ASPECT INDUSTRIAL ESTATE

Warehouse 6 & Warehouse 7 DA
Noise Impact Assessment

Prepared for:

Mirvac Industrial Developments Pty Ltd
Level 28
200 George Street
Sydney NSW 2000

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PREPARED BY

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
Tenancy 202 Submarine School, Sub Base Platypus, 120 High Street
North Sydney NSW 2060 Australia
T: +61 2 9427 8100
E: sydney@slrconsulting.com www.slrconsulting.com

BASIS OF REPORT

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

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

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

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.19127-R13-v1.1	4 October 2024	Joshua Ridgway	Aaron McKenzie	Aaron McKenzie
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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Mirvac Industrial Developments Pty Ltd to assess the potential noise and vibration impacts from construction and operation of the Aspect Industrial Estate (AIE). The AIE is located in the Mamre Road Precinct in Kemps Creek NSW.

Development Consent SSD-10448 was obtained from the Department of Planning and Environment (DPE) in May 2022, and subsequently modified.

The following noise impact assessments have been completed for the AIE:

- A Noise Impact Assessment *'Aspect Industrial Estate State Significant Development Application Noise and Vibration Impact Assessment'* was prepared as part of the SSD-10448 application (SSDA NIA) (SLR Report *610.19127-R02-v1.4*, dated February 2021).
- Two addendum memorandums to the SSDA NIA, *'Aspect Industrial Estate Noise Assessment Addendum'* (NIA Addendum) (SLR Report *610.19217-M01-v0.1-20210513*, dated May 2021), and the *'Aspect Industrial Estate Operational Noise Predictions – DPE Location'* (DPE ONPR) (SLR Report *610.19127-M03-v1.0-20210831*, dated August 2021).
- A Modification noise assessment prepared for SSD-10448 MOD 2 *'Aspect Industrial Estate SSD-10448 MOD 2 Operational Noise Impact Assessment'* (MOD 2 NIA) (SLR Report *610.19127-R06-v2.1-20220725*, dated July 2022).
- A Modification noise assessment prepared for SSD-10448 MOD 3 and SSD-46516461 application *'Aspect Industrial Estate SSD-10448 MOD 3 and Warehouse 9 SSDA Noise Impact Assessment'* (MOD 3 NIA) (SLR Report *610.19127-R07-v3.1-20221027*, dated October 2022).
- An addendum memorandum to the MOD 3 NIA *'Aspect Industrial Estate MOD 3 Revised Operational Noise Level Predictions'* (MOD 3 Addendum) (SLR Reference *610.19127-M01-MOD 3 Revised Results-v0.3-20230227*), dated February 2023.
- A Design Noise Verification Report for Warehouse 9 *'Aspect Industrial Estate Stage 2 Warehouse 9 Design Noise Verification Report'* (WH9 DNVR) (Renzo Tonin & Associates Report *TN328-02F02 DNVR (r6)*, dated July 2023).
- A noise assessment prepared for Warehouse 2 SSD-58257960 *'Aspect Industrial Estate SSD-58257960 Warehouse 2 Noise Impact Assessment'* (WH2 NIA) (SLR Reference *610.19127-R12-v2.0-20230919*, dated September 2023).
- A noise assessment prepared for SSD-10448 MOD 6 and Warehouse 8 SSD-60513208 application *'Aspect Industrial Estate SSD-10448 MOD 6 and Warehouse 8 SSD-60513208 Noise Impact Assessment'* (MOD 6 NIA) (SLR Reference *610.19127-R11-v2.1-20240404*, dated April 2024).

The design of Lot 6 and Lot 7 of the AIE has been updated as part of the Warehouse 6 and Warehouse 7 DA. This report (WH6 & WH7 NIA) summarises the assessment of the potential noise impacts associated with the construction and operation of Lot 6 and Lot 7 of the AIE and details the mitigation and management procedures for controlling the potential impacts, where required.

SLR is suitably qualified to produce this noise impact assessment. SLR is a member of the Australian Acoustical Society (AAS) and a member firm of the Association of Australasian Acoustical Consultants (AAAC).

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

1.1 Project Description

The Aspect Industrial Estate (AIE) is located within the Mamre Road Precinct (MRP) in Kemps Creek. The MRP is an area that has been rezoned to industrial use and is being developed into an employment hub in Kemps Creek. The AIE consists of nine warehouse and distribution centres with associated offices, car parking, loading areas and landscaping. Warehouse 6 and Warehouse 7 are located in the central area of the AIE.

As part of the staged development of the AIE, Mirvac is seeking approval for a new DA for the staged development of Warehouse 6, Warehouse 7 and an estate café. The development has been prepared in accordance with the approved concept development as well as the approved Stage 1, site preparation works and pad levels (SSD-10448). The proposal includes the following:

Warehouse 6 (Lot 6) – Stage 01

- Construction of a single building comprising Warehouse 6A and 6B to a height of 13.7 m including:
  - Warehouse 6A – 4,212 m^2 warehouse area and 500 m^2 of office space.
  - Warehouse 6B – 4,212 m^2 warehouse area and 500 m^2 of office space.
- Construction of two heavy vehicle crossings and two car park crossings to Access Road 3.
- Construction of hardstand area to the northeast of the warehouse for trucks manoeuvring.
- On site services and infrastructure.
- Grading and civil works, including a retaining wall.
- Landscaping along site frontages and within car park area.
- Parking for 72 cars across two car parking areas at the northwest and southeast sides of the warehouse building.
- Use of Warehouse 6A and 6B for the purposes of Warehouse and Distribution Centre use 24 hours a day, 7 days a week.

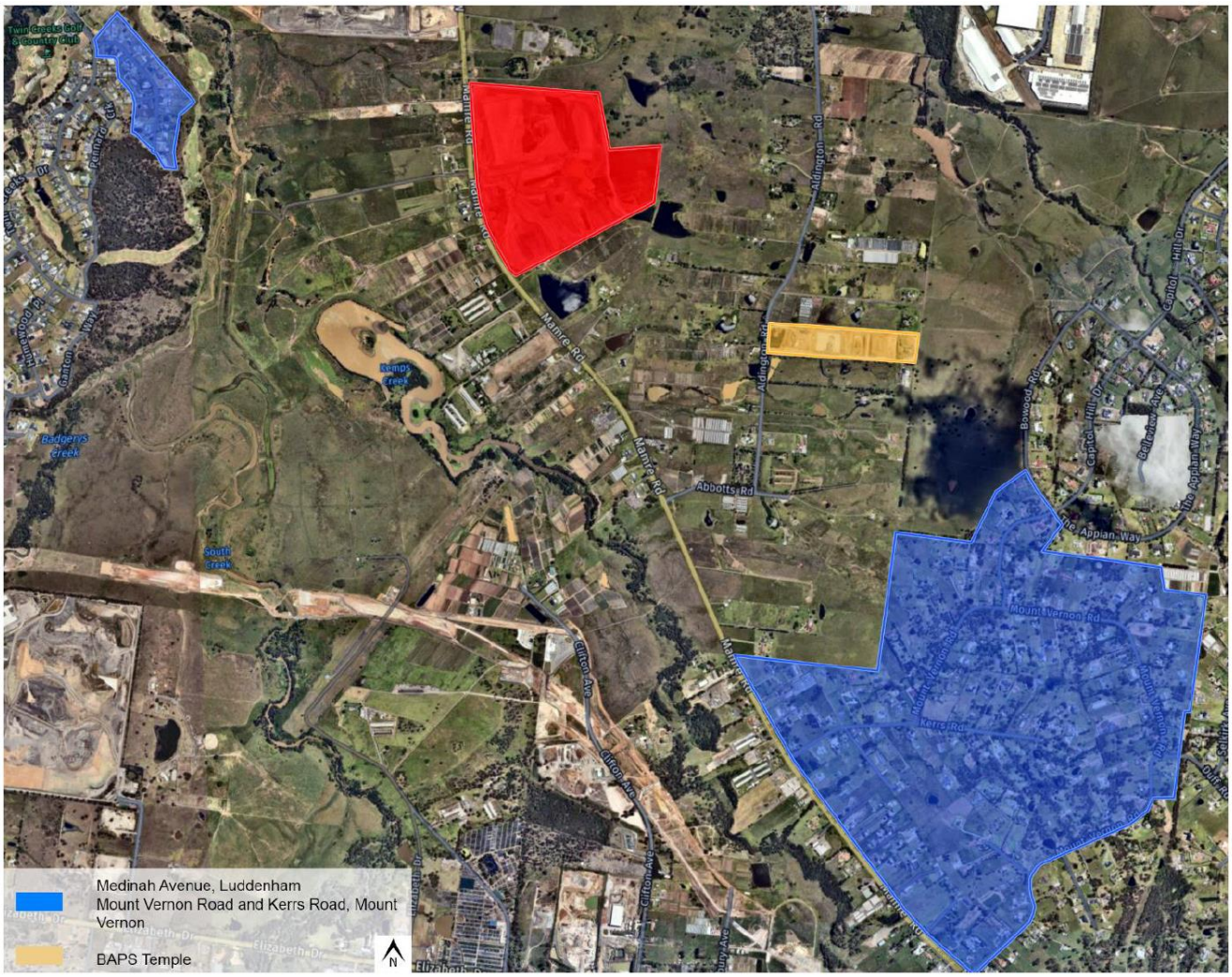
Warehouse 7 and Café (Lot 7) – Stage 02

- Construction of a single building comprising Warehouse 7 to a height of 13.7 m, including
  - 14,358 m^2 ambient warehouse area.
  - 750 m^2 office.
  - 100 m^2 dock office.
- Construction of a 112 m^2 café building at the northwest corner of Lot 7 to a height of 2.8 m.
- Construction of one heavy vehicle crossing and one car park crossing to Access Road 3 for access to Warehouse 7.
- Construction of one car park crossing to Access Road 4 for dedicated access to the proposed café.
- Construction of hardstand area to the southeast of the warehouse for truck manoeuvring.
- On site services and infrastructure.

- Grading and civil works, including retaining walls.
- Landscaping along site frontages and within car park area.
- Parking for 82 cars across:
  - 62 parking spaces at the car park area to the northeast of the warehouse building in support of the proposed Warehouse 7 operations.
  - 20 parking spaces at the car park area to the northwest of the warehouse building in support of the estate café.
- Use of Warehouse 7 for the purposes of Warehouse and Distribution Centre use 24 hours a day, 7 days a week.
- Use of the café as a Food and Drink Premises.

The location of the AIE and the nearest receiver areas are shown in **Figure 1.** The SSD-10448 MOD 6 AIE Masterplan development is shown in **Figure 2**. The proposed Warehouse 6 and Warehouse 7 developments are shown in **Figure 3** and **Figure 4**, respectively.

Figure 1 AIE Location and Nearest Receiver Areas



Note 1: Figure sourced from Appendix 3 of SSD-10448 Development Consent.

Figure 2 SSD-10448 MOD 6 AIE Masterplan Development

Figure 3 Proposed Warehouse 6 Development

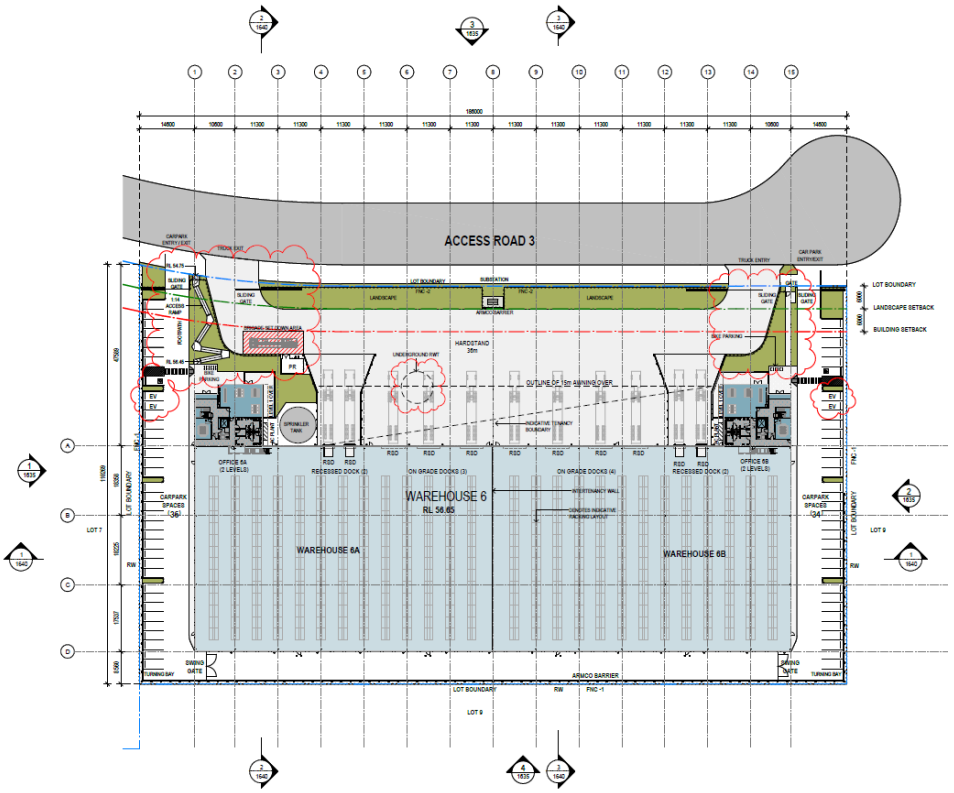
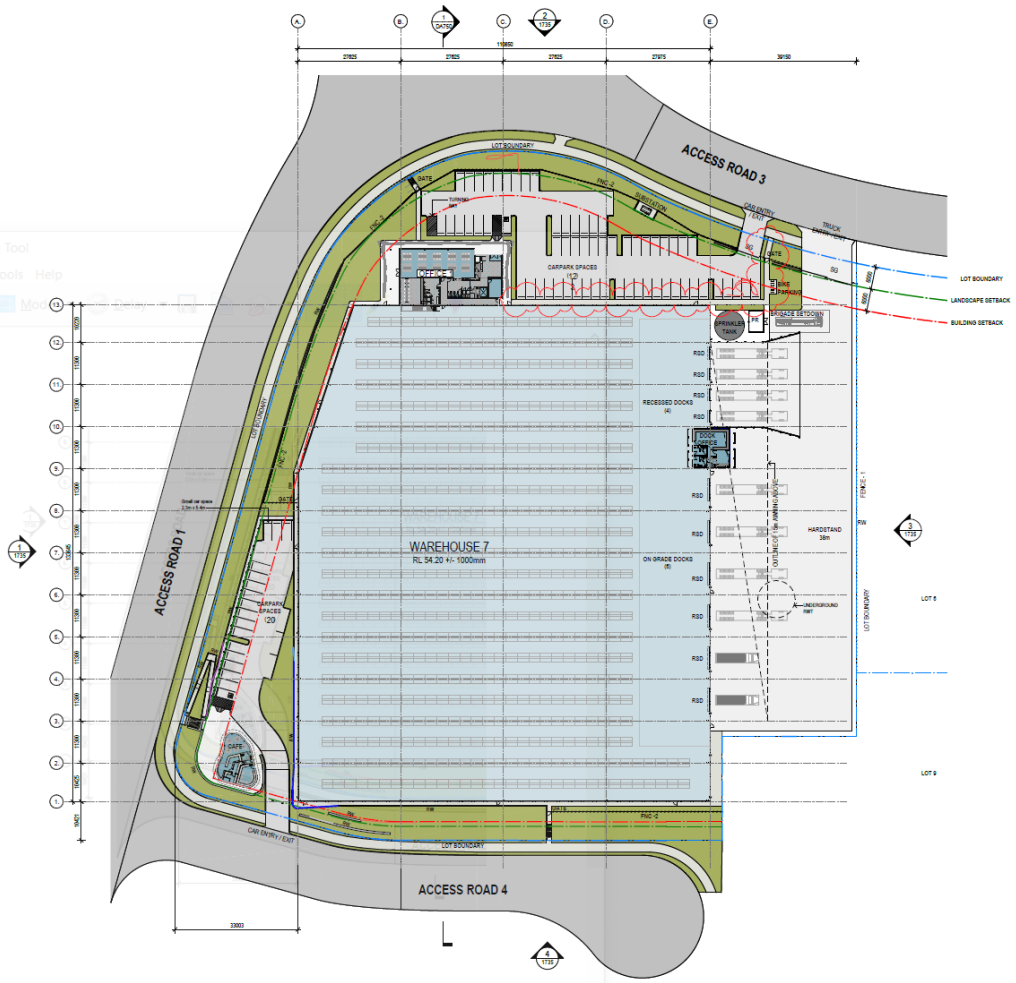


