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# PROPOSED ARDEX WAREHOUSE & MANUFACTURING FACILITY, 657-769 MAMRE ROAD, KEMPS CREEK

## Noise and Vibration Impact Assessment

8 November 2021

The Trust Company (Australia) Limited c/- Altis Frasers JV Pty Ltd

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# 1 Introduction

## 1.1 Overview and purpose of report

Renzo Tonin & Associates (RT&A) has been engaged by The Trust Company (Australia) Limited on behalf of Altis Frasers JV Pty Ltd to undertake an operational and construction noise and vibration impact assessment (NVIA) to accompany the State Significant Development (SSD) 25725029 for the proposed Ardex Warehouse and Manufacturing Facility at the proposed Lot 12, 657-769 Mamre Road, Kemps Creek (the Proposal).

This report assesses noise and vibration impacts during the construction and operational stages for the Proposal. It proposes mitigation and management measures to reduce impacts during the construction and operation phases of the Proposal. The report has been prepared to address the requirements of the Secretary of the Department of Planning, Industry and Environment (DPIE) ('the Secretary's environmental assessment requirements') (SEARs).

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 noise and vibration and operational noise, respectively.

## 1.2 Secretary's environmental assessment requirements

The Secretary's environmental assessment requirements relating to the project are detailed in the SSD 25725029 SEARs dated 3 September 2021, and these requirements are addressed in this report, as outlined in Table 1-1.

**Table 1-1: Secretary's environmental assessment requirements – Noise and vibration**

| Secretary's environmental assessment requirements | Where addressed |
|---|---|
| **5. Noise and vibration** | |
| 1. A quantitative noise and vibration impact assessment undertaken by a suitably qualified acoustic consultant in accordance with the relevant Environment Protection Authority guidelines and Australian Standards which includes: | |
| • the identification of impacts associated with construction, site emission and traffic generation at noise affected sensitive receivers, including the provision of operational noise contours and a detailed sleep disturbance assessment | Section 4 – Construction<br>Section 3.4 and 5.1 – Operational road traffic<br>Section 5.2 to 5.5 – Operational – Site emissions and sleep disturbance<br>APPENDIX E- Operational noise contours |
| • details of noise monitoring survey, background noise levels, noise source inventory and 'worst case' noise emission scenarios | Section 2 – Noise monitoring<br>Section 5.2.1 – Noise generating operations<br>Section 5.2.2 - 'Worst case' noise emission scenarios<br>APPENDIX D - Noise source inventory |
| • consideration of annoying characteristics of noise and prevailing meteorological conditions in the study area | Section 5.4.2 - Meteorological factors<br>Section 5.5.2 - Annoying characteristics |

| Secretary's environmental assessment requirements | Where addressed |
|---|---|
| • a cumulative impact assessment inclusive of impacts from other developments | Section 3.3.1 – Operational<br>Section 3.1.3 and 4.5.2 – Construction<br>Section 5.1.2 – Road traffic noise |
| • details and analysis of the effectiveness of proposed management and mitigation measures to adequately manage identified impacts, including a clear identification of residual noise and vibration following application of mitigation these measures and details of any proposed compliance monitoring programs. | Section 5.3 - Mitigation and management<br>Section 5.5 - Predictions<br>Section 5.5.4 - Operational noise management |

Additionally, in the SEARs general requirements, it is identified that:

- Consideration of issues discussed in the public authority responses to request for key issues should be included.
- An assessment demonstrating the proposal is consistent with the conditions, requirements and development standards of SSD 9522.

## 1.3 Proposal overview

### 1.3.1 Location

The Proposal location is shown in Figure 1, and is located within the Penrith Local Government Area (LGA) and is zoned IN1 General Industrial under the provisions of State Environmental Planning Policy (Western Sydney Employment Area) 2009 (SEPP WSEA).

### 1.3.2 Access

Access to the Proposal site is proposed via the publicly accessible estate access roads approved under SSD 9522. Access into the overall estate is made possible via Mamre Road, which is subject to future road widening as part of the Mamre Road Widening Project. The Proposal is connected to the arterial road network including Mamre Road and both the M4 & M7 Motorways via the public estate access roads.

The heavy vehicle ingress is proposed from the south of the site and egress exiting via the east, with one way movements through the site. A carpark for the site will be located on the southern and eastern sides of the site, accessible from a single driveway on the southern side of the site.

**Figure 1: Proposal location**




## 1.3.3 Proposal description

The Proposal is for the construction and operation of the proposed Ardex Warehouse and Manufacturing Facility at the proposed Lot 12, 657-769 Mamre Road, Kemps Creek (the Proposal). Ardex is a manufacturer and supplier of products which include renders, screeds, floor levelling and adhesive products, decorative surface finishes, mortars used in repair applications, tile adhesives, grouts, silicone products, waterproofing membranes, primers, bonding agents and additives, sealants, sealers, sound proofing systems, a range of "natural stone" products, and a range of tools used for flooring and wall applications.

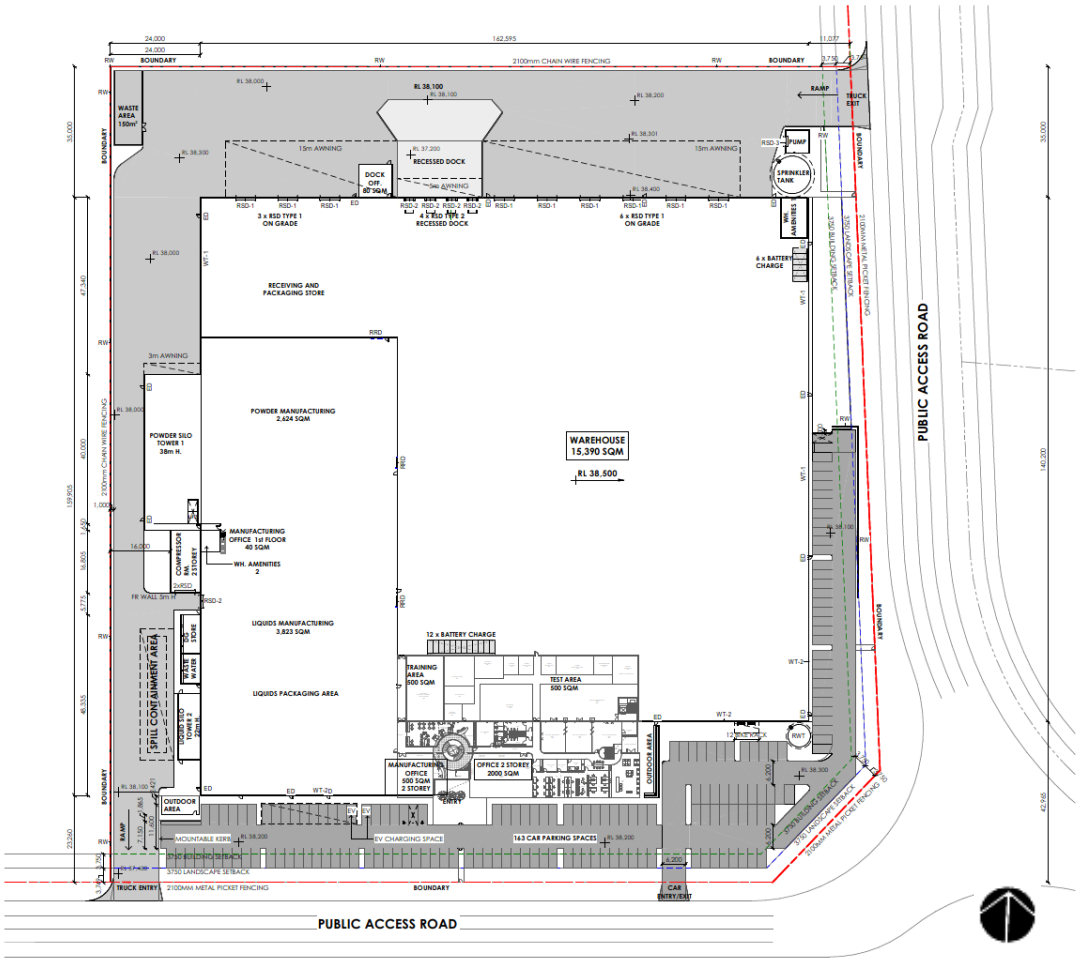
The facility has three main components, which include:

- Main warehouse, training and test area that is connected to 9 flush loading docks and 4 recessed loading docks.
- Powder and liquids manufacturing facilities.

- Main 2 storey office building for 75 staff.

The layout of the Proposal is shown in Figure 2.

**Figure 2: Proposal layout**




The following construction works will be required to construct, fit out and operate the Proposal.

- Minor earthworks involving cut and fill works, site preparation works and the establishment of a building pad;
- Infrastructure comprising civil works and augmentation of utilities servicing;
- Construction, internal fit out of a manufacturing facility and warehouse (27,470m$^2$), comprising:
    - Manufacturing areas and associated warehouse (24,970m$^2$)
    - Ancillary office areas (2,500m$^2$)
    - 163 car parking spaces and 12 bicycle spaces

- Powder silo tower
- Liquid silo tower
- Associated business identification signage
- Site landscaping (4,348m$^2$)
- 13 loading docks
- Three vehicle crossovers

- Torrens Title subdivision to create the subject allotment (proposed Lot 12) measuring approximately 4.3ha.

The operations of the Proposal will include the following:

- Production capacity up to approximately 48,000 tonnes per annum (tpa) of powder products, resulting in an indicative weekly maximum of 932 tonnes and daily maximum of 131.5 tonnes;
- Production capacity up to approximately 25,000 KL per annum of liquid products, resulting in an indicative weekly maximum of 480.7 KL and daily maximum of 68.5 KL;
- Storage of dangerous goods, comprising:
  - Class 2.1 – LPG
  - Class 3 – Flammable Liquid
  - Clause 4.1 – Flammable Solids
  - Clause 5.1 – Oxidising Substances
  - Clause 6.1 – Sub-risk Toxic Substances
  - Class 8 – Corrosive Substances

### 1.3.4 Proposal hours

The Proposal hours of operation is to be 24 hours, 7 days per week. The operations of the Proposal will typically operate with 2 worker shifts, broken into a morning shift (6:00am to 2:30pm) and an afternoon shift (2:30pm to 11:00pm).

## 1.4 Context

### 1.4.1 SSD 9522 ('The Yards', 657 – 769 Mamre Road, Kemps Creek)

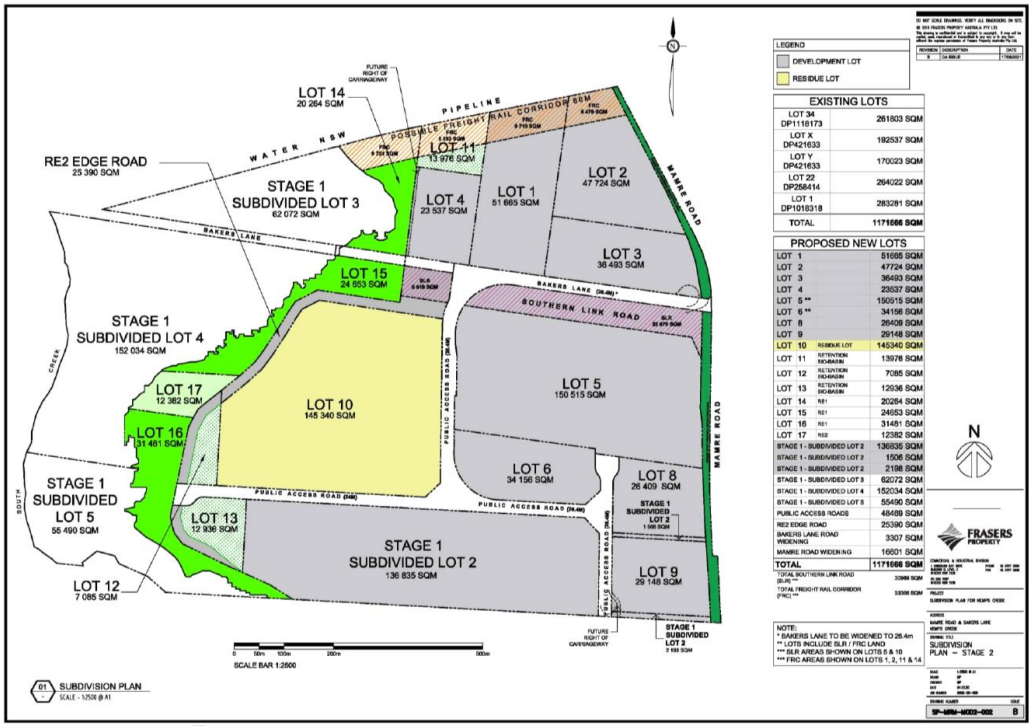
The Proposal is located within the broader industrial estate of The Yards, approved as SSD 9522 in December 2020 (modified September 2021), for the purpose of Warehouse, Logistics and Industrial Facilities. Under SSD 9522, the proposed allotment is notated as Lot 12 in accordance with Figure 1. Consistency with the conditions, requirements and development standards of the SSD 9522 approval is required by the SEARs. As part of that approval, the construction and operation of eight warehouses in the north-east corner of the estate were approved, for which noise limits were issued as part of the approval conditions. These are the warehouses located in Lots 1 to 6, and Lot 8 shown in Figure 1. As part of the works approved for SSD 9522, the Proposal site is undergoing bulk earthworks and infrastructure works.

To take into consideration SSD 9522, consent condition B52 identifies the following noise limits from noise generated by the operations of the developments covered under the SSD 9522 approval. This assessment has ensured that the same receiver locations are included in the selection of representative receivers assessed.

**Table 1-2: SSD 9522 operational noise limits (Consent condition B52)**

| Location | Day<br>$L_{Aeq\ 15minute}$ | Evening<br>$L_{Aeq\ 15minute}$ | Night<br>$L_{Aeq\ 15minute}$ |
|---|---|---|---|
| Receiver 1: residences on Medinah Avenue, Luddenham | 41 | 38 | 35 |
| Receiver 2: 654-674 Mamre Road, Kemps Creek | 48 | 43 | 38 |
| Receiver 3: 676-702 Mamre Road, Kemps Creek | 48 | 43 | 38 |
| Receiver 4: 706-752 Mamre Road, Kemps Creek | 48 | 43 | 38 |
| Receiver 5: 754-770 Mamre Road, Kemps Creek | 48 | 43 | 38 |
| Receiver 6: 771-781 Mamre Road, Kemps Creek | 48 | 43 | 38 |
| Receiver 7: 579-649 Mamre Road, Orchard Hills | 48 | 43 | 38 |
| Receiver A: Altis Warehouse and Distribution Hub, 585- 649 Mamre Road, Orchard Hills | 70 | 70 | 70 |

**Figure 3: Estate Subdivision Plan**




## 1.4.2 Mamre Road Precinct (MRP)

The Proposal is located within the Mamre Road Precinct (MRP). The MRP is within the Western Sydney Employment Area and was rezoned in June 2020. The MRP provides about 850 hectares of industrial land. The rezoning of the precinct preserves around 95 hectares of land for environmental conservation and open space and protects a site for a potential Western Sydney freight intermodal terminal (IMT). The draft development control plan (MRP DCP) was on public exhibition from 10 November to 17 December 2020. As of October 2020, the finalisation of the MRP DCP was still under consideration.

As detailed in Section 1.6 "*Precinct Vision*" of the MRP DCP states:

"*The Mamre Road Precinct will be a world-class industrial area, primarily catering for warehousing and logistics and forming an extension of the Western Sydney Employment Area. Larger consolidated land parcels will facilitate the development of these uses. A flexible zoning and land use controls will also allow other smaller industrial, manufacturing, commercial and clean industrial uses to locate here. Smaller industrial and urban services uses are encouraged throughout the Precinct, and particularly in transition areas, where the industrial area adjoins rural-residential properties.*

*This Precinct presents the opportunity for an intermodal terminal serviced by the planned Western Sydney Freight Line. Precinct design, including the provision of a dedicated connection into the freight terminal, will minimise adverse impacts on the amenity of adjoining rural-residential areas, including views and visual impacts, and noise.*

*The interface with adjoining rural-residential areas and educational facilities within the Precinct will be carefully managed so as to minimise adverse impacts. Considered site planning and building design will be required at the interface with Wianamatta-South Creek and Kemps Creek, bushland and open space, to ensure public spaces are attractive and activated…*"

Presented in Figure 4 is the structure plan for the MRP as part of the rezoning, while presented in Figure 5 are the currently proposed surrounding developments within the MRP, with the applicable SSD or Development Application (DA) reference.

**Figure 4: Mamre Road Precinct – Structure Plan (June 2020)**

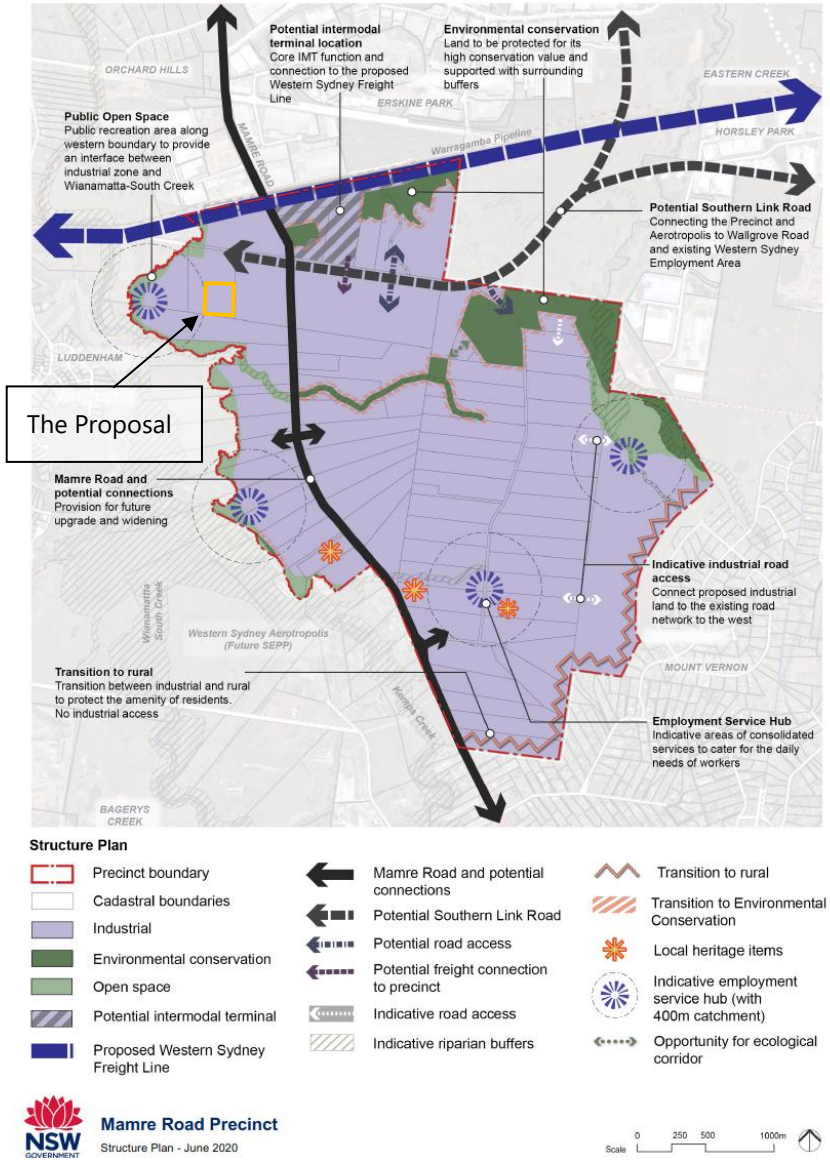
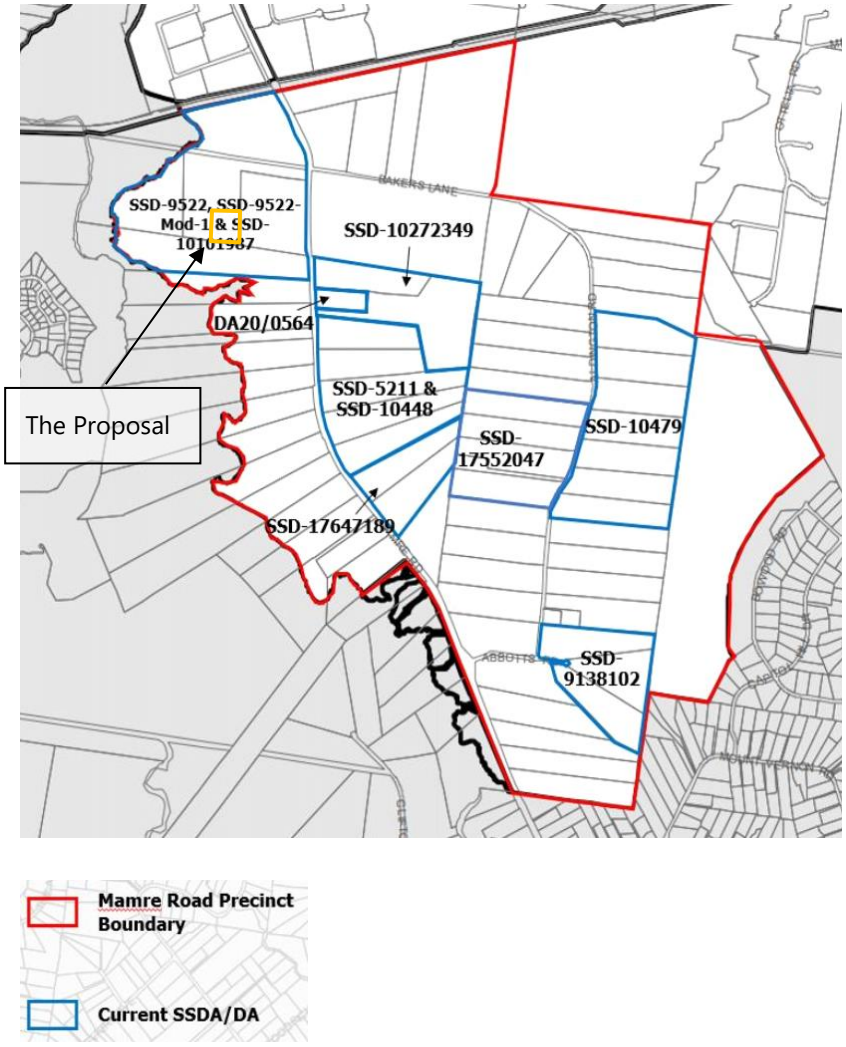



**Figure 5: Currently proposed surrounding developments within the MRP**



## 1.5 Assessment objectives

The assessment objectives are to determine the potential levels of noise and vibration 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, 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 2017)
- NSW *Road Noise Policy* (RNP) (DECCW 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)
- NSW *Noise Guide for Local Government* (NGLG) (EPA 2013).

In undertaking the assessment, attended and unattended noise monitoring was conducted to measure noise from the existing acoustic environment and potential noise sources.

## 1.6 Nearby noise and vibration sensitive receivers

### 1.6.1 Site and surrounding land use

The Proposal site is located within the MRP. The land surrounding the Proposal area currently comprise a predominantly rural typology, with a variety of rural dwellings, rural land, farm dams and scattered vegetation. As per Section 1.4.2, this land rezoned for the MRP from RU2 Rural Landscape zone to IN1 General Industrial zoning under the State Environmental Planning Policy (Western Sydney Employment Area) 2009 (WSEA SEPP). Subsequent to the approval of the MRP rezoning, large areas of this land have been purchased for industrial development, and construction has commenced on a number of approved developments.

The nearby sensitive receivers have been separated into receivers located within the MRP and outside of the MRP, noting the current rate of change and development across the MRP, the noise sensitive receivers located within the MRP are only likely to be located there short-term. 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 are assessed in accordance with the NPfI.

#### 1.6.1.1 Within the MRP

There are a number of currently existing residential receivers in the vicinity of the Proposal site.

A number of these were also identified as part of the SSD 9522 approval. These are identified as receivers R10 to R17 in Table 1-2. It is important to note that as part of the MRP rezoning, that these receivers are now located on land zoned as IN1 General Industrial.

Located to the east of the Proposal are the following sensitive receiver locations:

- Catholic Healthcare Emmaus Retirement Village (R14)
- Mamre Anglican School (R18)
- Trinity Primary School (R19)
- Emmaus Catholic College (R20)

Proposed recreation areas, which could be either passive or active are located to the west of the Proposal, as shown in Figure 4. The nearest land use zones are E2 Environmental Conservation, RE1 Public Recreation and RE2 Private Recreation located to the west of the Proposal, which are appropriately separated from the Proposal and SSD 9522. Identified as receiver R26.

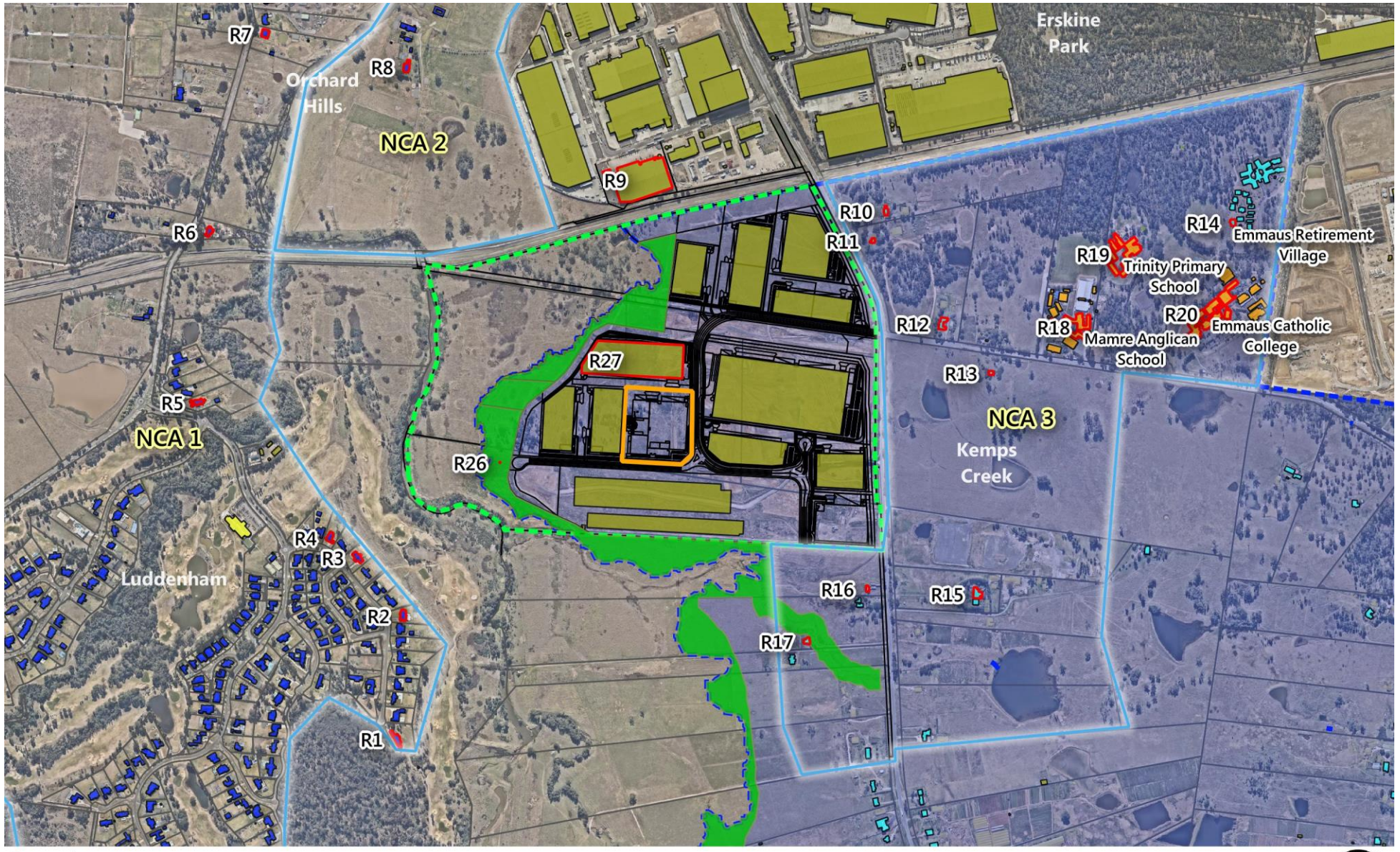
#### 1.6.1.2 Outside the MRP

The nearest long-term residential receivers are located in Luddenham (near Twin Creeks Golf & Country Club) to the west, along Medinah Avenue, Luddenham. The nearby noise sensitive receivers are presented in Figure 6 and described below:

- Residential properties west (dark blue colour buildings) located as follows:
    - Luddenham (near Twin Creeks Golf & Country Club) – with the closest residences approximately 700 metres west from the Proposal,
    - Orchard Hills – with the closest residences approximately 1,100 metres north west from the Proposal
    - Mount Vernon and Horsley Park – with the closest residences approximately 4 kilometres east and south-east from the Proposal
    - Kemps Creek – with the closest residences approximately 2 kilometres south from the Proposal

The extent of receiver buildings that have been included in the modelling for the NPfI assessment is presented in Appendix B.1. Given the large extent of the assessment area, a set of representative receiver locations have been selected and are presented in Section 1.6.3.

