vibration levels as produced by FFT.
BS	British Standard.
Continuous vibration	Vibration that continues uninterrupted over a defined period.
Cosmetic damage	Damage to a structure due to vibration that only affects the appearance of the structure and can be easily repaired, e.g. hairline cracks in mortar joints of brick or concrete constructions, or cracks in plasterwork.
Coupling loss	The change in vibration level when vibration is transmitted from the ground to a building's foundations.
Crest factor	The ratio of the peak value of a vibration event to the RMS value of a vibration event.
Damping	Reduction of vibrational energy due to friction or other forces.
DEC	NSW Department of Environment and Conservation, now the Department of Planning, Industry and Environment.
Decibel [dB]	The logarithmic unit used to represent sound and vibration levels. A vibration level in dB equals 20 times the logarithm to the base 10 of the ratio of the vibration level relative to the reference level. For vibration velocity, the reference level is commonly 1 nm/s. For vibration acceleration, the reference level is commonly 1 μm/s^2. Other reference values are commonly used. The reference value should always be stated.
DIN	German Standard.
Displacement	Change in position of a body from a reference point. Usually measured in m or mm.

EPA	Environment Protection Authority.
eVDV	Estimated Vibration Dose Value. See also VDV.
Filter	An electrical circuit that allows signals of certain frequency ranges to pass through and blocks all other frequencies. Types of filters include low pass filters, high pass filters, and band pass filters.
FFT	Fast Fourier Transform. An algorithm that converts a signal from the time domain to the frequency domain.
Frequency	In the case of vibration, frequency is the number of oscillations that occurs per second. Frequency is measured in units of Hertz (Hz).
Geophone	A vibration transducer sensor that is used to measure velocity.
Ground-borne noise	Vibration propagated through the ground and then radiated as noise by vibrating building elements such as wall and floor surfaces. This noise is more noticeable in rooms that are well insulated from other airborne noise. An example would be vibration transmitted from an underground rail line radiating as sound in a bedroom of a building located above.
Ground spike	A metal stake with a flat top that is driven into the ground and used to mount a vibration transducer to measure vibration levels.
Habitable Area	Includes a bedroom, living room, lounge room, music room, television room, kitchen, dining room, sewing room, study, playroom, family room, home theatre and sunroom. Excludes a bathroom, laundry, water closet, pantry, walk-in wardrobe, corridor, hallway, lobby, photographic darkroom, clothes drying room, and other spaces of a specialised nature occupied neither frequently nor for extended periods.
Intermittent vibration	Either interrupted periods of continuous vibration or repeated periods of impulsive vibration.
Impulsive vibration	Vibration that rapidly builds up to a peak followed by a damped decay. May consist of multiple impulsive events, typically less than 2 seconds in duration.
Isolation	The process of reducing the vibrational energy transmitted to an object, such as a piece of equipment or building, from the source of vibrations.
Minor damage	Damage to a structure due to vibration that affects the serviceability of residential style buildings or other sensitive structures but does not affect the structural elements. E.g. cracks in plastered or rendered surfaces, existing cracks enlarged or partitions detached.
Mode	A mode of vibration is a characteristic pattern or shape in which a mechanical system will vibrate. The actual vibration of a structure is a combination of all the vibration modes, but to varying degrees, depending on the vibration source.
Natural frequency	The frequency at which a system tends to oscillate in the absence of any driving or damping force.
Noise floor	The residual level of unwanted signal measured by an instrumentation system. The signal of interest must be above the noise floor to be measured accurately. See also Signal to noise ratio.
Octave	An octave represents a doubling or halving in frequency. Noise or vibration levels across a frequency spectrum are commonly given in octave or one-third octave frequency bands.
Peak-to-peak	The difference between the highest positive peak level and the lowest negative peak of a vibration event.
Peak vibration velocity	The absolute maximum value of the vibration velocity signal measured in the X, Y or Z axis during a given time interval. Also referred to as the peak component particle velocity.
PPV	Peak Particle Velocity. The absolute maximum value of the vibration velocity signal measured in any axis during a given time interval.
PVS	Peak Vector Sum. The vector sum of the peak vibration velocities measured in the three orthogonal axes.
Resonance	The phenomenon of increased amplitude that occurs when the frequency of an applied force is equal or close to the natural frequency of the system.
RMS	Root Mean Square value representing the average value of a signal.
Sampling rate	The number of samples per second taken from a continuous signal to make a discrete or digital signal. Measured in Hertz. To accurately record the signal and determine the spectrum, the sampling rate must two or more times the maximum frequency of interest.