Figure 4 Proposed Warehouse 7 Development



1.2 Nearest Receiver Areas

The nearest residential receiver areas to the AIE are residential properties to the west and southeast outside the MRP. The BAPS Temple is to the southeast of the site, within the MRP. The receiver areas are shown in **Figure 1** and detailed in **Table 1**.

Table 1 Nearest Receiver Areas

ID	Address	Type	Distance (m)	Direction
West Residential	Residences near Medinah Avenue, Luddenham	Residential	1,450	West
Southeast Residential	Residences near Mount Vernon Road and Kerrs Road, Mount Vernon	Residential	2,200	Southeast
BAPS Temple	232 Aldington Road, Kemps Creek	Place of Worship	900	Southeast

1.3 AIE SSD-10448 Development Consent Conditions

The Development Consent Conditions for SSD-10448 were issued in May 2022, and subsequently modified. The requirements relevant to this assessment are shown in **Table 2**.

Table 2 AIE SSD-10448 Development Consent Conditions

<table>
<tr><th>Noise</th><th>Where Addressed</th></tr>
<tr><td>
Noise Limits
A16. The Applicant must:
(a) ensure the cumulative noise emission of fixed external mechanical plant for each warehouse building do not exceed 90 dBA and do not exhibit tonal characteristic or strong low frequency content; and
(b) ensure the noise generated by the operation of the Development does not exceed the noise limits in Table 2.
Table 2 Operational Noise Limits for Concept Proposal (dBA)
<table>
<tr><th>Location</th><th>Day
LAeq(15minute)</th><th>Evening
LAeq(15minute)</th><th>Night
LAeq(15minute)</th></tr>
<tr><td>Residential receivers near Medinah Avenue (Luddenham), Mount Vernon Road (Mount Vernon) and Kerrs Road (Mount Vernon)</td><td>39</td><td>34</td><td>29</td></tr>
<tr><td>BAPS Temple – Outdoor Use Area (Except Car Parking Area)</td><td colspan="3">36 (When in use)</td></tr>
</table>
Note Noise generated by the development is to be measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the NSW Noise Policy for Industry (EPA, 2017) (as may be updated or replaced from time to time). Refer to the plan in Appendix 3 for the location of residential sensitive receivers.
</td><td>Sources of operational noise detailed in Section 2.

Comparison of the predicted noise levels to the noise limits is detailed in Section 3.

Consideration of mitigation and management measures is detailed in Section 4.</td></tr>
<tr><td>
B10. Future DAs must be accompanied by a Noise and Vibration Impact Assessment. The assessment must:
(a) identify the noise and vibration impacts during construction and operation;
(b) demonstrate compliance with the noise limits in Condition A16;
(c) provide an analysis of all external plant and equipment, including but not limited to, forklifts, air conditions and refrigeration systems and on-site vehicle movements;
(d) incorporate noise mitigation measures, such as increased building setbacks, building insulation, noise barriers, layout of truck loading areas or source controls, to demonstrate the noise limits in Condition A16 can be achieved;
(e) recommend mitigation and management measures (excluding measures at receivers) to be implemented to minimise noise during construction and operation.
</td><td>This assessment.

Sections 3 & 6
Section 3
Section 2

Section 4

Section 4</td></tr>
</table>

1.4 Penrith City Council Requirements

Pre-lodgement advice was provided by Penrith City Council in their letter *'Pre-lodgement Advice for Proposed Development Warehouses 6 and 7 (Warehouse and Distribution Premises), Estate Café, and Estate Office at the Aspect Industrial Estate (AIE)'*, dated 20 November 2023. The requirements relevant to this assessment are shown below.

> *Noise and Vibration*
> *The application is to include a noise and vibration assessment that meets the requirements of the various conditions in the SSD determination, including conditions A16, B10, D43, D44 and D49.*

The SSD conditions relevant to this assessment (ie Conditions A16 and B10) are detailed in **Table 2**. While Conditions D43, D44 and D49 relate to the Stage 1 Development, these are shown in **Table 3** and are addressed in this report.

Table 3 Additional AIE SSD-10448 Development Consent Conditions

Noise	Where Addressed
Construction Noise Limits D43. The development must be constructed to achieve the construction noise management levels detailed in the *Interim Construction Noise Guideline (DECC, 2009)* (as may be updated or replaced from time to time). All feasible and reasonable noise mitigation measures must be implemented and any activities that could exceed the construction noise management levels must be identified and managed in accordance with the management and mitigation measures in the Appendix 5.	**Sections 5, 6 & 7**
Construction Noise Management Plan D44. The Applicant must prepare a Construction Noise Management Plan (CNMP) for the development to the satisfaction of the Planning Secretary. The Plan must form part of a CEMP in accordance with condition E2 and must: a) be prepared by suitably qualified and experienced noise expert whose appointment has been endorsed by the Planning Secretary; b) be approved by the Planning Secretary prior to the commencement of construction of each stage of the development; c) describe procedures for achieving the noise management levels in EPA's *Interim Construction Noise Guideline* (DECC, 2009) (as may be updated or replaced from time to time); d) describe the measures to be implemented to manage high noise generating works, in close proximity to sensitive receivers, particularly for noise mitigation eligible receivers shown in Figure 7, in Appendix 4, including but not limited to the following: (i) details of a real-time noise monitoring system to identify occurrence of highly noise affected levels as defined in the *Interim Construction Noise Guideline*; and (ii) describe procedures for implementing respite periods and temporary relocation following identification of highly noise affected levels. e) include a complaints management system that would be implemented for the duration of the development.	A CNMP will be prepared prior to commencement of construction.

Noise	Where Addressed
Vibration Criteria D49. Vibration caused by construction at any residence or structure outside the site must be limited to: a) for structural damage, the criteria set in the latest version of *DIN 4150-3:2016-12 Vibration in Buildings – Part 3: Effects on Structures* (German Institute for Standardisation, 2016); and b) for human exposure, the acceptable vibration values set out in the *Environmental Noise Management Assessing Vibration: a technical guideline* (DEC, 2006) (as may be updated or replaced from time to time).	**Sections 5, 6 & 7**

2 Operational Noise Assessment Methodology

2.1 Operational Noise Limits

The operational noise limits applicable to the Warehouse 6 and 7 development are detailed in Condition A16 of the SSD-10448 Development Consent. The noise limits for the development detailed in Condition A16 are estate-wide criteria that apply to the AIE as a whole. As such, the assessment includes the potential cumulative noise impacts from all noise sources operating simultaneously across the entire AIE (all nine lots).

The noise limits specified in Condition A16 are shown in **Table 4**.

Table 4 Operational Noise Limits

Location	Day $L_{Aeq(15minute)}$	Evening $L_{Aeq(15minute)}$	Night $L_{Aeq(15minute)}$
Residential receivers near Medinah Avenue (Luddenham), Mount Vernon Road (Mount Vernon) and Kerrs Road (Mount Vernon)	39	34	29
BAPS Temple – Outdoor Use Area (Except Car Parking Area)	36 (When in use)		

Additionally, Condition A16(a) specifies that the cumulative noise emission of fixed external mechanical plant for each warehouse building must not exceed 90 dBA and must not exhibit tonal characteristic or strong low frequency content.

2.1.1 Cumulative Noise Impacts

The NPfI aims to limit continuing increases in industrial noise through the application of amenity noise levels. Project amenity noise levels in the MRP are determined using the approach to cumulative noise impacts detailed in Section 2.4.2 of the NPfI *"Amenity noise levels in areas near to an existing or proposed cluster of industry"*. This approach essentially divides the total industrial amenity noise criteria among the number of developments potentially contributing to the noise levels experienced at a particular receiver location, specifying an allowable amenity noise level for each development so that the total industrial noise emissions do not exceed the overall amenity noise criteria. By doing this, the policy accounts for potential cumulative impacts by lowering the criteria for each individual development. The NPfI states that *"where the project amenity noise level applies and it can be met, no additional consideration of cumulative industrial noise is required"*.

The amenity noise criteria for the AIE form part of the noise limits in the SSD-10448 Development Consent. As such, cumulative noise impacts of the AIE and other industrial noise sources in the area (including existing and future sources) are covered by compliance with the noise limits.

2.1.2 Sleep Disturbance

Guidance for assessing the potential for sleep disturbance impacts on nearby residences is provided in Section 2.5 of the *Noise Policy for Industry* (NPfI), which states:

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

Note that the $L_{Aeq(15minute)}$ criteria would be higher than the noise limits outlined in **Table 4**. As such, the assessment against $L_{Aeq(15minute)}$ noise limits is considered to address this part.

Night-time sleep disturbance screening noise levels for the residential receiver areas of L_{Amax} 52 dBA has been adopted for this assessment. Where the sleep disturbance screening noise level is predicted to be exceeded then a detailed maximum noise level event assessment should be undertaken.

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

2.2 Operational Noise Modelling

The AIE includes some lots with known tenants (Warehouse 1 and Warehouse 9), and other lots as spec warehouses with future tenants currently unknown. Several assumptions have been made regarding the unknown future tenants and sources of noise, based on the typical operations for warehouse and distribution centres with 24/7 operations. These assumptions have been used to develop representative typical worst-case noise modelling scenarios that reflect the expected highest noise emissions that the development would likely emit.

The noise emissions from the development (as detailed in the MOD 6 NIA) have been used as the base to assess the changes to Warehouses 6 and 7. The modified Warehouses 6 and 7 operations have been modelled and the potential cumulative noise impacts from the AIE have been determined by comparing the predicted typical worst-case noise levels to the noise limits in a 15-minute assessment period.

The below assessment scenarios are considered to be typical worst-case scenarios with several layers of conservatism. Where operational details are unknown (particularly for future spec warehouses on Lots 2 to 8) conservative assumptions have been made as follows. . These assumptions are consistent with the MOD 6 NIA except where modified for Warehouses 6 and 7.

- The highest vehicle movements in a 15-minute period during the daytime, evening and night-time periods were determined for each individual warehouse. This approach assumes that typical worst-case deliveries and vehicle movements occur at all lots at the same time during the 15-minute period. In reality, the typical worst-case 15-minute vehicle volumes would likely occur at different times for each warehouse, based on delivery schedules and shift times.

- Heavy vehicle movements at Warehouse 1 and Warehouse 9 would typically include both heavy (articulated) trucks and medium (rigid) trucks. However, for the typical worst-case 15-minute truck movements at Warehouse 1 and Warehouse 9, and all heavy vehicles have conservatively been assumed to be heavy (articulated) trucks.
- Hardstands and loading dock activities occur during the daytime, evening and night-time periods, based on the typical worst-case truck movements. It is conservatively assumed that all loading activities are occurring at the same time at each individual warehouse.
- Forklifts at Warehouse 9 will be electric forklifts. It is not known at this stage whether the other warehouses will use gas or electric forklifts. As such, the typical worst-case assessment conservatively assumes forklifts at all warehouses except Warehouse 9 will be gas forklifts, rather than the quieter electric forklifts. All forklifts are conservatively modelled as operating continuously for the full 15-minute period.
- Warehouse 9 includes the use of a compactor and skip bin for the disposal of household appliances and packaging. Warehouse 6 and Warehouse 7 have been assumed to use one compactor each. Use of the compactors and loading of skip bins would occur only during the daytime and evening periods, and would not occur during the night-time period.
- Mechanical plant and equipment servicing the office areas of the warehouses would typically operate during office hours, and other individual items of plant may not operate 24/7. All mechanical plant is conservatively assumed to be operating continuously 24/7.
- Warehouse 1 includes a temperature-controlled section of the facility which will accommodate refrigerated trucks. Refrigerated trucks would be only around 5% of the total heavy vehicle movements at Warehouse 1 and trailers would not typically be left running onsite overnight. However, the model conservatively assumes that two refrigerated trailers during the day and one during the night are operating continuously during the typical worst-case 15-minute periods.
- Hard ground (zero absorption) has conservatively been modelled across the entire developable area of the MRP. In reality, the area will consist of a mix of hard pavements (such as hardstands and roads), and softer surfaces such as vegetation, foliage and landscaping, and would achieve more absorption.