**Figure 6: Site location, nearby noise sensitive receivers, land uses and NCAs (see Appendix B.1 for all receivers locations)**



### 1.6.2 Noise catchment areas

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. The locations of these noise catchment area boundaries are also shown in Figure 6 and Appendix B.1.

### 1.6.3 Representative receivers

27 representative and worst-affected receiver locations have been identified to assess the potential range of noise emissions around the Proposal during each of the assessment scenarios. These locations were selected from all the nearby potentially worst-impacted receivers to simplify the assessment and reporting. They were selected considering a review of potential noise emissions. Additionally, receivers identified for SSD 9522 were included as shown in Table 1-3, to assist with reviewing consistency as required by the SEARs.

The following representative receivers have been identified:

- R1 to R7 are residential receivers to the east side of the Proposal, within NCA1
- R8 is a residential receivers north of the Proposal, within NCA2
- R9 is the industrial estate constructed to the north of the Proposal
- R10 to R17 are isolated residential receivers within the MRP to the east and south-east of the Proposal, within NCA3
- R18 to R22 are residential receivers on the south side of the Proposal, within NCA4
- R23 to R25 are residential receivers on the south-west side of the Proposal, within NCA5
- R26 is the MRP public open space recreation area
- R27 is the proposed industrial warehouse development north directly north of the Proposal

The locations of the representative receiver points for the operational noise assessment are presented in Table 1-3, and a map of these locations presented in Figure 6 (partial shown for reasonable scale) and Appendix B.1.

**Table 1-3: Representative receiver locations**

| Rec No. | Address / location | Receiver type | Residential noise catchment area (NCA) | SSD9522 consent condition receiver location | Approximate distance to the Proposal, metres |
|---|---|---|---|---|---|
| R1 | 31 Medinah Avenue, Luddenham | Residential | 1 | Receiver 1 | 1,000 |
| R2 | 15 Medinah Avenue, Luddenham | Residential | 1 | Receiver 1 | 770 |
| R3 | 7 Medinah Avenue, Luddenham | Residential | 1 | Receiver 1 | 810 |
| R4 | 3 Medinah Avenue, Luddenham | Residential | 1 | Receiver 1 | 870 |
| R5 | 2 Comargo Lane, Luddenham | Residential | 1 | - | 1,200 |
| R6 | 320-326 Luddenham Road, Orchard Hills | Residential | 1 | - | 1,300 |
| R7 | 262-266 Luddenham Road, Orchard Hills | Residential | 1 | - | 1,400 |
| R8 | 579a Mamre Road, Orchard Hills | Residential | 2 | Receiver 7 | 1,100 |
| R9 | 7-9 Distribution Drive, Orchard Hills | Industrial | - | Receiver A | 540 |
| R10 | 654-674 Mamre Road, Kemps Creek | Residential[1] | 3 | Receiver 2 | 760 |
| R11 | 676-702 Mamre Road, Kemps Creek | Residential[1] | 3 | Receiver 3 | 680 |
| R12 | 676-702 Mamre Road, Kemps Creek | Residential[1] | 3 | - | 740 |
| R13 | 706-752 Mamre Road, Kemps Creek | Residential[1] | 3 | Receiver 4 | 870 |
| R14 | Catholic Healthcare Emmaus Retirement Village (85 Bakers Lane, Kemps Creek) | Residential[1] | 3 | - | 1,600 |
| R15 | 772-782 Mamre Road, Kemps Creek | Residential[1] | 3 | Receiver 5 | 920 |
| R16 | 771-781 Mamre Road, Kemps Creek | Residential[1] | 3 | Receiver 6 | 640 |
| R17 | 783-797 Mamre Road, Kemps Creek | Residential[1] | 3 | - | 630 |
| R18 | Mamre Anglican School (45-59 Bakers Lane, Kemps Creek) | Educational | 3 | - | 1,000 |
| R19 | Trinity Primary School (61-83 Bakers Lane, Kemps Creek) | Educational | 3 | - | 1,200 |
| R20 | Emmaus Catholic College (87-109 Bakers Lane, Kemps Creek) | Educational | 3 | - | 1,400 |
| R21 | 40-46 Capitol Hill Drive, Mount Vernon | Residential | 4 | - | 4,200 |
| R22 | 53-59 Bowood Road, Mount Vernon | Residential | 4 | - | 3,800 |
| R23 | 52 Mount Vernon Road, Mount Vernon | Residential | 4 | - | 3,900 |
| R24 | 44 Kerrs Road, Mount Vernon | Residential | 5 | - | 4,000 |
| R25 | 949-965 Mamre Road, Kemps Creek | Residential | 5 | - | 2,200 |
| R26 | MRP Public Open Space | Passive recreation | - | - | 320 |
| R27 | SSD 9522 adjacent warehouse (north) | Industrial | - | - | Adjacent |

Notes: 1. Classified as an isolated residence within an industrial zone the industrial zone, in accordance with Table 2.3 of the NPfI for the assessment of operational noise impacts.

## 1.7 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 Section A.1. 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 and noise monitoring

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 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 7:00am, Monday to Sunday & Public Holidays.

## 2.1 Environmental noise monitoring

Noise measurements are ideally carried out at the nearest or most potentially affected locations surrounding a development in absence of noise from the subject site. Furthermore, representative locations may be established in the case of multiple receivers as it is usually impractical to carry out. As such, noise catchment areas have been established to group assessment receivers based on areas with similar acoustic characteristics.

At the time of preparing this noise and vibration impact assessment and report, the current COVID-19 situation and the associated lockdowns within Greater Sydney were both impacting the existing noise environment and were restricting the possibility of undertaking noise monitoring for the purposes of establishing true and representative background noise levels. As the existing noise environment is often controlled by road traffic noise (ie. Mamre Road) or urban activities, these noise levels would not be representative of a typical situation and so not suitable for the purposes of establishing true background noise levels in accordance with the NPfI.

Additionally, as SSD 9522 is approved and currently under construction and were taking place, which means that the noise generating construction works would potentially also influence the existing noise environment when these works are taking place. By adopting the background noise monitoring data established for the SSD 9522, it also ensures consistency with the SSD 9522 SSD approval as required by the SEARs.

As such, this assessment has reviewed recently approved State Significant Developments in the area to determine suitable noise monitoring locations and survey results that would be applicable to the project and representative of nearby residential receivers. The assessment has relied on the following noise measurement data presented in noise impact assessments obtained via the DPIE Planning Portal for the residential receivers in proximity to the Proposal, to establish background noise levels in accordance with the NPfI.

- *Acoustic Works, 657 – 769 Mamre Road, Kemps Creek (SSD 9622), report reference 1018022 R01AF Mamre Road Kemps Creek ENV (Acoustic Works, dated 6 August 2020)*
- *Acoustic Logic Consultancy, 585-649 Mamre Road, Orchard Hills (SSD 7173), report reference 20151211.4/0924A/R7/TT, dated 5/4/2016*
- *White Noise Acoustics, FKC Estate, 200 Aldington Road, Kemps Creek (SSD 9138102), report reference 20141_200819_Noise Impact Assessment_BW_R4.docx, dated 11/2/2021*
- *SLR, Aspect Industrial Estate (SSD 10448), report reference 610.19127-R02-v1.0, dated 15/05/2021*

Further details of these reference noise measurements are presented in Table 2-1.

**Table 2-1: Reference noise monitoring locations and data**

| Reference location | Address | Monitoring period | Description (as per relevant reporting) |
|---|---|---|---|
| L1 | 8 Medinah Avenue, Luddenham | 11/04/2018 – 19/04/2018 | Collected by Acoustic Works as part of the SSD 9522 SSDA. (Noise Monitor A).<br>The noise monitoring location is considered representative of receiver locations within NCA 1. |
| L2 | 73 Mandalong Close, Orchard Hills | 4/09/2015 – 11/09/2015 | Collected by Acoustic Logic Consultancy as part of SSD 7173, which was the proposed new Warehouse and Logistics Hub at 585-649 Mamre Road, Orchard Hills.<br>The noise monitoring location is considered representative of receiver locations within NCA 2. |
| L3 | 676-702 Mamre Road, Kemps Creek | 11/04/2018 – 19/04/2018 | Collected by Acoustic Works as part of the SSD 9522 SSDA. (Noise Monitor B). Noise levels were generally influenced my road traffic on Mamre Road.<br>The noise monitoring location is considered representative of receiver locations within NCA 3. |
| L4 | 240-242 Aldington Road, Kemps Creek | 11/08/2020 – 17/08/2020 | Collected by White Noise Acoustics as part of SSD 9138102, which was the proposed new ESR Kemps Creek Logistics Park Warehouse and Logistics Hub at 290-308 Aldington Road, 59-62 Abbotts Road, and 63 Abbotts Road. The daytime noise environment was dominated by vehicle movements on Aldington Road, surrounding land uses and natural sources.<br>The noise monitoring location is considered representative of receiver locations within NCA 4. |

| | | | |
|---|---|---|---|
| L5 | Lot 56, DP259135, Mamre Road, Kemps Creek | 11/11/2019 – 26/11/2019 | Collected by SLR as part of SSD 10448, which was the proposed Aspect Industrial Estate at Lots 54-58 in DP 259135, Mamre Road, Kemps Creek.<br>Noise logger deployed in an open area at the southern site boundary, approximately 120 metres from Mamre Road, adjacent to the nearest residence. Noise environment is influenced primarily by road traffic noise from Mamre Road<br>The noise monitoring location is considered representative of receiver locations within NCA 5. |

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.1.

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

| Ref. | Location description | Rating background noise levels (RBL), $L_{A90,\ 15\ minute}$ | | |
|---|---|---|---|---|
| | | Day[1] | Evening[2] | Night[3] |
| L1 | 8 Medinah Avenue, Luddenham | 36 | 33 | 30 (28[6])[5] |
| L2 | 73 Mandalong Close, Orchard Hills | 38 | 34 | 34 |
| L3 | 676-702 Mamre Road, Kemps Creek | 44 | 43 | 37 |
| L4 | 240-242 Aldington Road, Kemps Creek | 32 | 31 | 30[5,6] |
| L5 | Lot 56, DP259135, Mamre Road, Kemps Creek | 39 | 39 (40[7]) | 32 |

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 7.00am Monday to Sunday & Public Holidays
4. As required by the NPfI, the external ambient noise levels presented are free-field noise levels. [ie. no facade reflection]
5. As per NPfI Section 2.3, the minimum assumed RBL for the night period is 30 dB(A).
6. The reference report notes that this level has been documented where background noise levels have been measured below this NPfI minimum level.
7. 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

## 2.2 Similar facility noise measurements

Noise measurements and observations of typical operational activities were undertaken by RT&A at the existing Ardex manufacturing facility at Seven Hills, NSW on 30 August 2021. Measurements undertaken at this facility were able to provide representative noise levels of a range of activities that will take place within the Proposal.

The equipment used for noise measurements included an NTi Audio Type XL2 precision sound level analysers is a Class 1 instruments having accuracy suitable for field and laboratory use. The instrument was field checked for calibration prior and subsequent to measurements using a Bruel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed. All instrumentation complies with IEC 61672 (parts 1-3) '*Electroacoustics - Sound Level Meters*' and IEC 60942 '*Electroacoustics - Sound calibrators*' and carries current NATA certification (or if less than 2 years old, manufacturers certification).

These measurements were used to derive a range of noise source levels for this Proposal and are presented in APPENDIX D.

Measurements of the noise source levels from the key noise generating plant/equipment were undertaken with a sufficient duration to capture the total activity noise level (ie. entire forklift loading operation) 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. A summary of the measured noise levels for the key activities are presented in APPENDIX C.

The key activity noise source measurements conducted at these facilities were as follows:

a) Raw material deliveries

   1. Raw liquid pumping operation
   2. Raw powders pumping operation

b) Loading dock receiving and dispatching

   1. Truck idling – Container truck
   2. Forklift container unloading operations
   3. Forklift truck unloading operations
   4. Forklift manoeuvres and pallet handling
   5. Truck airbrake events
   6. Truck reversing beeper operation

c) Manufacturing activities

   1. Liquid mixers
   2. Powder mixers
   3. Powder manufacturing area internal noise levels
   4. Liquids manufacturing area internal noise levels
   5. Dust collector external noise emissions (including air releases)

# 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**

| Time of day | Management level $L_{Aeq\ (15\ min)}$ * | How to apply |
|---|---|---|
| **Recommended standard hours:**<br>Monday to Friday<br>7am to 6pm<br>Saturday 8am to 1pm<br>No work on Sundays or public holidays | Noise affected<br>RBL + 10 dB | The noise affected level represents the point above which there may be some community reaction to noise.<br>• 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.<br>• 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. |

| Time of day | Management level $L_{Aeq\ (15\ min)}$ * | How to apply |
|---|---|---|
| | Highly noise affected<br>75 dB(A) | The highly noise affected level represents the point above which there may be strong community reaction to noise.<br>• 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:<br>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<br>2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times. |
| **Outside recommended standard hours** | Noise affected<br>RBL + 5 dB | • A strong justification would typically be required for works outside the recommended standard hours.<br>• The proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>• 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.<br>• For guidance on negotiating agreements see *ICNG* section 7.2.2. |

* 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 other noise sensitive receiver locations.

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

| Land use | Time of day | Where objective applies | Management level $L_{Aeq\ (15\ min)}$ |
|---|---|---|---|
| Classrooms at schools and other educational institutions | When in use | Indoor noise level | 45 dB(A) |
| | | Outdoor noise level[1] | 55 dB(A) |
| Hospital wards and operating theatres | When in use | Indoor noise level | 45 dB(A) |
| | | Outdoor noise level[1] | 55 dB(A) |
| Places of worship | When in use | Indoor noise level | 45 dB(A) |
| | | Outdoor noise level[1] | 55 dB(A) |
| Active recreation areas | When in use | Outdoor noise level | 65 dB(A) |
| Passive recreation areas | When in use | Outdoor noise level | 60 dB(A) |
| Commercial premises | When in use | Outdoor noise level | 70 dB(A) |
| Industrial premises | When in use | Outdoor noise level | 75 dB(A) |

Notes: 1. Outdoor noise level based on internal noise level in ICNG and assumes 10 dB loss through an open window

### 3.1.2 Summary of construction noise management levels

Table 3-3 presents the construction noise management levels established for the nearest noise sensitive residential receivers based upon the noise monitoring outlined in Section 2. The assessment locations and nearby sensitive receivers for the construction assessment are identified in Figure 6.

**Table 3-3: Construction noise management levels**

| NCA / Rec. Id | Location description | Noise management level $L_{Aeq(15min)}$[1]<br>Monday to Fridays (7:00am to 6:00pm)<br>Saturdays (8:00am to 1:00pm) |
|---|---|---|
| NCA1 | Residential premises (R1 to R7) | 46 |
| NCA2 | Residential premises (R8) | 48 |
| NCA3[4] | Residential premises[4] (R10 to R20) | 54 |
| NCA4 | Residential premises (R21 to R23) | 42 |
| NCA5 | Residential premises (R24 to R25) | 49 |
| R18 to R20 | Education – classroom (external) | 55[2,3] |
| R26 | Passive recreation areas | 60[2] |
| R9 and R27 | Industrial premises | 75[2] |

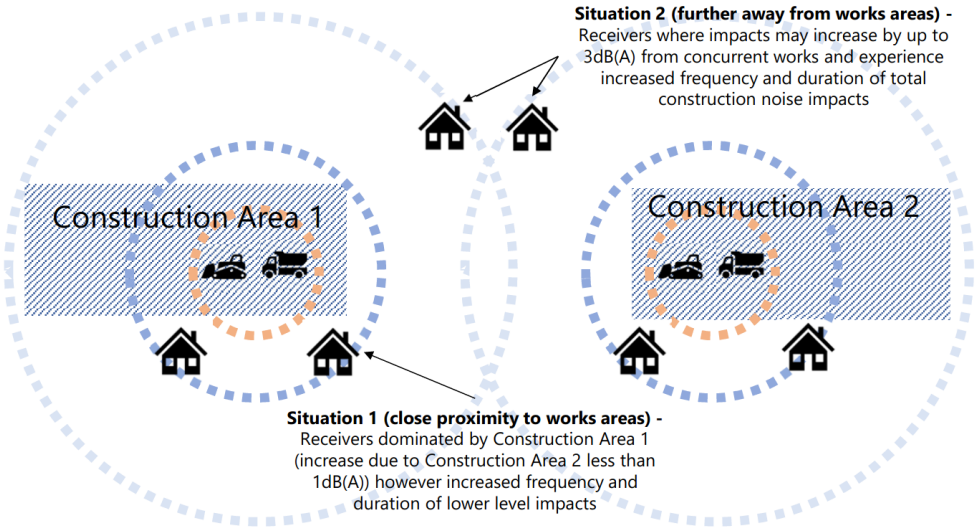
Notes:
1. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.
2. Noise management levels apply when receiver areas are in use only.
3. External noise management level. A conversion from internal to external assumes 10dB(A) loss from outside to inside through open window.
4. In accordance with the ICNG, the residences located in the MRP are assessed as residential receivers.

### 3.1.3 Cumulative construction project noise

The Proposal is located within the MRP and The Yards (SSD 9522) industrial estate, across which there are a large number of sites in which similar industrial facility construction projects over the next couple of years, shown by the various proposed/approved projects presented in Figure 5. As such, there will be multiple projects undergoing noise generating construction works concurrently.

Typically, while impacts from one project or one construction site may be relatively short-term or noise intensive periods intermittent, when multiple construction projects are occurring at the same time near to a particular receiver cumulative construction noise impacts can occur. This can mean that construction noise impacting a sensitive receiver may be louder than from an individual set up works (ie. by up to 3 dB(A) with similar contributions from one other project), the overall duration of construction impacts may be overall longer or impacts more frequent. Typically, concurrent projects can impact nearby receiver locations in one of two ways, as also shown in Figure 7.

**Figure 7: Cumulative construction noise impacts**




As such, because there is potential for cumulative noise impacts as a result of the Proposal combined with other concurrent construction projects it is recommended that mitigation and management measures are implemented in order to minimise cumulative impacts, as detailed in Section 4.5.2.

## 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 predicted vibration 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. The 'Low probability of adverse comment eVDV' represent the preferred and maximum value 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 $m/s^{1.75}$ |
|---|---|---|---|---|
| Critical areas (day or night)[1] | 0.28 | 0.1 to 0.2 | 0.2 to 0.4 | 0.4 to 0.8 |
| Residential buildings 16 hr day[2] | 0.56 | 0.2 to 0.4 | 0.4 to 0.8 | 0.8 to 1.6 |
| Residential buildings 8 hr night[2] | 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 |

1. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above
2. 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.

#### 3.2.2.1 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, mm/s | | |
|---|---|---|---|---|---|
| | | | 4Hz to 15Hz | 15Hz to 40Hz | 40Hz and above |
| 1 | Reinforced or framed structures Industrial and heavy commercial buildings | Cosmetic | 50 | | |
| | | Minor* | 100 | | |
| | | Major* | 200 | | |
| 2 | Un-reinforced or light framed structures Residential or light commercial type buildings | Cosmetic | 15 to 20 | 20 to 50 | 50 |
| | | Minor* | 30 to 40 | 40 to 100 | 100 |
| | | Major* | 60 to 80 | 80 to 200 | 200 |

Notes: 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.

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

#### 3.2.2.2 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 and are of great intrinsic value (eg listed buildings) | 3 | 3 to 8 | 8 to 10 | 8 | 20 |

### 3.2.3 Damage to vibration sensitive equipment

Some high technology manufacturing facilities, hospitals and laboratories utilise equipment that is highly sensitive and susceptible to vibration, for example scanning electron microscopes and micro-electronic manufacturing facilities. In addition, buildings housing sensitive computer or telecommunications equipment may require assessment against stricter criteria than those nominated for building damage.

There is no explicit guidance on acceptable vibration levels for such equipment, so recommended vibration levels should be obtained from instrument manufacturers. In the absence of equipment specific data provided by manufacturers, there are generic vibration criteria that can be used to assess the impact of vibration generating activities on buildings housing vibration sensitive equipment. For example, the Vibration Criteria (VC) curves are often referred to as they are generic and apply to all tools/ equipment types within each category. The VC curves are defined over the frequency range 8 to 100 Hz.

Table 3-7 below summarises a range of suitable and conservatively stringent vibration limits that are applicable to buildings housing vibration sensitive equipment which may potentially be affected by construction vibration.

**Table 3-7: Acceptable vibration limits for vibration measured on building structure housing sensitive equipment**

| Equipment Requirements | Vibration Limit[1] mm/s, | | Description of Use[3] |
|---|---|---|---|
| | RMS[4] | Peak [5] | |
| Computer Areas[2] | 0.7 | 1.0 | Barely perceptible vibration. Adequate for computer equipment accommodation environments. |
| Medical[2, 3] | 0.1 | 0.14 | Vibration not perceptible. Suitable in most instances for microscopes to 100X and for other equipment of low sensitivity. |
| VC-A[3] | 0.05 | 0.07 | Vibration not perceptible. Adequate in most instances for optical microscopes to 400X, microbalances, optical balances, proximity and projection aligners, etc |

Notes: 1. As measured in one-third octave bands of frequency over the frequency range 8 to 100 Hz. Vibration measured on the building structure near vibrating equipment or in areas containing sensitive equipment.

2. Based on AS 2834 Computer Accommodation

3. Gordon CG Generic Vibration Criteria for Vibration Sensitive Equipment

4. Root Mean Square value representing the average value of a signal

5. In the absence of Peak limits, RMS limits are converted to Peak by conservatively assuming the vibration signal is sinusoidal and random with a nominal crest factor of 1.414

### 3.2.4 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 3-8 below.

**Table 3-8: 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 3-8 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 NSW 'Noise Policy for Industry' (NPfI), 2017. 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 Cumulative industrial noise

#### 3.3.1.1 Cumulative industrial noise management in accordance with the NPfI

The management of cumulative operational noise is required by both the SEARs (Section 1.2) and 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 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 aims to ensure that the total industrial noise level (existing plus new) remain within the recommended amenity noise levels for an area.

The standard approach adopted in the NPfI (NPfI Section 2.4) to address the potential for cumulative industrial noise is to subtract 5 dB from the recommended amenity noise level, which is derived on the basis that a receiver may be impacted by three to four individual industrial operations concurrently. However, one of the exceptions to following this approach is where the proposed development is located in a major industrial cluster, which is the case for the Proposal.

There are two aspects of cumulative noise that are applicable for large industrial developments/clusters, the first being the total cumulative noise from the multiple operations within a proposed development (ie. a warehouse estate with multiple warehouse operations), while the second is the cumulative build-up of noise from other nearby developments outside of the proposed development combined with the Proposal impacting the same receiver location. As the Proposal is a single operation, the first aspect is not applicable for this Proposal.

Beyond the standard approach in NPfI Section 2.4, the NPfI provides a number of approaches for addressing the contribution from multiple developments, including NPfI Section 2.4.2 (*Amenity noise levels in areas near an existing or proposed cluster of Industry*) and NPfI Section 2.8 (*Noise management precincts*). These approaches represent the two extremes of addressing cumulative operational noise,

where the approach in NPfI Section 2.8 of establishing a noise management precinct applies where a single entity has control over all or the majority of industrial operations - this is not applicable for the Proposal and the MRP. At the other extreme, the approach detailed in NPfI Section 2.4.2, sets out a simplistic method of allocation of noise criteria where a development is proposed adjacent to a cluster of industrial operations. The method equally proportions the allowable noise levels, independent of a large range of considerations such as size, intensity, distance to receiver and potential for the development to impact receivers. Adopting this approach for new large multi-development rezoned industrial areas such as MRP can result in very low noise criteria allocated to developments that would not be reasonable in accordance with the NPfI.

In recent discussions with the NSW Environment Protection Authority (EPA), it was noted that the NPfI does not cover, and does not aim to address a process where there has been a large rezoning of landuse to industrial, which is the situation for the Proposal and the MRP. The NPfI provides guidance generally about the concepts that should be considered when determining appropriate criteria, but a specific process is not provided. The method for managing rezoning and changes of landuse are to be addressed in the specific planning instruments for the rezoned area as there may be site specific issues and considerations that are relevant. These instruments should consider what protections they put in place to address landuse conflict issues and address existing landuse rights of nearby receivers, while also being consistent with the proposed future planning outcomes for the rezoned area.

#### 3.3.1.2 Cumulative considerations and issues for the MRP

There are a large number of potential new industrial developments within the MRP, as shown in Figure 5, with other areas not already covered by proposed developments within the MRP also with the potential of becoming industrial developments.

The draft MRP DCP does not address the issue of cumulative noise in detail. The noise related requirements set out in the draft MRP DCP are presented in Section 3.5. Due to a range of factors such as size, type of operations and number of operations across the MRP, the specific approaches detailed in the NPfI are not appropriate for deriving the applicable criteria for development within the MRP.