Settlement	The movement of soil due to vibration or other forces, often in relation to a building's foundations. The indirect effect of settlement and ground movement may cause building damage, separately from the direct of effect of building vibration.
Signal to noise ratio	A ratio of the level of a desired signal to the level of the background, often expressed in decibels.
Source vibration	A source that generates vibration. Can be quantified by the amplitude, frequency content and duration of the vibration. Common sources of vibration include rail and road traffic, construction and demolition activities and blasting.
Spectrum	The result of transforming a signal from the time domain to the frequency domain.
Structural damage	Damage to a structure due to vibration that may affect its serviceability due to damage to structural elements. May result in the reduced stability of the building and/or reduction in load-bearing capacities.
Structural fatigue	The weakening of a material caused by cyclic loading that results in progressive and localised structural damage and the growth of cracks.
Structure-borne Noise	Audible noise generated by vibration induced in the ground and/or a structure. Vibration can be generated by impact or by solid contact with a vibrating machine. Structure-borne noise cannot be attenuated by barriers or walls but requires the isolation of the vibration source itself. This can be achieved using a resilient element placed between the vibration source and its support such as rubber, neoprene or springs or by physical separation (using an air gap for example). Examples of structure-borne noise include the noise of trains in underground tunnels heard to a listener above the ground, the sound of footsteps on the floor above a listener and the sound of a lift car passing in a shaft.
Tactile vibration	Vibration of a level that can be felt by humans, dependant on the amplitude and frequency of the source. Note that vibration may also be perceived through indirect effects such as ground-borne noise or the shaking of building elements.
Transducer	A device that converts energy from one form to another. Vibration transducers convert either acceleration, velocity or displacement to an electrical signal that is processed by the monitoring system.
Triaxial	Three axes. Measurement systems often consist of three vibration transducers arranged triaxially – oriented at 90° from each other.
VDV	Vibration Dose Value. A measure of tactile vibration levels used to assess intermittent vibration.
Velocity	The rate of change of vibration displacement, usually measured in mm/s.
Vibration	A mechanical phenomenon whereby oscillations occur about an equilibrium point; a periodic back-and-forth motion of an elastic body or medium, commonly resulting when almost any physical system is displaced from its equilibrium condition.
Vrms	Root mean square (RMS) vibration level for the train passby, typically expressed in mm/s
Waveform	A graphical representation of a vibration event in the time domain, showing the measured vibration levels for each sample.

A.3 Acoustic concepts

A.3.1 Sound and noise

The terms 'sound' and 'noise' are almost interchangeable, except that in common usage 'noise' is often used to refer to unwanted sound. Sound is a vibration that travels as an audible wave of pressure through the air from a source to a receiver location such as the human ear. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) is a unit of measurement used to express the ratio of a quantity to another on a logarithmic scale to make the wide range of sound pressure more manageable.

Sound power is the rate at which a source emits acoustic energy and is unaffected by the environment. It is a property of the source that is emitting acoustic energy.

In contrast, **sound pressure** is the effect, and it is affected by factors associated with the built and natural environment such as distance, direction, obstacles etc. The sound pressure is the acoustic energy or 'noise level' at a distance away from the noise source. The relationship between sound power and sound pressure can be explained by considering the analogy of an electric heater, which radiates heat into a room and temperature is the effect. Like sound pressure, temperature also reduces with distance from the source following the inverse square law.

In this technical working paper, **sound power level** is identified by the symbols **SWL** or **L_w**, while **sound pressure level** is represented by **SPL** or **L_p**, and both have the same scientific unit in dB.

A.3.2 Individual's perception of sound

The loudness of sound depends on its sound pressure level. The A-weighted decibel [dB(A)] is generally used for the purposes of environmental noise impact assessment as it has been adjusted to account for the varying sensitivity of the human ear to different frequencies of sound. People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dB(A) is a good measure of the loudness of environmental noise to the human ear as it considers this frequency dependant sensitivity.

Different noise sources having the same dB(A) level generally sound equally loud. However, the frequency of a sound is what gives it a distinctive pitch or tone – for example, the rumble of distant thunder is an example of a low frequency sound and a whistle is an example of a high frequency sound. Most sounds we hear in our daily lives have sound pressure levels in the range of 30 to 90 dB(A). The following table provide some points of reference, measured in dB(A), of familiar sounds and those from construction activities.

Table A-1 – Perception of sound – familiar sounds and construction noise

Common sounds	Construction noise	Sound pressure level
Leaf blower at operator's ear	Concrete saw or jack hammer 7 metres away	90 dB(A)
Airplane cabin during cruise (Airbus 321)	Excavator (with bucket) 7 metres away	80 dB(A)
General traffic noise kerbside next to Military Road	Towable compressor 7 metres away	75 dB(A)
Normal conversation at 1 metre		60 dB(A)
Outdoor air conditioning unit 1 metre away	Towable compressor 50 metres away	55 dB(A)
General office		50 dB(A)
Inside private office	Ground-borne noise from road header tunnel excavation between depths of 20 metres to 50 metres	40 dB(A)
Inside bedroom		30 dB(A)

In terms of sound perception, a change of 1 dB(A) or 2 dB(A) in the sound pressure level is difficult for most people to detect, whilst a 3 dB(A) to 5 dB(A) change corresponds to a small but noticeable change in loudness. An increase in sound level of 10 dB(A) is perceived as a doubling of loudness. However, individuals may perceive the same sound differently since many factors can influence an individual's response, including:

- The specific characteristics of the noise (eg. frequency, intensity, duration of the noise event)
- Time of day noise events occur
- Individual sensitivities and lifestyle
- Reaction to an unfamiliar sound
- Understanding of whether the noise is avoidable and the notions of fairness.