2.3 Operational Noise Sources

The AIE consists of nine warehouse and distribution centres with associated offices, car parking, loading areas and landscaping. Heavy vehicle deliveries would park in the hardstand loading areas or recessed loading docks while they are loaded/unloaded, before exiting the site. Light vehicle car parking is provided at each warehouse which would generally be used by staff.

Internal noise sources would generally be minimal and associated with typical logistical, distribution, warehousing and office space activities. There would be no use of manufacturing equipment within any warehouses. Noise breakout from warehouse activities occurring internally would be insignificant compared to the external noise producing activities. The AIE would operate 24 hours a day.

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

- Delivery vehicle (trucks and vans) movements within each warehouse lot
- Passenger vehicle movements and car parking
- Loading dock activities in hardstands areas of the warehouses
- Fixed mechanical plant and equipment.

The noise modelling methodology and source noise levels are generally consistent with the MOD 6 NIA. A summary of the noise sources for the Warehouses 6 and 7 assessment and expected realistic worst-case assessment scenarios associated with the operation of the development is provided below.

All items of acoustic instrumentation utilised in all measurements detailed below were designed to comply with AS/NZS IEC 61672.1 *Electroacoustics – Sound level meters* and carried current calibration certificates. Where possible SLR have adopted measurement procedures with consideration to ISO 3744:2010 *Acoustics _Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free field over a reflecting plane*.

2.3.1 On-Site Traffic

Typical worst-case vehicle volumes for each lot in the AIE were provided by Mirvac. Volumes specific to the customer's operations have been provided for the following warehouses, with volumes for the other warehouses are based on their gross floor area (GFA), consistent with the MOD 6 NIA:

- Warehouse 1 (CEVA – based on tenant specific movements detailed in the SSD-10448 MOD 2 (then MOD 1) traffic impact assessment report *Aspect Industrial Estate, Mamre Road Precinct – Modification 1 to Stage Significant Development Application (SSD 10448)*, Ason reference P1897|01)
- Warehouse 9 (Winnings – based on tenant specific movements detailed in the SSD-46516461 traffic impact assessment report *Traffic Statement – Warehouse 9 – Aspect Industrial Estate, Mamre Road Precinct*, Ason reference P1901r01v3)
- Warehouses 2, 3, 4, 5, 6, 7 and 8 use generic movements based on the GFA and the below vehicles types, consistent with the previous noise assessments (as detailed in the MOD 6 NIA).

Heavy vehicles for the estate are anticipated to be around 66% medium trucks (rigid trucks), and 34% heavy trucks (7% semi-trailer trucks, 2% b-double trucks and 25% a-double trucks). Warehouse 1 and Warehouse 9 have been conservatively assumed to be heavy trucks for the typical worst-case 15-minute period. Warehouse 9 also has a fleet of transit/sprinter vans which would access the hardstand and on-lot truck access. The vehicle routes are shown in **Figure 5**.

On-site vehicles have been modelled using the data in **Table 5** and **Table 6**. The volumes are representative of the expected typical worst-case 15-minute period for the daytime, evening, and night-time. Medium and heavy trucks have been modelled in hardstands and on-lot truck access roads. Transit/sprinter vans are used in the Warehouse 9 hardstands and on-lot truck access roads. An increased sound power level has been applied to all heavy/medium trucks in areas where they are expected to accelerate, such as at the entrance/exit of each lot. Light vehicles have been modelled in car parks and on-lot light-vehicle access roads.

The modelling conservatively assumes that all light and heavy vehicles concurrently access all warehouses during the typical worst-case 15-minute assessment periods. In reality, vehicle access across the lots would be spread over a longer period, particularly during the night-time.

Table 5 Vehicle Traffic Data – Typical Worst-case 15-Minute Period

Warehouse	Number of Vehicles in Typical Worst-case 15-minute Period[1,2]					
	Daytime / Evening			Night-time		
	Light Vehicles	Medium Trucks	Heavy Trucks	Light Vehicles	Medium Trucks	Heavy Trucks
Warehouse 1	20	0	1	20	0	1
Warehouse 2	12	3	2	11	2	1
Warehouse 3	10	3	2	9	2	1
Warehouse 4	9	2	1	8	2	1
Warehouse 5	6	2	1	6	1	1
Warehouse 6	5	1	1	4	1	1
Warehouse 7	7	2	1	7	2	1
Warehouse 8	19	5	3	18	3	2
Warehouse 9	12	0 medium 6 vans	3	7	0 medium 5 vans	2
Estate Café	3	1	0	3	0	0

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

Note 2: Warehouses 6 and 7 vehicles are based on generic movements calculated from the GFA (as detailed in the Warehouses 6 and 7 traffic assessment report. Vehicles for other warehouses are consistent with the previous noise assessments. Minor discrepancies with the volumes compared to the traffic report may be apparent due to the rounding displayed in the respective tables.

Table 6 Vehicle Sound Power Levels

Vehicle Type	Location	Sound Power Level (dBA)	Vehicle Speed (km/h)
Heavy trucks	Hardstands and on-lot truck access roads	108[1] Slow speed movement	10
		112[1] Acceleration	10
Medium trucks	Hardstands and on-lot truck access roads	103[1] Slow speed movement	10
		107[1] Acceleration	10
Transit/sprinter vans	Warehouse 9 hardstands and on-lot truck access roads	91[2]	10
Light vehicles	Car parks and on-lot light-vehicle access roads	90[3]	20

Note 1: Sound power level for heavy vehicles based on noise measurements undertaken by Renzo Tonin & Associates (RTA).

Note 2: Sound power level for Warehouse 9 transit/sprinter vans measured at Winnings facility in Rosehill NSW (Warehouse 9 customers' existing site) and takes slow speed movements and acceleration into account.

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

The sound power levels detailed in **Table 6** are consistent with the MOD 6 NIA. The sound power levels for heavy vehicle movements are based on noise measurements undertaken previously by RTA at other similar warehouse and distribution facilities, and represent the upper end of the typical expected noise source levels for each vehicle type and activity.

The sound power level for light vehicles is based on measurement data from SLR's noise measurement database taken over multiple years at multiple locations and includes various light vehicle types and models. Measurements of the L_{Amax} sound power level were made of light vehicle passbys at speeds of up to around 40 km/h, including accelerating conditions. SLRs database for light vehicles indicates a SWL range of 73-90 dBA.

The sound power level of Warehouse 9 light commercial (Ford Transit/ Mercedes-Benz Sprinter) vans was measured on 7 February 2023 at Winnings facility in Rosehill NSW (Warehouse 9 customer's existing site). A series of controlled passby measurements of several different vans were undertaken at a distance of 5 m from the vans travelling at 10 km/h and 20 km/h, as well as accelerating past the measurement location. The derived SWL of each passby ranged from 84 dBA to 91 dBA. A sound power level of 91 dBA has been adopted for this assessment.

2.3.2 Loading Docks

Details of the loading dock noise sources are shown in **Table 7**. The sources and sound power levels are consistent with the MOD 6 NIA. Consistent with the MOD 6 NIA, external forklift movements (ie outside of the warehouses) have been modelled in the at-grade dock areas of the hardstands at a rate of one forklift per heavy vehicle onsite, operating continuously during any one 15-minute period. The hardstand/loading dock areas are shown in **Figure 5**.

Warehouse 9 will have electric forklifts, with the other warehouses conservatively assumed to have gas forklifts (consistent with the MOD 6 NIA).

Warehouse 9 compactor operation and skip bin loading/unloading will take place in the south-eastern hardstand area of Warehouse 9 (adjacent to the overflow car park). Compactor operation and skip bin loading/unloading would occur only during the daytime/evening periods (not during the night-time).

Warehouse 6 has been assumed to have one compactor on the hardstand between Warehouses 6A and 6B. Warehouse 7 has been assumed to have one compactor on the hardstand adjacent to the dock office. These have been assumed to operate only during the daytime/evening periods (not during the night-time), consistent with the operation of compactor at Warehouse 9.

Refrigerated truck trailers have been modelled for Warehouse 1, operating continuously during the typical worst-case 15-minute period. Two refrigerated truck trailers have been modelled during the daytime and evening periods, with one refrigerated truck trailer during the night-time period. This is consistent with the MOD 6 NIA.

Table 7 Typical Loading Dock Noise Sources – All Warehouses

Noise Source	Sound Power Level (dBA)[1]	Typical Duration of Use in Typical Worst-case 15-minute Period
Truck reversing alarm	107[2]	30 seconds
Forklift reversing alarm	102[2]	90 seconds
Truck air brakes	118	1 second
Gas forklift	97[3]	900 seconds
Electric forklift	92[3]	900 seconds
Warehouse 1 refrigerated truck trailer	102[4]	900 seconds
Warehouse 9 compactor	91[5]	300 seconds
Warehouse 9 skip bin waste disposal	91[5]	450 seconds
Warehouses 6 and 7 compactors	91[5]	300 seconds

Note 1: Sound power level taken from SLR's measurement database unless specified otherwise.

Note 2: Sound power level includes a -3 dB reduction due to alarms being discrete events.

Note 3: Sound power level of gas and electric forklifts based on noise measurements undertaken by RTA

Note 4: Taken from measurement data and *Sound Power Levels and Directivity Patterns of Refrigerated Transport Trailers*, Roy et al, 2017.

Note 5: Sound power levels for Warehouse 9 compactor and disposal of unwanted appliances and waste in skip bins measured at Winnings facility in Rosehill NSW (Warehouse 9 customers' existing site).

The sound power level of the Warehouse 9 auger compactor was measured on 15 March 2023 at Winnings facility in Rosehill NSW (Warehouse 9 customer's existing site). Measurement of the operation of the compactor while compacting packaging materials was undertaken around the compactor to determine the noisiest location adjacent to the compactor. The L_{Aeq} sound power level at this location was measured for several minutes of operation, with a measured sound power level of 91 dBA. The compactor typically operates for around 5 minutes in a 15-minute period, equating to a $L_{Aeq(15minute)}$ sound power level of 86 dBA. This sound power level has been used for the assumed Warehouse 6 and Warehouse 7 compactors.

The sound power level of Warehouse 9 skip bin waste disposal activities were measured at Winnings facility in Rosehill NSW (Warehouse 9 customer's existing site) on 15 March 2023 by SLR and 6 July 2023 by RTA. The disposal of unwanted appliances in the skip bins includes the operation of an electric forklift to pick up the appliances from the collection area and place them into skip bins to be sent to appropriate waste and recycling centres. The measurements followed the forklift as it picked up various combinations of appliances from the collection area then moved to the skip bin then placed the appliances into the skip bin, staying at a constant distance from the forklift for the duration of the measurement. The measured L_{Aeq} sound power level of each movement cycle (from collecting the appliance to placing the appliance in the skip bin and returning for the next appliance) ranged from 87 dBA to 91 dBA. A sound power level of 91 dBA has been adopted for this assessment. The forklift typically operates for around 7.5 minutes in a 15-minute period, with periodic placement of appliances in the skip bin, equating to a $L_{Aeq(15minute)}$ sound power level of 88 dBA. The measured L_{Amax} sound power level of impact noise from placing the appliance into the skip bin was no higher than 115 dBA.

2.3.3 Mechanical Plant

The details of the assessed mechanical plant are shown in **Table 8**. The sources and sound power levels are consistent with the MOD 6 NIA. The assumed hours of operation of the various items are shown in the table. The mechanical plant locations are shown in **Figure 5**.

Manufacturer data was used for the specific units being installed at Warehouse 1 and Warehouse 9.

Mechanical plant specifications and locations for the speculative Warehouses 2 to 8 are based on indicative mechanical services designs for Warehouse 3. Each warehouse would utilise ventilation and air conditioning plant with a cumulative sound power level up to 90 dBA, in accordance with the limits in Condition A16(a). For Warehouses 2 to 8 around half of the rooftop smoke extraction fans could be operated to provide ventilation to the warehouses. This is a non-typical operation of smoke extraction fans, however it has been included in the noise model to provide a conservative assessment. Smoke extraction fans at Warehouse 1 and Warehouse 9 would only be operated in emergency situations and have not been included in the assessment.

Table 8 External Mechanical Plant

Plant Item	Details and Sound Power Level[1]	Location and Operating Hours
Warehouse 1 – Cumulative total 88 dBA		
Warehouse refrigeration / temperature control units	Fusion VPAC – 7 units – 80 dBA each	Roof of temperature-controlled area of warehouse. Assumed to operate 24/7.
Warehouse smoke extraction fans	SEF units – 9 units – 94 dBA each	Roof the warehouse. Emergency use only[2]
Warehouses 2 to 8 – Cumulative total up to 90 dBA each warehouse		
Warehouse air conditioning condensers	VRV condensers – 2 units – 82 dBA and 79 dBA	Adjacent to main offices at ground level. Assumed to operate 24/7.
Main offices exhaust fans	OAF unit – 1 unit – 75 dBA TEF unit – 1 unit – 64 dBA	Roof of each main office. Assumed to operate 24/7.
Dock offices fans	Daikin ACU – 1 unit – 70 dBA Blauberg TEF – 1 unit – 60 dBA	Roof of each dock office. Assumed to operate 24/7.
Warehouse smoke extraction fans	Pacific Ventilation SEF units – 9 units – 78 dBA each	Roof of each warehouse. <50% during normal operation (100% during fire emergencies) Assumed to operate 24/7.