As such, the project amenity noise levels have been derived consistent with the intentions and guidance in the NPfI considering the following aspects:

- A large number of industrial developments are proposed. The MRP was rezoned in 2020 and covers approximately 75 separate allotments across about 850 hectares of industrial land, generally zoned as IN1 General Industrial.
- The MRP covers a large area, with substantial distances between some areas and sensitive receivers. The MRP is approximately 4.5km north to south, and 4km east to west. Resulting in receivers ranging from approximately 150 metre to 4 kilometres from proposed industrial developments.
- Many of the proposed developments will be made up of multiple noise generating operations, ranging from single operation developments to 13 warehouses across seven existing lots.

- The larger the development cluster and number of developments, the more unlikely it is that all developments would be operating with reasonable worst case operations concurrently and contributing these worst case noise levels at the same time to nearby receivers. As such, for large development clusters proportioning criteria without factoring this in considering this would not be a reasonable approach.
- The greater the distance between the industrial cluster, the greater the number of potential operations would contribute noise, however would likely do so at lower noise levels.
- As the existing background noise levels are less than 35 dB(A) for all NCAs except for NCA3 and background noise levels are controlled by distant traffic noise (as presented in Section 2), it is determined that the existing industrial noise level is more than 5 dB lower than the relevant recommended amenity noise level of 40 dB(A) $L_{Aeq\ period}$ for rural residential receivers, and so cumulative modifications are based upon the 'amenity noise level' for these NCAs.
- As the nature of the landuse is substantially changing in the surrounding area, considering the range of proposed infrastructure projects proposed by the NSW Government, this will likely change the nature of the ambient noise environment. Even if industrial noise levels are controlled considering existing noise levels, there is no equivalent control for the contributions from the road traffic noise increases. Arterial roads will likely be a main contributor to the background noise levels in the area around the MRP. As such, the existing low background noise levels [less than 35 dB(A)] at these receivers would not likely be maintained due to the increase in urban activities, traffic volumes and noise generating activities associated with the landuse changes in this area.
- Individual warehouse developments have the ability to manage and allocate noise criteria to future tenants. As such, they can then allocate or assign allocated noise criteria across a masterplan to individual tenancies via NPfI Section 2.4.2, or as a Noise Management Precinct approach (NPfI Section 2.8), or a mixture of these approaches. In these cases, the potential types of noise generating premises, or the potential shielding provided by future warehouse buildings could be taken into consideration.

Considering the above points and noting that much of the potential industrial operations within the MRP are unknown, and there is no single overarching management entity, then more complex approaches may not achieve better acoustic outcomes while potentially resulting in unintended and adverse planning outcomes.

While more complex approaches could take into account the distance from receivers, consider potential shielding, or determine zones of influence, they will generally require a cohesive approach across the MRP, considering the potential usages and proposed development types, and as such would be more appropriate coming through a planning instrument.

Equally proportioning noise across all of the proposed developments (ie. NPfI Section 2.4.2 method) it is not a reasonable approach to adopt, as it assumes that all operations are operating in a reasonable worst case concurrently and that more distant operations can contribute the same as closer operations, which is unlikely to occur and provides a portion of the overall criteria to developments that are unlikely to contribute noise to a receiver.

As such, the approach that has been adopted for this assessment has focused on delivering reasonable outcomes for the intended proposed future landuse, noting the precinct vision and objectives of Western Sydney Employment Area (Mamre Road Precinct) stated in the draft MRP DCP (Section 1.4.2).

**The approach adopted for this assessment reduces the project amenity noise level by 10 dB(A) to make allowance for contributions from other industrial developments (near and far).**

This approach assumes that up to 10 industrial operations would be impacting the same receiver at the same time as when the Proposal operates under reasonable worst case conditions with similar levels of noise contribution.

This would allow for other developments, such as the Kemps Creek Data Centre (SSD 10101987) immediately south of the site, to be provided with a suitable allowance of the overall cumulative noise emissions from the MRP so that cumulative noise impacts can be appropriately managed.

In absence of any clear guidance in the draft MRP DCP, this has been adopted as a reasonable and conservative approach. This allows for reasonable levels of noise emissions from the Proposal operations, while reasonably allowing other future industrial facilities to operate within the MRP without unnecessarily stringent constraints that are unworkable and potentially sterilising land for future use. The derivation of the project amenity noise levels in this manner is based upon delivering a reasonable outcome for the intended proposed landuse for the MRP and details provided in the draft MRP DCP.

As such, to ensure that the total industrial noise level (existing plus new) remain within the recommended amenity noise levels for the area, the project amenity noise level that applies for the Proposal is determined as follows:

**$L_{Aeq,period}$ Project amenity noise level = $L_{Aeq,period}$ Recommended amenity noise level – 10dB(A)**

This consideration for cumulative industrial noise applies to all receiver categories.

#### 3.3.1.3 Consistency with SSD 9522

This approach also takes into account the noise emissions from the eight Warehouses approved for SSD 9522 (see Section 1.4.1) noting that the criteria for that proposal has been derived in accordance the NPfI, but did not take into account all the potential other future MRP developments. The SSD 9522 consent condition B52 night noise limit is 35 dB(A) $L_{Aeq\ 15minute}$ at NCA1. As such, the approved SSD 9522 warehouses could make up one of the 10 contributing developments. If 9 developments contribute 33 dB(A) $L_{Aeq\ 15minute}$ each at one receiver and one development (SSD 9522) contributes 35 dB(A) $L_{Aeq\ 15minute,}$ the total industrial noise level would still remain at 43 dB(A) $L_{Aeq\ 15minute}$ (equivalent to 40 dB(A) $L_{Aeq\ period}$) when summed together. As such, this approach would maintain the total industrial noise level (existing plus new) so that it would achieve the NPfI amenity noise level.

### 3.3.2 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 aim is so that there is not a noticeable difference as a result of a new development. However, due to the situation with the MRP where there are a large number of future developments, this is not necessarily, considering the intended planning outcomes from the MRP.

The project intrusiveness noise level, which is only applicable to residential receivers, is determined as follows:

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

However, when evaluating the noise impacts for a proposed site it is important to consider the likely future state and any changing character of the surrounding landuse and noise environment. NPfI Section 2.4.3 "*Effects of changing land use*" is relevant in the context of the Proposal for deriving project trigger noise levels for the Proposal. NPfI Section 2.4.3 states;

*When land uses in an area are undergoing significant change, for example, residential subdivisions with associated development of local and regional roads, the background noise levels would be expected to change, sometimes significantly. The impact of noise from an existing industry on a proposed new residential area should be made using the recommended amenity noise level for the residential land use, not the project intrusiveness noise level.*

Consistent with the precinct vision for the MRP detailed Section 1.4.2, and considering the following **proposed future planning outcomes** for the surrounding area envisaged by the state planning instruments, it is likely that existing night time background noise levels will increase from existing levels:

- Western Sydney Employment Area (Mamre Road Precinct)
- Mamre Road Upgrade
- Sydney Metro (Western Sydney Airport)
- Western Sydney Airport
- Western Sydney Aerotropolis
- M12 Motorway

**As such, consistent with NPfI Section 2.4.3, it is not recommended that project intrusive noise levels are used to determine the applicable project noise trigger levels due the area undergoing significant change and the existing noise environment likely changing.**

Project intrusive noise levels are derived in Table 3-9 for reference purposes only.

This approach will not likely alter the overall acoustic outcome of the assessment and noise emissions from the Proposal, considering the required consideration for cumulative industrial noise impacts detailed in Section 3.3.1, which means that the project amenity criteria (Section 3.3.3) taking into consideration potential cumulative impacts will be the controlling criteria.

**Table 3-9: Intrusiveness noise levels (for reference only)**

| Receiver | Intrusiveness noise level, $L_{Aeq,15min}$ | | |
|---|---|---|---|
| | Day | Evening | Night |
| NCA1 | 36 + 5 = 41 | 33 + 5 = 38 | 30 + 5 = 35 |
| NCA2 | 38 + 5 = 43 | 34 + 5 = 39 | 34 + 5 = 39 |
| NCA3 | 44 + 5 = 49 | 43 + 5 = 48 | 37 + 5 = 42 |
| NCA4 | 32 + 5 = 37 | 31 + 5 = 36 | 30 + 5 = 35 |
| NCA5 | 39 + 5 = 44 | 39[4] + 5 = 44[4] | 32 + 5 = 37 |

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 7:00am Monday to Saturday and 10:00pm to 8:00am Sundays & Public Holidays
4. Consistent with Section 2.3 of the NPfI, the project intrusiveness noise level for the shoulder is set no greater than for Daytime.

### 3.3.3 Amenity noise levels

The project amenity noise levels for different time periods of 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 subject receiver areas are reproduced from the NPfI Table 2.2 in Table 3-10 below.

**Table 3-10: 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 |
| Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks | See column 4 | See column 4 | 5 dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day |
| School classroom (internal) | All | Noisiest 1-hour period when in use | 35[5] |
| Hospital ward | All | | |
| - Internal | | Noisiest 1-hour | 35 |
| - External | | Noisiest 1-hour | 50 |
| Place of worship (internal) | All | When in use | 40 |
| Passive recreation (e.g. national park) | All | When in use | 50 |
| Active recreation (e.g. school playground, golf course) | All | When in use | 55 |
| Commercial premises | All | When in use | 65 |
| Industrial premises | All | When in use | 70 |
| Industrial interface (applicable only to residential noise amenity areas) | All | When in use | Add 5 dB(A) to recommended noise amenity area |

Notes:
1. Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am.
2. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
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
5. In the case where existing schools are affected by noise from existing industrial noise sources, the acceptable LAeq noise level may be increased to 40 dB LAeq(1hr)

#### 3.3.3.1 Residential amenity category

Table 2.3 "*Determining which of the residential receiver categories applies*" of the NPfI provides guidance on assigning residential receiver noise categories. It presents three methods for determining which of the residential receiver noise categories apply. The three methods presented are:

- typical planning zoning (column 2 of NPfI Table 2.3);
- typical existing background noise levels (column 3 of NPfI Table 2.3); and
- description of the acoustical environment (column 4 of NPfI Table 2.3).

Recent clarification sought from the NSW EPA identified that selecting the appropriate amenity category would follow the above order from top to bottom of the above list. Assigning a noise category based on planning zoning alone provides for a conservative assessment without giving any consideration to the existing acoustic environment, and so following this the noise environment should be considered if appropriate for the situation.

##### 3.3.3.1.1 Residence located in Mount Vernon, Horsley Park, Kemps Creek, Luddenham and Orchard Hills

The nearest residential receivers that are located outside of the MRP are located in Mount Vernon, Horsley Park, Kemps Creek, Luddenham (near Twin Creeks Golf & Country Club) and Orchard Hills. The residences in these areas are located in areas zoned E2 Environmental Living, RU2 Rural Landscape and RU4 Primary Production Small Lots with falls under the Rural residential category in column 2 of NPfI Table 2.3, as shown in Table 3-11 and presented in the zoning maps presented in Appendix B.2.

**Table 3-11: Zoning of residential receivers**

| Location / Suburb | Zoning of residence | Column 2 of NPfI Table 2.3 classification |
|---|---|---|
| Mount Vernon | E4 Environmental Living | Rural residential |
| Kemps Creek | RU2 Rural Landscape, RU4 Primary Production Small Lots | Rural residential |
| Luddenham | E4 Environmental Living | Rural residential |
| Orchard Hills | RU2 Rural Landscape | Rural residential |

As such and in-line with undertaking a conservative assessment these receivers have been categorised as 'rural'.

##### 3.3.3.1.2 Isolated residences within an industrial zone within the MRP

In the notes of Table 2.3 of the NPfI, it states that "*… for isolated residences within an industrial zone the industrial zone amenity level would usually apply*". As a result of the rezoning of the area to be IN1 Industrial, as part of the Mamre Road Precinct (see Section 1.4.2), substantial portions of the land across the MRP has been acquired for proposed industrial developments (see Section 1.4.2). As such, the residential receivers that remain located within the MRP would be classified as "*isolated residences within an industrial zone*" in accordance with the NPfI. This is the classification that has been adopted

for this assessment. Furthermore, given that these receivers would likely be in place for only a short time, it would not be reasonable to provide mitigation or management measures in order to achieve the same acoustic amenity as for long-term receivers, and subsequently any consideration of mitigation or management measures should take this into account.

#### 3.3.3.1.3 Other sensitive receivers within an industrial zone within the MRP

The following non-residential sensitive receivers are located within the MRP, to the east of the Proposal:

- Emmaus Catholic College
- Trinity Primary School
- Mamre Anglican School

Even though these educational receivers are located within the land rezoned as industrial as part of the MRP (see Figure 4), they have been assessed as sensitive receivers because future development in the land covered by these receivers has not yet been approved.

### 3.3.3.2 Project amenity noise levels

To ensure that the total industrial noise level (existing plus new) remains within the recommended amenity noise levels for an area, the project amenity noise level should apply for each new industrial noise source coming into the area. Adjustments are required to take into consideration potential other industrial noise generating operations, and so for the Proposal the adjustments detailed in Section 3.3.1 have been adopted to consider the potential cumulative industrial noise levels. 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.

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

The project amenity noise levels ($L_{Aeq,\ 15min}$) applied for the Proposal are reproduced in Table 3-12.

**Table 3-12: Project amenity noise levels**

| Type of receiver | Noise amenity area | Time of day | Recommended noise level, dB(A) | |
|---|---|---|---|---|
| | | | $L_{Aeq,\ Period}$ | $L_{Aeq,\ 15min}$ |
| Residence | Rural (NCA 1,2,4,5) | Day | 50 – 10[4] = 40 | 40 + 3 = **43** |
| | | Evening | 45 – 10[4] = 35 | 35 + 3 = **38** |
| | | Night[1] | 40 – 10[4] = 30 | 30 + 3 = **33** |
| Isolated residences within an industrial zone (NCA3) | All | When in use or occupied | 70 – 10[4] = 60 | 60 + 3 = **63** |
| School classroom (internal)[3] | All | Noisiest 1-hour period when in use | 40 – 10[4] = 30 | 30 + 3 = **33** |
| Place of worship (internal) | All | When in use | 40 - 10[4] = 30 | 30 + 3 = **33** |
| Hospital ward | All | Noisiest 1-hour | 50 – 10[4] = 40 | 40 + 3 = **43** |
| Active recreation area (school playground) | All | When in use | 55 – 10[4] = 45 | 45 + 3 = **48** |
| Passive recreation area | All | When in use | 50 – 10[4] = 40 | 40 + 3 = **43** |
| Commercial Premises | All | When in use | 65 – 5[5] = 60 | 60 + 3 = **63** |
| Industrial premises | All | When in use | 70 – 5[5] = 65 | 65 + 3 = **68** |

Notes:
1. Daytime 7:00am to 6:00pm; Evening 6:00pm to 10:00pm; Night-time 10:00pm to 5:00am. On Sundays and Public Holidays, Daytime 8:00am - 6:00pm; Evening 6:00pm - 10:00 pm; Night-time 10:00pm - 7:00am.
2. The $L_{Aeq}$ index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.
3. In the case where existing schools are affected by noise from existing industrial noise sources, the acceptable LAeq noise level may be increased to 40 dB LAeq(1hr)
4. Refer to Section 3.3.1 for explanation and justification of the 10 dB(A) correction to account for cumulative industrial noise contributions.
5. Due to the close proximity of these types of development in order for noise impacts to occur, the NPfI approach of 5 dB(A) reduction to consider 3 to 4 developments contributing is appropriate.

### 3.3.4 Project noise trigger levels

The project noise trigger levels have been converted to $L_{Aeq\ 15min}$ values in accordance with Section 3.3.3.2 and these are presented in Table 3-13. The project intrusive noise levels have been presented for reference purposes only as per Section 3.3.2, and have not been used to determine the final project noise trigger levels.

**Table 3-13: Project noise trigger levels for residential receivers**

| Receiver location | $L_{Aeq, 15min}$ Project noise trigger levels, dB(A) | | | | | |
|---|---|---|---|---|---|---|
| | Day | | Evening | | Night | |
| | Intrusive[1] | Amenity | Intrusive[1] | Amenity | Intrusive[1] | Amenity |
| NCA1 | *41* | 43 | *38* | 38 | *35* | 33 |
| NCA2 | *43* | 43 | *39* | 38 | *39* | 33 |
| Isolated residences within an industrial zone within the MRP (NCA3) | *49* | 63[2] | *48* | 63[2] | *42* | 63[2] |
| NCA4 | *37* | 43 | *36* | 38 | *35* | 33 |
| NCA5 | *44* | 43 | *44* | 38 | *37* | 33 |

Notes: 1. Project intrusiveness levels shown from reference only, see Section 3.3.2 for further explanation.
2. See Section 3.3.3.1.2 for further explanation

In accordance with the NPfI the project noise trigger levels (PNTL), are presented in Table 3-14 below.

**Table 3-14: Project noise trigger levels**

| Receiver location | $L_{Aeq, 15min}$ Project noise trigger levels, dB(A) | | |
|---|---|---|---|
| | Day | Evening | Night |
| **Residential receivers[4]** | | | |
| NCA1 | 43 | 38 | 33 |
| NCA2 | 43 | 38 | 33 |
| Isolated residences within an industrial zone within the MRP (NCA3) | 63 | 63 | 63 |
| NCA4 | 43 | 38 | 33 |
| NCA5 | 43 | 38 | 33 |
| **Other sensitive receivers[5]** | | | |
| Childcare/School play area | 48 | n/a[3] | n/a[3] |
| School classroom (external equivalent) | 43[2] | n/a[3] | n/a[3] |
| Place of worship (external equivalent) | 43[2] | 43[2] | n/a[3] |
| Passive recreational area | 43 | 43 | n/a[3] |
| Commercial | 63 | 63 | 63[3] |
| Industrial | 68 | 68 | 68[3] |

Notes:
1. Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 5.00 am. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am.
2. Conversion of trigger levels from internal to external for school classroom and place of worship assumes 10dB(A) loss from outside to inside through open window.
3. Project noise trigger level is only applicable when the receiver type is in use.
4. For a residence, the project noise trigger level and maximum noise levels are to be assessed at the reasonably most-affected point on or within the residential property boundary.
5. For commercial or industrial premises the noise level is to be assessed at the reasonably most-affected point on or within the property boundary.

### 3.3.5 Sleep disturbance noise levels

The potential for sleep disturbance due to maximum noise level events from the Proposal site during the night-time period needs to be considered. In accordance with NPfI, a detailed maximum noise level event assessment should be undertaken where the subject development night-time noise levels 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 3-15.

**Table 3-15: EPA NPfI Sleep disturbance assessment trigger levels - Night (10:00pm to 7:00am)**

| Receiver type | Assessment level $L_{Aeq,15min}$ | Assessment level $L_{AFmax}$ |
|---|---|---|
| NCA1/2/4/5 | 40[1] | 52[2] |
| NCA3 | 42 | 52 |

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

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 (see Section 3.3.5.1.1).

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 (see Section 3.3.5.1.2).

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

#### 3.3.5.1 Current reference literature

##### 3.3.5.1.1 NSW RNP

In relation to maximum noise level events, the NSW 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. Given the equivalent external noise levels and considering the second point above, an $L_{Amax}$ 65 dB(A) has then been used as the assessment noise level to determine the potential for awakening reactions.

##### 3.3.5.1.2 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 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 NVIA 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 night-time to below 45 dB(A) $L_{night\ (outside)}$, 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 (eg $L_{Amax}$), 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 night time and therefore only includes recommendations about average noise indicators, e.g. $L_{night\ (outside)}$.

#### 3.3.5.2 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 3-16 below.

**Table 3-16: Sleep disturbance project assessment noise levels[5]**

| Receiver location | EPA NPfI sleep disturbance assessment levels | | WHO 2018 $L_{Aeq,15min}$[3] | Awakening reaction[4], $L_{Amax}$ |
|---|---|---|---|---|
| | Assessment level $L_{Aeq,15min}$ | Assessment level $L_{AFmax}$ | | |
| NCA1/2/4/5 | 40[1] | 52[2] | 48[3] | 65 |
| NCA3 | 42 | 52 | | |

Notes:
1. As per NPfI Section 2.5, minimum screening level is the greater of LAeq 40 dB(A) or RBL + 5dB.
2. As per NPfI Section 2.5, minimum screening level is the greater of LAFmax 52 dB(A) or RBL + 15dB.
3. As per Section 2.2 of the NPfI, the WHO 45 dB(A) Lnight (outside) has been converted to a LAeq,15minute level by adding 3 dB(A).
4. As per the NSW RNP, as detailed in Section 3.3.5.1.1.
5. Sleep disturbance assessment is applicable for the night period (10:00pm to 7:00am), as per Section 2.5of the NPfI.

## 3.4 Road traffic noise

Noise impacts from the potential increases in traffic on the surrounding road network due to construction and operational activities from the Proposal is assessed in accordance with the NSW *Road Noise Policy* (DECCW, 2011) (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 impacts 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 using sub-arterial / arterial roads and not local roads. Therefore, for existing residences affected by additional traffic on existing sub-arterial / arterial roads generated by land use developments, the following RNP road traffic noise criteria would apply.

**Table 3-17: 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.

## 3.5 Mamre Road Precinct Development Control Plan (Draft)

The MRP Draft Development Control Plan (DCP) 2020 applies to the Mamre Road Precinct within the State Environmental Planning Policy (Western Sydney Employment Area) 2009 (SEPP WSEA). Sections 4.3.1 relates to Noise and Vibration and is presented below.

> ***4.3.1 Noise and Vibration***
>
> ***Objectives***
>
> *a) Establish design criteria for noise emissions from industrial or other employment-generating development.*
>
> *b) Establish acoustic environmental goals for existing and future adjacent residential areas.*
>
> *c) Establish noise contributions for individual allotments within the employment zones when related to residential boundaries.*

***Controls***

*1) Any machinery or activity considered to produce noise emissions from a premise shall be adequately sound-proofed so that noise emissions are in accordance with the provisions of the Protection of the Environment Operations Act 1997.*

*2) The use of mechanical plant and equipment may be restricted in areas close to sensitive receivers, such as adjoining rural residential development. Developers in all areas should ensure through design of their development that no offensive noise is emitted.*

*3) Where it is considered likely that a development may cause an adverse impact on nearby rural or residential areas, an acoustic report from a qualified acoustical engineer will be required to be submitted for consideration with the development application. The acoustic report will need to demonstrate that the proposed development will not create any adverse impact.*

*4) All development shall comply with the requirements of relevant Australian Standards and State Government policies and guidelines relating to noise.*

***Erection of Buildings:***

*5) An acoustic report shall be required for developments that are likely to generate high noise levels and for development within 500m of residential areas and other sensitive noise receivers, including seniors housing, places of public worship and educational establishments. The acoustic design report should refer to the relevant Australian Standards and State Government policies and guidelines relating to noise.*

*6) If an acoustic report is not required at the development application stage, conditions will be imposed as part of the development consent which requires compliance with the relevant Australian Standards and State Government policies and guidelines relating to noise. Applicants must have regard to the criteria and demonstrate a standard of acoustic treatment for the building to comply with such criteria.*

*7) It is essential that potential developers investigate noise amelioration features to be included in building design, which will assist in achieving compliance with Council's acoustic criteria. Having regard to the surrounding topography, it is critical that the roof element of all buildings be acoustically capable of controlling potential breakout noise.*

Additionally, **Section 2.11 of the MRP DCP** is concerned with Aviation Safeguarding and is presented below:

***Objectives***

*a) To safeguard the future operations of the Western Sydney Airport, including 24-hour operations and provide appropriate protections for the surrounding community.*

*b) To ensure compatible development that exhibits design excellence occurs on surrounding land.*

*c) To ensure development does not introduce or intensify noise sensitive uses.*

***Controls***

*1) An Aviation Safeguarding Assessment is to be submitted detailing compliance with aviation safeguarding measures and the controls outlined below.*

*…*

***Noise***

*3) Development is constructed in accordance with Australian Standards AS2021 – Acoustics Noise Intrusion – Building Siting and Construction.*

*4) Renovations to existing houses or minor extensions within ANEC/ANEF 20 and above must be constructed in accordance with Australian Standard AS2021 – Acoustics – Aircraft Noise Intrusion – Building Siting and Construction.*

## 3.6 State Environmental Planning Policy (Western Sydney Employment Area) 2009 (SEPP WSEA)

In the SEPP WSEA (2009) Clause 23 contains items related to noise emissions, and Clause 33D contains items related to aircraft noise.

By addressing Section 2.11 of the MRP DCP, this will address the noise requirements detailed in Clause 33D of the SEPP WSEA (2009).

By addressing the requirements of the NPfI, this will address the noise requirements detailed in Clause 23 of the SEPP WSEA (2009).

## 3.7 Aircraft noise intrusion

As required by the MRP DCP (Section 2.11) and the SEPP WSEA (2009), Proposed developments should be assessed to determine that they can achieve the noise level requirements of *Australian Standards AS2021 – Acoustics Noise Intrusion – Building Siting and Construction*.

The Western Sydney Airport ANEC contours have been reviewed, as an ANEF chart would be developed as part of the airport detailed design for endorsement by Airservices Australia. As such, the Western Sydney Airport (WSA) Airport Plan September 2021 has been reviewed, and Figure 15 "*Indicative ANEC contours for Prefer 05 and Prefer 23 operating modes – Long Term*" shows that the Proposal site is located outside of the ANEC 20 contour, as shown in Figure 8. The ANEC contours for the Western Sydney Airport have been reviewed, and the Proposal site is located outside of the ANEC 20 contour, except for the "*Stage 1 Additional Capacity (One Runway Year 2050) Prefer 05 Direction*" situation for which the Proposal is located on the ANEC 20 contour. As such, a further review of the of the potential aircraft noise levels has been undertaken in accordance with AS2021:2015.

**Figure 8: Western Sydney Airport ANEC (One Runway (Year 2050) – Preferred 05 direction)**




Notes: 1. Western Sydney Airport Noise modelling tool, https://www.westernsydneyairport.gov.au/about/flight-paths/noise-tool, sourced 8/10/2021

### 3.7.1 AS2021-2015 - aircraft noise intrusion

Aircraft noise intrusion from take-off, landing and circuit training operations at civil aerodromes or military airfields is assessed using Australian Standard A2021-2015 – '*Acoustics – Aircraft Noise Intrusion – Building Siting and Construction*' ('AS2021'). This section of the report outlines the application of AS2021. The scope of AS2021-2015 is stated as:

> *This standard, together with the relevant Australian Noise Exposure Forecast (ANEF) chart provides guidelines for determining-*
>
> *a. whether the extent of aircraft noise intrusion makes building sites 'acceptable', 'unacceptable' or 'conditionally acceptable' for the types of activity to be, or being, undertaken (Clause 2.3);*
>
> *b. for 'conditionally acceptable' sites, the extent of noise reduction required to provide acceptable noise levels indoors for the types of activity to be, or being, undertaken; and*

*c. the type of building construction necessary to provide a given noise reduction, provided that external windows and doors are closed.*

### 3.7.2 Building site acceptability

AS2021 contains advice on the acceptability of building sites based on Australian Noise Exposure Forecast (ANEF) zones. The ANEF chart provides a predicted cumulative exposure to aircraft flyover noise in communities near aerodromes. The chart presents zones represented by noise contours overlaid on a locality map specific to an airport. The ANEF system was developed as a land use planning tool aimed at controlling encroachment on airports by noise sensitive buildings.