A.3.3 Environmental noise assessment indicators

Environmental noise is an accumulation of noise pollution that occurs outside and is most commonly attributed to various modes of transport as well as industrial and construction activities. Environmental noise has been shown to have an adverse effect on the quality of life, especially following long-term exposure. The focus of the present technical assessment is on annoyance and sleep disturbance as they constitute most of the burden related to the impact of environmental noise on health outcomes. Noise annoyance is defined by the World Health Organization as a feeling of displeasure, nuisance, disturbance or irritation caused by a specific sound. Sleep disturbance relates to difficulty with sleep initiation, consolidation as well as awakening and reduced quality of sleep.

In New South Wales, contemporary environmental noise assessment criteria for addressing noise annoyance and sleep disturbance are specified by the Environment Protection Authority (EPA). Potential road traffic noise impact is assessed in accordance with the NSW Road Noise Policy. For motorway and ventilation facilities that are permanently fixed, and associated noise emissions are long-term in nature, noise criteria have been adopted in accordance with the Noise Policy for Industry. For enabling construction activities which are temporary in nature and highly variable, EPA's Interim Construction Noise Guideline provides the underlying assessment principles for the determination of potential construction noise impact. Each policy/guideline is discussed in detail in the body of this report:

- Section 3.4 details the NSW Road Noise Policy
- Section 3.3 details the Noise Policy for Industry
- Section 3.1 details the EPA's Interim Construction Noise Guideline.

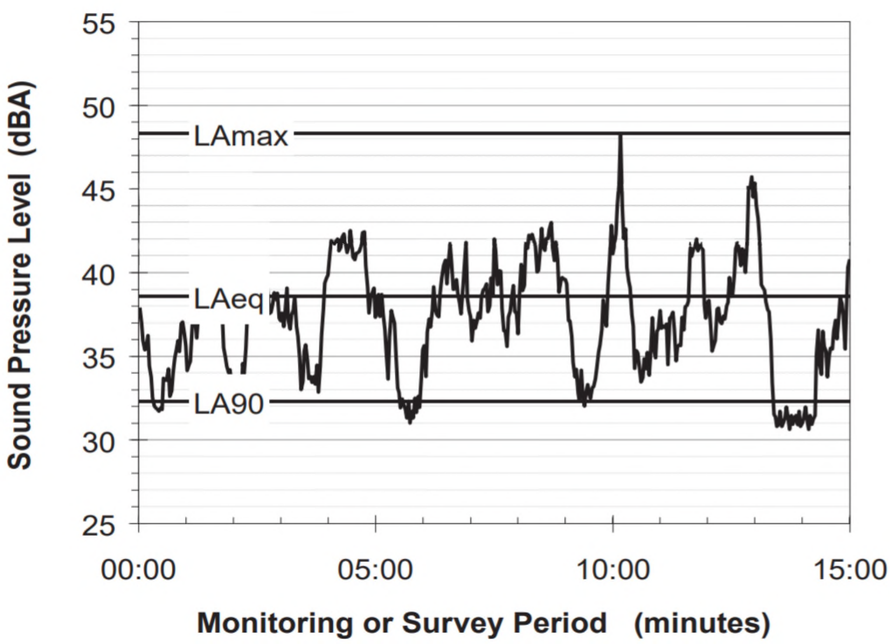
L_{Aeq} – To protect against long-term repeated noise exposure, the indicator for assessing the cumulative noise exposure level over a specific time interval is the equivalent sound pressure level, denoted as L_{Aeq}. The L_{Aeq} indicator accounts for the total energy content from all sources of sound under consideration. The fact that the L_{Aeq} is a cumulative measure means that louder activities have greater influence over the L_{Aeq} level than do quieter ones, and activities that last longer in time have greater L_{Aeq} than do shorter ones. An increase in the number of events also increases the L_{Aeq}. Further, people react to the duration of noise events, judging longer events to be more annoying than shorter ones, assuming equal maximum noise levels.

L_{Amax} – It is important to note that L_{Aeq} levels are numerically lower than maximum noise levels (denoted as L_{Amax}). None of the noise is ignored, just as all the rain that falls in the rain gauge in one hour counts toward the total. In the case of noisy but short-lived maximum noise events, which can sometime result in immediate short-term awakening reaction, potential impact is assessed using the L_{Amax} indicator in which its emergence above the background noise environment is evaluated.

L_{A90} – The L_{A90} is the level of noise that is present almost constantly, or for 90 per cent of the time and is commonly referred to as the background noise. Typical examples of what types of noise may contribute to the background noise levels are continuously flowing traffic or air conditioner noise.