Plant Item	Details and Sound Power Level[1]	Location and Operating Hours
Warehouse 9 – Cumulative total 90 dBA		
Main office air conditioning	Hitachi RAS-3HVNC1 – 1 unit – 58 dBA Hitachi RAS-24FSXNS – 1 unit – 74 dBA Hitachi RAS-22FSXNS – 1 unit – 72 dBA Hitachi RAS-18FSXNS – 2 units – 73 dBA each Hitachi RAS-16FSXNS – 1 unit – 71 dBA	Main office plant area (ground level). Assumed to operate 24/7.
	Pacific Ventilation AX63DB18A-4DAF – 1 unit – 87 dBA Pacific Ventilation DQ56DB16P-4CSF – 1 unit – 87 dBA	Main office roof. Assumed to operate 24/7.
Dock office air conditioning	Hitachi RAS-3HVNC – 2 units at each dock office (4 total) – 58 dBA each	Adjacent to each dock office (ground level). Assumed to operate 24/7.
Warehouse smoke extraction fans	Pacific Ventilation SEF units – 16 units – 78 dBA each	Roof of the warehouse. Emergency use only[2]
Estate Café – Cumulative 71 dBA		
Café air conditioning	Daikin ACU – 1 unit – 70 dBA Blauberg TEF – 1 unit – 60 dBA	Café roof. Assumed to operate 24/7.
Kitchen extraction fan	Extraction fan – 1 unit – 61 dBA Indicative sound power level based on SLR measurements of similar café kitchen extraction fans.	Café roof. Assumed to operate 24/7.

Note 1: Sound power level based on manufacturer data – refer to WH9 DNVR for specification sheets.

Note 2: Emergency use only. Not included in the typical worst-case operations.

2.3.4 Noise Sources with Potential for Sleep Disturbance

As the development would operate 24-hours a day, noise emissions during the night-time require assessment for potential sleep disturbance in the residential receiver areas. The details of typical activities with the potential to cause sleep disturbance are shown in **Table 9**.

Table 9 Sleep Disturbance Noise Events – L_{Amax} Sound Power Levels

Noise Source	Sound Power Level L_{Amax} (dBA)
Accelerating trucks in hardstands and on-lot truck access	112
Truck air brakes in hardstands	118
Truck reversing alarm in recessed docks	110
Forklift reversing alarm in hardstands	105
Light vehicle movements in car parks and on-lot light-vehicle access	100

2.3.5 Corrections for Annoying Noise Characteristics

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

- **Tonality** – the only source identified with potential tonal characteristics is reversing alarms. However, when considering broadband reversing alarms have been recommended as a noise mitigation measure (see **Section 4**), it is unlikely that this noise source would result in tonal noise impacts at the receivers and no corrections have been applied.
- **Low frequency noise** – review of the predicted noise levels at the nearest receivers and previous measurements of sources similar to those operating at the development indicate that low frequency noise impacts are not expected, and no corrections have been applied.
- **Intermittent noise** – the NPfI defines intermittent noise as noise heard at the receiver where the level suddenly drops or increases several times during the assessment period, with a noticeable change of at least 5 dB. The intermittent correction does not apply to short-term events that emerge above the general industrial noise level and is therefore not applicable to industrial or commercial sites that have vehicle or plant movements at night, including audible reversing alarms. No sources have been identified with potential intermittent characteristics.

In accordance with Condition A16(a), activities on the site are not expected to result in annoying characteristics at the nearest receivers as determined in accordance with the NPfI and AS 1055:2018.

2.3.6 Summary of Typical Worst-Case Operational Scenarios

To assess noise impacts from the AIE, typical worst-case 15-minute operational scenarios have been developed based on the activities, noise sources and sound power levels detailed above. A summary of the scenarios is provided in **Table 10**. The source locations are shown in **Figure 5**.

Table 10 Representative Typical Realistic Worst-Case 15-minute Operational Scenarios

Activity	Day/Evening Scenario	Night Scenario
Vehicle Movements within each Warehouse Lot (refer to Section 2.3.1)		
Heavy trucks (semi-trailer, B-double, A-double) - located in hardstands and on-lot truck access roads / driveways for all warehouses	Warehouse 1 – 1 heavy truck Warehouse 2 – 2 heavy trucks Warehouse 3 – 2 heavy trucks Warehouse 4 – 1 heavy truck Warehouse 5 – 1 heavy truck Warehouse 6 – 1 heavy truck Warehouse 7 – 1 heavy truck Warehouse 8 – 3 heavy trucks Warehouse 9 – 3 heavy trucks	Warehouse 1 – 1 heavy truck Warehouse 2 – 1 heavy truck Warehouse 3 – 1 heavy truck Warehouse 4 – 1 heavy truck Warehouse 5 – 1 heavy truck Warehouse 6 – 1 heavy truck Warehouse 7 – 1 heavy truck Warehouse 8 – 2 heavy trucks Warehouse 9 – 2 heavy trucks

Activity	Day/Evening Scenario	Night Scenario
Medium trucks (rigid) - located in hardstands and on-lot truck access roads / driveways for all warehouses	Warehouse 1 – 0 medium trucks Warehouse 2 – 3 medium trucks Warehouse 3 – 3 medium trucks Warehouse 4 – 2 medium trucks Warehouse 5 – 2 medium trucks Warehouse 6 – 1 medium truck Warehouse 7 – 2 medium trucks Warehouse 8 – 5 medium trucks Warehouse 9 – 0 medium trucks Estate café – 1 medium truck	Warehouse 1 – 0 medium trucks Warehouse 2 – 2 medium trucks Warehouse 3 – 2 medium trucks Warehouse 4 – 2 medium trucks Warehouse 5 – 1 medium truck Warehouse 6 – 1 medium truck Warehouse 7 – 2 medium trucks Warehouse 8 – 3 medium trucks Warehouse 9 – 0 medium trucks Estate café – 0 medium trucks
Transit/sprinter vans - located in hardstands and on-lot truck access roads / driveways for Warehouses 9 only	Warehouse 9 – 6 vans	Warehouse 9 – 5 vans
Light vehicles - located in car parks and on-lot light-vehicle access roads / driveways for all warehouses	Warehouse 1 – 20 light vehicles Warehouse 2 – 12 light vehicles Warehouse 3 – 10 light vehicles Warehouse 4 – 9 light vehicles Warehouse 5 – 6 light vehicles Warehouse 6 – 5 light vehicles Warehouse 7 – 7 light vehicles Warehouse 8 – 19 light vehicles Warehouse 9 – 12 light vehicles Estate café – 3 light vehicles	Warehouse 1 – 20 light vehicles Warehouse 2 – 11 light vehicles Warehouse 3 – 9 light vehicles Warehouse 4 – 8 light vehicles Warehouse 5 – 6 light vehicles Warehouse 6 – 4 light vehicles Warehouse 7 – 7 light vehicles Warehouse 8 – 18 light vehicles Warehouse 9 – 7 light vehicles Estate café – 3 light vehicles
Loading Dock Activities (refer to Section 2.3.2)		
Forklift loading / unloading (including reverse alarms) -number of forklifts equal to total number of heavy vehicles (medium and heavy trucks) - located in at-grade dock areas of hardstands for all warehouses	Warehouse 1 – 1 gas forklift Warehouse 2 – 5 gas forklifts Warehouse 3 – 5 gas forklifts Warehouse 4 – 3 gas forklifts Warehouse 5 – 3 gas forklifts Warehouse 6 – 2 gas forklifts Warehouse 7 – 3 gas forklifts Warehouse 8 – 8 gas forklifts Warehouse 9 – 3 electric forklifts	Warehouse 1 – 1 gas forklift Warehouse 2 – 3 gas forklifts Warehouse 3 – 3 gas forklifts Warehouse 4 – 3 gas forklifts Warehouse 5 – 2 gas forklifts Warehouse 6 – 2 gas forklifts Warehouse 7 – 3 gas forklifts Warehouse 8 – 5 gas forklifts Warehouse 9 – 2 electric forklifts
Truck air brakes and reverse alarms - equal to total number of heavy vehicles (medium and heavy trucks) - located in at-grade and recessed loading dock areas of hardstands for all warehouses	Warehouse 1 – 1 heavy-vehicle Warehouse 2 – 5 heavy-vehicles Warehouse 3 – 5 heavy-vehicles Warehouse 4 – 3 heavy-vehicles Warehouse 5 – 3 heavy-vehicles Warehouse 6 – 2 heavy-vehicles Warehouse 7 – 3 heavy-vehicles Warehouse 8 – 8 heavy-vehicles Warehouse 9 – 3 heavy-vehicles	Warehouse 1 – 1 heavy-vehicle Warehouse 2 – 3 heavy-vehicles Warehouse 3 – 3 heavy-vehicles Warehouse 4 – 3 heavy-vehicles Warehouse 5 – 2 heavy-vehicles Warehouse 6 – 2 heavy-vehicles Warehouse 7 – 3 heavy-vehicles Warehouse 8 – 5 heavy-vehicles Warehouse 9 – 2 heavy-vehicles

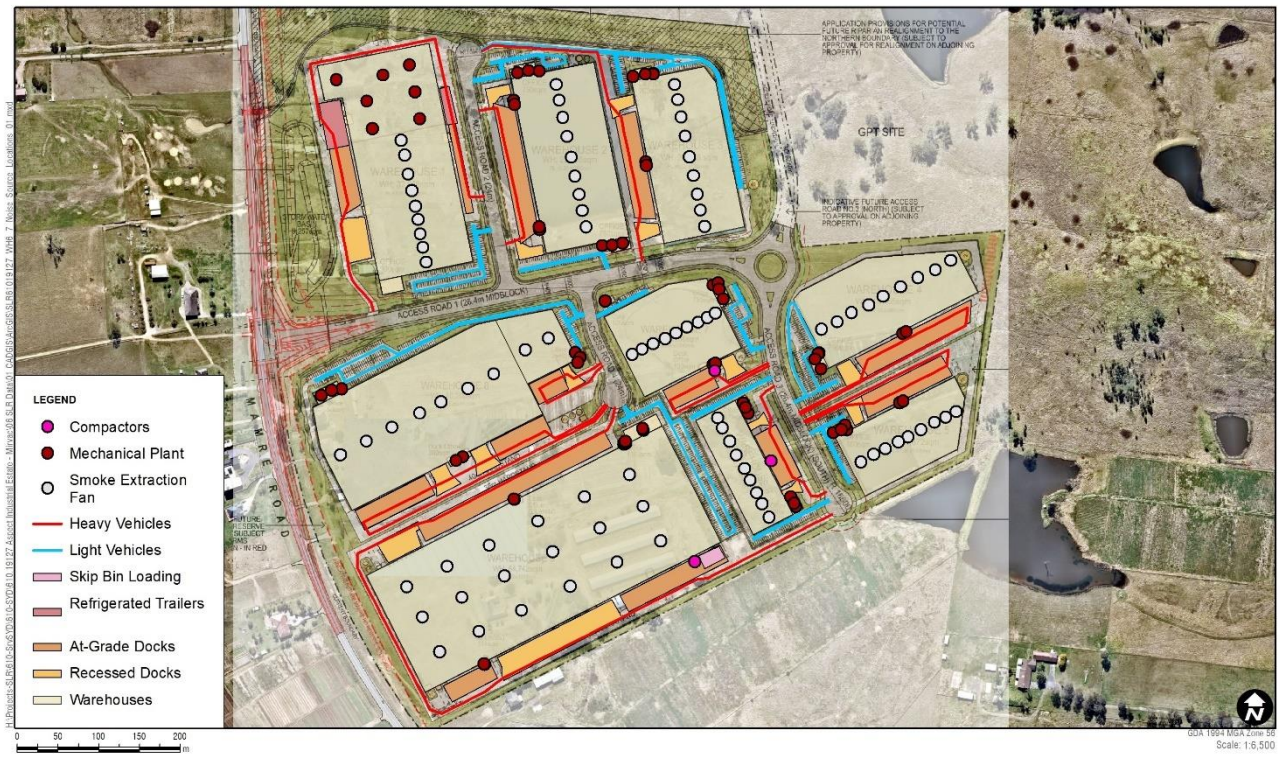
Activity	Day/Evening Scenario	Night Scenario
Compactors - located in south-eastern hardstand area of Warehouse 9 - located on Warehouse 6 hardstand between 6A and 6B - located on Warehouse 7 hardstand adjacent to dock office	Warehouse 9 – 1 compactor Warehouse 6 – 1 compactor Warehouse 7 – 1 compactor Typically operate for 5 minutes in a 15-minute period	No operation at night
Skip bin waste disposal - includes forklift movements to pick up appliances and place into skip bins – located in south-eastern hardstand area of Warehouse 9	Typically operate for 7.5 minutes in a 15-minute period	No operation at night
Refrigerated trucks - located in north-western and north-eastern hardstand areas of Warehouse 1	Warehouse 1 – 2 refrigerated trucks	Warehouse 1 – 1 refrigerated truck
External Fixed Mechanical Plant and Equipment (refer to Section 2.3.3)		
Warehouse 1 mechanical services plant - located on the roof of Warehouse 1	Warehouse 1 – 7 Fusion VPAC units	Warehouse 1 – 7 Fusion VPAC units
	Warehouse 1 – 9 x SEF (emergency use only)	Warehouse 1 – 9 x SEF (emergency use only)
Warehouse 2 to 8 mechanical services plant - located on the roof of each warehouse/office of Warehouse 2 to Warehouse 8 as detailed in **Section 2.3.3**	Warehouse 2 – 2 condensers, 1 ACU, 3 fans and 9 smoke exhaust fans (50% running)	Warehouse 2 – 2 condensers, 1 ACU, 3 fans and 9 smoke exhaust fans (50% running)
	Warehouse 3 – 2 condensers, 1 ACU, 3 fans and 9 smoke exhaust fans (50% running)	Warehouse 3 – 2 condensers, 1 ACU, 3 fans and 9 smoke exhaust fans (50% running)
	Warehouse 4 – 2 condensers, 1 ACU, 3 fans and 9 smoke exhaust fans (50% running)	Warehouse 4 – 2 condensers, 1 ACU, 3 fans and 9 smoke exhaust fans (50% running)
	Warehouse 5 – 2 condensers, 1 ACU, 3 fans and 9 smoke exhaust fans (50% running)	Warehouse 5 – 2 condensers, 1 ACU, 3 fans and 9 smoke exhaust fans (50% running)
	Warehouse 6A & 6B – 2 condensers, 1 ACU, 3 fans and 9 smoke exhaust fans (50% running)	Warehouse 6A & 6B – 2 condensers, 1 ACU, 3 fans and 9 smoke exhaust fans (50% running)
	Warehouse 7 – 2 condensers, 1 ACU, 3 fans and 9 smoke exhaust fans (50% running)	Warehouse 7 – 2 condensers, 1 ACU, 3 fans and 9 smoke exhaust fans (50% running)
	Warehouse 8 – 2 condensers, 1 ACU, 3 fans and 9 smoke exhaust fans (50% running)	Warehouse 8 – 2 condensers, 1 ACU, 3 fans and 9 smoke exhaust fans (50% running)

Activity	Day/Evening Scenario	Night Scenario
Warehouse 9 mechanical services plant - located in the Warehouse 9 ground level main office plant area, main office roof, warehouse roof, and adjacent to dock offices as detailed in **Section 2.3.3**	Warehouse 9 – main office ground – 6 Hitachi units	Warehouse 9 – main office ground – 6 Hitachi units
	Warehouse 9 – main office roof – 2 Pacific Ventilation units	Warehouse 9 – main office roof – 2 Pacific Ventilation units
	Warehouse 9 – dock offices – 2 Hitachi units each	Warehouse 9 – dock offices – 2 Hitachi units each
	Warehouse 9 – warehouse roof – 9 x SEF (emergency use only)	Warehouse 9 – warehouse roof – 9 x SEF (emergency use only)
Estate café mechanical services plant - located on café roof	Estate café – 1 ACU, 1 fan, 1 kitchen extraction fan	Estate café – 1 ACU, 1 fan, 1 kitchen extraction fan

Note 1: Volumes are rounded up to whole numbers for display purposes.