Table 2.1 of AS2021 sets acceptability zones for different building types and land uses. Table 3-18 reproduces the sections of AS2021 Table 2.1 relevant to the Proposal and given it is situated on the 20 contour is acceptable.

**Table 3-18: Building site acceptability based on ANEF zones (Table 2.1 of AS2021)**

| Building type | ANEF zone of site | | |
|---|---|---|---|
| | Acceptable | Conditional | Unacceptable |
| Commercial building | Less than ANEF 25 | 25 to 35 ANEF[2] | Greater than 35 ANEF |
| Light industrial | Less than ANEF 30[1] | 30 to 40 ANEF[2] | Greater than 40 ANEF |
| Other industrial | Acceptable in all ANEF zones | | |

Section 2.3 of AS2021 details the actions resulting from the acceptability determination. Table 3-19 presents the outcomes as a result of the Proposal building being classified as acceptable.

**Table 3-19: Description of building site acceptability**

| Zone | Description |
|---|---|
| Acceptable | If from Table 2.1, the building site is classified as 'acceptable', there is usually no need for the building construction to provide protection specifically against aircraft noise. However, it should not be inferred that aircraft noise will be unnoticeable in areas outside the ANEF 20 contour. (See Notes 1, 2 and 3 of AS2021:2015 Table 2.1.) |

As such the Proposal has been assessed as acceptable and it is determined that no further assessment is required to address the requirements of AS2021:2015.

# 4 Construction noise and vibration assessment

## 4.1 Background

Construction activities associated with the proposed development will result in increased noise levels during construction hours. The works undertaken in the various stages 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 project.

As part of the works approved for SSD 9522, the Proposal site is undergoing bulk earthworks bulk earthworks and infrastructure. A construction noise and vibration management plan has been prepared by Acoustic Works (*reference 1018022 R02D Mamre Road Kemps Creek NMP.doc dated 22 April 2020*) which covers the bulk earthworks and infrastructure phases of the Proposal, and has been approved by DPIE. As such, these stages have not been assessed as part of this application.

## 4.2 Proposal construction works

The following construction works will be required to construct, fit out Proposal, as detailed in Section 1.3.3.

- Minor earthworks involving cut and fill works, site preparation works and the establishment of a building pad;
- Infrastructure comprising civil works and augmentation of utilities servicing;
- Construction, internal fit out of a manufacturing facility and warehouse (27,470m$^2$)

## 4.3 Construction hours

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

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

## 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.

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 noise assessments.

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.

The approximate phases and duration of works are presented in Table 4-1.

**Table 4-1: Approximate construction phases and duration of works**

| Stage / Description | | Details | Time frame | Approximate dates (subject to approval) |
|---|---|---|---|---|
| Earthworks | Site establishment | Undertaken under in accordance with the existing approval for SSD 9522 | | |
| | Earthworks and civil works | | | |
| Minor civil works | Cut and fill works, site preparation work | Cut and fill works, site preparation works and the establishment of a building pad | < 0.5 year | Early 2022 |
| | Utility augmentation works | Civil works and augmentation of utilities servicing | < 0.5 year | Early 2022 |
| Site construction | Building construction | Construction of the main building structure | 1 year | Mid 2022 |
| | Building fit-out | Deliveries and fitout of the distributions centre, deliveries of operational plant and equipment | 0.5 year | Late 2022 |

### 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 construction waste 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. When construction-related traffic moves on the public road network, a different noise assessment methodology is appropriate as vehicle movements would be regarded as additional road traffic on public roads rather than as part of the construction site's activities.

The primary potential route to and from the Proposal for construction vehicles would be via Mamre Road, with trucks accessing the Proposal site from the M4 Western Motorway either via the Erskine Park Road interchange from the northeast or the Mamre Road interchange in the north. Another potential route would be via Mamre Road and the Elizabeth Drive interchange with the M7 Motorway from the

south. RMS currently identifies both routes as heavy vehicle routes. Construction of the Proposal would generate additional truck movements along these routes. Given that these routes currently carry high volumes of heavy vehicles, construction of the development would not have a significant impact on the performance of Mamre Road, Erskine Park Road, Elizabeth Road, the M4 Motorway or the M7 Motorway.

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 per hour, over a standard 10 hour work day. However, as SSD 9522 already covers the more truck intensive activities of demolition, excavation and civil works, and that this Proposal only includes the minor civil works, building construction and building fit-out, the required trucks are likely to be less than this peak.

Considering the existing traffic volumes of the primary potential routes to/from the site presented in Section 5.1.2, this volume of construction traffic as a result of this Proposal is not expected to significantly alter existing traffic noise.

Construction traffic from the site on 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 4-2 below.

**Table 4-2: Typical construction equipment & sound power levels, dB(A) re 1pW**

| Plant item | Plant description | Estimated number of items | Individual source/activity sound power level ($L_w$ re. 1pW), $L_{Aeq,15min}$, dB(A) |
|---|---|---|---|
| **Ref.** | **Cut and fill works, site preparation work** | | |
| 1 | Dozer (CAT D9) | 1 | 116 |
| 2 | Grader | 2 | 110 |
| 3 | Vibratory roller | 2 | 109 |
| 4 | Compactor | 2 | 108 |
| 5 | Powered hand tools | Various | 107 |
| 6 | Double bogey tippers | 4 | 105 |
| 7 | Water cart | 1 | 105 |
| 8 | 20-tonne excavator with claw/bucket | 2 x 20-tonne excavators in total | 105 |
| 9 | Bobcat | 2 | 102 |
| 10 | Non-powered hand tools | Various | 98 |

| Plant item | Plant description | Estimated number of items | Individual source/activity sound power level ($L_w$ re. 1pW), $L_{Aeq,15min}$, dB(A) |
|---|---|---|---|
| | **Utility augmentation works** | | |
| 11 | Delivery trucks | 2 | 108 |
| 12 | Plate compactor | 2 | 108 |
| 13 | Hand tools | Various | 107 |
| 14 | Excavator with bucket | 1 | 105 |
| 15 | Generator (enclosed) | 1 | 103 |
| 16 | Bobcat | 2 | 102 |
| 17 | Franna crane | 1 | 98 |
| | **Building construction** | | |
| 18 | Concrete trucks | 2 | 108 |
| 19 | Delivery trucks | 2 | 108 |
| 20 | Hand tools | Various | 107 |
| 21 | Mobile/Tower crane | 2 | 110 |
| 22 | Concrete pump | 2 | 102 |
| 23 | Bobcat | 2 | 102 |
| 24 | Concrete vibrator | 8 | 99 |
| 25 | Non-powered hand tools | Various | 98 |
| | **Building fit-out** | | |
| 26 | Delivery trucks | 2 | 108 |
| 27 | Hand tools | Various | 107 |
| 28 | Bobcat | 2 | 102 |
| 29 | Scissor lift | 2 | 99 |
| 30 | Non-powered hand tools | Various | 98 |

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 Interim Construction Noise Guideline (ICNG), information from past projects and/or information held in our library files.

## 4.5 Construction noise and vibration 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 Section 4.4.1.

Table 4-3 presents noise levels likely to be experienced at the nearby affected receivers based on the construction activities and plant and equipment associated with the proposed site. The predicted noise levels have conservatively been based upon the noise level when the plant or equipment are at the location closest to the receiver. Noise levels were calculated taking into consideration attenuation due to distance between the construction works and the receiver locations.

For the construction assessments, it has been conservatively assumed that none of the surrounding warehouses in SSD 9522 have been constructed at the time of the construction works. However, it is likely that during building construction of a number of these developments will be occurring concurrently, and as such, there may be additional intervening structures to assist with reducing construction noise emissions.

The worst affected receivers for are typically in the first row of houses with direct line-of-sight to the construction work area. Receivers in the next row of houses back 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 4-3: Predicted $L_{Aeq(15min)}$ noise levels for typical construction plant, dB(A)**

| Plant item | Plant description | Predicted $L_{Aeq(15min)}$ construction noise levels | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Receiver Type | Residential | | | | | | | | | | | Education | Industrial |
| | NCA | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | - | - |
| | Representative receiver | R1 | R2 | R3 | R5 | R8 | R10 | R11 | R13 | R14 | R15 | R16 | R18 | R9 |
| **Noise management level (external)<br>Standard construction hours<br>Mon-Fri – 7:00am to 5:00pm<br>Sat – 8:00am to 1:00pm** | | **46** | **46** | **46** | **46** | **48** | **54** | **54** | **54** | **54** | **54** | **54** | **55[1]** | **75** |
| **Cut and fill works, site preparation work** | | | | | | | | | | | | | | |
| 1 | Dozer (CAT D9) | 39 | 43 | 43 | 38 | 34 | 41 | 43 | 44 | 25 | 41 | 43 | 33 | 43 |
| 2 | Grader | 33 | 37 | 37 | 32 | 28 | 35 | 37 | 38 | <20 | 35 | 37 | 27 | 37 |
| 3 | Vibratory roller | 32 | 36 | 36 | 31 | 27 | 34 | 36 | 37 | <20 | 34 | 36 | 26 | 36 |
| 4 | Compactor | 31 | 35 | 35 | 30 | 26 | 33 | 35 | 36 | <20 | 33 | 35 | 25 | 35 |
| 5 | Powered Hand tools | 30 | 34 | 34 | 29 | 25 | 32 | 34 | 35 | <20 | 32 | 34 | 24 | 34 |
| 6 | Double Bogey Tippers | 28 | 32 | 32 | 27 | 23 | 30 | 32 | 33 | <20 | 30 | 32 | 22 | 32 |
| 7 | Water cart | 28 | 32 | 32 | 27 | 23 | 30 | 32 | 33 | <20 | 30 | 32 | 22 | 32 |
| 8 | 20-tonne excavator with claw/bucket | 28 | 32 | 32 | 27 | 23 | 30 | 32 | 33 | <20 | 30 | 32 | 22 | 32 |
| 9 | Bobcat | 25 | 29 | 29 | 24 | <20 | 27 | 29 | 30 | <20 | 27 | 29 | <20 | 29 |
| 10 | Non-powered hand tools | 21 | 25 | 25 | 20 | <20 | 23 | 25 | 26 | <20 | 23 | 25 | <20 | 25 |
| | Up to 3 (noisiest) plant operating concurrently | 41 | 45 | 44 | 40 | 35 | 43 | 45 | 45 | 26 | 43 | 45 | 35 | 45 |
| **Utility augmentation works** | | | | | | | | | | | | | | |
| 11 | Delivery trucks | 31 | 35 | 35 | 30 | 26 | 33 | 35 | 36 | <20 | 33 | 35 | 25 | 35 |
| 12 | Plate compactor | 31 | 35 | 35 | 30 | 26 | 33 | 35 | 36 | <20 | 33 | 35 | 25 | 35 |
| 13 | Hand tools | 30 | 34 | 34 | 29 | 25 | 32 | 34 | 35 | <20 | 32 | 34 | 24 | 34 |
| 14 | Excavator with bucket | 28 | 32 | 32 | 27 | 23 | 30 | 32 | 33 | <20 | 30 | 32 | 22 | 32 |
| 15 | Generator (enclosed) | 26 | 30 | 30 | 25 | 21 | 28 | 30 | 31 | <20 | 28 | 30 | 20 | 30 |
| 16 | Bobcat | 25 | 29 | 29 | 24 | <20 | 27 | 29 | 30 | <20 | 27 | 29 | <20 | 29 |
| 17 | Franna crane | 21 | 25 | 25 | 20 | <20 | 23 | 25 | 26 | <20 | 23 | 25 | <20 | 25 |
| | Up to 3 (noisiest) plant operating concurrently | 36 | 40 | 39 | 35 | 30 | 38 | 40 | 40 | <20 | 38 | 40 | 30 | 40 |

| Plant item | Plant description | Predicted $L_{Aeq(15min)}$ construction noise levels | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Receiver Type | Residential | | | | | | | | | | | Education | Industrial |
| | NCA | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | - | - |
| | Representative receiver | R1 | R2 | R3 | R5 | R8 | R10 | R11 | R13 | R14 | R15 | R16 | R18 | R9 |
| **Noise management level (external)**<br>**Standard construction hours**<br>**Mon-Fri – 7:00am to 5:00pm**<br>**Sat – 8:00am to 1:00pm** | | **46** | **46** | **46** | **46** | **48** | **54** | **54** | **54** | **54** | **54** | **54** | **55**[1] | **75** |
| **Building construction** | | | | | | | | | | | | | | |
| 18 | Concrete trucks | 31 | 35 | 35 | 30 | 26 | 33 | 35 | 36 | <20 | 33 | 35 | 25 | 35 |
| 19 | Delivery trucks | 31 | 35 | 35 | 30 | 26 | 33 | 35 | 36 | <20 | 33 | 35 | 25 | 35 |
| 20 | Hand tools | 30 | 34 | 34 | 29 | 25 | 32 | 34 | 35 | <20 | 32 | 34 | 24 | 34 |
| 21 | Mobile/Tower crane | 33 | 37 | 37 | 32 | 28 | 35 | 37 | 38 | <20 | 35 | 37 | 27 | 37 |
| 22 | Concrete pump | 25 | 29 | 29 | 24 | <20 | 27 | 29 | 30 | <20 | 27 | 29 | <20 | 29 |
| 23 | Bobcat | 25 | 29 | 29 | 24 | <20 | 27 | 29 | 30 | <20 | 27 | 29 | <20 | 29 |
| 24 | Concrete vibrator | 22 | 26 | 26 | 21 | <20 | 24 | 26 | 27 | <20 | 24 | 26 | <20 | 26 |
| 25 | Non-powered hand tools | 21 | 25 | 25 | 20 | <20 | 23 | 25 | 26 | <20 | 23 | 25 | <20 | 25 |
| | Up to 3 (noisiest) plant operating concurrently | 37 | 41 | 40 | 36 | 31 | 39 | 40 | 41 | 23 | 39 | 41 | 31 | 41 |
| **Building fit-out** | | | | | | | | | | | | | | |
| 26 | Delivery trucks | 31 | 35 | 35 | 30 | 26 | 33 | 35 | 36 | <20 | 33 | 35 | 25 | 35 |
| 27 | Hand tools | 30 | 34 | 34 | 29 | 25 | 32 | 34 | 35 | <20 | 32 | 34 | 24 | 34 |
| 28 | Bobcat | 25 | 29 | 29 | 24 | <20 | 27 | 29 | 30 | <20 | 27 | 29 | <20 | 29 |
| 29 | Scissor lift | 22 | 26 | 26 | 21 | <20 | 24 | 26 | 27 | <20 | 24 | 26 | <20 | 26 |
| 30 | Non-powered hand tools | 21 | 25 | 25 | 20 | <20 | 23 | 25 | 26 | <20 | 23 | 25 | <20 | 25 |
| | Up to 3 (noisiest) plant operating concurrently | 34 | 38 | 38 | 33 | 29 | 36 | 38 | 39 | 21 | 36 | 38 | 28 | 38 |

Notes: 1. 55 dB(A) for classroom spaces (external), and 65 dB(A) for playground areas. By achieving the classroom NML, the playground level will be achieved.

The predicted noise levels presented above indicate that the noise levels during the cut and fill works, utility augmentation works, building construction and building fit-out stages are all likely to achieve the NML at all nearby sensitive receivers. No residential receivers are predicted to be highly noise affected [i.e., exposed to noise levels greater than 75 dB(A)].

In light of 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 4.5.3 below.

### 4.5.2 Cumulative noise impacts

Due to the number of other concurrent construction projects proposed as part of the MRP and The Yards (SSD 9522) industrial estate occurring over a similar timeframe to the Proposal, there is the potential for cumulative noise impacts on nearby receivers.

However, as the highest predicted construction noise levels at the closest receiver locations is 41 dB(A), 5 dB(A) below the standard hours NML, cumulative construction impacts are unlikely. However, considering the large number of potential concurrent projects, to ensure that potential noise impacts are managed, either in terms of level or overall duration of exposure. The following measures are to be used to mitigate and manage cumulative noise impacts along with potential construction fatigue:

- Coordinating work between construction sites to minimise cumulative noise impacts, where feasible and reasonable (ie. to ensure that multiple sites are not undertaking noise intensive works concurrently with direct line of sight to receivers).
- Community consultation to gauge key noise impacts and issues and identify any unknown impacts from concurrent or consecutive sets of constructions works.
- Consideration of cumulative construction noise impacts during the development of noise mitigation and management measures for the worksites, including coordination between construction projects, where reasonable and feasible.

These mitigation measures would be included in the CNVMP or CEMP and would include how the above measures would be incorporated during the works.

### 4.5.3 Construction noise mitigation measures

#### 4.5.3.1 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 4-4 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 4-4: 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 | RT&A | AS 2436 | RT&A |
| 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 4-5 below identifies possible noise control measures, which are applicable on the construction plant likely to be used on site.

**Table 4-5: Possible noise control measures for likely construction plant**

| Plant Description | Screening | Acoustic enclosures | Silencing | Alternative process |
|---|---|---|---|---|
| Concrete truck | ✔ | ✖ | ✔ | ✖ |
| Delivery trucks | ✔ | ✖ | ✔ | ✖ |
| Electric / mobile crane | ✔ | ✔ | ✖ | ✖ |
| Hand tools | ✔ | ✖ | ✔ | ✖ |

#### 4.5.3.2 Noise management measures

The following recommendations provide feasible and reasonable noise control solutions to reduce noise impacts to sensitive receivers. **These should be considered and implemented where feasible and reasonable where there is potential for the noise management levels presented in Section 3.2 to be exceeded by the construction works either individually or cumulatively**.

**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.
- 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.
- 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 toolbox talks 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.

#### 4.5.3.3 Noise monitoring

Given that all noisy activities such as earthworks and civil works are to be undertaken under the existing approval for SSD 9522, and given that the construction noise predictions presented in Section 4.5.1 do not show exceedances, verification noise monitoring are not considered necessary during the Proposal construction stages. However, should complaints be received then monitoring may be necessary as part of the investigation into the complaints.

### 4.5.4 Vibration assessment

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.

During the building construction and building fit-out phases vibration intensive plant and equipment are not proposed to be typically used as part of the construction works.

During the minor civil works stages, vibration intensive equipment such as vibratory rollers and compactors will likely be required. For these vibration intensive plant items, the recommended minimum working distance typically required to achieve the vibration levels presented in Section 3.2 are up to 25 metres for building structure damage and 100 metres for human annoyance.

Considering that the closest existing sensitive receiver structure is greater than 600 metres away, and the closest proposed warehouse is approximately 15 metres from the Proposal building structure and is unlikely to be constructed at the time of the Proposal construction works, there is a low to negligible risk of vibration impacts. This of course depends on the location of the construction works and whether sensitive structures have been constructed nearby when vibration intensive works are proposed.

The only potential vibration impacts to nearby buildings are to the proposed adjacent future warehouse and industrial structures during their construction as they are structurally sound once built. As these structures may not be present on the adjacent lots at the time of vibration intensive construction works, this is only applicable if they are present and in a state of partial construction where they may be vibration sensitive. Albeit there is a low to negligible risk of vibration impact.

If the plant, equipment and processes are different or more vibration intensive (eg percussive piling, rock hammering, etc), and there are sensitive receivers in proximity to the works (ie. the proposed adjacent future warehouse structures or tenant operations are vibration sensitive), then they should be reviewed with consideration to the nearest sensitive structures, and site specific minimum working distances established to achieve the vibration levels presented in Section 3.2.

### 4.5.5 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 F.

# 5 Operational noise assessment

## 5.1 Operational road traffic

### 5.1.1 Proposal vehicle movements and traffic generation

Heavy vehicle movements for operational traffic to and from the Proposal site will be along approximately 1 km of the public roads within the SSD 9522 industrial development, and then along Mamre Road and connecting to the nearby major arterial roads. These are shown in Figure 9, which shows that heavy and light vehicles generated by the Proposal are likely to use the following two routes:

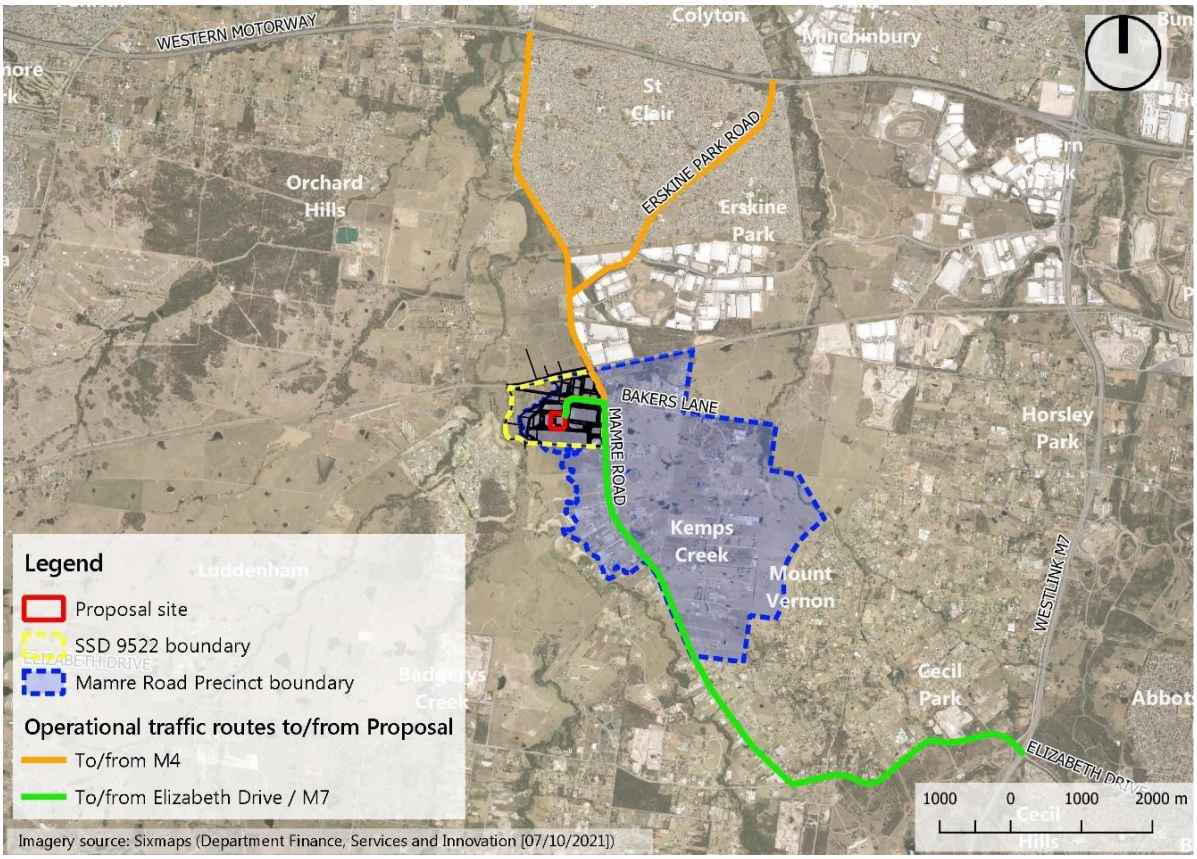
- Departing the site/travel to the site from for the M4 Western Motorway via Mamre Road (and Erskine Park Road) (**orange line** in Figure 9)
- Departing the site/travel to the site from Elizabeth Drive / M7 Motorway (**green line** in Figure 9)

The traffic volumes used for traffic noise predictions and assessment were based on traffic movement data and route distribution data provided by the project team. The potential routes for developments within the SSD 9522 masterplan, which includes the Proposal site, are detailed in the SSD 9522 Traffic Impact Assessment (*Ason, Traffic Impact Assessment - Proposed Warehouse, Logistics and Industrial Facilities Hub, 657-769 Mamre Road, Kemps Creek, ref: 0584r04v4, dated 3/8/202*0) (SSD 9522 TIA).

Potential routes and indicative peak hour movements are shown in Appendix E-1 of the SSD 9522 TIA, based upon the expected routes likely to be used by traffic generated by the SSD 9522.

The site is proposed to generate up to 70 heavy vehicle and 280 light vehicle trips per day (inbound and outbound movements), with the night (10:00pm to 7:00am) proportion of those trips being up to 12 heavy vehicle and 45 light vehicle trips.

**Figure 9: Operational truck routes**




### 5.1.2 Future context - Mamre Road upgrade (MRU), Elizabeth Drive upgrade (EDU) and M12 Motorway

For vehicles heading north to the M4 via Mamre Road, it is known that the road network in the general vicinity of the MRP is due to receive significant road upgrades in the future as part of the Mamre Road Upgrade (MRU) strategy. This is similar for vehicles heading south, as it these vehicles will go along Elizabeth Drive which is being upgraded as part of the Elizabeth Drive upgrade (EDU), in addition to being covered by the M12 Motorway project which impacts some of the same receivers.

During August/September 2021, the Review of Environmental Factors (REF) for the proposed Mamre Road upgrade between the M4 Motorway and Erskine Park Road was on public display.

As part of the REF, a noise and vibration impact assessment (MRU NVIA) (*SLR, Mamre Road Upgrade - Stage 1 Noise and Vibration Assessment, report reference 610.30064-R02-v1.0, dated 23/07/2021)* was included. This assessment was based upon the road traffic volumes and modelling presented in the Traffic and transport assessment report (*Aurecon/SMEC, Mamre Road Upgrade - Stage 1 Concept Design, REF and Detailed Design – Traffic and Transport Assessment Report, report reference 509458, Rev G, dated 17/08/2021) (MRU TTAR)*.

As detailed in the MRU TTAR Section 2.6.3, which states:

*The land use in the area is changing rapidly and there are a number of strategic planning documents and proposals that have been accounted for in the traffic volume forecast, namely:*

- *Mamre West Precinct*
- *Mamre Road precinct and proposed inter-modal terminal*
- *Horsley Park and Cecil Park Structure Plan*
- *Western Sydney Airport and Aerotropolis in the Western Parkland City*

Similar to vehicles heading north, the traffic generated as part of the MRP have also been considered as part of the M12 Motorway EIS. The traffic modelling detailed in the M12 EIS TTAR Section 7.4.2 was the basis of the noise and vibration impact assessment for the M12. The cumulative impact assessments of the operation of the Elizabeth Drive and Mamre Road upgrades include traffic volumes used for the cumulative assessments and are detailed in Section 4.2.5 of the M12 NVIA.

As such, the potential traffic generated from the MRP, such as that from the Proposal has already been considered as part of the proposed road upgrade projects that the Proposal traffic will be using.

Additionally, presented in Appendix D of the MRU NVIA are the build and no-build traffic volumes for the upgrade project, as traffic volumes are expected to increase from 2020 levels. This presents the potential traffic volumes along the routes that the Proposal traffic will operate, to consider against the traffic generation by the Proposal. The proposed traffic volumes along Mamre Road north of the Proposal, are presented in Table 5-1.