These three noise indicators of L_{Amax}, L_{Aeq} and L_{A90} are presented in Figures A-1 for a sample noise monitoring survey period showing the sound pressure level of a varying noise environment such as environmental noise.

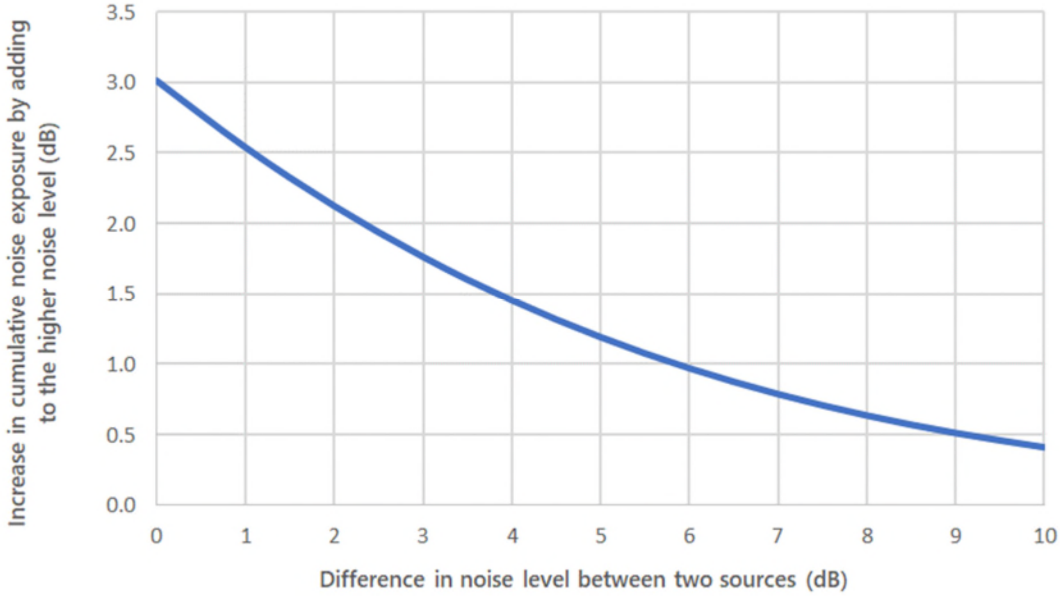
Figure A-1 – Environmental noise assessment indicators