Emergency plant and/or equipment such as fire pumps and smoke extractions fans would not form part of normal operations and have not been included in the typical worst-case 15-minute operations. It is assumed these systems may be tested once every couple of months during the daytime period.

Figure 5 Noise Source Locations



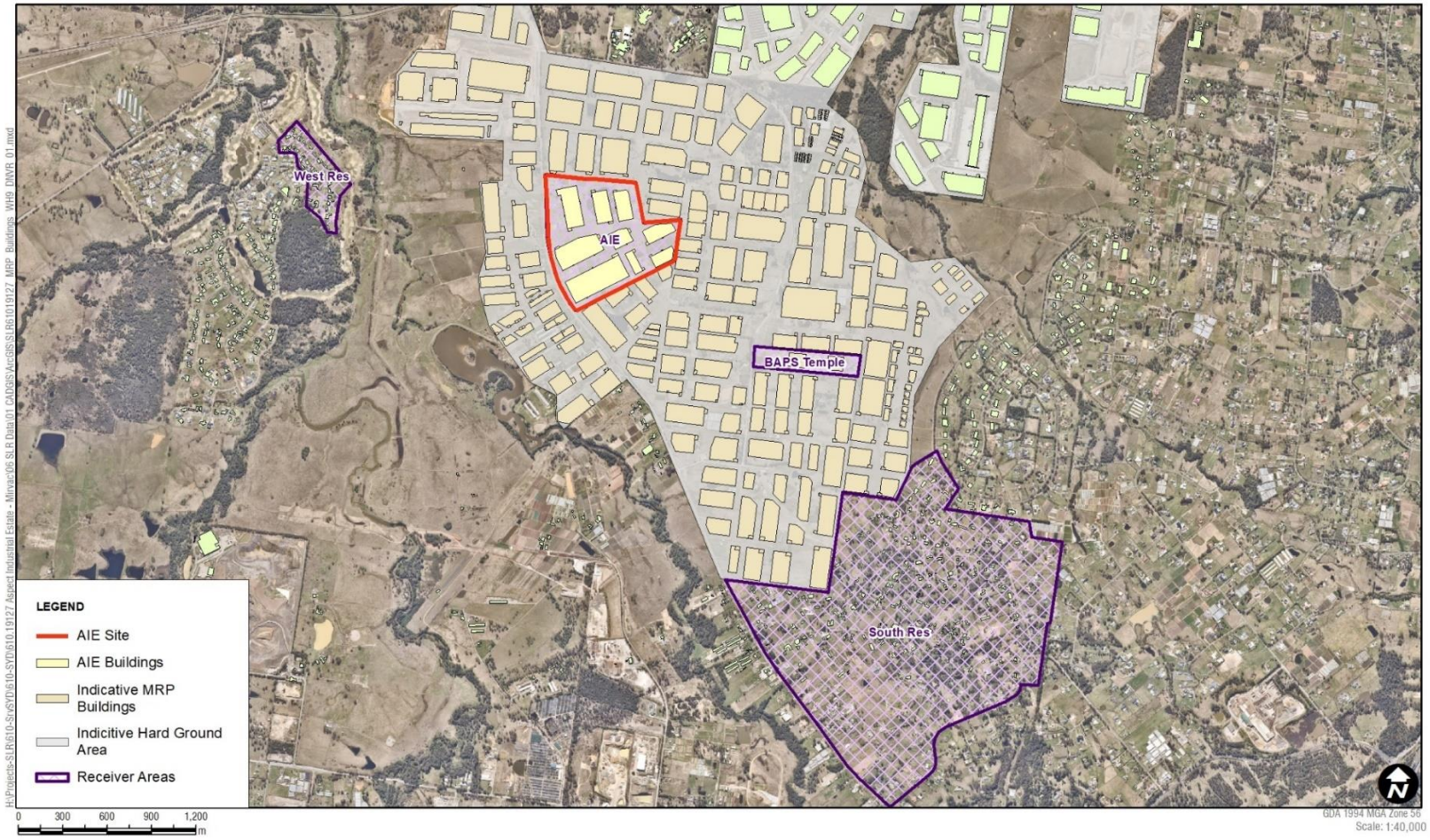
Note 1: Refer to above sections for noise source details.

2.4 Mamre Road Precinct

Consistent with the MOD 6 NIA, indicative future warehouse buildings throughout the MRP have been included in the noise model, along with associated areas of hard ground (modelled with a ground absorption of 0.00). Other areas are modelled with rural soft ground (ground absorption of 0.75). The buildings throughout the MRP are indicative and subject to change in their respective future development applications.

The modelled indicative buildings with associated hard ground are shown in **Figure 6**.

Figure 6 Indicative Future MRP Warehouse Buildings



2.5 Noise Modelling Algorithm

The WH9 DNVR compared predicted noise levels in each receiver area using the Concawe and ISO 9613-2 industrial noise modelling algorithms. The WH9 DNVR determined that predicted noise levels in the west residential area are higher using ISO 9613-2, while the noise levels in the southeast residential area and the BAPS temple are higher using Concawe. The WH9 DNVR used the higher predicted noise levels for each receiver area for a conservative assessment.

To maintain consistency with the WH9 DNVR and MOD 6 NIA, and to allow direct comparison of noise levels, the WH6 & WH7 NIA has used ISO 9613-2 to predict noise levels at the west residential area, and Concawe to predict noise levels at the southeast residential area and the BAPS Temple.

2.6 Prevailing Weather Conditions

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

Detailed analysis of the prevailing weather conditions was undertaken in accordance with the NPfI for a 10-year period from 2013 to 2022 as part of the MOD 6 NIA to determine the prevailing wind and temperature inversion conditions at the site. Wind data was obtained from the Bureau of Meteorology automatic weather station at Horsley Park, and cloud cover data (to determine the occurrence of temperature inversions) from the Bureau of Meteorology automatic weather station at Bankstown Airport.

The weather data was analysed to determine the frequency of occurrence of wind speeds up to 3 m/s in each period. The NPfI states that where wind blows from the source to the receiver at speeds of up to 3 m/s for more than 30% of the daytime, evening or night-time in any season, then wind is considered to be a feature of the area. The results of the wind analysis are presented for the daytime, evening and night-time periods in **Table 11**, **Table 12**, and **Table 13** respectively.

Table 11 Occurrence of Noise-Enhancing Winds for Daytime Period

Season	Percentage of Occurrence of Noise-Enhancing Winds (0.5-3 m/s)(Winds Blowing From)							
	North	Northeast	East	Southeast	South	Southwest	West	Northwest
Summer	7.4%	19.0%	12.5%	13.4%	14.0%	10.6%	7.2%	10.2%
Autumn	5.6%	13.3%	8.7%	10.3%	14.1%	19.0%	17.7%	16.4%
Winter	6.2%	7.4%	3.8%	5.8%	9.2%	18.5%	23.1%	23.4%
Spring	7.4%	14.6%	8.7%	7.7%	8.5%	10.8%	12.2%	16.5%

Note 1: Noise-enhancing winds (0.5-3 m/s) were calculated per direction ±45 degrees during the daytime (7 am to 6 pm) for each season.

Table 12 Occurrence of Noise-Enhancing Winds for Evening Period

Season	Percentage of Occurrence of Noise-Enhancing Winds (0.5-3 m/s)(Winds Blowing From)							
	North	Northeast	East	Southeast	South	Southwest	West	Northwest
Summer	1.6%	13.3%	20.6%	16.4%	9.6%	3.6%	2.1%	2.4%
Autumn	1.9%	13.3%	19.6%	22.3%	22.2%	16.8%	10.5%	6.8%
Winter	4.0%	6.2%	8.8%	14.3%	20.6%	25.1%	21.4%	16.8%
Spring	2.5%	14.9%	20.2%	16.8%	11.4%	7.3%	7.5%	6.7%

Note 1: Noise-enhancing winds (0.5-3 m/s) were calculated per direction ±45 degrees during the evening (6 pm to 10 pm) for each season.

Table 13 Occurrence of Noise-Enhancing Winds for Night-time Period

Season	Percentage of Occurrence of Noise-Enhancing Winds (0.5-3 m/s)(Winds Blowing From)							
	North	Northeast	East	Southeast	South	Southwest	West	Northwest
Summer	2.5%	11.0%	13.6%	19.6%	28.4%	22.8%	9.0%	4.1%
Autumn	1.3%	2.8%	2.5%	6.1%	21.2%	**35.7%**	24.0%	9.9%
Winter	3.9%	1.9%	0.3%	1.2%	10.0%	**33.0%**	**33.0%**	20.5%
Spring	3.8%	6.9%	7.0%	10.3%	20.7%	26.1%	17.2%	10.5%

Note 1: Noise-enhancing winds (0.5-3 m/s) were calculated per direction ±45 degrees during the night-time (10 pm to 7 am) for each season.

The analysis determined that standard weather conditions are prevalent in the MRP during the daytime, evening and night-time periods, with noise-enhancing wind in southwest or west directions only during the night-time period.

The weather data was also analysed to estimate the frequency of occurrence of temperature inversions during the night-time in winter. This analysis used the Pasquill-Gifford stability classification scheme based on cloud cover as detailed in Fact Sheet D of the NPfI. The NPfI states that where the sum total of F and G category inversions occur for at least 30% of the total night-time during the winter, then temperature inversions are considered to be a feature of the area. The results of the stability class analysis are presented in **Table 14**.

Table 14 Occurrence of Stability Classification Distribution during the Night-time Period in Winter

Stability Class	Category Description	Frequency of Occurrence During Night-time in Winter
D	Neutral	3%
E	Slightly stable	10%
F	Moderately stable	17%
G	Extremely stable	31%
Sum Total: F+G	**Moderately to Extremely Stable**	**48%**

Note 1: Stability classes A (extremely unstable), B (moderately unstable) and C (slightly unstable) have not been shown as they are not relevant to the analysis of temperature inversions.

The above analysis shows that noise-enhancing temperature inversions are a feature of the area during the night-time in winter.

Based on the above assessments and consistent with the MOD 6 NIA, the weather conditions included in the WH6 & WH7 NIA noise model are detailed in **Table 15**.

Table 15 Modelled Weather Conditions

Period	Weather Condition	Meteorological Parameters Used in Assessment
Daytime	Standard	Stability category D with 0.5 m/s source to receiver winds
Evening	Standard	
Night-time	Standard	
	Noise-enhancing	Wind – Stability category D with 3 m/s source to receiver winds Inversion – Stability category F with 2 m/s source to receiver winds

3 Assessment of Operational Noise Impacts

3.1 Predicted Noise Levels

A summary of the predicted typical worst-case operational noise levels from the AIE is shown in **Table 16**. The predicted levels include all noise sources operating simultaneously across the entire AIE (all nine lots) and represent the expected highest cumulative noise emissions that the development would likely emit. Noise contours for the typical worst-case noise emission scenarios from the development are in **Appendix B.**

Feasible and reasonable mitigation measures have been investigated for the development with the aim of minimising noise emissions from the site. A detailed investigation of all potential feasible and reasonable mitigation measures considered and applied to the AIE is provided in **Section 4**.

The following predictions include the recommended mitigation measures.

Table 16 Operational Noise Assessment – WH6 & WH7 NIA Masterplan Development

Receiver Area	Period (weather)	LAeq(15 minutes) Noise Level (dBA)					Compliance
		Noise Limit	WH6 & WH7 NIA Predicted	Exceedance	MOD 6 NIA Predicted	Change	
West Residential	Daytime (standard)	39	30	-	30	0	Yes
	Evening (standard)	34	30	-	30	0	Yes
	Night-time (standard)	29	29	-	29	0	Yes
	Night-time (noise-enhancing)	29	29	-	29	0	Yes
Southeast Residential	Daytime (standard)	39	27	-	27	0	Yes
	Evening (standard)	34	27	-	27	0	Yes
	Night-time (standard)	29	26	-	26	0	Yes
	Night-time (noise-enhancing)	29	26	-	26	0	Yes
BAPS Temple	When in use (day/ evening) (standard)	36	33	-	33	0	Yes

The above assessment indicates the following:

- The predicted noise levels in the receiver areas comply with the noise limits during all periods.
- The predicted noise levels are consistent with the MOD 6 NIA noise levels.
- Typical worst-case noise levels at the west residential area are predicted to be up to 30 dBA during the daytime and evening, and up to 29 dBA during the night-time.
- Typical worst-case noise levels at the southeast residential area are predicted to be up to 27 dBA during the daytime and evening, and up to 26 dBA during the night-time.
- Typical worst-case noise levels at the BAPS Temple are predicted to be up to 33 dBA when in use.
- The differences between standard weather conditions and noise-enhancing weather conditions are shown to be insignificant at the receiver areas. This is because the meteorological conditions detailed in **Table 15** are Concawe Category 5 for standard conditions and Concawe Category 6 for noise-enhancing conditions. At large distances the Concawe Category 5 and Category 6 attenuation levels are very similar.

3.2 Sleep Disturbance Assessment

A summary of the predicted L_{Amax} noise levels from the AIE during the night-time period is shown in **Table 17**. The predicted L_{Amax} levels are compared to the sleep disturbance screening level.