**Table 5-1: MRU NVIA traffic volumes – Mamre Road (MRU NVIA, Appendix D, At-opening 2026)**

| Location | Direction | Average hourly traffic from 7:00am – 10:00pm (15 hour) | | | Average hourly traffic from 10:00pm – 7:00am (9 hour) | | |
|---|---|---|---|---|---|---|---|
| | | Total Vehicles | Light | Heavy | Total Vehicles | Light | Heavy |
| **No Build (without project) 2026** | | | | | | | |
| Between Bakers Ln & James Erskine Dr | Southbound | 10,539 | 9,181 | 1,358 | 2,945 | 2,624 | 321 |
| | Northbound | 9,717 | 8,501 | 1,216 | 1,894 | 1,637 | 257 |
| | Both direction | 20,256 | 17,682 | 2,574 | 4,839 | 4,261 | 578 |
| Erskine Park Road | Eastbound | 5,689 | 4,715 | 974 | 1,249 | 1,017 | 232 |
| | Westbound | 7,528 | 6,489 | 1,039 | 1,772 | 1,525 | 247 |
| | Both direction | 13,217 | 11,204 | 2,013 | 3,021 | 2,542 | 479 |
| **Build (with project) 2026** | | | | | | | |
| Between Bakers Ln & James Erskine Dr | Southbound | 11,240 | 9,882 | 1,358 | 3,141 | 2,820 | 321 |
| | Northbound | 10,530 | 9,314 | 1,216 | 2,053 | 1,796 | 257 |
| | Both direction | 21,770 | 19,196 | 2,574 | 5,194 | 4,616 | 578 |
| Erskine Park Road | Eastbound | 6,867 | 5,893 | 974 | 1,617 | 1,385 | 232 |
| | Westbound | 7,528 | 6,489 | 1,039 | 1,772 | 1,525 | 247 |
| | Both direction | 14,395 | 12,382 | 2,013 | 3,389 | 2,910 | 479 |

**Table 5-2: M12 Motorway traffic volumes (M12 NVIA, Appendix D)**

| Location | Direction | Average hourly traffic from 7:00am – 10:00pm (15 hour) | | | Average hourly traffic from 10:00pm – 7:00am (9 hour) | | |
|---|---|---|---|---|---|---|---|
| | | Total Vehicles | Light | Heavy | Total Vehicles | Light | Heavy |
| **2017 Existing traffic counts** | | | | | | | |
| Elizabeth Drive (East of Mamre Road) | Eastbound | 10,539 | 9,181 | 1,358 | 2,945 | 2,624 | 321 |
| | Westbound | 9,717 | 8,501 | 1,216 | 1,894 | 1,637 | 257 |
| | Both direction | 20,256 | 17,682 | 2,574 | 4,839 | 4,261 | 578 |
| **Build (with project) 2026[1]** | | | | | | | |
| Elizabeth Drive (Duff Road to Mamre Road) | Eastbound | 10,461 | 9,340 | 1,121 | 2,581 | 2,283 | 298 |
| | Westbound | 12,341 | 10,218 | 2,123 | 2,606 | 2,294 | 312 |
| | Both direction | 22,802 | 19,558 | 3,244 | 5,187 | 4,577 | 610 |

Notes: 1. As the M12 Motorway will take some traffic off Elizabeth Drive at this location, the Build (with project) 2026 numbers are shown.

### 5.1.3 Road traffic noise assessment outcome

The site proposes to generate up to 70 heavy vehicle and 280 light vehicle trips per day (inbound and outbound movements), with the night (10:00pm to 7:00am) proportion of those trips being up to 12 heavy vehicle and 45 light vehicle trips. The portion of traffic generated by the Proposal makes up an insignificant amount of traffic compared to the potential future traffic volumes along the Mamre Road and Elizabeth Drive as shown in the data presented in Section 5.1.2. Additionally, these levels of traffic have already been factored in to other proposed major projects along the Proposal traffic routes, and as Section 6.5 of the TIA notes the Proposal traffic generation is likely to be lower than the approved traffic generation as part of the approved SSD 9522 and the MRP contribution. As such, potential impacts from the road traffic generated by the Proposal on public roads does not require further consideration.

Section 3.5 "*Cumulative impacts from traffic generating developments*" of the RNP is important for consideration with regard to the MRP. However, as the potential generation by the Mamre Road precinct and proposed inter-modal terminal are being considered as part of the Mamre Road Upgrade (MRU), Elizabeth Drive Upgrade (EDU) and M12 Motorway projects, then this requirement of the RNP will be addressed by those road projects accordingly.

### 5.1.4 Southern Link Road (SLR)

Therefore, following the above assessments, the traffic noise levels as a result of the operational traffic from the Proposal on public roads would meet the RNP requirements.

Additionally, the Southern Link Road (SLR) is proposed as part of the MRP. This will likely substantially alter the traffic patterns in the area, and for traffic generated by developments within the MRP.

However, as this has not been approved, this has not been considered further in this assessment.

## 5.2 Operations noise sources

To undertake a noise and vibration assessment for the facility, the NPfI requires a comprehensive assessment of the potential operational noise emissions from the Proposal. The basis of these noise emissions is what would be the "reasonable worst case 15-minute period" noise emissions for each of the Day (7:00am to 6:00pm), Evening (6:00pm to 10:00pm) and Night (10:00pm to 7:00am) periods.

The noise sources associated with the operation of the Proposal can be separated into the following categories:

- truck movements within the manufacturing facility
  - raw material deliveries
  - receiving and dispatching trucks
- passenger vehicle movements and car parking
- loading dock receiving and dispatching activities
- internal manufacturing activities
- office related activities (fixed mechanical plant)

The following sections detail the key noise generating plant and equipment that will operate as part of typical operations of the manufacturing facility and warehouse. This section is separated into the following two parts:

1. Description of operational assumptions
2. Summary of reasonable worst-case assessment scenarios

All noise generating activities modelled for the facility operations have been based upon noise measurements undertaken at the existing similar manufacturing facility as per Section 2.2 and APPENDIX C or sourced from the RT&A database of previous measured levels representative of the proposed noise generating activity.

The noise source levels used for the modelling are presented in APPENDIX D. The type and quantity for the each of the various noise sources assessed across the operational scenarios are detailed in Table 5-9. The locations for the various modelled noise sources across the Proposal site are presented in Figure 10.

### 5.2.1 Description of operational assumptions

#### 5.2.1.1 Overview of noise generating activities

A general description of external noise source operations is presented in Table 5-3, to provide a picture of the typical proposed operations within the facility. Based upon these operations, 'reasonable' worst-case scenarios (15-minute period) have been developed to undertake an assessment of site noise emissions in accordance with the NPfI and are detailed in Section 5.2.2.

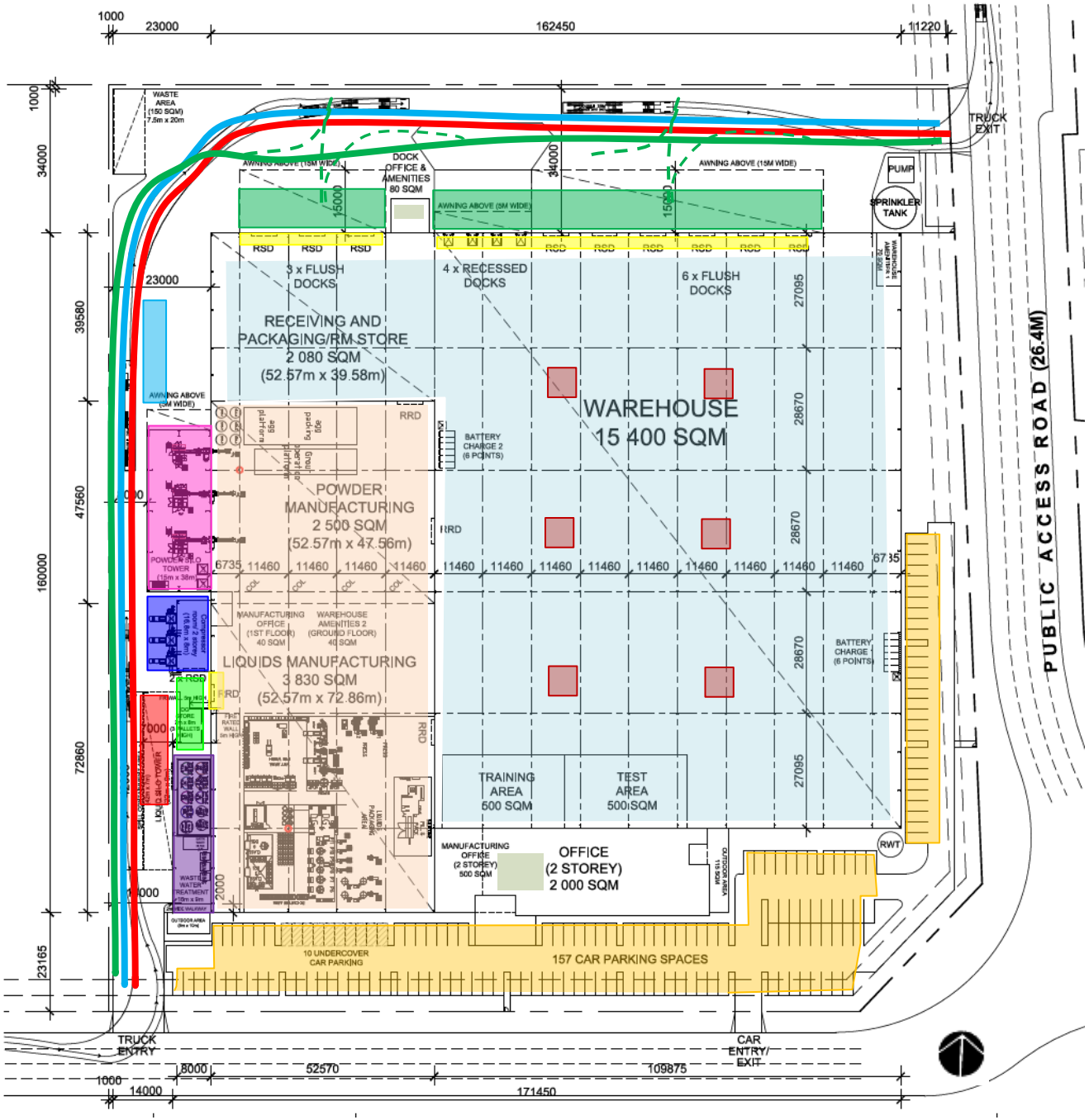
Figure 10 presents a plan showing the assumed locations of noise generating activities as part of the noise modelling based upon the operational information provided by the client in preparation of this NVIA.

**Table 5-3: Description of external noise generating activities**

| Operational element | Description of operation | Typical quantity and timing of operation |
|---|---|---|
| Raw material deliveries - Liquids | Typically single tanker but could be double tanker, enter facility and move the loading area adjacent to the liquids silo on the western side of the building as shown in shown in Figure 10.<br>Unloading would take place for over 1 hour (single tanker) to 2.5 hours (double tanker), with the main noise source being fixed facility mounted pump. Following the tanker would directly depart the facility.<br>The unloading is using a fixed facility pump, and so there is no truck based noise during the operation. | Typical deliveries between 5:00AM and 5:00PM. Unloading time 1-2.5 hours<br>Could occur concurrently with a powder delivery. |
| Raw material deliveries - Powders | Up to a double tanker, enter facility and move the loading area adjacent to the powders silo on the western side of the building as shown in shown in Figure 10.<br>Unloading would take place for 1 hour (single tanker) to 2 hours (double tanker), with the main noise source being a tanker mounted pump. Following the tanker would directly depart the facility.<br>They are unloaded by a truck based pump which is the main source of noise during the pumping operation. | Typical deliveries between 5:00AM and 2:00PM. Unloading time 1-2 hours<br>Could occur concurrently with another powder delivery or liquids delivery. |
| Loading dock receiving and dispatching | Typically semi-trailer with container but can be small, medium or large rigid trucks, enter facility and move to one of the 13 docks.<br>Unloading would take place over 5-10 minutes.<br>Loading at the flush docks would take place with forklifts side loaded.<br>Loading at the recessed docks would take place with forklifts entering the truck from internal via an elevated loading dock.<br>Loading or unloading activities at these docks would include palletised product, raw material unloading, or the return of empty pallets.<br>Other loading, packaging and warehouse activities would take place within the facility across the warehouse area.<br>External loading would not typically occur. | Loading dock activities would occur throughout the work shifts period of 6:00AM to 11:00PM, but would not typically occur during the 10:00pm-11:00pm period. |
| Manufacturing activities | Manufacturing operations during the main working shifts from 6:00am to 11:00pm. The noise generating activities that take place within the facility are:<br>• Powder processes<br>• Liquids processes<br>• Packaging machinery process<br>• Conveyors inside the facility<br>• Mixers, dosers, motors and dispersers<br>• Water treatment plant<br>Some noise sources would operate 24/7, such as the compressors and dust extraction system. | 2 worker shifts, with first shift from 6:00am to 2:30pm & second shift from 2:30pm to 11:00pm.<br>Noise intensive internal activities would be 6am to 11pm.<br>Some noise sources would operate 24/7, such as the compressors and dust extraction system. |

| Operational element | Description of operation | Typical quantity and timing of operation |
|---|---|---|
| | The main noise sources are located within the powder and liquids manufacturing areas within the facility, which are within and enclosed space within the warehouse, minimising the noise breakout from these key noise generating areas. | |
| Office activities | General office operations (both main office, manufacturing office and dock office) | 75 of office staff. Office hours are typically 8:30AM to depart 5:00PM Monday to Friday.<br>Manufacturing office could operate on Saturdays. |
| Carparking | General carparking activities (weekdays) | 75 office staff – Arrive over 7:30am to 8:30am period.<br>45 first shift staff – Depart over 5:00am to 6:00am period.<br>20 second shift staff – Arrive over 1:30pm to 2:30pm period.<br>45 first shift staff – Depart over 2:30pm to 3:30pm period.<br>75 office staff – Depart over 5:00pm to 6:00pm period.<br>Plus 10 visitors/ contractor/ other during the day. |

**Figure 10: Indicative external noise sources diagram and vehicle movement paths**




***Vehicle path***

- Raw material deliveries - Liquids
- Raw material deliveries - Powders
- Loading dock receiving and dispatching
- Loading dock – truck acceleration/reverse
- Carparking activities

***Loading dock and delivery activities***

- Raw material deliveries - Liquids
- Raw material deliveries - Powders
- Loading dock receiving and dispatching activities

***Manufacturing activities***

- Internal warehouse *(breakout)* (via open roller doors)
- Internal warehouse *(breakout)* (via façade)
- Compressor room and dust collectors
- Powers tower *(breakout)*
- Liquids tower *(breakout)*
- Liquids/Powders manufacturing area *(breakout)*
- External forklift activities
- Warehouse roof mounted ventilation fans

*Breakout for the warehouses area façade (including any contribution from the manufacturing areas) has been modelled*

***Office areas***

#### 5.2.1.2 Truck movements

The trucks operating through the site would travel to and from the site as detailed in Section 5.1. Once these trucks enter the Proposal site they are assessed in accordance with the NPfI. While outside of the site, such as on public roads within the SSD 9522 industrial estate, they are assessed using the RNP, as per Section 5.1. Trucks would arrive and enter the site via the routes shown in Figure 10 to access the loading dock or raw material delivery areas. The truck movements through the facility generally follow the same path, and can be separated into 3 main components, as described in Table 5-3:

- Raw material deliveries - Liquids
- Raw material deliveries - Powders
- Loading dock receiving and dispatching

It is expected that the trucks that operate through the facility would typically comprise the following:

- Two axle rigids – typically 10 trucks daily
- Semi-trailers – typically 10 to 15 trucks daily
- B-doubles – typically 10 to 15 trucks daily

Trucks would move around the site at 15 km/h when not undertaking manoeuvres. During manoeuvres, the trucks would operate at slower speeds, and different noise levels as per assumptions in APPENDIX D.

The typical vehicle movements that would operate through the facility can be summarised as follows:

- Over the day period there will be up to 70 trucks movements on average expected to move through the facility. The types could vary, with up to 65 truck movements (in or out) that use the loading docks daily and 35 tankers movements (in or out) that service the towers (raw product). However, the distribution is expected to not substantially vary over the day, with peak periods up to 4 trucks in a 15-minute period.
- Dispatch and receiving hours would typically be 6:00am to 11:00pm Monday to Friday and 6:00am to 2:30pm on Saturday.
- Raw product deliveries would typically take place in the morning from 6:00am, and it is possible for up to two deliveries to occur concurrently.

Based upon the above potential maximum reasonable worst case 15-minute period movement assumptions, the following assumptions were used for noise modelling.

**Table 5-4: Reasonable worst case 15-minute period truck movements**

| Trucks | Day | Evening | Night |
|---|---|---|---|
| ***Representative period with maximum movements*** | ***10:00am-11:00am*** | ***8:00pm-9:00pm*** | ***6:00am-7:00am*** |
| Dispatch and receiving trucks | 2 | 1 | 1 |
| Raw product deliveries | 2 | 1 | 2 |
| **Total trucks through the facility per 15 minute period** | **4** | **2** | **3** |

Notes: 1. One truck movement has been modelled moving along the associate route shown in Figure 10 to occur within a 15-minute period.

#### 5.2.1.3 Delivery and loading dock activities

**Loading dock receiving and dispatching activities**

Trucks would arrive and enter the site via the routes shown in Figure 10 to access the loading dock areas. Loading dock activities would include trucks reversing into the loading dock and being loaded via forklifts either side loaded or from internally, subject to the type of truck, the materials, and if a flush or recessed loading dock is being used.

Typically drivers would be required to reverse into dock, and then complete paperwork or similar. Similarly, this may be required prior to departure, before the truck then accelerates to site speed in order to depart the facility. As such, these noise sources have been included in the model.

**Raw material deliveries – Liquids**

The raw liquids deliveries take place via tanker truck. The liquid is transferred into silos via a liquids pump that is part of the facility. The truck does not generate noise during the liquids loading operation.

**Raw material deliveries – Powders**

The raw powder deliveries take place via tanker truck. The powder is transferred into silos via a truck mounted pump. As such, the truck is the main source of noise during the power loading operation.

#### 5.2.1.4 Manufacturing operations

The Proposal site will include a research and development laboratory, warehouse storage of raw materials and packaging, distribution of packed products, and manufacturing of powder and liquid products.

The key noise generating component of these activities are the:

- Powder manufacturing
- Liquid manufacturing
- Dust collector and compressor plant room

The powder manufacturing process involves the use of dry powder batching, mixing and bagging processes where most batching is completed via an automated process with some manual dosing into industrial mixers, and then followed by semi-automatic bagging and palletising. The activities will primarily consist of mixing non-flammable and non-combustible powdered chemicals (including cement, limestone and sand) to produce saleable products for the construction industry.

Liquid manufacturing will involve the use of liquid batching, mixing and filling processes, where most batching is completed via a semi-automated process with manual dosing into various industrial mixers. The activities will primarily consist of mixing and filling water dispersed polymers (emulsion/latex) with or without non-combustible fillers, silicon packing, as well as water dispersion of epoxy resins to produce saleable products for the construction industry.

The key potential for noise breakout from these activities is through the building facade elements. These include:

- Building facade metal cladding
- Translucent light sheeting or windows
- Ventilation louvres

**Table 5-5: Key potential noise breakout facade elements of the warehouse and manufacturing areas**

| Building element | Key breakout elements | Reference |
|---|---|---|
| Powders tower | Facade is metal deck or glazed window or translucent sheeting<br>West facade - No louvres<br>South facade - No louvres<br>East facade – Two 11mx1.5m louvres, two 6mx1.5m louvres<br>North facade - One 11mx1.5m louvres, one 6mx1.5m louvre<br>Roof - No louvres/openings | Powder Silo Tower<br>(Pace Architecture, Project 210618, Drawing 210618 - DA 610, Issue A, dated 24/9/2021) |
| Liquids tower | Facade is metal deck or glazed window or translucent sheeting<br>West facade - One 14mx1.5m louvres<br>South facade - No louvres<br>East facade – No louvres<br>North facade - No louvres<br>Roof - No louvres/openings | Liquid Silo Tower<br>(Pace Architecture, Project 210618, Drawing 210618 - DA 611, Issue A, dated 24/9/2021) |
| Manufacturing area | Facade and roof is metal deck or glazed window or translucent sheeting<br>Roller door located on western façade. | Warehouse Elevation SHT 2<br>(Pace Architecture, Project 210618, Drawing 210618 - DA 602, Issue A, dated 24/9/2021) |

It has been assumed that the building construction is generally pre-cast concrete to 2.5 metres, and metal cladding / glazed window / translucent sheeting construction for the rest of the building façade around the warehouse and manufacturing areas. Only assumed openings are as per Table 5-5.

Noise levels can substantially vary within the powders tower, liquids towers, warehouse and manufacturing areas. As such, conservative internal noise levels have been assumed in the noise model, which have been based upon the noise measurements undertaken as per Section 2.2, occupational noise surveys undertaken by Ardex at a similar facility in Queensland, and information provided by the client. These assumed internal noise levels are presented in APPENDIX D (Table 6-6).

#### 5.2.1.5 Staff vehicle movements and car parking

The Proposal is expected to generate up to 280 light vehicle trips per day (inbound and outbound movements). These will be made up of shift workers and office workers.

The proposed carpark movement assumptions are detailed in Section 5.2.2.

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 premises was determined for each relevant period based on the number of vehicle movements expected to occur during that period. For this assessment, the proposed staff requirements for the facility has been reviewed to determine the maximum number of car movements within the carpark during each assessment period. This distribution has considered the following:

- The office will have up to 75 staff. Office hours are typically 8:30AM to depart 5:00PM Monday to Friday.
- Manufacturing works in 2 worker shifts, with first shift with typically 45 workers from 6:00am to 2:30pm & second shift with typically 20 workers from 2:30pm to 11:00pm. Typically Monday to Friday, with some working on Saturday.
- Potentially 10 visitors/ contractor/ other during the day.
- The Proposal staff carpark has 163 spaces.
- Cars are expected to move at 10 km/h in the carpark area.

The carpark activity distribution for this assessment is summarised in Table 5-6 for the highest one-hour period for the day, evening, night and morning periods.

**Table 5-6: 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 | 80 | 7:30am to 8:30am |
| Evening | 10 | 9:00pm to 10:00pm |
| Night | 45 | 5:00am to 6:00am |

#### 5.2.1.6 Key building services and mechanical plant

The specific type of building services and mechanical plant and their location on site are yet to be finalised at this early development approval stage of the project.

The key known building services and mechanical plant items are:

- Compressor room and dust collectors
- Office air conditioning mechanical plant
- Warehouse ventilation

Table 5-7 details the mechanical plant assumed as part of the modelling for this assessment are detailed in Section 5.2.2, with noise source levels included in APPENDIX D.

**Table 5-7: Assumed mechanical plant noise sources, dB(A)**

| Noise source | Number of units (See Section 5.2.2 for assumed operations) | Individual source/activity sound power level ($L_w$ re. 1pW), $L_{Aeq,t}$, OR sound pressure level ($L_p$), dB(A) | Location |
|---|---|---|---|
| Office condenser units | 6 | Refer to APPENDIX D | On top of office roof and dock office roof |
| Warehouse roof mounted ventilation fans | 6 | | Warehouse area roof |
| Dust extraction system<br>- Dust collector fan<br>- Compressors<br>- Pumps | - | | Duct extraction and compressor plant room |

Note: 1. Plant and equipment not listed above has not been assessed.

#### 5.2.1.7 In principle mechanical plant measures

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 based upon measurements of existing plant/equipment items or information provided by the client. Where required, indicative mitigation (ie. acoustic louvres, attenuation to air openings, acoustic absorption lining, etc.) have been assumed as detailed in Section 5.2.1.6. 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 on site.

- 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*'.

#### 5.2.1.8 Emergency plant and equipment

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

1. Fire pump, located within a pump house on the northern-eastern corner of the site, adjacent to the exit onto the public road.

Due to the infrequent and non-typical operating nature of this emergency plant and equipment, 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 relevant NSW guideline for emergency generators and stand-by equipment, they do not form part of the reasonable worst case 15-minute scenario modelling. However, in order to minimise the potential noise impacts on nearby sensitive receivers, the following recommendations should be incorporated. The project trigger levels presented in Section 3.3.4 are not directly suitable or applicable to the stand-by and emergency plant, but can serve as a guide for reviewing selections at detailed design.

1. For selection and installation of the emergency fire pump, it is to be located within an acoustically rated building, and a residential grade exhaust flue silencer is to be installed to minimise noise impacts at the nearest residential receivers during testing and maintenance procedures.

2. All emergency plant and equipment are to be tested and maintained during the day (7:00 am to 6:00 pm).

3. All noise mitigation and management measures should generally be selected to not substantially increase the site noise emissions during testing (ie. increase the existing site noise emission by more than 5 dB(A)).

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

### 5.2.2 Reasonable worst-case intrusiveness scenarios (15-minute period)

To assess noise impacts from the Proposal, 'reasonable' worst-case scenarios (15-minute period) have been developed based upon the above described operational assumptions, the observations of activities at a similar warehouse / manufacturing facility and the operational inputs from the project team with adjustments for the variation in specific future throughput for the facility.

The operational noise source levels, assumptions and reasonable worst-case operational assessment scenarios have been gleaned largely from the existing manufacturing facility at Seven Hills, which undertakes similar operations to that proposed.

Table 5-9 details the 'reasonable' worst-case scenarios (15-minute period), covering the noise generating activities and noise intensive periods for the main areas of noise generation across the Proposal site. The locations of these key areas are shown in Section 5.2.1.1 for reference.

#### 5.2.2.1 Operational assessment scenarios and scenarios A and B

The main noise generating activities externally that could vary and influence the site noise emissions are the two types of raw material deliveries to the silos. Noise emissions would vary depending upon if either of these operations occur:

- Raw material deliveries - Liquids
- Raw material deliveries - Powders

As such, the assessments have looked at the two potential 'reasonable' worst-case scenarios (15-minute period) for these delivery activities, separating them into two scenarios:

- **Scenario A** = Reasonable worst case concurrent liquids + powder deliveries
- **Scenario B** = Reasonable worst case concurrent powder deliveries (noting powder deliveries are more noise intensive than liquids deliveries).

Not all scenarios have then been carried forward to the noise assessment modelling stage. To simplify the assessment outcomes, the four worst case operational assessment scenarios from those presented in Section 5.2.2 are assessed in Section 5.5.

As the evening period has reduced activities compared to the day and early morning / night periods, this assessment period has not been further assessed, as compliance during the other assessment periods will result in compliance during the evening assessment period as well. Similarly, this approach was followed during the periods at night when no deliveries are to occur.

The following table summarise the reasonable worst-case 15-minute noise emissions from the operations as detailed in Section 5.2.2, with all specific assessment assumptions detailed in Table 5-9.