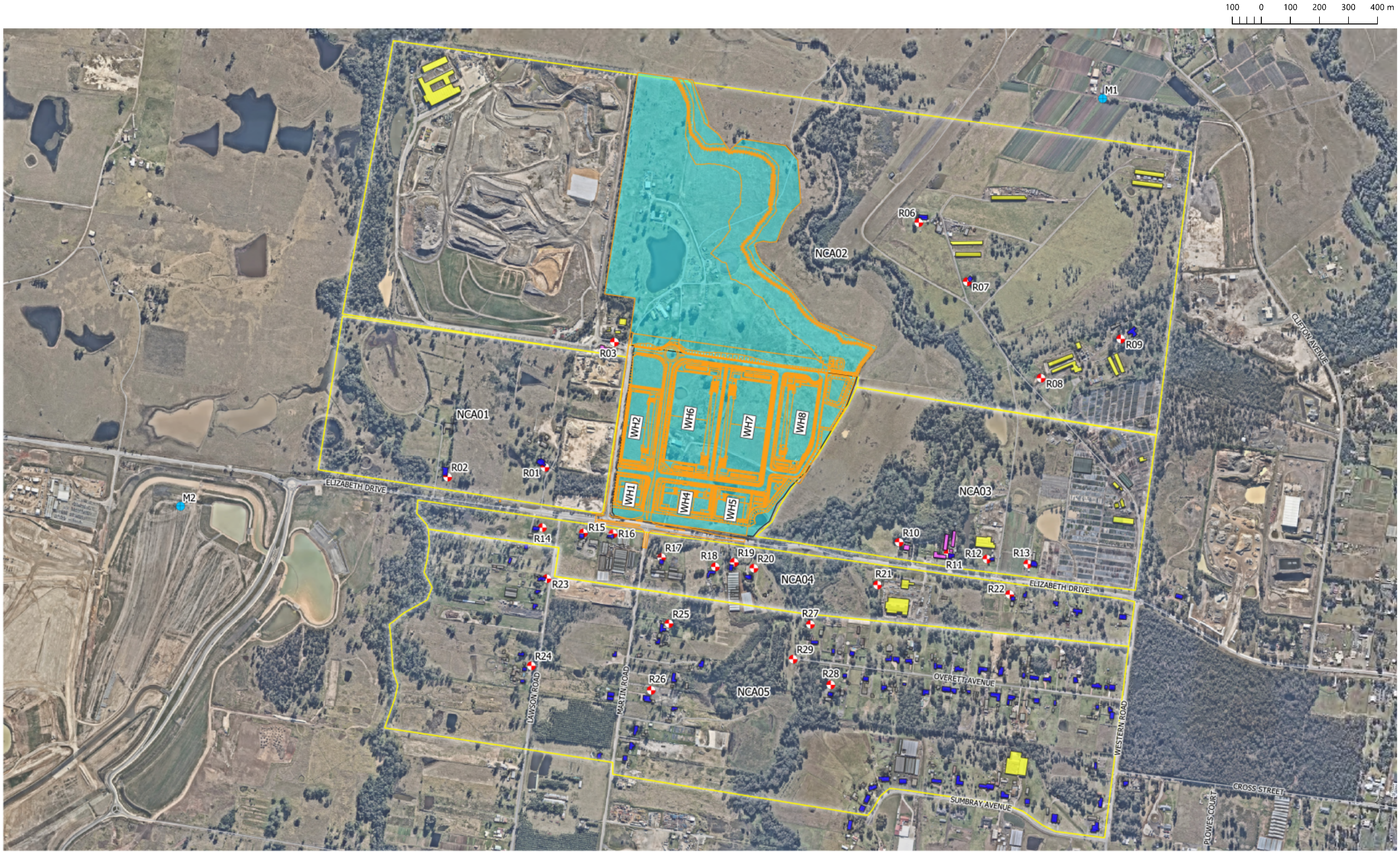
A.3.4 Cumulative sound exposure

As illustrated in Figure A-2, for two activities that result in the same amount of acoustical energy or noise level at a receiver location, the cumulative sound exposure level would be 3 dB higher than the level of just one single activity. This is because the decibel (dB) scale is logarithmic. Conversely, if the activity closer to your home results in noise exposure level that is 10 dB higher than the activity occurring further away, the quieter works would contribute very little to the cumulative noise exposure level.

Figure A-2 – Difference in noise level between two sources



APPENDIX B Land use survey and representative receivers



Legend

- Proposal site
- Noise catchment boundary
- Stage 1 SSDA Masterplan and Stage 2 Temporary Bund and Basin
- Representative receiver location
- Noise monitoring location*

Receiver type

- Residential
- Commercial
- Industrial
- Non-receiver

Client: Mirvac Projects Pty Ltd

Project: ELIZABETH ENTERPRISE PRECINCT, BADGERYS CREEK

Description: Overview - Receiver identification

Notes
*Noise monitoring conducted as part of the M12 Motorway EIS
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APPENDIX C Predicted operational noise contours

C.1 Predicted operational noise levels, $L_{Aeq,15minute}$

Legend

- Proposal site
- Noise catchment boundary
- Proposed warehouse

Receiver type

- Residential
- Commercial
- Industrial
- Non-receiver

Predicted noise level, LAeq, dB(A)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- >60

Project:
ELIZABETH ENTERPRISE PRECINCT, BADGERYS CREEK

Client:
Mirvac Projects Pty Ltd

Notes
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Description:
Operational noise contour (1.5m NPfI assessment height)
Daytime - LAeq 15min
Standard meteorological conditions

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Legend

- Proposal site
- Noise catchment boundary
- Proposed warehouse

Receiver type

- Residential
- Commercial
- Industrial
- Non-receiver

Predicted noise level, LAeq, dB(A)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- >60

Project:
ELIZABETH ENTERPRISE PRECINCT, BADGERYS CREEK

Client:
Mirvac Projects Pty Ltd

Notes
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Description:
Operational noise contour (1.5m NPfI assessment height)
Evening - LAeq 15min
Standard meteorological conditions

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Legend

- Proposal site
- Noise catchment boundary
- Proposed warehouse

Receiver type

- Residential
- Commercial
- Industrial
- Non-receiver

Predicted noise level, LAeq, dB(A)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- >60

Project:
ELIZABETH ENTERPRISE PRECINCT, BADGERYS CREEK

Client:
Mirvac Projects Pty Ltd

Notes
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Description:
Operational noise contour (1.5m NPfI assessment height)
Night - LAeq 15min
Standard meteorological conditions

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Legend

- Proposal site
- Noise catchment boundary
- Proposed warehouse

Receiver type

- Residential
- Commercial
- Industrial
- Non-receiver

Predicted noise level, LAeq, dB(A)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- >60

Project:
ELIZABETH ENTERPRISE PRECINCT, BADGERYS CREEK

Client:
Mirvac Projects Pty Ltd

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Description:
Operational noise contour (1.5m NPfI assessment height)
Morning shoulder - LAeq 15min
Standard meteorological conditions

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Legend

- Proposal site
- Noise catchment boundary
- Proposed warehouse

Receiver type

- Residential
- Commercial
- Industrial
- Non-receiver

Predicted noise level, LAeq, dB(A)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- >60

Project:
ELIZABETH ENTERPRISE PRECINCT, BADGERYS CREEK

Client:
Mirvac Projects Pty Ltd

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Description:
Operational noise contour (1.5m NPfI assessment height)
Daytime - LAeq 15min
Enhanced meteorological conditions