Table 17 Sleep Disturbance Screening Assessment – WH6 & WH7 NIA Masterplan Development

Receiver Area	Period	Screening Noise Level (dBA)	Predicted L_{Amax} Noise Level (dBA)[1]	Exceedance (dB)	Compliance
West Residential	Night	52	42	-	Yes
Southeast Residential	Night	52	41	-	Yes
BAPS Temple	n/a	n/a	n/a	n/a	n/a

Note 1: Predicted L_{Amax} noise levels are shown for noise-enhancing weather conditions.

L_{Amax} noise levels from the development are not predicted to exceed the 52 dBA sleep disturbance screening noise level. As such, sleep disturbance impacts are unlikely and further detailed assessment of maximum noise levels is not required.

3.3 Intermediate Monitoring Locations

As part of the Operational Noise Management Plan prepared for the AIE (AIE ONMP) (SLR Report *610.V14410.00002-ONMP-R01-v1.2-20240118*, dated January 2024), intermediate monitoring locations and associated reference noise levels were specified as part of the operational noise compliance monitoring. The locations and noise levels in the AIE ONMP were sourced from the WH9 DNVR. The nominated intermediate locations are shown in **Figure 7**.

Figure 7 Nominated Intermediate Monitoring Locations

Note 1: Figure sourced from AIE ONMP.

The reference noise levels at each intermediate location were determined in the WH9 DNVR using the operational noise model. The reference noise levels correspond to the maximum allowable $L_{Aeq(15minute)}$ noise levels at the intermediate locations that are predicted to result in compliance with the noise limits at the relevant compliance locations. The correlation between the intermediate location and the compliance location is derived from the difference in predicted noise levels between the two locations for each period and relevant weather conditions.

The reference noise levels have been reviewed for the proposed Warehouses 6 and 7 development and are detailed below. The WH6 & WH7 NIA reference noise levels at each intermediate location and their correlation to the noise limits at the relevant compliance locations are summarised in **Table 18**.

Table 18 Intermediate Monitoring Location Reference Levels

Location ID	Relevant Compliance Location	Period	Noise Level LAeq(15minute) (dBA)				
			Noise Limit at Compliance Location	Correlation Between Intermediate and Compliance Location – WH6 & WH7 NIA	Reference Level at Intermediate Location – WH6 & WH7 NIA	Reference Level at Intermediate Location – MOD 6 NIA	Change in Reference Level
L01	West Residential	Day (standard weather)	39	32	**71**	71	0
		Evening (standard weather)	34	32	**66**	66	0
		Night (standard weather)	29	28	**57**	57	0
		Night (noise-enhancing weather)	29	28	**57**	57	0
L02	West Residential	Day (standard weather)	39	24	**63**	63	0
		Evening (standard weather)	34	24	**58**	58	0
		Night (standard weather)	29	24	**53**	53	0
		Night (noise-enhancing weather)	29	24	**53**	53	0
L03	Southeast Residential	Day (standard weather)	39	37	**76**	76	0
		Evening (standard weather)	34	37	**71**	71	0
		Night (standard weather)	29	36	**65**	65	0
		Night (noise-enhancing weather)	29	36	**65**	65	0
	BAPS Temple	When in use (day/evening) (standard weather)	36	30	**66**	66	0
L04	Southeast Residential	Day (standard weather)	39	35	**74**	74	0
		Evening (standard weather)	34	35	**69**	69	0
		Night (standard weather)	29	35	**64**	64	0
		Night (noise-enhancing weather)	29	35	**64**	64	0
	BAPS Temple	When in use (day/evening) (standard weather)	36	28	**64**	64	0

The above table shows that the reference levels at the intermediate locations for the Warehouses 6 and 7 development are consistent with the previous reference levels for the MOD 6 NIA and ONMP. As such, no change is required to the reference noise levels or locations in relation to Warehouses 6 and 7.

The intermediate locations and associated reference noise levels will be reviewed as part of any updates to the ONMP, as required.

4 Operational Noise Mitigation and Management Measures

Where operational noise impacts are predicted from a development, all feasible and reasonable operational noise mitigation and management measures should be considered.

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

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

A detailed assessment of all feasible and reasonable mitigation measures that could be applied to the development to minimise the operational noise impacts has been completed and is summarised in **Table 19**.

Table 19 Feasible and Reasonable Mitigation for AIE

Ref.	Mitigation Option	Noise Impact/Benefit	Reasonable and Feasible to Apply
Source Control			
S1	Optimised site layout to minimise noise emissions from the site	Where possible, the site layout was designed so that the warehouse buildings screen the noisier areas of the development (ie hardstands and truck routes) from the nearest receivers.	Yes – Applied during design of the masterplan No significant changes to the masterplan layout are proposed as part of the Warehouses 6 and 7 development.
S2	Limit vehicle movements	A reduction in concurrent vehicle movements across the site by staggering delivery/pickup times and/or employee shift change times could reduce noise emissions. In practice, this would occur naturally across the estate due to operational requirements of the different tenants.	No – Vehicle volumes used in this assessment are likely needed to meet future tenant's requirements. Placing restrictions on allowable vehicle movements across the different tenancies is unlikely to be feasible and reasonable. Assumptions and considerations are based on Warehouses 6 and 7 operating as 24/7 warehouse and distribution centres, reflecting the size of the warehouses.
S3	Use broadband and/or ambient sensing alarms on trucks and forklifts where they are required to reverse during the night-time.	Reduce potential for annoying noise emissions during the night-time from forklifts and trucks.	Yes – Use broadband and/or ambient sensing alarms on forklifts and trucks where they are required to reverse during the night-time. This measure to also be encouraged for contractor vehicles where possible. This should be adopted for all permanent and tenant owned/controlled vehicles where feasible and reasonable.

Ref.	Mitigation Option	Noise Impact/Benefit	Reasonable and Feasible to Apply
S4	Appropriate design of site layout to minimise the need for trucks to stop or brake outside of loading docks with line of sight to residential receivers.	Minimise noise emissions, particularly from truck airbrakes.	Yes – Applied during design of the concept masterplan
S5	PA systems designed to reduce noise nuisance to receiver areas	Restrict and minimise PA noise	Yes – Any PA systems required as part of normal operation that emit sound within the facility will 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 enclosed areas of the facility during the night period, where practicable.
S6	No speed humps or uneven pavements	Reduce noise from vehicles moving over uneven surfaces	Yes – For all non-enclosed areas of the facility (ie car parks, hardstands, on-lot access roads and entry/exit areas): - all pavement must be smooth (ie no speed bumps). - transitions from the public estate roads to the site or between internal road elements (hardstands/ramps) must be smooth to avoid jolting of trucks/materials or excessive truck acceleration. - drainage grates must designed and maintained to not result in noise events when driven over.
S7	Building services and mechanical plant selection	Reduce mechanical plant noise	Yes – Assessment of noise emissions from building services, mechanical plant and plantroom spaces is to be undertaken during detailed design stage of each warehouse. All building services, mechanical plant and plantroom spaces are to be designed to not result in any exceedances of the applicable noise limits, and must not exceed the sound power level limits in Condition A16(a) (including tonality and low frequency emissions).
S8	Building material selection	Reduce breakout noise from internal warehouse activities	Yes – Materials for warehouse facades and roofs selected during the detailed design stage of each warehouse would be selected so that any noise breakout from internal activities, including through louvres, openings or penetrations, would result in a negligible increase in overall noise emissions from the facility.

Ref.	Mitigation Option	Noise Impact/Benefit	Reasonable and Feasible to Apply
S9	Review of noise emissions from new tenants	Reduce risk of noise exceedances from tenant operations	Yes – When a new tenant or change of tenant is proposed for a warehouse an acoustic review is to be undertaken. This would include review of potential noise emissions from the tenants proposed operations to confirm that any noise impacts would not result in exceedance of the applicable noise limits.
S10	Production of an Operational Noise Management Plan (ONMP)	This would detail the measures that could be used by the various tenants to minimise general noise emissions from the site. Reference can be made to the Best Management Practice (BMP) and Best Available Technology Economically Available (BATEA) measures listed in the NPfI.	Yes – An ONMP has been prepared for the AIE, as required by the SSD-10448 Development Consent. The ONMP is to be reviewed, and updated if necessary, whenever there are any significant changes to the operations or tenant of any warehouse in the estate.
Path Control			
P1	Noise barriers – not required	Noise barriers could be constructed around the development to minimise noise levels at the receivers	No – The development does not exceed the applicable noise limits.
Receiver Control			
R1	Not required	n/a	n/a
Verification Monitoring			
V1	Noise monitoring	Verify post-construction operational noise levels are compliant with the relevant noise limits.	Yes – Noise monitoring would be completed once the development is operational, as required by the ONMP.

5 Construction Noise and Vibration Assessment Methodology

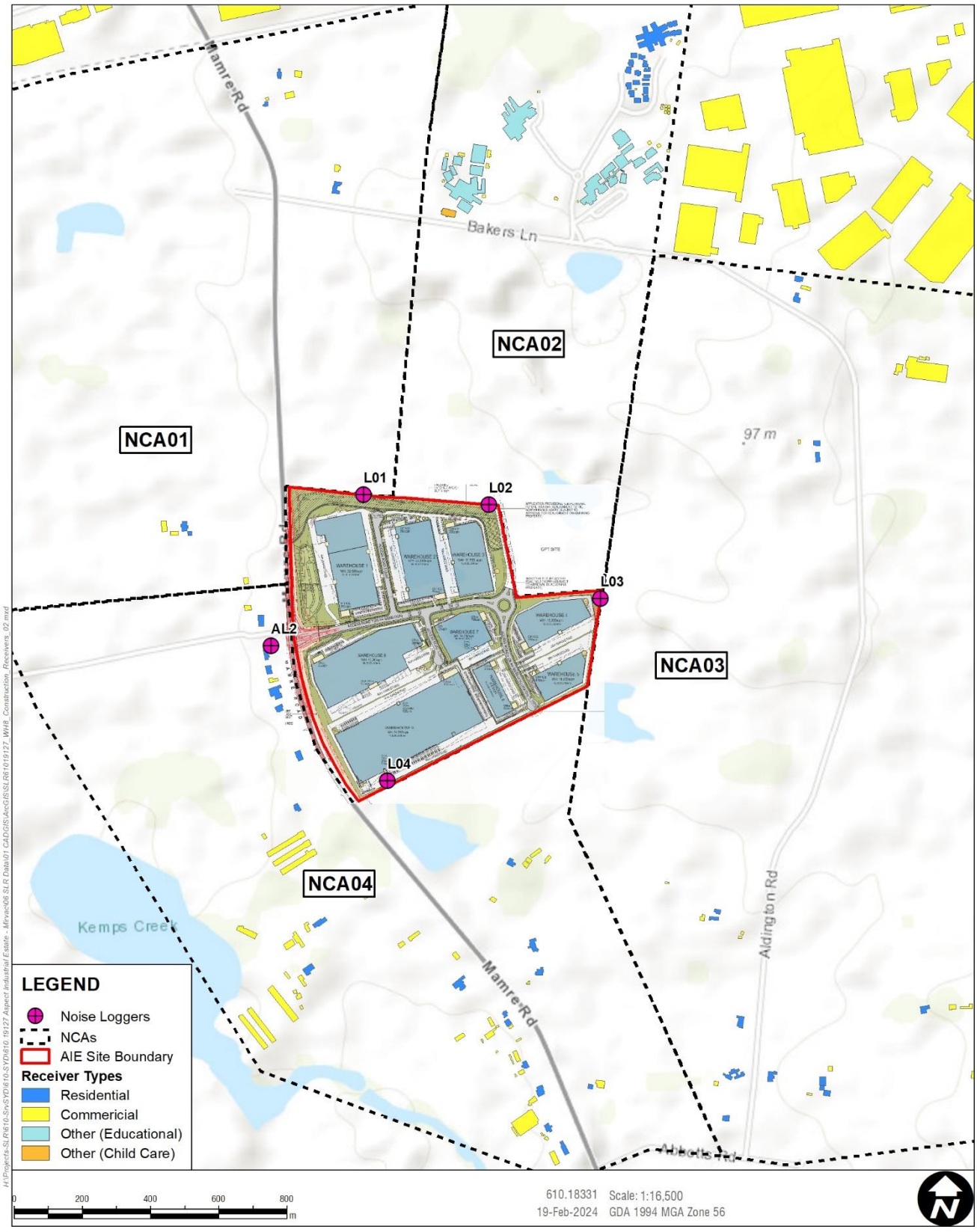
Construction noise and vibration assessment criteria and methodology for the AIE is detailed in the Estate Construction Noise and Vibration Management Plan (AIE CNVMP) (SLR Report *610.19127-CNVMP-R05-v4.1-20240125*, dated January 2024). The relevant sections are summarised below.

5.1 Nearest Receivers and Existing Environment

The nearest receivers to the site are located within the Mamre Road Precinct. The construction assessment considers impacts at these close receivers and does not include future industrial buildings within the MRP. The locations of the surrounding receivers are shown in **Figure 8**. The AIE CNVMP notes that numerous receivers surrounding the site have been demolished or permanently vacated prior to their development into industrial sites, and have not been included in this assessment. The receivers in each Noise Catchment Area (NCA) are detailed below:

- NCA01 – one residence to the northwest and several residences to the north.
- NCA02 – several schools, a childcare centre and an aged-care facility to the north.
- NCA03 – multiple residences to the northeast and southeast.
- NCA04 – multiple residences to the west and south. The residences to the west of Mamre Road are the nearest receivers to the site.

Figure 8 Nearest Receivers for Construction Assessment



Unattended noise monitoring was completed as part of the SSDA NIA in November 2019 and subsequently by the estate construction contractor in July and August 2022 prior to commencement of construction. A summary of the relevant locations is detailed in **Table 20**. The locations are shown on **Figure 8.**

Table 20 Summary of Ambient Noise Levels

ID	Address	Measured Noise Levels (dBA)[1]					
		Background Noise (RBL)			Average Noise (L_{Aeq})		
		Day	Evening	Night	Day	Evening	Night
L01	(formerly) Lot 58 DP259135	39	39	32	50	49	50
L02	(formerly) Lot 58 DP259135	35	33	32	43	42	43
L03	(formerly) Lot 56 DP259135	34	33	29	44	41	41
L04	(formerly) Lot 54 DP259135	39	40	32	52	53	54
AL2	833A Mamre Road	49	43	34	61	57	57

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

Note 1: RBL increased to the minimum RBL specified in the NSW EPA *Noise Policy for Industry* (NPfI).