**Table 5-8: Summary of operational assessment scenarios**

| Assessment period | Scenario reference | Scenario description | Progressed to assessment modelling in Section 5.5 |
|---|---|---|---|
| Daytime | Scenario A | One liquids and one powder raw material delivery + other site operations | ✓ |
| | Scenario B | Two powder raw material deliveries + other site operations | ✓ |
| Evening | Scenario A | One liquids raw material delivery + other site operations | × |
| | Scenario B | One powder raw material deliveries + other site operations | × |
| Night | No deliveries | Site base noise emissions (No deliveries or manufacturing operations) | × |
| | Scenario A | One liquids and one powder raw material delivery + other site operations | ✓ |
| | Scenario B | Two powder raw material deliveries + other site operations | ✓ |

**Table 5-9: Representative 'reasonable' worst-case 15-minute noise generating assessment scenarios**

| **Activity / Assessment period** | **Daytime** ***(Scenario A & B)*** **(7:00am to 6:00pm)** | **Evening** ***(Scenario A & B)*** **(6:00pm to 10:00pm)** | **Night** ***(No deliveries)*** **(10:00pm to 7:00am)** | **Night** ***(Scenario A & B)*** **(10:00pm to 7:00am)** |
|---|---|---|---|---|
| ***Representative noise intensive period*** | ***10:00am-11:00am*** | ***6:00pm-7:00pm*** | ***2:00am-3:00am*** | ***5:00am-6:00am*** |
| **Internal heavy vehicle movements** | | | | |
| Raw product deliveries – Liquids<br>B-Double tanker | Refer to Section 5.2.1.2.<br>Modelling also includes the following for each truck:<br>Arrive or depart: Truck airbrake release/2 minute idle | Refer to Section 5.2.1.2.<br>Modelling also includes the following for each truck: arrive or depart; truck airbrake release/2 minute idle | None | Refer to Section 5.2.1.2.<br>Modelling also includes the following for each truck: arrive or depart; truck airbrake release/2 minute idle |
| Raw product deliveries - Powders<br>B-Double tanker | Refer to Section 5.2.1.2.<br>Modelling also includes the following for each truck:<br>Arrive or depart: Truck airbrake release | Refer to Section 5.2.1.2.<br>Modelling also includes the following for each truck: arrive or depart: Truck airbrake release | | Refer to Section 5.2.1.2.<br>Modelling also includes the following for each truck:<br>Arrive or depart: Truck airbrake release |
| Loading dock receiving and dispatching<br>Semi-trailers or B-Doubles | Refer to Section 5.2.1.2.<br>Includes the following for each truck arriving/departing the loading area:<br>Arrive: Reverse and truck airbrake release<br>Depart: 2 minute idle and then acceleration from loading area | Refer to Section 5.2.1.2.<br>Includes the following for each truck arriving/departing the loading area:<br>Arrive: Reverse and truck airbrake release<br>Depart: 2 minute idle and then acceleration from loading area | None | Refer to Section 5.2.1.2.<br>Includes the following for each truck arriving/departing the loading area:<br>Arrive: Reverse and truck airbrake release<br>Depart: 2 minute idle and then acceleration from loading area |
| Carpark | Assume reasonable worst case 35 in 15 minutes, based upon the movements in Table 5-6 | Assume reasonable worst case 5 in 15 minutes, based upon the movements in Table 5-6 | Assume reasonable worst case 5 in 15 minutes, based upon the movements in Table 5-6 | Assume reasonable worst case 20 in 15 minutes, based upon the movements in Table 5-6 |
| **Loading dock and delivery activities** | | | | |
| Flush docks (North) | 2 x trucks being loaded via forklift externally | 2 x trucks being loaded via forklift externally | None | 2 x trucks being loaded via forklift from internal |
| Recessed docks (North) | 1 x truck being loaded via forklift from internal | 1 x truck being loaded via forklift from internal | None | 1 x truck being loaded via forklift from internal |
| External forklift loading activities | Forklift loading activities to/from warehouse, typically 5 minutes of loading operations in 15-minutes. Moving is 50% of the forklift operation. Handling is 50% of operation. | Forklift loading activities to/from warehouse, typically 5 minutes of and loading operations in 15-minutes. Moving is 50% of the forklift operation. Handling is 50% of operation. | None | Forklift loading activities to/from warehouse, typically 5 minutes of and loading operations in 15-minutes. Moving is 50% of the forklift operation. Handling is 50% of operation. |

| **Activity / Assessment period** | **Daytime** ***(Scenario A & B)*** **(7:00am to 6:00pm)** | **Evening** ***(Scenario A & B)*** **(6:00pm to 10:00pm)** | **Night** ***(No deliveries)*** **(10:00pm to 7:00am)** | **Night** ***(Scenario A & B)*** **(10:00pm to 7:00am)** |
|---|---|---|---|---|
| ***Representative noise intensive period*** | ***10:00am-11:00am*** | ***6:00pm-7:00pm*** | ***2:00am-3:00am*** | ***5:00am-6:00am*** |
| Raw material deliveries – Liquids<br>B-Double tanker | **Scenario A:** 1 liquids delivery loading via pump into the silos. | **Scenario A:** 1 liquids delivery loading via pump into the silos. | None | **Scenario A:** 1 liquids delivery loading via pump into the silos. |
| | **Scenario B:** None | **Scenario B:** None | | **Scenario B:** None |
| Raw material deliveries - Powders<br>B-Double tanker | **Scenario A:** 1 powder truck deliveries loading via pump into the silos. | **Scenario A:** None | None | **Scenario A:** 1 powder truck deliveries loading via pump into the silos. |
| | **Scenario B:** 2 powder truck deliveries loading via pump into the silos. One powder truck backs up to the silo base during the15-minute period. | **Scenario B:** 1 powder truck delivery loading via pump into the silos. One powder truck backs up to the silo base during the15-minute period. | | **Scenario B:** 2 powder truck deliveries loading via pump into the silos. One powder truck backs up to the silo base during the15-minute period. |
| **Warehouse operations** | | | | |
| Warehouse roof mounted fans | Warehouse roof mounted fans x6 | | | |
| Internal warehouse activities | 2 forklifts operating within the warehouse area.<br>Internal noise level based upon similar warehouses (see APPENDIX D) | 2 forklifts operating within the warehouse area.<br>Internal noise level based upon similar warehouses (see APPENDIX D) | None | 2 forklifts operating within the warehouse area.<br>Internal noise level based upon similar warehouses (see APPENDIX D) |
| **Manufacturing activities** | | | | |
| Internal manufacturing activities | Internal noise generating operations:<br>• Powder processes<br>• Liquids processes<br>• Packaging machinery process<br>• Conveyors inside the facility<br>• Mixers and dispersers<br>• Water treatment plant<br>Internal noise level based upon similar warehouses (see APPENDIX D)<br>Breakout via façade (including towers)<br>Breakout via louvres<br>Western roller door open<br>See Section 5.2.1.4 for more details | Internal noise generating operations:<br>• Powder processes<br>• Liquids processes<br>• Packaging machinery process<br>• Conveyors inside the facility<br>• Mixers and dispersers<br>• Water treatment plant<br>Internal noise level based upon similar warehouses (see APPENDIX D)<br>Breakout via façade (including towers)<br>Breakout via louvres<br>Western roller door open<br>See Section 5.2.1.4 for more details | None | Internal noise generating operations:<br>• Powder processes<br>• Liquids processes<br>• Packaging machinery process<br>• Conveyors inside the facility<br>• Mixers and dispersers<br>• Water treatment plant<br>Internal noise level based upon similar warehouses (see APPENDIX D)<br>Breakout via façade (including towers)<br>Breakout via louvres<br>Western roller door closed<br>See Section 5.2.1.4 for more details |
| External forklift operations | Forklift moving palleted goods from internal to the storage area south of the compressor room and dust collectors. | Forklift moving palleted goods from internal to the storage area south of the compressor room and dust collectors. | None | Forklift moving palleted goods from internal to the storage area south of the compressor room and dust collectors. |

| **Activity / Assessment period** | **Daytime *(Scenario A & B)*** **(7:00am to 6:00pm)** | **Evening *(Scenario A & B)*** **(6:00pm to 10:00pm)** | **Night *(No deliveries)*** **(10:00pm to 7:00am)** | **Night *(Scenario A & B)*** **(10:00pm to 7:00am)** |
|---|---|---|---|---|
| ***Representative noise intensive period*** | ***10:00am-11:00am*** | ***6:00pm-7:00pm*** | ***2:00am-3:00am*** | ***5:00am-6:00am*** |
| Compressor room and dust collectors (within plantroom) | Compressors<br>Chillers<br>Dust collector fans | | | |
| **Office area** | | | | |
| Building services (Manufacturing office and office) | Office condenser units x 6 | Office condenser units x 6 | Office condenser units x 6 | Office condenser units x 6 |
| Dock office (north) | Office condenser unit | Office condenser unit | Office condenser unit | Office condenser unit |

For **emergency plant and/or equipment** such as a fire pump, this would not form part of normal operations. It is assumed that is may be tested once every couple of months during the daytime period.

Across these operational areas, presented in Table 5-10 are the potential noise sources that could result in instantaneous noise events that could typically occur as part of operations that have been assumed in the sleep disturbance assessment at night. The locations of these key areas are shown in Figure 10 for reference.

**Table 5-10: Instantaneous noise events assessment scenarios (night period)**

| Location / activity | Instantaneous noise sources ($L_{Amax}$ event) |
|---|---|
| **Internal heavy vehicle movements** | |
| Tanker - Raw material deliveries – Liquids | Truck acceleration |
| Tanker - Raw material deliveries - Powders | |
| Semi-trailers or Rigid - Loading dock receiving and dispatching | |
| Carpark | Car acceleration<br>Car door slam |
| **Loading dock and delivery activities** | |
| Loading dock area | 1. Truck airbrake<br>2. Trailer loading<br>3. Truck accelerate<br>4. Reversing activities |
| **Manufacturing activities** | |
| Dust collector | Compressor air releases |

## 5.3 Initial assessment and acoustic mitigation and management review

### 5.3.1 Initial assessment outcome

Based upon an initial assessment, it was determined that noise emissions from site operations may exceed the noise limits presented in Section 3.3.4 without further review of noise inputs assumptions and reasonable mitigation and management measures applied across the facility. Key noise sources that were contributing to the overall cumulative noise emission level at nearby receivers were:

- Liquids delivery pumping operations
- Powders delivery pumping operations
- Liquids silo louvre breakout
- Powders silo façade breakout
- Dust collector and compressor plant room noise emissions

As such, a detailed review of input assumptions across all contributing noise sources was undertaken, and feasible and reasonable mitigation and management measures that could be implemented have been identified and recommended in order to ensure that the site can achieve the requirements of the NPfI and draft MRP DCP.

### 5.3.2 Design mitigation and management measures

Following the initial assessment of the site noise emissions, a range of feasible and reasonable mitigation and management measures were investigated and identified in order to determine a design that would achieve the required NPfI project trigger levels detailed in Section 3.3.4 and minimise noise emissions from the site.

The mitigation and management measures presented in Table 5-11 should be further reviewed as required so that they can be reasonably incorporated into the Proposal design where feasible. These are specific recommendations required for the Proposal, and further operational noise management measures that should be considered are detailed in Section 5.5.4. In order for the site to achieve the requirements of the NPfI and the draft MRP DCP, these mitigation or management measures are required to be implemented or further investigated during further design development.

The predicted noise levels presented in Section 5.5 incorporate the following operational noise mitigation and management measures presented in Table 5-11.

**Table 5-11: Recommended noise mitigation and management measures**

| Item | Activity / noise source |
|---|---|
| M1.1 | Materials of the manufacturing facility and warehouse facade would be selected during detailed design, so that any noise break-out from internal activities would result in a negligible increase in overall noise emissions from the facility to achieve the Proposal project trigger noise levels.<br>The following areas should be reviewed in detail:<br>i. Powder tower<br>ii. Liquids tower<br>iii. Powder and liquids manufacturing areas.<br>The required constructions would be subject to the final internal noise levels, which would be subject to the final selection of plant and equipment within these spaces, and any noise mitigation applied to these items.<br>Items identified in this review that should be reviewed during later design stages are:<br>i. Western facade louvre of the liquids tower<br>ii. Facade constructions of the powders tower |
| M1.2 | The liquid pump should be selected or designed with either local enclosure or barrier, with acoustic absorptive lining. to provide a maximum sound power level of 93 dB(A), this is 10 dB(A) of reduction from current source noise levels.<br>Located the liquids pump to maximise acoustic shielding from adjacent buildings (ie. warehouse) and structures to minimise noise emissions, noting the source is intermittent at source and the liquids silo has line-of-sight to some residences to the west.<br>Review at during detailed design where feasible and reasonable the requirement for any acoustic enclosure or barriers in proximity to the pump to minimise noise emissions. |
| M1.3 | When not in use, external roller doors are to be kept closed during the night periods (10:00pm to 7:00am) except as required for ingress/egress. |

| Item | Activity / noise source |
|---|---|
| M1.4 | Ensure that for all non-enclosed areas of the facility with line-of-sight (or near line-of-sight) to the western residences (NCA1), the following design elements are incorporated -<br>- All pavement is smooth (ie. no speed bumps)<br>- Transitions from the external public road to the site are smooth, as to not result in jolting, or unnecessary accelerating of the truck the truck is required.<br>- Drainage grates are designed to not result in noise events.<br>- Ensure that trucks do not have to stop/brake and then accelerate (ie. pedestrian crossing points, security gates).<br>These areas that this applies to in particular are:<br>- Southern heavy vehicle access driveway area<br>- Liquids tower delivery area |
| M1.5 | Building services, mechanical plant and plantroom spaces are to be designed to not increase total site noise emissions. This will likely include selection of quiet plant/equipment, acoustic absorption, noise barriers, and the use of acoustic louvres and attenuators as part of the design.<br>This in particular the following areas and items would require a detailed review:<br>- Dust collector – Recommended maximum source level of 101 dB(A) (5 dB(A) less than measured at the existing facility)<br>- Compressor plantroom |
| M1.6 | Alternate methods and practices to the use of horns as a safety warning for onsite moving forklifts should be reviewed and incorporated into site operations and safety practices. |
| M1.7 | Any PA systems required as part of normal operation that emit sound outside of the facility, are to be designed so that they would result in a negligible increase in overall noise emissions from the facility. PA announcements as part of normal operations would be restricted to within the enclosed areas of the facility during the night period. |

### 5.3.3 Considerations of the recommended mitigation and management measures

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 are consistent with the outcomes of this assessment.

Additionally, due to the staged nature of the developments within the broader "The Yards" industrial estate boundary (SSD 9522) and the greater MRP, nearby development design changes or Proposal design changes have the potential to influence noise emissions from the Proposal (ie. shielding), which should be considered.

## 5.4 Noise prediction methodology

### 5.4.1 Modelling overview

Modelling and assessment of airborne noise impacts from the Proposal were determined by modelling the noise sources, receiver locations and topographical features, and possible noise mitigation measures using a 3D noise modelling package, CadnaA (Version 2021 MR 1). 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 (including multi-storey buildings).
- Heights of sources and receivers referenced to digital ground contours (1 metre contour intervals) or relative to the Proposal building structure.
- Noise source levels of individual plant and equipment.
- Internal noise levels within the facility, and the breakout of these noise levels through the façade building elements.
- Separation distances between sources and receivers.
- Ground type and reflections between sources and receivers (ground absorption value of 0 for the site, warehouse areas and roads, and 0.5 outside of this area (ie. from grassed areas / suburban areas).
- Attenuation from barriers, buildings and structures (natural terrain and purpose built).
- Shielding from proposed buildings as part of the approved SSD 9522 Masterplan, proposed SSD 10101987 data centre buildings and structures, and buildings proposed for the adjacent Lot 10 (as shown in Figure 3, future Lots 11 and 13). These were based upon:
  - SSD 9522 Masterplan (Appendix 1 of consolidated consent, dated 3/9/2021)
  - SSD 9522 Response to Submissions Architectural Plans (SP-KC1_DA-200/201/202/203/206/207/208 Rev L, SP-KC1_DA-204/205 Rev M)
  - SSD 10101987 Architectural Plans (Greenbox Architecture, Job 190086 SYD AZ3 Kemps Creek, Drawing A010, Issue 2 & A200, Issue 2)
  - State Significant Development Application Plan for Kemps Creek (Altis Frasers, drawing SSD-MRM-TM-009< Rev D, dated 6/4/2021) showing Lot 10 (as shown in Figure 3, future Lots 11 (Warehouse 11) and 13 (Warehouse 13A & 13B).
- Atmospheric losses and meteorological conditions.

- Feasible and reasonable noise mitigation/treatments and management measures that have been determined for the Proposal.

The CONCAWE noise propagation algorithm was implemented for assessing potential noise impacts because:

- The potentially nearest residential receivers are located at large distances often greater than 700 metres from the Proposal, and as such this algorithm allows for prevailing noise enhancing weather conditions to be included and accounted for in the assessment and provides a provides for a conservative assessment.
- CONCAWE allows for the meteorological conditions presented in NPfI Fact Sheet D to be directly considered.

### 5.4.2 Meteorological factors

In accordance with the NPfI, the noise assessment is required to consider the effects of adverse meteorological conditions such as wind and temperature inversions.

The NPfI recommends that project noise criteria are to apply under weather conditions characteristic of an area. These may include standard meteorological conditions (ie. calm) and noise-enhancing meteorological conditions (ie. 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, either use of default parameters or 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.

Noise modelling has considered prevailing temperature inversions and prevailing winds using the CONCAWE noise modelling algorithm implementing both the standard and the noise-enhancing meteorological conditions presented in NPfI Fact Sheet D. In accordance with Table D1 of the NPfI, the following default parameters have been used when modelling under meteorological conditions.

**Table 5-12 – Default parameters for meteorological conditions**

| Meteorological conditions | Default parameters | Assessment periods |
|---|---|---|
| **Standard conditions** | • Stability Category D<br>• 0.5m/s wind speeds[1] | • Day (7am to 6pm)<br>• Evening (6pm to 10pm)<br>• Night (10pm to 7am) |
| **Noise-enhancing conditions** | Wind<br>• Stability Category D<br>• 3m/s wind speeds[1] | • Day (7am to 6pm)<br>• Evening (6pm to 10pm)<br>• Night (10pm to 7am) |
| | Temperature Inversions<br>• Stability Category F<br>• 2m/s wind speeds[1] | • Night (10pm to 7am) |

Notes: 1. All directions considered.

## 5.5 Noise predictions

### 5.5.1 Predicted operational noise levels

To assess operational noise emissions from the Proposal, the assessment scenarios identified in Section 5.2.2 have been evaluated to progress to the modelling and assessment stages.

As operations take place during the night period, there is also the potential for sleep disturbance noise impacts to occur from high noise events activities within the facility (ie. airbrake releases) these have also been assessed.

Each of these assessment scenarios represent the reasonable worst-case operating scenarios that would take place. However, where all the assumed activities do not occur simultaneously during the same 15-minute period, then noise levels are likely to be lower than those predicted.

The predicted noise levels presented in this section include all feasible and reasonable mitigation and management measures presented in Section 5.3, which have been recommended based upon an initial evaluation and the progressive assessment process.

Predicted noise levels have been assessed to the nearby representative receivers, and a summary of these results are presented in Table 5-13. Noise contour maps at 1.5 metres above the local ground level for each of the scenarios assessed are presented in APPENDIX E.

**Table 5-13: Predicted operational noise levels – Standard meteorological conditions; $L_{Aeq,15minute}$, dB(A)**

| Assessment scenario | | | Daytime (Scenario A & B)[4] (7:00am to 6:00pm) | | | Night (Scenario A) (10:00pm to 7:00am) | | | Night (Scenario B) (10:00pm to 7:00am) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Representative period:* | | | *10:00am-11:00am* | | | *6:00am-7:00am* | | | *6:00am-7:00am* | | |
| *Rec. No.* | Receiver type | NCA | PNTL | Predicted noise level, $L_{Aeq,15min}$, dB(A) | Exceedance | PNTL | Predicted noise level, $L_{Aeq,15min}$, dB(A) | Exceedance | PNTL | Predicted noise level, $L_{Aeq,15min}$, dB(A) | Exceedance |
| R1 | Residential | 1 | 43 | 25 | - | 33 | 25 | - | 33 | 25 | - |
| R2 | Residential | 1 | 43 | 31 | - | 33 | 31 | - | 33 | 31 | - |
| R3 | Residential | 1 | 43 | 32 | - | 33 | 31 | - | 33 | 32 | - |
| R4 | Residential | 1 | 43 | 31 | - | 33 | 31 | - | 33 | 31 | - |
| R5 | Residential | 1 | 43 | 26 | - | 33 | 25 | - | 33 | 25 | - |
| R6 | Residential | 1 | 43 | 24 | - | 33 | 24 | - | 33 | 24 | - |
| R7 | Residential | 1 | 43 | 22 | - | 33 | 22 | - | 33 | 22 | - |
| R8 | Residential | 2 | 43 | 26 | - | 33 | 25 | - | 33 | 26 | - |
| R9 | Industrial | - | 68 | 36 | - | 68 | 36 | - | 68 | 36 | - |
| R10 | Residential[3] | 3 | 63 | 29 | - | 63 | 29 | - | 63 | 29 | - |
| R11 | Residential[3] | 3 | 63 | 30 | - | 63 | 29 | - | 63 | 29 | - |
| R12 | Residential[3] | 3 | 63 | 37 | - | 63 | 37 | - | 63 | 37 | - |
| R13 | Residential[3] | 3 | 63 | 34 | - | 63 | 34 | - | 63 | 34 | - |
| R14 | Residential[3] | 3 | 63 | <20 | - | 63 | <20 | - | 63 | <20 | - |
| R15 | Residential[3] | 3 | 63 | 31 | - | 63 | 31 | - | 63 | 31 | - |
| R16 | Residential[3] | 3 | 63 | 35 | - | 63 | 35 | - | 63 | 35 | - |
| R17 | Residential[3] | 3 | 63 | 32 | - | 63 | 32 | - | 63 | 32 | - |
| R18 | Educational | 3 | 43 | 27 | - | -[1] | 27 | - | -[1] | 27 | - |
| R19 | Educational | 3 | 43 | 23 | - | -[1] | 23 | - | -[1] | 23 | - |
| R20 | Educational | 3 | 43 | <20 | - | -[1] | <20 | - | -[1] | <20 | - |
| R21 | Residential | 4 | 43 | <20 | - | 33 | <20 | - | 33 | <20 | - |
| R22 | Residential | 4 | 43 | <20 | - | 33 | <20 | - | 33 | <20 | - |
| R23 | Residential | 4 | 43 | <20 | - | 33 | <20 | - | 33 | <20 | - |
| R24 | Residential | 5 | 43 | <20 | - | 33 | <20 | - | 33 | <20 | - |
| R25 | Residential | 5 | 43 | <20 | - | 33 | <20 | - | 33 | <20 | - |
| R26 | Passive recreation | - | 43 | 39 | - | -[1] | 38 | - | -[1] | 39 | - |
| R27 | Industrial | - | 68 | 68 | - | 68 | 67 | - | 68 | 68 | - |

Notes:
1. Project specific noise limits only applicable when in use
2. Receiver locations shown in Appendix B.1.
3. See Section 3.3.3.1.2 for further explanation
4. The presented value is the maximum out of both Scenario A & B

**Table 5-14: Predicted operational noise levels – Noise enhancing meteorological conditions; $L_{Aeq,15minute}$, dB(A)**

| Assessment scenario | | | Daytime (Scenario A & B)[4] (7:00am to 6:00pm) | | | Night (Scenario A) (10:00pm to 7:00am) | | | Night (Scenario B) (10:00pm to 7:00am) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Representative period:* | | | *3:00pm-4:00pm* | | | *6:00am-7:00am* | | | *6:00am-7:00am* | | |
| *Rec. No.* | Receiver type | NCA | PNTL | Predicted noise level, $L_{Aeq,15min}$, dB(A) | Exceedance | PNTL | Predicted noise level, $L_{Aeq,15min}$, dB(A) | Exceedance | PNTL | Predicted noise level, $L_{Aeq,15min}$, dB(A) | Exceedance |
| R1 | Residential | 1 | 43 | 26 | - | 33 | 26 | - | 33 | 26 | - |
| R2 | Residential | 1 | 43 | 32 | - | 33 | 32 | - | 33 | 32 | - |
| R3 | Residential | 1 | 43 | 33 | - | 33 | 32 | - | 33 | 33 | - |
| R4 | Residential | 1 | 43 | 32 | - | 33 | 31 | - | 33 | 32 | - |
| R5 | Residential | 1 | 43 | 26 | - | 33 | 26 | - | 33 | 26 | - |
| R6 | Residential | 1 | 43 | 25 | - | 33 | 25 | - | 33 | 25 | - |
| R7 | Residential | 1 | 43 | 23 | - | 33 | 23 | - | 33 | 23 | - |
| R8 | Residential | 2 | 43 | 26 | - | 33 | 26 | - | 33 | 26 | - |
| R9 | Industrial | - | 68 | 37 | - | 68 | 37 | - | 68 | 37 | - |
| R10 | Residential[3] | 3 | 63 | 30 | - | 63 | 30 | - | 63 | 30 | - |
| R11 | Residential[3] | 3 | 63 | 31 | - | 63 | 30 | - | 63 | 30 | - |
| R12 | Residential[3] | 3 | 63 | 38 | - | 63 | 38 | - | 63 | 38 | - |
| R13 | Residential[3] | 3 | 63 | 35 | - | 63 | 35 | - | 63 | 35 | - |
| R14 | Residential[3] | 3 | 63 | <20 | - | 63 | <20 | - | 63 | <20 | - |
| R15 | Residential[3] | 3 | 63 | 32 | - | 63 | 32 | - | 63 | 32 | - |
| R16 | Residential[3] | 3 | 63 | 36 | - | 63 | 36 | - | 63 | 36 | - |
| R17 | Residential[3] | 3 | 63 | 33 | - | 63 | 33 | - | 63 | 33 | - |
| R18 | Educational | 3 | 43 | 28 | - | -[1] | 28 | - | -[1] | 28 | - |
| R19 | Educational | 3 | 43 | 23 | - | -[1] | 23 | - | -[1] | 23 | - |
| R20 | Educational | 3 | 43 | <20 | - | -[1] | <20 | - | -[1] | <20 | - |
| R21 | Residential | 4 | 43 | <20 | - | 33 | <20 | - | 33 | <20 | - |
| R22 | Residential | 4 | 43 | <20 | - | 33 | <20 | - | 33 | <20 | - |
| R23 | Residential | 4 | 43 | <20 | - | 33 | <20 | - | 33 | <20 | - |
| R24 | Residential | 5 | 43 | <20 | - | 33 | <20 | - | 33 | <20 | - |
| R25 | Residential | 5 | 43 | <20 | - | 33 | <20 | - | 33 | <20 | - |
| R26 | Passive recreation | - | 43 | 40 | - | -[1] | 39 | - | -[1] | 40 | - |
| R27 | Industrial | - | 68 | 68 | - | 68 | 68 | - | 68 | 68 | - |

Notes:
1. Project specific noise limits only applicable when in use
2. Receiver locations shown in Appendix B.1.
3. See Section 3.3.3.1.2 for further explanation
4. The presented value is the maximum out of both Scenario A & B

From the above tables, the predicted operational noise levels indicate compliance with the project noise trigger levels presented in Section 3.3.4 at all nearby assessment receivers for all assessment periods.