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Legend

- Proposal site
- Noise catchment boundary
- Proposed warehouse

Receiver type

- Residential
- Commercial
- Industrial
- Non-receiver

Predicted noise level, LAeq, dB(A)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- >60

Project:
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Client:
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Description:
Operational noise contour (1.5m NPfI assessment height)
Evening - LAeq 15min
Enhanced meteorological conditions

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Legend

- Proposal site
- Noise catchment boundary
- Proposed warehouse

Receiver type

- Residential
- Commercial
- Industrial
- Non-receiver

Predicted noise level, LAeq, dB(A)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- >60

Project:
ELIZABETH ENTERPRISE PRECINCT,
BADGERYS CREEK

Client:
Mirvac Projects Pty Ltd

Notes
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Description:
Operational noise contour (1.5m NPfI assessment height)
Night - LAeq 15min
Enhanced meteorological conditions

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Legend

- Proposal site
- Noise catchment boundary
- Proposed warehouse

Receiver type

- Residential
- Commercial
- Industrial
- Non-receiver

Predicted noise level, LAeq, dB(A)

- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- >60

Project:
ELIZABETH ENTERPRISE PRECINCT, BADGERYS CREEK

Client:
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Description:
Operational noise contour (1.5m NPfI assessment height)
Morning shoulder - LAeq 15min
Enhanced meteorological conditions

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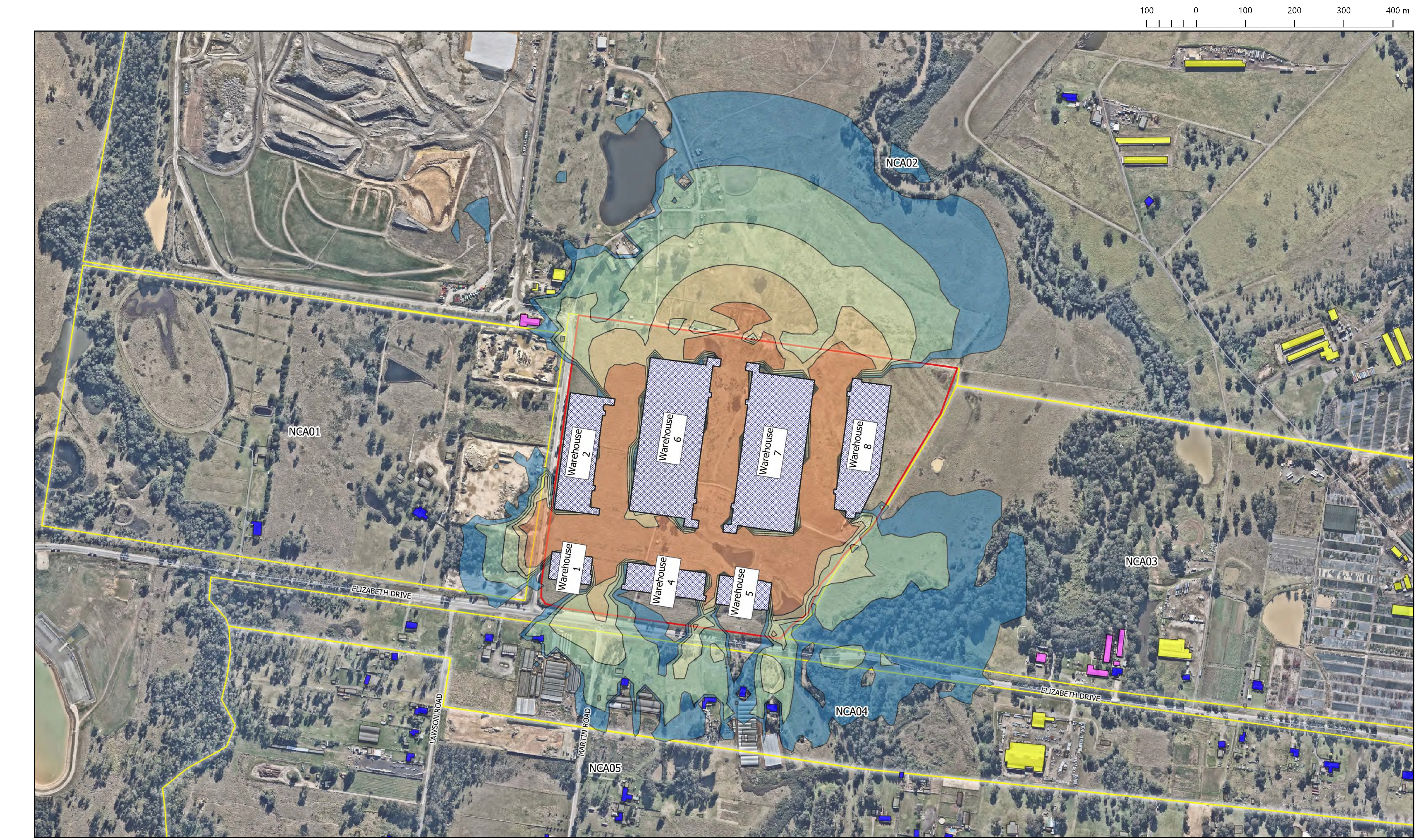
C.2 Predicted operational noise levels – Sleep disturbance, L_{Amax}