The results at L01 to L04 are used for receivers in NCA01 to NCA04 respectively.

The AL2 results have been adopted for receivers 819, 833A, 833B, 845, 845A, and 859 Mamre Road, where the residences are located a similar distance from Mamre Road. The above additional monitoring has been adopted for these receivers as it is considered to be more representative of these specific receivers than the previous noise monitoring undertaken at L04, which was around twice the distance from Mamre Road as these receivers. L04 is considered representative of all other receivers in NCA04.

5.2 Construction Noise Criteria

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

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

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

The NMLs for the project are detailed in the AIE CNVMP and reproduced in **Table 21**.

Table 21 Site Specific Noise Management Levels (dBA)

Receiver Type	NCA	Representative Noise Monitoring Location	NML ($L_{Aeq(15minute)}$ – dBA)				Sleep Disturbance Screening Level (L_{Amax} dBA)
			Standard Construction Hours (RBL+10dB)	Out of Hours (RBL+5dB)			
			Daytime	Daytime[3]	Evening	Night-time	Night-time
Residential	NCA01	L01	49	44	44	37	52
Residential	NCA02	L02	45	40	38	37	52
Residential	NCA03	L03	45[1]	40	38	35	52
819, 833, 845, 859 Mamre Rd	NCA04	AL2	59	54	47	39	52
All other NCA04 Residential		L04	49	44	44[2]	37	52
Educational	NCA02	n/a	55	55 (when in use)			-
Commercial	Various	n/a	70	70 (when in use)			-

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

Note 2: Where the evening RBL is higher than the daytime RBL, the daytime RBL has been used.

Note 3: Daytime out of hours is 7 am to 8 am and 1 pm to 6 pm on Saturday, and 8 am to 6 pm on Sunday and public holidays.

In addition to the above NMLs, residential receivers are considered to be 'highly noise affected' if the predicted level exceeds 75 dBA $L_{Aeq(15minute)}$.

5.3 Construction Vibration Guidelines

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

- Those in which the occupants of buildings are disturbed (**human comfort**). People can sometimes perceive vibration impacts when vibration generating construction work is located close to occupied buildings. Vibration from construction work tends to be intermittent in nature and the EPA's *Assessing Vibration: a technical guideline* (2006) provides criteria for intermittent vibration based on the Vibration Dose Value (VDV), as shown in **Table 22**.
- Those where building contents may be affected (**building contents**). People perceive vibration at levels well below those likely to cause damage to building contents. For most receivers, the human comfort vibration criteria are the most stringent and it is generally not necessary to set separate criteria for vibration effects on typical building contents. Exceptions to this can occur when vibration sensitive equipment, such as electron microscopes or medical imaging equipment, are in buildings near to construction work. No such equipment has been identified in the study area.
- Those where the integrity of the building may be compromised (**structural/cosmetic damage**). If vibration from construction work is sufficiently high, it can cause cosmetic damage to elements of affected buildings. Industry standard cosmetic damage vibration limits are specified in British Standard BS 7385 and German Standard DIN 4150. The limits are shown in **Table 23** and **Table 24**.

Table 22 Human Comfort Vibration – Vibration Dose Values for Intermittent Vibration

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

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

Table 23 Cosmetic Damage – BS 7385 Transient Vibration Values for Minimal Risk of Damage

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

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

Table 24 Cosmetic Damage – DIN 4150 Guideline Values for Short-term Vibration on Structures

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

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

5.3.1 Heritage Buildings or Structures

Heritage listed buildings and structures should be considered on a case-by-case basis but as noted in BS 7385 should not be assumed to be more sensitive to vibration, unless structurally unsound. Where a heritage building is deemed to be sensitive, the more stringent DIN 4150 Group 3 guideline values in **Table 24** can be applied.

No heritage buildings have been identified in the vicinity of the Site.

5.3.2 Minimum Working Distances for Vibration Intensive Works

Minimum working distances for typical vibration intensive construction equipment are provided in the CNVG and are shown in **Table 25**. The minimum working distances are for both cosmetic damage (from BS 7385 and DIN 4150) and human comfort (from the NSW EPA *Assessing Vibration: a technical guideline*). They are calculated from empirical data which suggests that where work is further from receivers than the quoted minimum distances then impacts are not considered likely.

Table 25 Recommended Minimum Working Distances from Vibration Intensive Equipment

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

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

5.4 Construction Activities

Representative construction scenarios have been developed to assess the likely impacts from the various construction phases of the project. These scenarios are detailed in **Table 26**.

Table 26 NVIA Construction Scenario Descriptions

Equipment	Total SWL	Concrete Pump	Concrete Truck	Concrete Vibrator	Crane – Mobile (100t)	Dozer	Elevated Working Platform	Excavator (20t)	Front End Loader	Hand Tools	Roller – Vibratory[1]	Truck – Dump	Truck – Flatbed	Water Truck
Sound Power Level		109	109	113	113	116	97	105	112	104	114	110	103	107
Estimated on-time in any 15-minutes		10	15	5	15	10	15	10	10	15	15	10	10	10
Scenario														
Earthworks	119					X		X	X		X	X		X
Construction of pads and hardstands	113	X	X	X										
Construction of structures	114				X		X			X			X	

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

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

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

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

6 Assessment of Construction Impacts

6.1 Construction Noise

The predicted noise levels at the most-affected sensitive receivers surrounding the site are shown in **Table 27** and exceedances of the NMLs are shown in **Table 28**.

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

Table 27 Predicted Construction Noise Levels – Standard Daytime Construction Hours

Receiver	NCA	NML (dBA)	Predicted Noise Level – $L_{Aeq(15minute)}$ (dBA)		
			Earthworks	Hardstands	Structures
Residential	NCA01	49	50	44	45
	NCA02	45	41	35	36
	NCA03	45	48	42	43
819, 833, 845, 859 Mamre Rd	NCA04	59	54	48	49
All other NCA04 Residential		49	53	47	48
Other Sensitive	Various	55	45	39	40

Table 28 Predicted Exceedance at Nearest Receivers – Standard Daytime Construction Hours

Receiver	NCA	NML (dBA)	Predicted Noise Level – $L_{Aeq(15minute)}$ (dBA)		
			Earthworks	Hardstands	Structures
Residential	NCA01	49	1	-	-
	NCA02	45	-	-	-
	NCA03	45	3	-	-
819, 833, 845, 859 Mamre Rd	NCA04	59	-	-	-
All other NCA04 Residential		49	4	-	-
Other Sensitive	Various	55	-	-	-
Legend (NML exceedances)	= Minor to marginal (1 to 10 dB exceedance)		= Moderate (11 to 20 dB exceedance)		= High (>20 dB exceedance)

The above worst-case predictions show the following:

- Minor exceedances of up to 1 dB during 'earthworks' are predicted at one residence in NCA01 (799-803 Mamre Road). No exceedances are predicted at any receivers in NCA01 during 'construction of pads and hardstands' or 'construction of structures'.
- Minor exceedances of up to 3 dB during 'earthworks' are predicted at one residence in NCA03 (235-251 Aldington Road). No exceedances are predicted at any receivers in NCA03 during 'construction of pads and hardstands' or 'construction of structures'.

- Minor exceedances of up to 4 dB during 'earthworks' are predicted at one residence in NCA04 (930-966 Mamre Road).
- No exceedances of the NMLs are predicted at any other receivers during the construction works.
- No residential receivers are predicted to be highly noise affected (>75 dBA).
- Works would only occur during Standard Daytime Construction Hours. There is no expectation that evening or night-time work would be required.

The impacts during construction of the proposal are predicted to be consistent with major construction work near to sensitive receivers. The predicted noise levels are lower than those for the AIE estate construction earthworks (refer to AIE CNVMP).

The duration of each works activity would be determined prior to commencement of construction. The presented impacts would only be expected to occur when noisy work is being completed close to the site boundaries, relative to each receiver. When work is further from the receiver, or when less noise intensive equipment is being used, the noise levels would be lower.

Feasible and reasonable construction noise mitigation measures should be applied where exceedances of the NMLs are predicted. A Construction Noise and Vibration Management Plan (CNVMP) with specific feasible and reasonable mitigation and management measures would be prepared prior to commencement of construction. Construction noise mitigation and management measures are discussed in **Section 7**.

6.1.1 Cumulative Construction Noise Impacts

Where multiple construction activities are being undertaken concurrently on different stages of the AIE or adjacent estates there is potential for cumulative construction noise impacts to occur. When works from two different construction sites/activities are roughly equivalent in noise level at the receiver, the total cumulative noise level may be up to 3 dB higher than the predicted noise level from either activity. When there are more than two activities roughly equal this could increase further.

Typically, noise impacts would be dominated by the nearest construction to the receiver, or the noisier activity if quiet works are being undertaken at the closer site. Instances where the noisiest works from multiple sites/activities are roughly equivalent at any particular receiver would be unlikely and infrequent, and noise levels at the receiver would be unlikely to be significantly higher than the predicted noise levels from the individual activities. As such, the standard construction noise mitigation and management measures discussed in **Section 7** would also be likely to be sufficient for cumulative construction noise impacts.

6.2 Construction Vibration

Vibration intensive items of plant proposed for use during the construction of the site would include the use of vibratory rollers during 'earthworks'.

Offset distances for the vibration intensive equipment have been determined from the CNVG minimum working distances for cosmetic damage and human response (see **Table 25**).

The nearest vibration sensitive receivers are located around 400 m from the site boundary, therefore, no receivers are located within the minimum working distances.

Where commercial/industrial buildings are constructed on other lots of the AIE prior to construction of Warehouses 6 and 7, these may be within the minimum working distances for human comfort vibration. This may be applicable to Lot 2, Lot 3, Lot 4, Lot 5, Lot 8 and Lot 9.

Feasible and reasonable construction mitigation measures should be applied where vibration intensive works are proposed to be undertaken within the minimum working distances. Construction noise mitigation and management measures are discussed in **Section 7**.

7 Construction Noise and Vibration Mitigation and Management Measures

The impacts during construction of the proposal are predicted to be consistent with major construction work near to sensitive receivers. No works outside of Standard Construction Hours are currently proposed.

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

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

8 Conclusion

SLR has been commissioned to assess the potential construction and operational noise and vibration impacts of Warehouses 6 and 7 of the Aspect Industrial Estate.

This report assesses the potential cumulative operational noise impacts from the entire AIE masterplan development, including sleep disturbance during the night-time period.

All feasible and reasonable mitigation measures have been considered and included in the assessment to control the operational noise impacts from the development as far as practicable.

Operational noise levels are predicted to comply with the noise limits during all periods. The predicted operational noise levels are generally consistent with the MOD 6 NIA. Maximum noise levels do not exceed the sleep disturbance screening noise levels.

Construction noise levels are generally expected to comply with the management levels. Minor to moderate exceedances are, however, predicted at the nearest sensitive receivers during some of the noisier scenarios, particularly when noise intensive items of equipment, such as dozers, are in use. Mitigation measures have been recommended to address the potential construction impacts.

Appendix A:

Acoustic Terminology

1. Sound Level or Noise Level

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

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

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

2. 'A' Weighted Sound Pressure Level

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

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

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

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

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

3. Sound Power Level

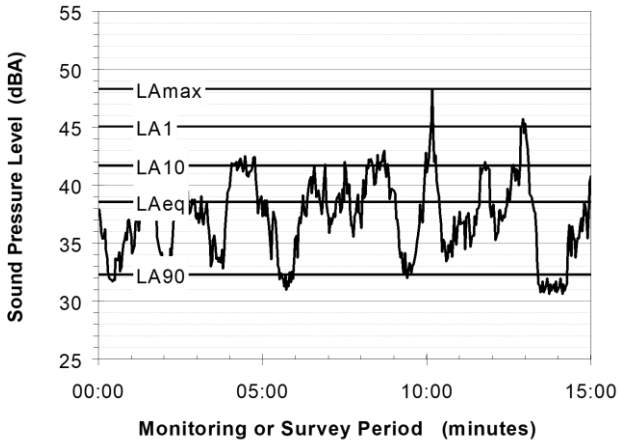
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

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

4. Statistical Noise Levels

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

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



Of particular relevance, are:

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

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

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

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

5. Frequency Analysis

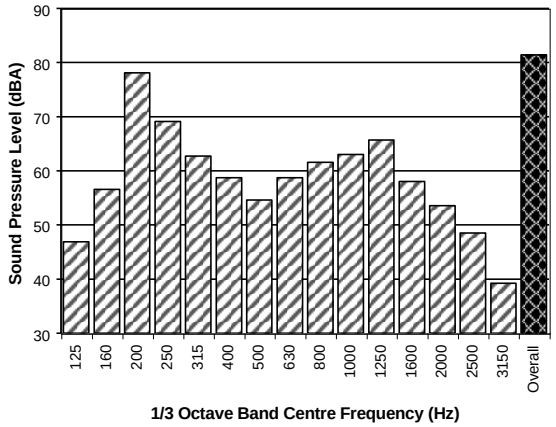
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

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

Frequency analysis can be in:

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

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



6. Annoying Noise (Special Audible Characteristics)

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

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

7. Vibration

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

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

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

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

8. Human Perception of Vibration

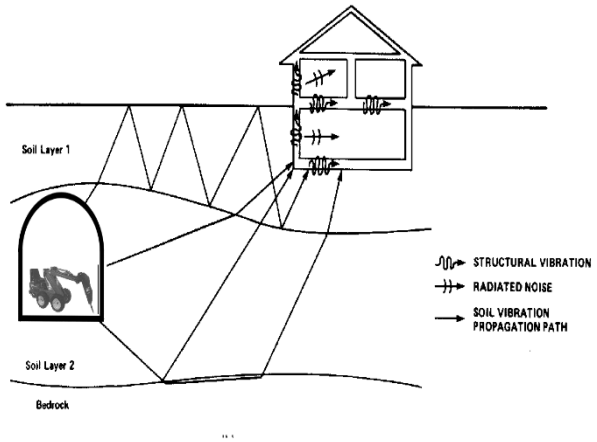
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience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