### 5.5.2 Annoying noise characteristics adjustments

Where the character of the industrial noise is assessed as particularly annoying at a receiver location (ie. if the resulting noise level at a receiver location is tonal, low frequency or is intermittent at night), then an adjustment would be added to penalise the predicted noise for its potential increase in annoyance. The 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 before comparison with the project noise trigger levels.

Measurements of the noise source levels from the key noise generating plant/equipment were undertaken at a similar facility with a sufficient duration to capture the total activity noise level (ie. departure manoeuvre, idle 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.

#### 5.5.2.1 Tonality

A number of noise sources were identified as tonal at source and as having the potential to be tonal at the nearby receivers, these being

1. Tonal reversing alarms on heavy vehicles
2. Dust collector

However, noting that the contribution from these sources at the nearby residential receivers from typical operations is less than the background level, this would mean that these noise sources are unlikely to exceed the tonality requirement of the NPfI, and so the predicted noise levels do not require an annoyance penalty to be applied.

#### 5.5.2.2 Intermittent noise

The NPfI details that the test for intermittent noise that applies during the night period to be *"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 stage it is not possible to listen and subjectively assess the noise at the receiver as required by the guideline. However, only where all of the following tests are met shall a penalty be applicable to the predicted noise level at the relevant receiver:

- 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; and
- the predicted noise level from the subject source at a receiver is clearly audible over the ambient noise environment.

There are a range of noise sources onsite which exhibit intermittent qualities at source, such as cycling on and off, these include:

1. Pumps and mixers *(typically occur within the facility)*
2. Liquids pumping operation
3. Compressor air releases
4. Reversing alarms fitted to the heavy vehicles that operate throughout the facility
5. Manual manufacturing activities (ie. tin closing with hammer etc.) *(typically occurs within the facility)*
6. Automated manufacturing activities (ie. mixers etc.) *(typically occurs within the facility)*

A screening test was undertaken to determine the likely instantaneous noise level from each of these sources to determine if an intermittent penalty was required in accordance with the NPfI.

The screening test determined that considering the distance to the nearest residential receivers, and the noise environment at the receivers when the project is operational, the instantaneous noise events from the six identified intermittent sources are unlikely to change noise levels at nearby receivers by more than 5 dB(A) and fail the NPfI intermittent test, given the low project specific trigger levels that the facility is required to meet to take into consideration cumulative industrial noise.

As the loading dock is located on the north of the facility, and there are proposed warehouses in Lot 11 and Lot 13, these noise generating operations have substantial shielding to the nearest residential receivers, the noise level from this source was generally predicted to be similar to or substantially below the existing background noise levels. Similarly, most other sources are located internally within the facility, or have recommendations (see recommended mitigation M1.2 for the liquids pump). As such, it has been assessed as unlikely to be clearly audible at the nearby receivers.

As such, the screening test demonstrated that the noise emissions during the night time period are unlikely to require an intermittent penalty as identified in the NPfI.

#### 5.5.2.3 Impulsiveness noise

The *Draft Industrial Noise Guidelines Technical Background Paper* (EPA, 2015), proposed to seek the views of acoustical practitioners as part of the review/consultation process, and impulsiveness had not been included in the NSW *EPA draft Industrial Noise Guideline* (draft ING). Subsequently, impulsiveness was not included in the NPfI released by the EPA in 2017.

AS1055-2018 describes how potentially annoying characteristics, such as impulsiveness, should be assessed. Section 6.7.4 Impulse adjustment (K2) of AS1055-2018 states:

*"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 application of an impulse adjustment to measured receiver noise 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."*

Three noise sources that occur externally have been identified as potentially exhibiting impulsive characteristics at source as part of the operations. These include:

1. Truck park / trailer brake full system air release events *(typical locations is the northern loading docks or delivery areas)*
2. Forklift loading activities *(typical locations is the northern loading docks or western roller door)*
3. Compressor air releases *(typical locations is the Compressor and dust collector plant room)*

The location of these sources on site have substantial shielding to the nearest residential receivers by nearby structures and buildings. A screening test was carried out as per Appendix E of AS1055-2018 using predicted levels and potential future ambient levels to look at the contribution of these sources at the nearby residential receivers.

Due to the large distance to the nearest residential receivers (> 700m metres), the substantial shielding from adjacent buildings, and the low project specific trigger levels to take into consideration cumulative industrial noise which controls the overall $L_{Aeq,15minute}$ noise emission levels, the contributions from individual instantaneous noise source levels are also substantially mitigated.

The screening test reviewed the instantaneous contributions at nearby receivers from these noise sources. It determined that even though the noise sources may exhibit a 10 dB(A) increase per second noise at source, that when considering the noise environment at the receivers, the prominence of these substantially attenuated 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, specifically looking at the maximum noise levels ($L_{AFmax}$).

Refer to Section 5.5.1 for the $L_{Aeq15\ minute}$ predicted noise levels. The EPA NPfI minimum $L_{Aeq15\ minute}$ sleep disturbance assessment levels is 40 $L_{Aeq15\ minute}$. The highest predicted night period noise level is 33 dB(A) $L_{Aeq15\ minute}$ under noise enhancing meteorological conditions at a long-term residential receiver

and 38 dB(A) $L_{Aeq15\ minute}$ at an isolated residence within the MRP, and as such achieves the EPA NPfI $L_{Aeq15\ minute}$ sleep disturbance assessment level.

Potentially loud instantaneous noise events that could occur across the Proposal operations with the potential to disturb sleep are detailed in Table 5-10. Activities such as truck loading activities, truck manoeuvring, when trucks stop and release airbrakes or intermittent manufacturing activities and operations (ie. compressed air releases) exhibit non-steady noise characteristics with loud instantaneous noise events. Table 5-10 details the various locations where they may typically occur and accordingly modelled. As such, these maximum noise levels have been assessed for the potential to disturb sleep, in accordance with the NPfI.

In regard 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 3.3.5.2], the highest predicted night period noise level is 33 dB(A) $L_{Aeq15\ minute}$ under noise enhancing meteorological conditions at a long-term residential receiver and 38 dB(A) $L_{Aeq15\ minute}$ at an isolated residence within the MRP, and as such clearly achieves the WHO 2018 recommended level.

Predicted noise level for the Proposal operations at nearby representative receivers during the night period are presented in Table 5-15. Noise contour maps at 1.5 metres above the local ground level for each of the existing scenarios assessed are presented in APPENDIX E.

**Table 5-15: Sleep disturbance assessment; $L_{Amax}$, dB(A) - (Scenario A & B)[1]**

| Representative receiver | Screening level | Awakening reaction | Standard meteorological conditions | | | Noise enhancing meteorological conditions | | |
|---|---|---|---|---|---|---|---|---|
| | | | Predicted noise level, $L_{AFmax}$, dB(A) | Exceedance | | Predicted noise level, $L_{AFmax}$, dB(A) | Exceedance | |
| | | | | Screening level | Awakening reaction | | Screening level | Awakening reaction |
| R1 | 52 | 65 | 26 | - | - | 26 | - | - |
| R2 | 52 | 65 | 37 | - | - | 38 | - | - |
| R3 | 52 | 65 | 40 | - | - | 42 | - | - |
| R4 | 52 | 65 | 42 | - | - | 43 | - | - |
| R5 | 52 | 65 | 27 | - | - | 28 | - | - |
| R6 | 52 | 65 | 26 | - | - | 27 | - | - |
| R7 | 52 | 65 | 24 | - | - | 24 | - | - |
| R8 | 52 | 65 | 27 | - | - | 27 | - | - |
| R10 | 52 | 65 | 38 | - | - | 39 | - | - |
| R11 | 52 | 65 | 36 | - | - | 37 | - | - |
| R12 | 52 | 65 | 46 | - | - | 47 | - | - |
| R13 | 52 | 65 | 44 | - | - | 45 | - | - |
| R14 | 52 | 65 | 24 | - | - | 24 | - | - |
| R15 | 52 | 65 | 31 | - | - | 32 | - | - |
| R16 | 52 | 65 | 41 | - | - | 42 | - | - |
| R17 | 52 | 65 | 39 | - | - | 40 | - | - |
| R21 | 52 | 65 | <20 | - | - | <20 | - | - |
| R22 | 52 | 65 | <20 | - | - | <20 | - | - |
| R23 | 52 | 65 | <20 | - | - | <20 | - | - |
| R24 | 52 | 65 | <20 | - | - | <20 | - | - |
| R25 | 52 | 65 | <20 | - | - | <20 | - | - |

Notes: 1. The presented value is the maximum out of both Scenario A & B

The maximum noise level events associated with on-site truck activities, loading dock and raw product delivery activities have been reviewed to determine their potential to cause sleep disturbance at nearby residential receivers.

Considering the substantial shielding given by nearby structures and buildings, in addition to the large distance to the nearest residences (> 700m metres), and the low project specific trigger levels to take into consideration cumulative industrial noise which controls the overall $L_{Aeq,15minute}$ noise emission levels, the contributions from individual instantaneous noise source levels are also substantially mitigated.

As shown in Table 5-15, the predicted noise levels from these noise sources are below the sleep disturbance screening levels at the nearby residences because the site mitigation measures also effectively reduce noise emissions from these events. As such, the $L_{Amax}$ noise levels associated with these events are predicted to generally be below the sleep disturbance assessment trigger levels.

### 5.5.4 Operational noise management

Operational noise management measures can be considered to further reduce noise at the source where feasible and reasonable. 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 where feasible and reasonable:

- 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:

- 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 (ie. at entrance to site).

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 mitigation 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.

# 6 Conclusion

Renzo Tonin & Associates was engaged by The Trust Company (Australia) Limited on behalf of Altis Frasers JV Pty Ltd to undertake an operational and construction noise and vibration impact assessment (NVIA) to accompany the State Significant Development (SSD) 25725029 for the proposed Ardex Warehouse and Manufacturing Facility at the proposed Lot 12, 657-769 Mamre Road, Kemps Creek.

This report assesses noise and vibration impacts during the construction and operational stages for the Proposal. It proposes mitigation and management measures to reduce potential noise emissions and resulting noise impacts during the construction and operation phases of the Proposal. The report has been prepared to address the requirements of the Secretary of the Department of Planning, Industry and Environment (DPIE) ('the Secretary's environmental assessment requirements') (SEARs).

## 6.1 Operational noise assessment

Operational noise impacts from the proposed warehouse and manufacturing facility has been assessed, potential noise impacts identified and a range of feasible and reasonable mitigation measures recommended and/or incorporated into the Proposal design to minimise noise emissions and potential impacts on sensitive receivers nearby to the Proposal site.

The assessment has reviewed the existing noise environment and established the noise emission objectives in accordance with the NSW Noise Policy for Industry (NPfI) (EPA 2017).

As the site is located within the recently rezoned Mamre Road Precinct (MRP), which rezoned about 850 hectares of existing rural and rural residential into industrial land, the potential for cumulative industrial noise was an important aspect of determining acceptable noise levels from the Proposal. In absence of any clear guidance in the draft MRP Development Control Plan (DCP), a reasonable approach as adopted consistent with guidance and concepts for controlling cumulative industrial noise in the EPA Noise Policy for Industry (NPfI) (EPA, 2017). The derivation of the project amenity noise levels was done in a manner based upon delivering a reasonable outcome for the intended proposed landuse and precinct vision for the MRP and taking into consideration a range of factors that are part of cumulative industrial noise for a very large greenfield industrial area.

The assessment then undertook a review of the potential noise generating activities that will likely take place as part of operations of the facility, including noise measurements of a range of the noise generating activities as part of the Proposal at a similar existing manufacturing facility to provide additional confidence for the assessment inputs.

The assessment has predicted the potential noise impacts from the reasonable worst case site operations under both standard meteorological conditions and noise-enhancing meteorological conditions. Following the initial assessment of the site noise emissions, it was determined that noise emissions from site operations may exceed the project noise limits without reasonable mitigation and management being investigated and applied across the facility. The assessment then reviewed and recommended a range of mitigation and management measures to be reviewed and implementation

across the facility where feasible and reasonable. Following this the assessment demonstrated that the predicted noise emissions from the facility can comply with the requirements of the NPfI and MRP DCP at all potentially impacted receivers that surround the Proposal site.

Considering the substantial shielding given by nearby structures and buildings, in addition to the large distance to the nearest residences (> 700m metres) and the low project specific trigger levels to take into consideration cumulative industrial noise which controls the overall $L_{Aeq,15minute}$ noise emission levels, this also results in effective mitigation of the maximum noise level events. As such, the $L_{Amax}$ noise levels associated with the onsite noise generating activities are predicted to generally be below the sleep disturbance assessment trigger levels.

The Proposal expects to generate up to 70 heavy vehicle and 280 light vehicle trips per day (inbound and outbound movements), with the night proportion of those trips being up to 12 heavy vehicle and 45 light vehicle trips, and the portion of traffic generated by the Proposal is insignificant compared to the potential future traffic volumes along the arterial road that the Proposal operations will use. As the surrounding area and the associated road networks are undergoing substantial change, potential road noise impacts on receivers adjacent to these road corridors are generally being identified and addressed as part of larger state projects, such as the Mamre Road Upgrade. As such, the traffic noise levels as a result of the operational traffic from the Proposal project would meet the RNP requirements.

The Proposal site is located outside of the Western Sydney Airport ANEC 20 contour, except for the "*Stage 1 Additional Capacity (One Runway Year 2050) Prefer 05 Direction*" situation for which the Proposal is located on the ANEC 20 contour. As such the Proposal has been assessed in accordance with AS2021:2015 and determined as acceptable and so no further assessment was required to address the requirements of AS2021:2015.

## 6.2 Construction noise and vibration assessment

As part of the works approved for SSD 9522, the Proposal site is undergoing bulk earthworks bulk earthworks and infrastructure, as such the assessment has reviewed the potential construction noise and vibration impacts from the minor civil works, building construction and building fit-out stages of the Proposal.

The expected construction noise levels have been predicted and presented in Section 4.5.1. Noise mitigation and management measures have been presented in Section 4.5.3 to aid in providing additional noise reduction benefits where exceedance of the objectives occurs.

During the building construction and building fit-out phases, vibration intensive plant and equipment are not proposed to be typically used as part of the construction works, while during the minor civil works stages vibration sensitive receivers are likely to be outside of the minimum working distance to the type of vibration intensive plant items, and so the risk of vibration impacts are minimal.

If vibration intensive equipment is required, and vibration sensitive structures are nearby (ie. newly constructed warehouses) management measures have been presented in Section 4.5.4 to aid in minimising any potential vibration impacts.

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

# References


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3. NSW Department of Environment and Climate Change (2009), *Interim Construction Noise Guideline* (ICNG)
4. NSW Environment Protection Authority (2017), *Noise Policy for Industry* (NPfI)
5. NSW Environment Protection Authority (2015*), Draft Industrial Noise Guideline Technical Background Paper*
6. Standards Australia (2016), *Guide to Noise Control on Construction, Demolition and Maintenance Sites*, AS 2436:2010 (R2016)
7. Standards Australia (2018), *Acoustics—Description and measurement of environmental noise,* AS1055:2018
8. UK Department of Transport 1988, *Calculation of Road Traffic Noise* (CORTN)
9. World Health Organisation (2009), *Night Noise Guidelines for Europe*
10. 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 and to assist in understanding the technical issues presented.

| | |
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| 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: |

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| | 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 | | |
| Discontinuous Construction | A wall system having a minimum 20mm cavity between two separate leaves, where, for other than masonry there is no mechanical linkage between leaves except at the periphery. | | |
| DnT,w | Weighted Standardised Field Level Difference<br>A measure of sound insulation performance of a building element. It is characterised by the difference in noise level on each side of a wall or floor. It is measured in-situ.<br>It is a field measurement that relates to the Rw laboratory measured value but is not equal to it because an in-situ space is not of the same quality as a laboratory space.<br>The value is indicative of the level of speech privacy between spaces. The higher its value the better the insulation performance. | | |
| 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'<br>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.<br>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. | | |

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| FIIC | Field Impact Isolation Class.<br>A measure of the noise impact performance of a floor. The value indicates the resistance of the floor to the transmission of impact sound and is measured using a standard tapping machine. It is measured in-situ and is therefore subject to the inherent accuracies involved in such a measurement.<br>The term is defined in ASTM E492 and E1007. It is a field measure of the level of impact sound transmitted to a space via a floor. The equivalent measurement in a laboratory is termed the IIC. The higher the value the better the performance. |
| Flanking | Flanking is the transfer of sound through paths around a building element rather than through the building element material directly.<br>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. |
| FSTC | Field Sound Transmission Class<br>A measure of the sound insulation performance of a building element. It is characterised by the difference in noise level on each side of a wall or floor. It is measured in the field and is therefore subject to the inherent inaccuracies involved in such a measurement.<br>The term was referred to in older superseded versions of the Building Code of Australia and has now been replaced with the term DnT,w. |
| 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.<br>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 |
| IIC | Impact Isolation Class<br>A measure of the noise impact performance of a floor. It is measured in very controlled conditions in a laboratory and is characterised by how much sound reaches the receiving room from the operation a standard tapping machine placed on the floor.<br>The term is defined in ASTM E492 and E1007. The higher the number the better the performance. |
| Impact Noise | The noise in a room, caused by impact or collision of an object onto the walls or the floor. Typical sources of impact noise are footsteps on the floor above a tenancy and the slamming of doors on cupboards mounted on the common wall between tenancies. |
| 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. |
| Intertenancy wall | Walls that separate buildings or units within a building. They may provide sound resistance or serve as a fire wall. Synonymous with 'party wall'. |
| Intrusive noise | Refers to noise that intrudes above the background level by more than 5 dB(A). |

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| 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<br>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.<br>A lower value indicates a better performing floor. |
| LnT,w | Weighted Standardised Field Impact Sound Pressure Level<br>As for Ln,w but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement.<br>The equivalent measurement in a laboratory is the Ln,w.<br>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) |

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| 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.<br>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'. |
| NRC | Noise Reduction Coefficient.<br>A measure of the ability of a material to absorb sound. The NRC is generally a number between 0 and 1 but in some circumstances can be slightly greater than 1 because of absorption at the edges of the material. A material with an NRC rating of 1 absorbs 100% of incoming sound, that is, no sound is reflected back from the material.<br>The NRS is the average of the absorption coefficient measured in the octave bands 250Hz, 500Hz, 1kHz & 2kHz which correspond to the predominant frequencies associated with the human voice. |
| Partition wall | A wall dividing two rooms. |
| Party wall | A wall dividing two tenancies. Synonymous with 'Intertenancy Wall'. |
| 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<br>A measure of the sound insulation performance of a building element. It is measured in very controlled conditions in a laboratory.<br>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.<br>The higher the value the better the acoustic performance of the building element. |
| R'w | Weighted Apparent Sound Reduction Index.<br>As for Rw but measured in-situ and therefore subject to the inherent accuracies involved in such a measurement.<br>The higher the value the better the acoustic performance of the building element. |
| RNP | Road Noise Policy, NSW, March 2011 |
| Sabine | A measure of the total acoustic absorption provided by a material.<br>It is the product of the Absorption Coefficient (alpha) and the surface area of the material (m2). For example, a material with alpha = 0.65 and a surface area of 8.2m2 would have 0.65 x 8.2 = 5.33 Sabine.<br>Sabine is usually calculated for each individual octave band (or third-octave). |
| 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. |

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| 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 micro 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.<br>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<br>A measure of the sound insulation performance of a building element. It is measured in controlled conditions in a laboratory.<br>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.<br>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).<br>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.<br>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 specifically to describe vibration and to assist in understanding the technical issues presented.

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| Acceleration | The rate of change of velocity, often measured in m/s2 or g's. 1 g = 9.81 m/s2. 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. |

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| 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.<br>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 $\mu m/s^2$. 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. |

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| 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.<br>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 then 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. |

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| 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.<br>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).<br>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 $\mathbf{L_w}$, while **sound pressure level** is represented by **SPL** or $\mathbf{L_p}$, 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<br>7 metres away | 90 dB(A) |
| Airplane cabin during cruise (Airbus 321) | Excavator (with bucket)<br>7 metres away | 80 dB(A) |
| General traffic noise kerbside next to Military Road | Towable compressor<br>7 metres away | 75 dB(A) |
| Normal conversation at 1 metre | | 60 dB(A) |
| Outdoor air conditioning unit<br>1 metre away | Towable compressor<br>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.

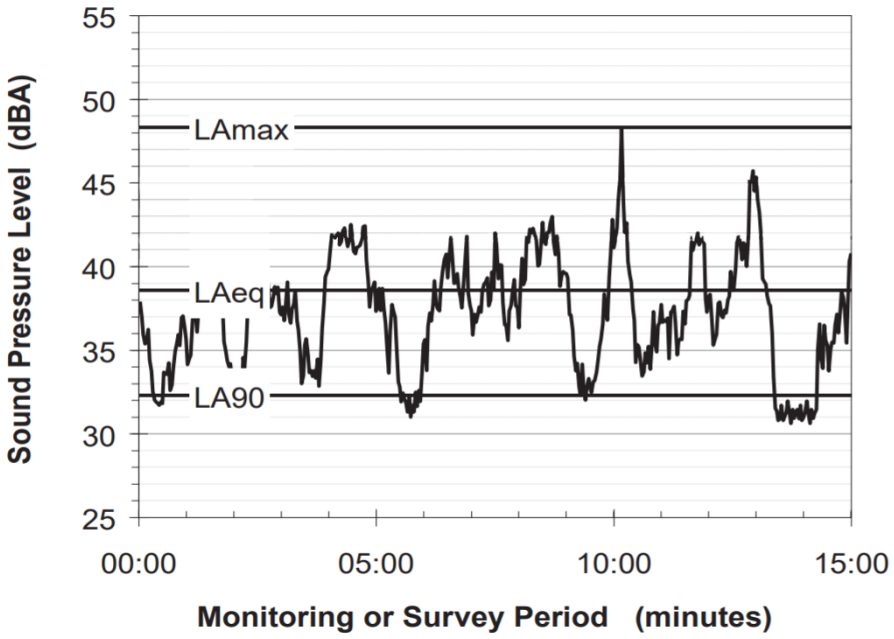
**$L_{Aeq}$** - To protect against long-term repeated noise exposure, the indicator for assessing the cumulative noise exposure level over a specific time interval is the equivalent sound pressure level, denoted as $L_{Aeq}$. The $L_{Aeq}$ indicator accounts for the total energy content from all sources 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.

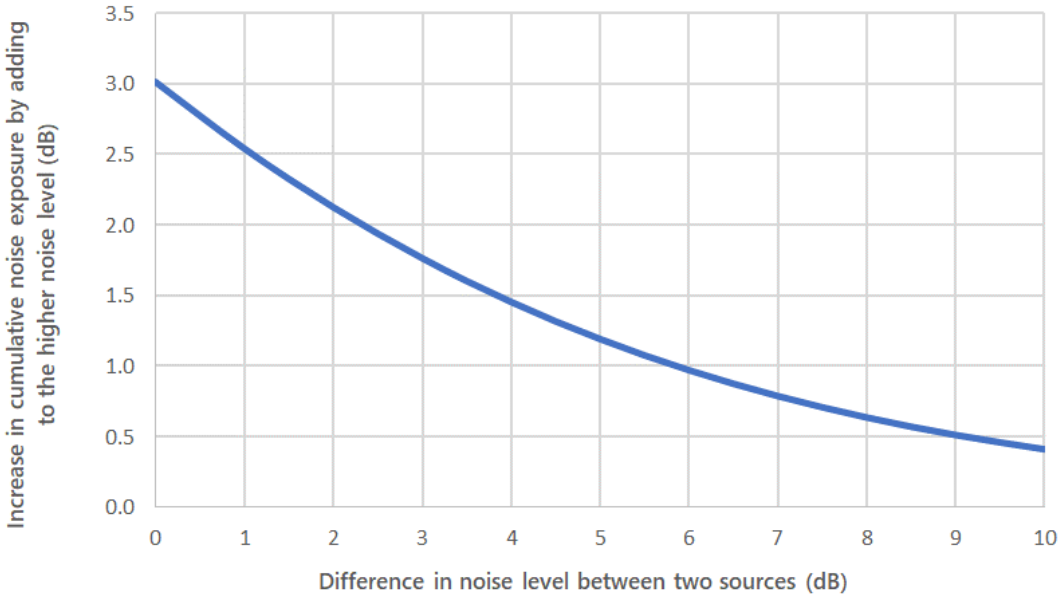
**Figure A-1: Environmental noise assessment indicators**




### 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 respresentative receivers

## B.1 Locality map, sensitive receiver type identification, and operational assessment representative receivers locations