Legend

- Proposal site
- Noise catchment boundary
- Proposed warehouse

Receiver type

- Residential
- Commercial
- Industrial
- Non-receiver

Predicted noise level, LAmax, dB(A)

- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- >75

Project:
ELIZABETH ENTERPRISE PRECINCT, BADGERYS CREEK

Client:
Mirvac Projects Pty Ltd

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Description:
Operational noise contour (Sleep disturbance assessment, 1.5m NPfI assessment height)
Night/Shoulder - LAmax
Standard meteorological conditions

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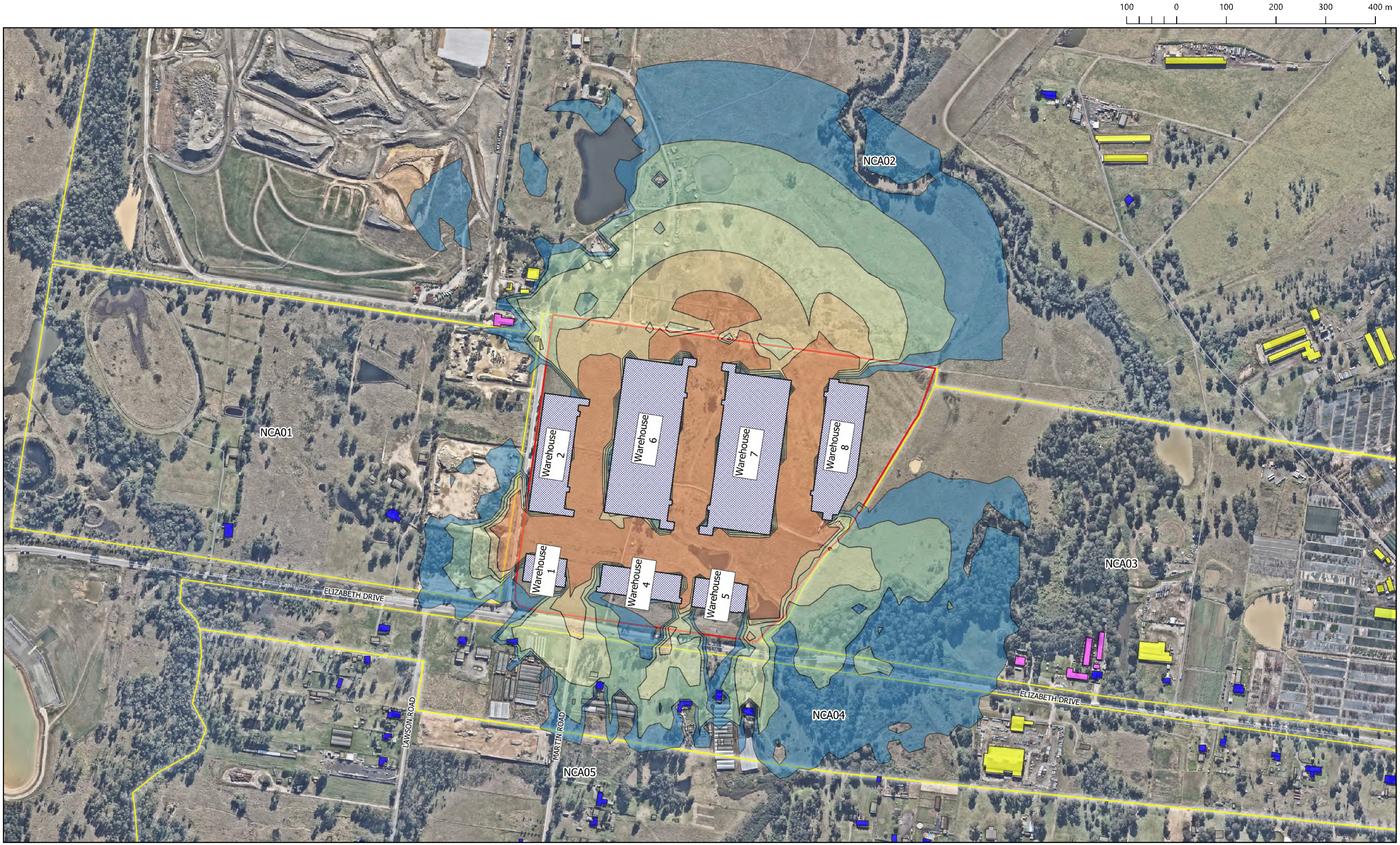

Legend

- Proposal site
- Noise catchment boundary
- Proposed warehouse

Receiver type

- Residential
- Commercial
- Industrial
- Non-receiver

Predicted noise level, LAmax, dB(A)

- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- >75

Project:
ELIZABETH ENTERPRISE PRECINCT, BADGERYS CREEK

Client:
Mirvac Projects Pty Ltd

Notes
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Description:
Operational noise contour (Sleep disturbance assessment, 1.5m NPfI assessment height)
Night/Shoulder - LAmax
Enhanced meteorological conditions

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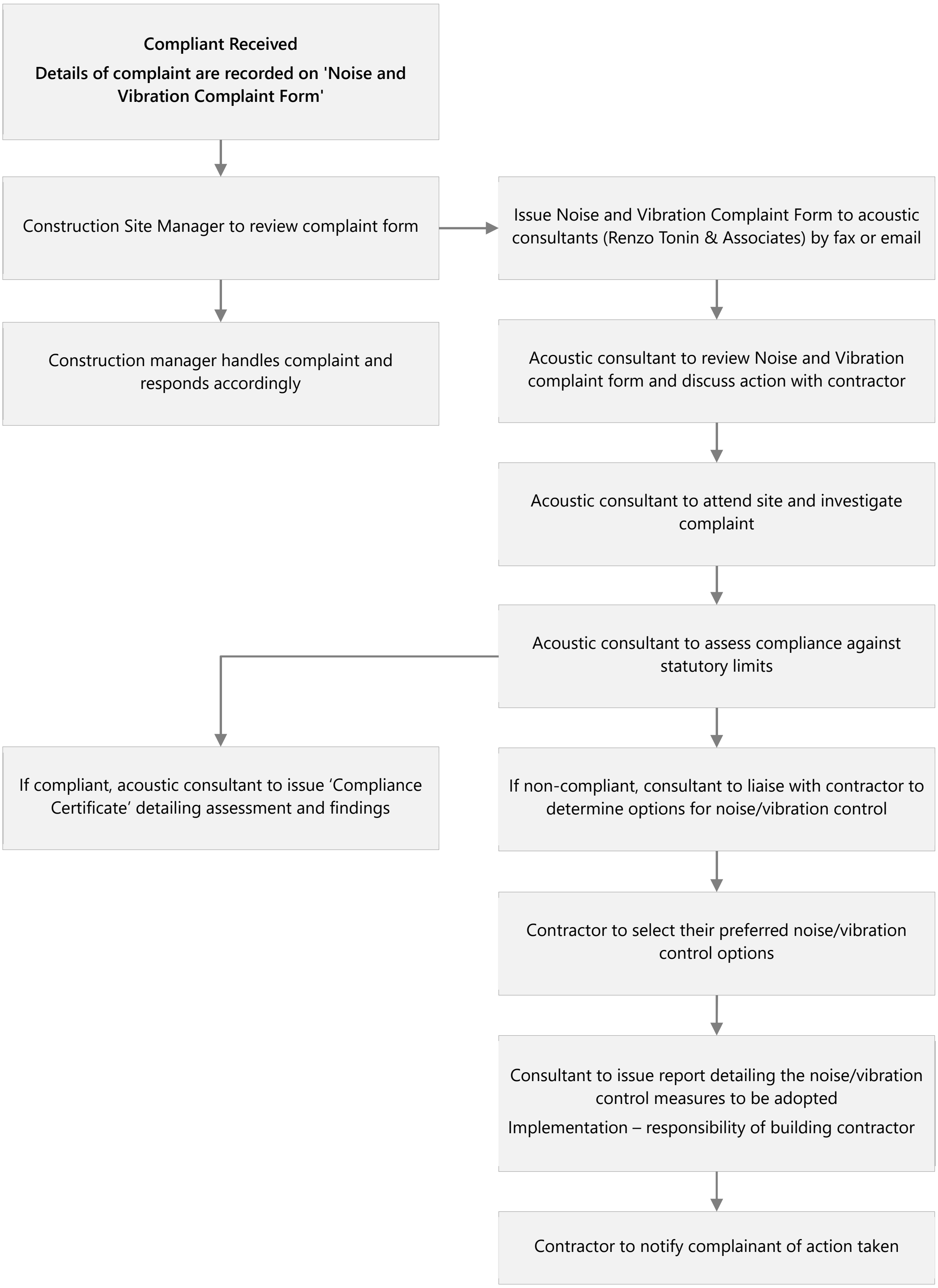
APPENDIX D Noise / vibration complaint management procedure



NOISE/ VIBRATION COMPLAINT FORM

Project title: ______________________ **Date:** ______________

Site contractor: ______________________ **Phone:** ______________

Site contact: ______________________ **Email:** ______________

Complaint details

Received by (circle): Phone / Email / In person / Other: ______________

Name: ______________________ H Ph: ______________

Address: ______________________ W Ph ______________

Email: ______________________ M Ph ______________

Describe when the problem occurred (date and time), what equipment caused the complaint (if known) and where person was standing when he/she experienced the noise/vibration:

Investigation

Question foreman responsible on site and obtain information on what equipment or processes would most likely have caused the complaint:

Following approval from the Project Manager, email/fax this form to Renzo Tonin & Associates