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## B.2 Relevant zoning maps

**Figure 11: Mamre Road Precinct – Zoning Map**

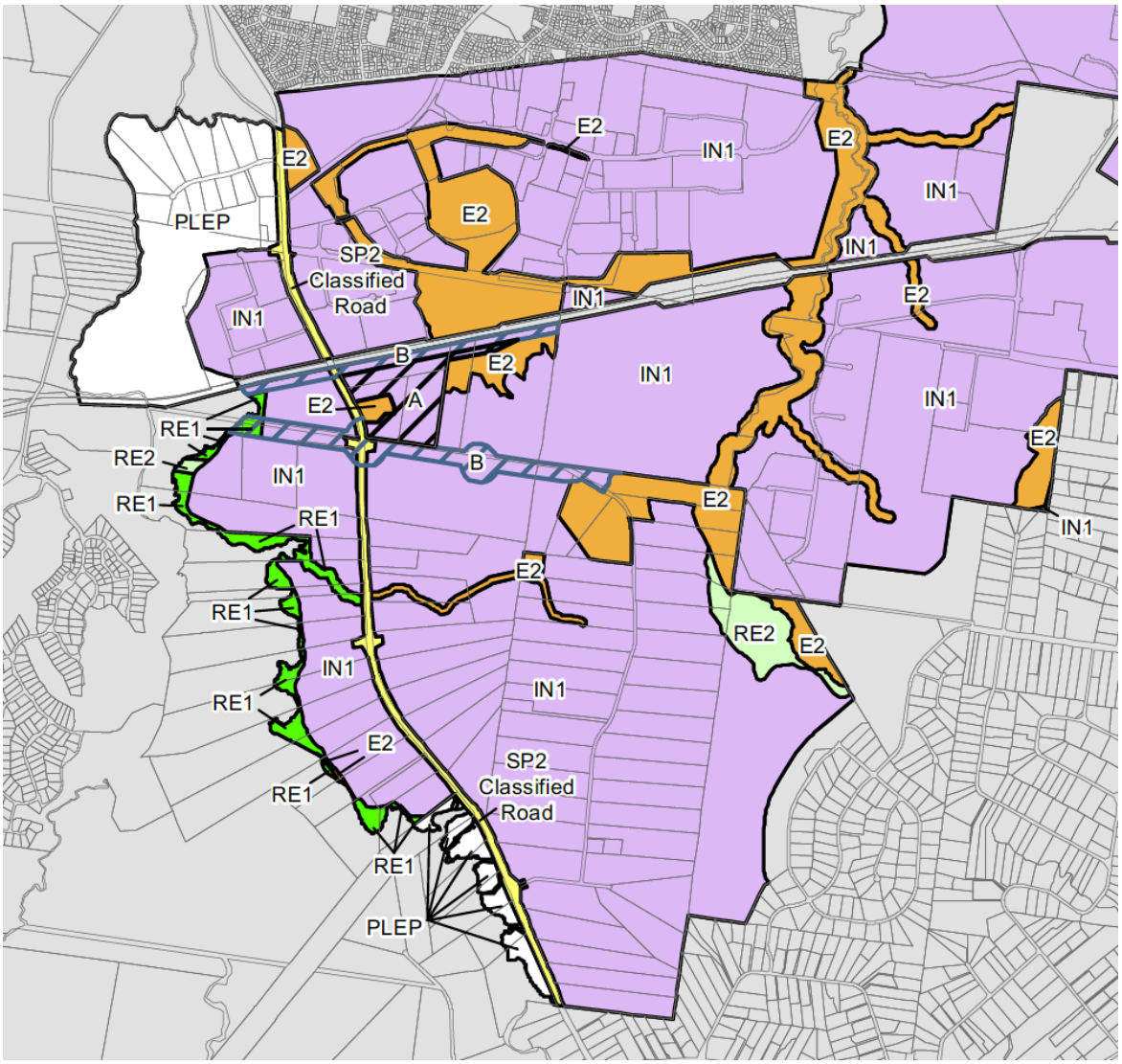
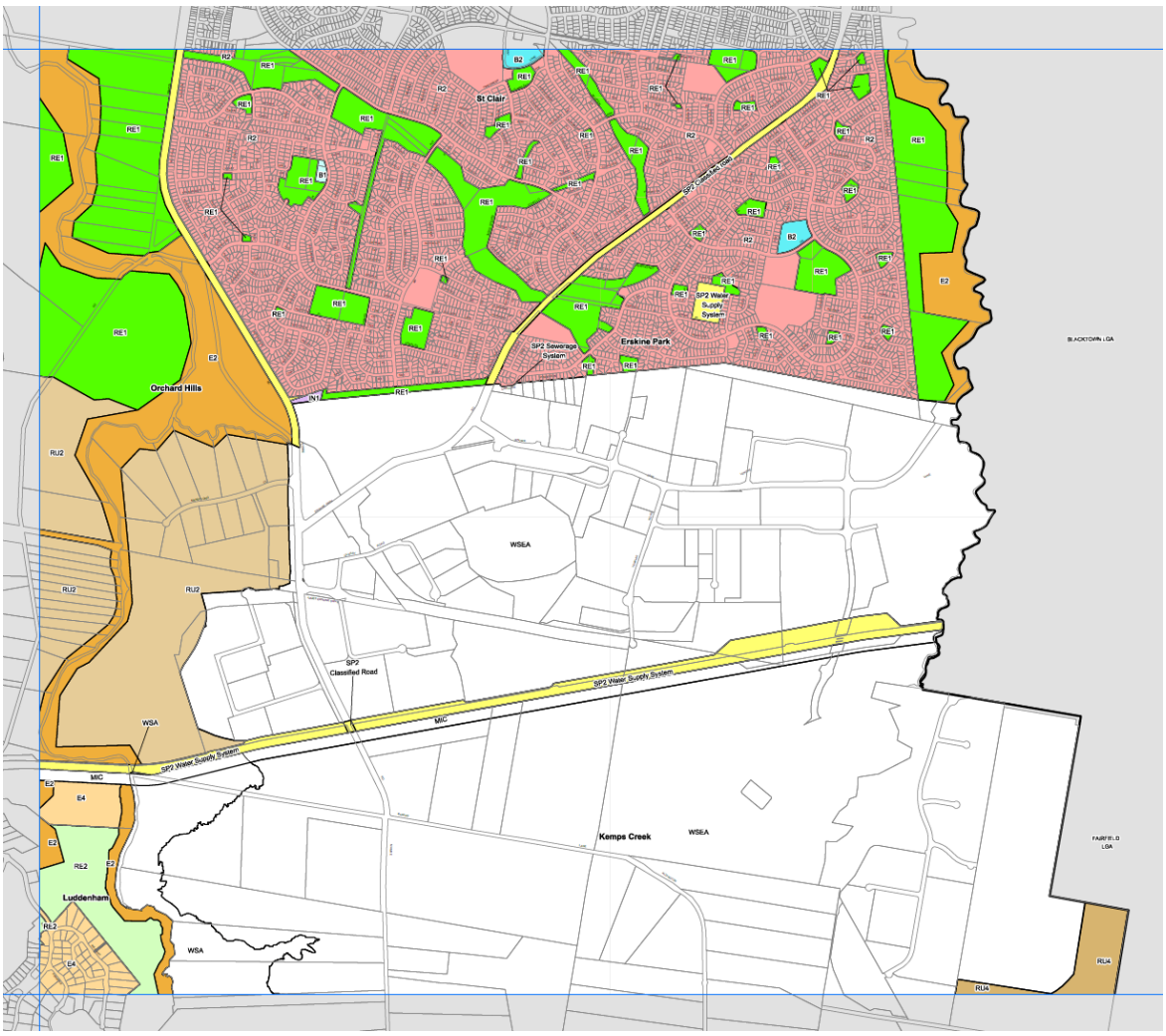


**Figure 12: Penrith Local Environment Plan 2010 – Zoning Map – LZN_020 (31 March 2021 to current [6/10/2021])**



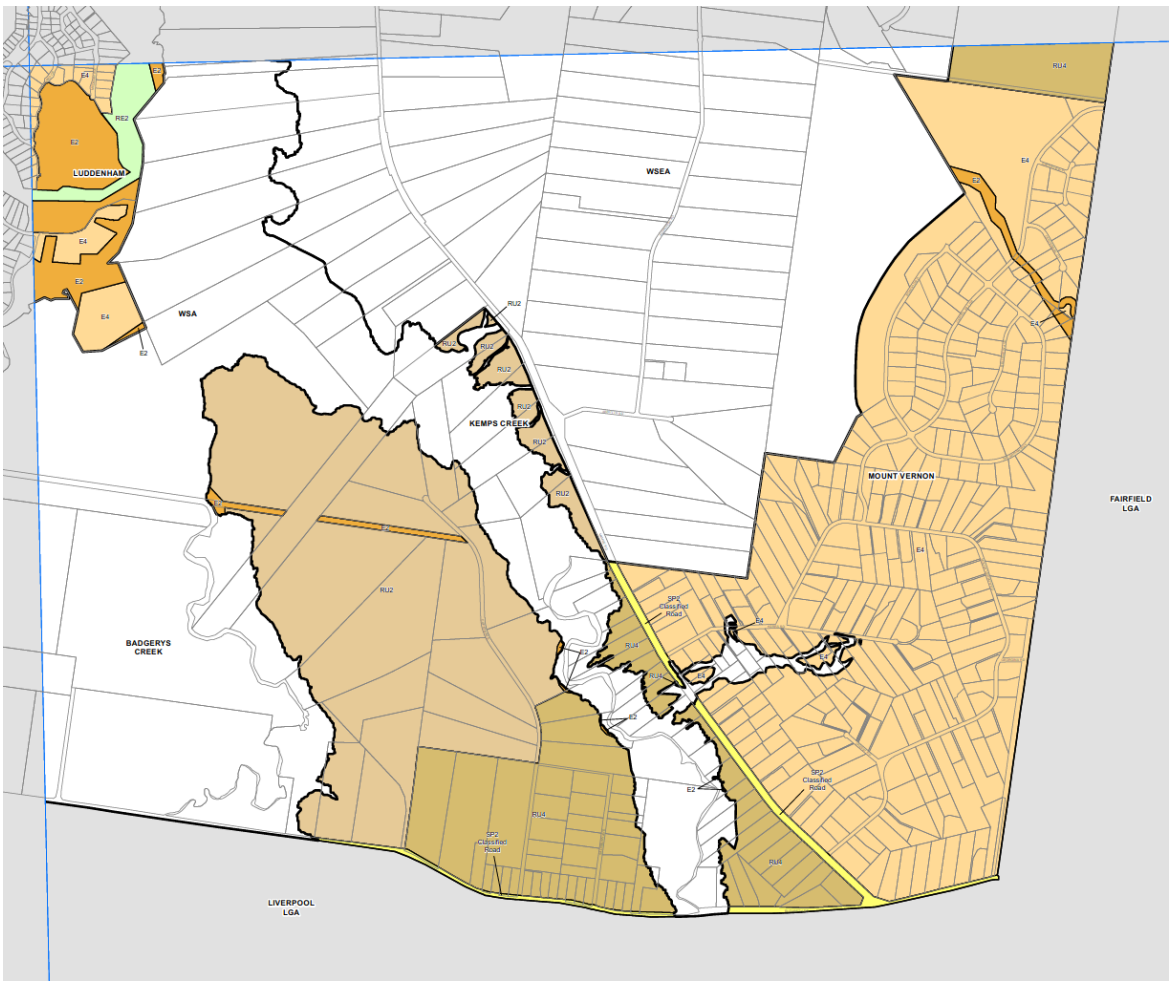

**Zone**

| | |
|---|---|
| B1 | Neighbourhood Centre |
| B2 | Local Centre |
| B3 | Commercial Core |
| B4 | Mixed Use |
| B5 | Business development |
| B6 | Enterprise Corridor |
| B7 | Business Park |
| E1 | National Parks and Nature Reserves |
| E2 | Environmental Conservation |
| E3 | Environmental Management |
| E4 | Environmental Living |
| IN1 | General Industrial |
| IN2 | Light Industrial |
| R1 | General Residential |
| R2 | Low Density Residential |
| R3 | Medium Density Residential |
| R4 | High Density Residential |
| R5 | Large Lot Residential |
| RE1 | Public Recreation |
| RE2 | Private Recreation |
| RU1 | Primary Production |
| RU2 | Rural Landscape |
| RU4 | Primary Production Small Lots |
| RU5 | Village |
| SP1 | Special Activities |
| SP2 | Infrastructure |
| SP3 | Tourist |
| W1 | Natural Waterways |
| W2 | Recreational Waterways |
| DM | Deferred Matter |
| WSEA | SEPP (Western Sydney Employment Area) 2009 |
| SM | SREP No. 30 - St Marys |
| MIC | SEPP (Major Infrastructure Corridors) 2020 |
| WSA | SEPP (Western Sydney Aerotropolis) 2020 |

**Cadastre**

Cadastre 15/03/2021 © Penrith City Council

**Figure 13: Penrith Local Environment Plan 2010 – Zoning Map – LZN_021 (18 Dec 2020 to current [6/10/2021])**




**Zone**

- B1 Neighbourhood Centre
- B2 Local Centre
- B3 Commercial Core
- B4 Mixed Use
- B5 Business Development
- B6 Enterprise Corridor
- B7 Business Park
- E1 National Parks and Nature Reserves
- E2 Environmental Conservation
- E3 Environmental Management
- E4 Environmental Living
- IN1 General Industrial
- IN2 Light Industrial
- R1 General Residential
- R2 Low Density Residential
- R3 Medium Density Residential
- R4 High Density Residential
- R5 Large Lot Residential
- RE1 Public Recreation
- RE2 Private Recreation
- RU1 Primary Production
- RU2 Rural Landscape
- RU4 Primary Production Small Lots
- RU5 Village
- SP1 Special Activities
- SP2 Infrastructure
- SP3 Tourist
- W1 Natural Waterways
- W2 Recreational Waterways
- DM Deferred Matter
- WSEA SEPP (Western Sydney Employment Area) 2009
- SM SREP No. 30 St Marys
- MIC SEPP (Major Infrastructure Corridors) 2020
- WSA SEPP (Western Sydney Aerotropolis) 2020

**Cadastre**

- Cadastre 23/11/2020 © Penrith City Council

# APPENDIX C Existing facility noise measurements

**Points sources/stationary sources** measured for the project area as follows:

**Table 6-1: Attended noise measurement results – Stationary sources**

| Noise generating operation/activity | Measured noise level, dB(A) | | | | | Comments on measured noise levels |
|---|---|---|---|---|---|---|
| | $L_{Amax}$ | $L_{A1,t}$ | $L_{A10,t}$ | $L_{Aeq,t}$ | $L_{A90,t}$ | |
| Package drop by forklift | 86 | 85 | 78 | 76 | 62 | Measurement distance 14m. Includes a wooden pallet being dropped by forklift. |
| B-double air brake | 76 | 76 | 76 | 72 | 66 | Measurement distance 28m. 2 second sample |
| Container truck air brake | 78 | 78 | 77 | 72 | 66 | Measurement distance 15m. 5 second sample |
| Container truck idling[1] | 65 | 65 | 64 | 63 | 62 | Measurement distance 21m. |
| Forklift manoeuvring with product operation off trucks | 81 | 77 | 70 | 66 | 61 | Forklift lifting and manoeuvring with product off trucks, and then depositing product, multiple times. Measured at ~14m. Lifting a pallet off a delivery truck. Contribution from forklift pushing or dragging the pallet off the truck. |
| Forklift unloading from container | 82 | 82 | 73 | 69 | 62 | Measurement distance 7m from container uploading operation. |
| Dust collector | 80 | 80 | 80 | 80 | 79 | Measurement distance 8m, 5-6 releases per minute. |
| Dust collector air releases[1] | 88 | 88 | 85 | 81 | 79 | Measurement distance 7m. Pump is an intermittent process. |
| Liquid pumping | 83 | 83 | 82 | 78 | 73 | Measurement distance 7.5m, within facility. |
| Liquid Mixer (400rpm) [1] | 77 | 77 | 76 | 75 | 75 | Measurement distance 7.5m, within facility. |
| Liquid Mixer (800rpm) | 78 | 78 | 77 | 76 | 76 | Powder tanker pumping at 11m. |
| Powder tanker pumping operations | 84 | 82 | 81 | 80 | 80 | Powder tanker finishing pumping at 11m, with cyclic cooling operation increase by 2 dB. |
| Powder Mixer | 87 | 87 | 87 | 84 | 76 | Measurement distance 5m. |
| Air compressor running | 81 | 79 | 74 | 73 | 71 | Measurement distance 15m. 5 second sample |

Notes: 1. Based upon a representative measurement from a measurement sets/campaign.

**Line sources / moving sources** measured for the project area as follows:

**Table 6-2: Attended noise measurement results – Line sources / Moving sources**

| Noise generating operation/activity | Measured noise level, dB(A) | | Speed (km/h) | Comments on measured noise levels |
|---|---|---|---|---|
| | $L_{Amax}$[1] | $L_{Aeq,t}$ | | |
| 3 axle rigid truck – Passby | 77 | 73 | 12 | Rigid truck pass-by at 7m |
| Reversing operations (including tonal reversing beeper) - Container truck | 73 | 69 | 1 | Reversing operation up driveway passing by at 16m. |
| Reversing operations (including tonal reversing beeper) - 6 axle articulated truck | 89 | 82 | 2 | Reversing operation up driveway passing by at 11m. Lw based upon LAeq, as loud reversing beeper $L_{Amax}$, with strong directivity and truck speed was very slow. |
| Forklift pass-by | 66 | 62 | 5 | Pass-by at 12m at ~5km/h |

Notes: 1. Maximum pass-by noise level
2. Based upon a representative measurement from a measurement set/ measurement campaign.

**Area sources / distributed sources / internal noise levels** measured for the project area as follows:

**Table 6-3: Attended noise measurement results – Area sources / distributed sources / internal noise levels**

| Noise generating operation/activity | Measured noise level, dB(A) | | | Comments on measured noise levels |
|---|---|---|---|---|
| | $L_{Amax}$[1] | $L_{Aeq,t}$ | $L_{A90,t}$ | |
| Powders manufacturing area (general internal noise level) | 88 | 75 | 73 | Mixers, dosers, conveyors, forklifts with horns and reversing beepers, metals bangs and clangs from operations. |
| Liquids manufacturing area (general internal noise level) | 87 | 75 | 72 | Mixers, internal radios, bangs from manual work (ie. hammers), forklifts with horns and reversing beepers, general machinery noise. |
| General warehouse storage area noise level | 91 | 70 | 63 | Warehouse general operations, including forklifts using horns, contributions from powders and liquids areas activities. |
| Gate 1 (south side) general noise level at door | 67 | 67 | 66 | Powders and liquid area operations contributing. Internal forklift movements contributing, including forklift horns and reversing beepers, internal yelling, |
| Gate 2 general noise level at door | 86 | 68 | 65 | Powders and liquid area operations contributing. Internal forklift movement and reversing beepers on contributing. Bangs from manual work (ie. hammers). |

# APPENDIX D Noise source assumptions

**Points sources/stationary source levels** used for the project are as follows:

**Table 6-4: Noise sources - Point source levels/ stationary sources**

| Noise generating operation/activity | Plant/ equipment item | Individual source/ activity $L_{Aeq,t}$ | | | | Individual source/ activity $L_{Amax,t}$ | |
|---|---|---|---|---|---|---|---|
| | | Sound power $L_{Aeq,t}$[1], dB(A) | Duration[2] | Sound power $L_{Aeq,15\ min}$, dB(A) | Modelled source height, metres | Sound power$L_{Amax,t}$,[1] dB(A) | Modelled source height, metres |
| **Delivery and loading dock activities (see Section 5.2.1.3)** | | | | | | | |
| Powder tanker truck pumping operation | Tanker | 109 | 15 min | 109 | 2 | 112 | 2 |
| Liquids tank loading pump | Liquids tank pump | 103 | 15 min | 103 | 2 | 108 | 2 |
| Delivery truck (idling) | All truck types | 97 | 15 min | 97 | 2.5 | 100 | 2.5 |
| Airbrake full release | Semi-trailer (trailer) or Tanker | 116 | 3 sec | 90 | 0.5 | 122 | 0.5 |
| Truck loading activity | Forklift | 97 | 84 | 90 | 2 | 116 | 2 |
| **Manufacturing operations (see Section 5.2.1.4)** | | | | | | | |
| Warehouse roof mounted fan | Fan | 90 | 15 min | 90 | 1[3] | 90 | 1[3] |
| Dust collector (air release) | Dust collector | 115 | 4 sec | 108 | 5.5 | 115 | 5.5 |
| Forklift handling products from truck | Forklift | 97 | 40 | 84 | 2 | 116 | 2 |
| Forklift handling products inside container | Forklift | 94 | 20 | 78 | 2 | 107 | 2 |
| **Office and carparking activities** | | | | | | | |
| Typical condenser unit operation | Condenser unit | 78 | 15 min | 78 | 1.2[3] | 79 | 1.2[3] |
| Carparking activities | Car door slams and engine starts | 93 | 1 sec | 65 | 1 | 97 | 1 |

Notes:
1. Sound power level $L_w$ re. 1pW, dB(A)
2. Duration of this level within 15-minutes (minutes)
3. Relative to mountain location (ie. roof level)

**Line sources / moving sources** used for the project are as follows:

**Table 6-5: Noise sources - Line sources / moving sources**

| Noise generating operation/activity | Plant/equipment item | Individual source/ activity $L_{Aeq,t}$ | | | Individual source / activity $L_{Amax,t}$ | |
|---|---|---|---|---|---|---|
| | | Sound power, dB(A) | Modelled source height, metres | Speed (km/h)[2] | Sound power $L_{Amax,t}$, dB(A) | Modelled source height, metres |
| **Truck movements** | **(see Section 5.2.1.2)** | | | | | |
| Moving onsite | Semi-trailer[3] | 106 | 2 | 15 | 110[4] | 2 |
| Moving onsite | B-Double or Tanker | 107 | 2 | 15 | 111[4] | 2 |
| Reversing operations (including tonal reversing beeper) | Used for all truck types | 108 | 2 | 2 | 117[3] | 2 |
| Accelerating from stationary (ie. dock) | Used for all truck types | 109 | 2 | 10 | 112 | 2 |
| **Delivery and loading dock activities (see Section 5.2.1.3)** | | | | | | |
| Warehouse loading moving product | Forklift | 95 | 1.5 | 5 | 99 | 1.5 |
| **Manufacturing operations (see Section 5.2.1.4)** | | | | | | |
| Forklift moving pass-by | Forklift | 95 | 1.5 | 5 | 99 | 1.5 |
| Forklift manoeuvring with product operation from trucks | Forklift | 97 | 1.5 | 5 | 112 | 1.5 |
| **Office and carparking activities** | | | | | | |
| Moving in carpark | Car | 79 | 1 | 10 | 90 | 1 |

Notes:
1. Sound power level $L_w$ re. 1pW, dB(A)
2. Continuous = Where a source will operate continuously along a line throughout a 15-minute period over a defined line, which will be covered in a 15-minute period, use the word 'continuous', to represent the energy is distributed along that line.
3. Conservatively also adopted for two axle rigids, based upon loudest 6 axle truck. Other reversing operations were 12dB(A) lower.
4. During non-steady movement events

**Area source sources / distributed sources / internal noise level sources** used for the project are as follows:

**Table 6-6: Noise sources - Area source sources / distributed sources / internal noise levels**

| Noise generating operation/activity | Plant/ equipment item | Individual source/ activity $L_{Aeq,t}$ | | | | | Individual source / activity $L_{Amax,t}$ | |
|---|---|---|---|---|---|---|---|---|
| | | $L_{Aeq,t}$, dB(A) | Duration[3] | $L_{Aeq,15\ min}$, dB(A) | Modelled source height, metres | Size / area ($m^2$) | $L_{Amax,t}$, dB(A) | Modelled source height, metres |
| **External noise sources** | | **Sound power level, $L_w$[1]** | | | | | | |
| **Delivery and loading dock activities (see Section 5.2.1.3)** | | | | | | | | |
| Trailer loading activity from internal at recessed dock | Pallet loader | 105 | 24 sec | 90 | 2.4[6] | 13 | 115 | 2.4[6] |
| **Manufacturing operations (see Section 5.2.1.4)** | | | | | | | | |
| Dust extraction system operating | • Dust collector fan<br>• Compressors<br>• Pumps | 106 | 15 min | 106 | 4.5 | 53 | 106 | 4.5 |
| **Internal levels / Noise breakout** | | **Sound pressure level, $L_p$[2]** | | | | | | |
| **Delivery and loading dock activities (see Section 5.2.1.3)** | | | | | | | | |
| Internal warehouse activity noise at facade | Warehouse area | 70 | 15 min | 70 | -[5] | -[5] | 86 | -[5] |
| **Manufacturing operations (see Section 5.2.1.4)** | | | | | | | | |
| Internal powder tower noise at façade and louvres | Powder tower equipment | 85 | 15 min | 85 | -[5] | -[5] | 90 | -[5] |
| Internal liquids tower noise at façade and louvres | Liquids tower equipment | 85 | 15 min | 85 | -[5] | -[5] | 90 | -[5] |
| Internal liquids and powders manufacturing area noise at façade | Liquids and powders manufacturing equipment | 80 | 15 min | 80 | -[5] | -[5] | 90 | -[5] |
| Warehouse open roller door breakout | Forklift/ internal activities | 70 | 15 min | 70 | -[6] | See Section 5.2.2 | 86 | -[6] |

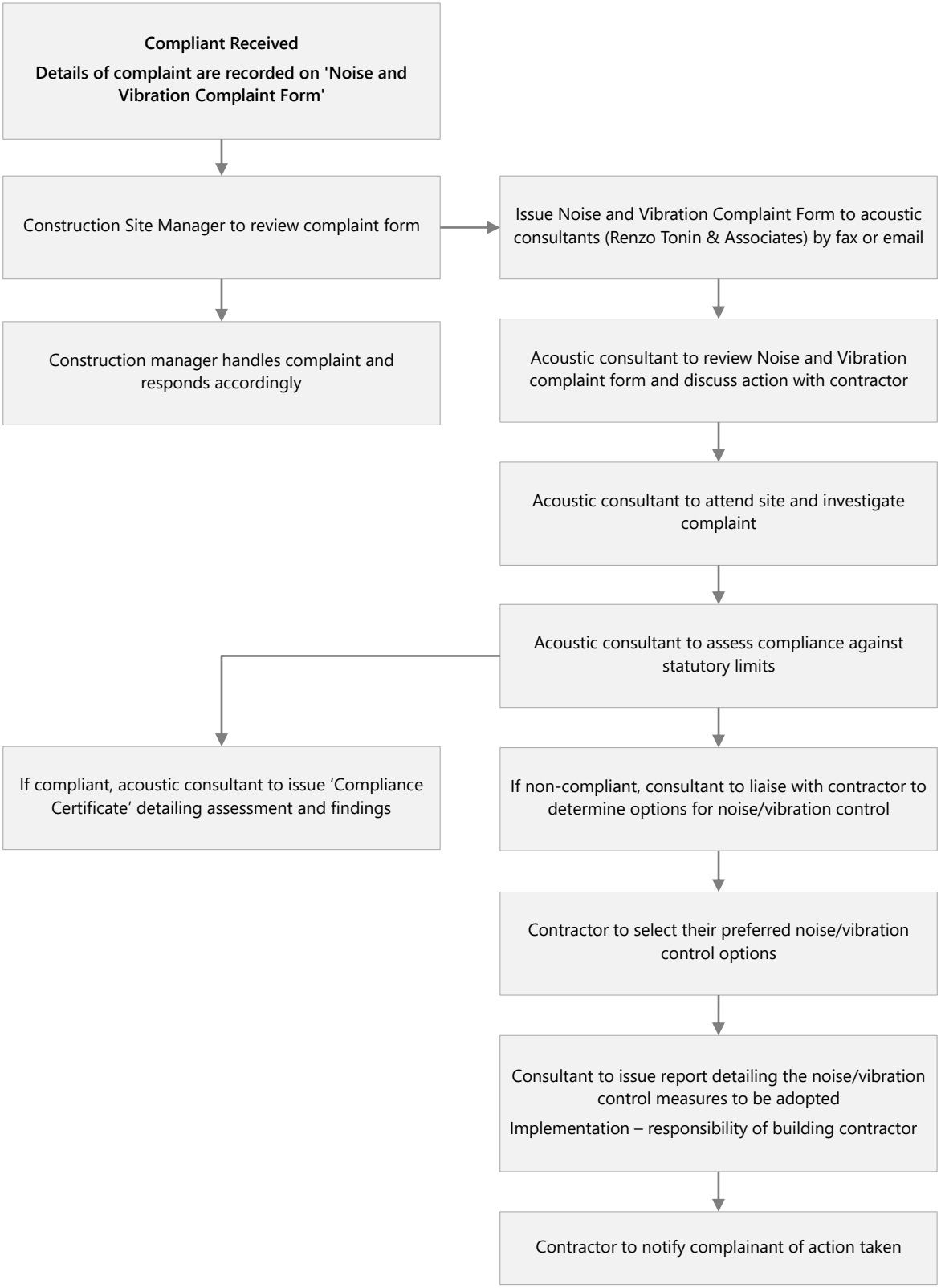
Notes:
1. Sound power level $L_w$ re. 1pW, dB(A)
2. Sound pressure level Lp re. 20µPa, dB(A)
3. Duration of this level within 15-minutes (minutes)
4. For vertical area source heights can be referenced against the geometric centre, with dimensions referenced in the notes.
5. Modelled for all façades and roof
6. Vertical area source

# APPENDIX E Predicted operational noise contours

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

## E.2 Predicted operational noise levels – Sleep disturbance, $L_{Amax}$

# APPENDIX F 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**