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

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

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

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

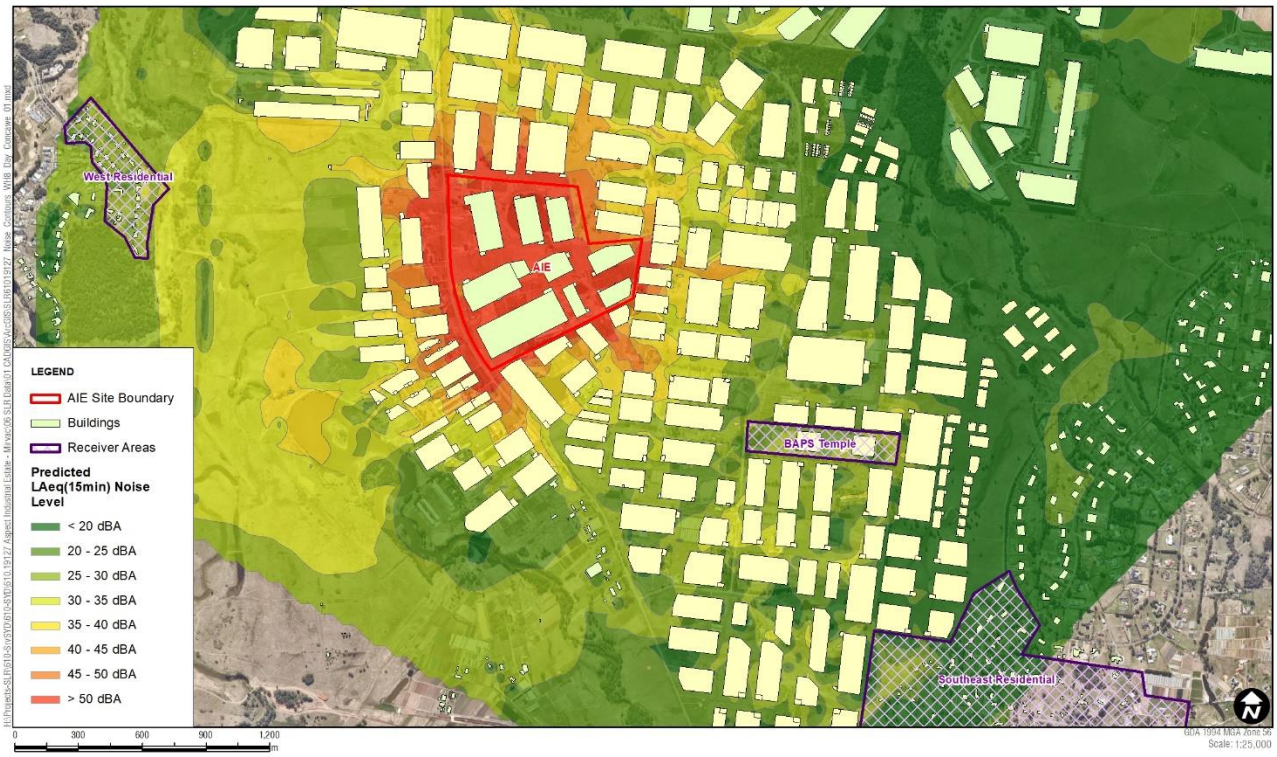


The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect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

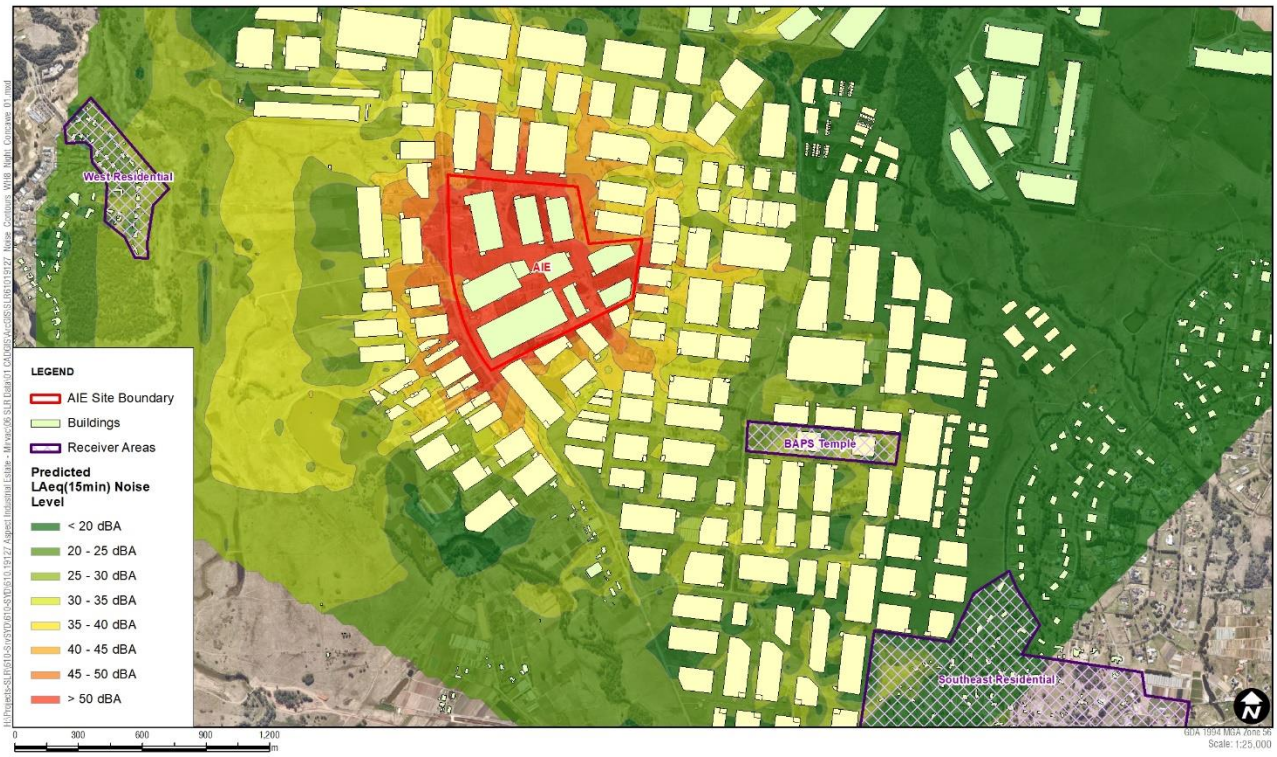
Appendix B:

Operational Noise Level Prediction Contour Maps

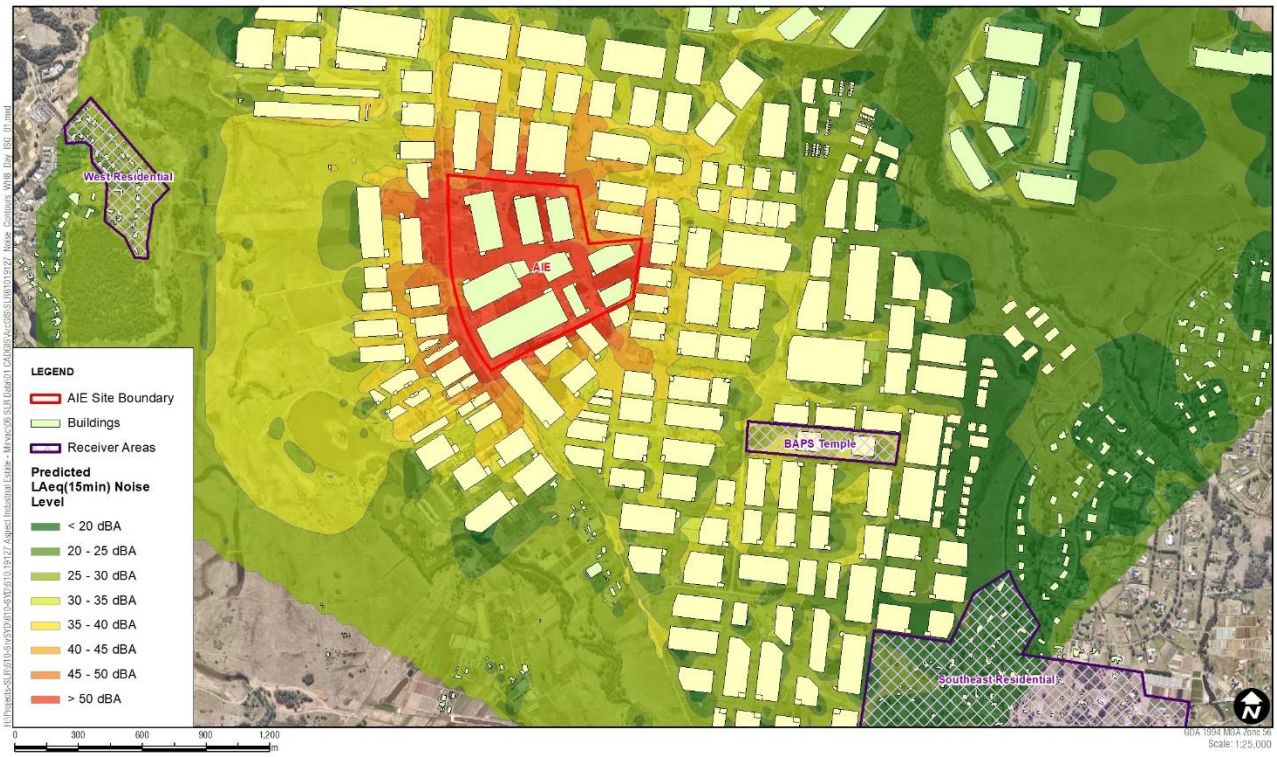
Predicted Operational Noise Contours – Daytime/Evening – Concawe Standard Weather Conditions



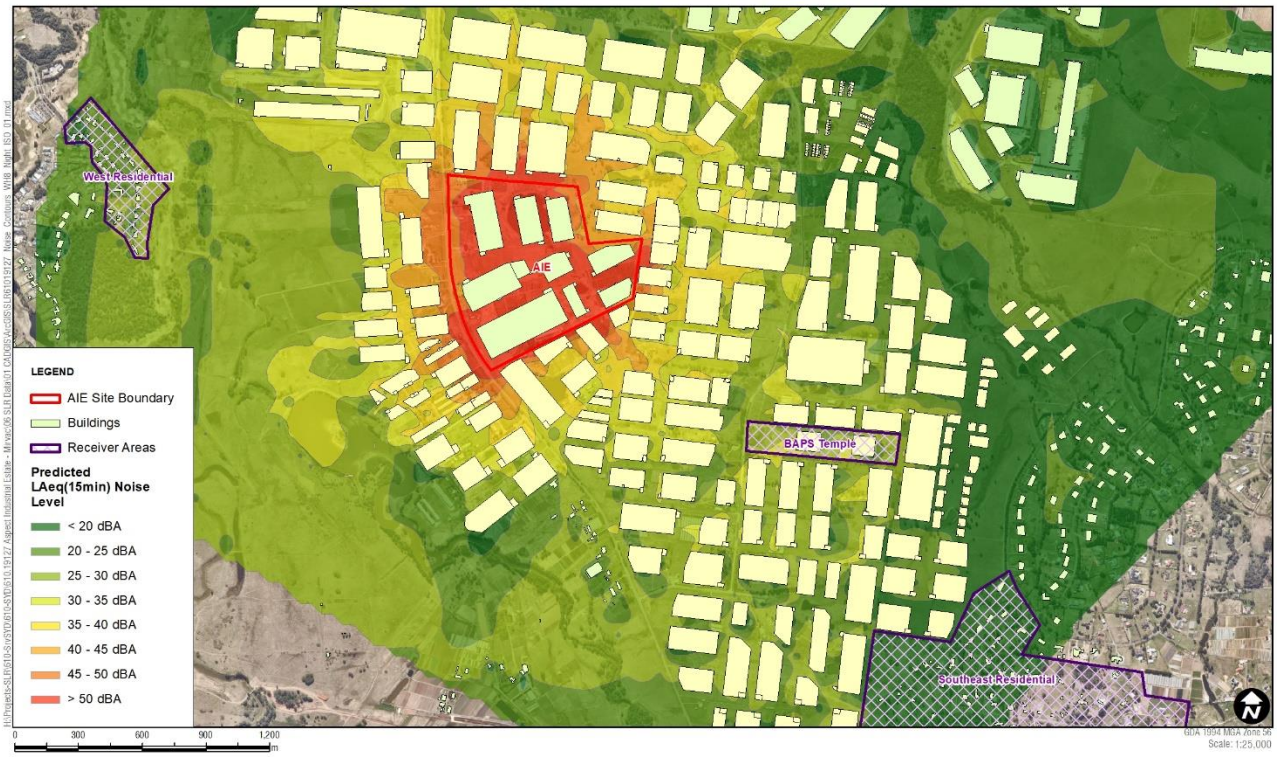
Predicted Operational Noise Contours – Night-time – Concawe Noise-enhancing Weather Conditions



Predicted Operational Noise Contours – Daytime/Evening – ISO 9613-2



Predicted Operational Noise Contours – Night-time – ISO 9613-2



Appendix C:

CNVG Mitigation Measures

CNVG Standard Mitigation and Management Measures

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

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

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

ASIA PACIFIC OFFICES

ADELAIDE
60 Halifax Street
Adelaide SA 5000
Australia
T: +61 431 516 449
E: adelaide@slrconsulting.com

BRISBANE
Level 16, 175 Eagle Street
Brisbane QLD 4000
Australia
T: +61 7 3858 4800
E: brisbane@slrconsulting.com

CAIRNS
Level 1, Suite 1.06
14 Spence Street
Cairns QLD 4870
Australia
T: +61 7 4722 8090
E: cairns@slrconsulting.com

CANBERRA
GPO 410
Canberra ACT 2600
Australia
T: +61 2 6287 0800
E: canberra@slrconsulting.com

DARWIN
Unit 5, 21 Parap Road
Parap NT 0820
Australia
T: +61 8 8998 0100
E: darwin@slrconsulting.com

GOLD COAST
Level 2, 194 Varsity Parade
Varsity Lakes QLD 4227
Australia
M: +61 438 763 516
E: goldcoast@slrconsulting.com

MACKAY
1/25 River Street
Mackay QLD 4740
Australia
T: +61 7 3181 3300
E: mackay@slrconsulting.com

MELBOURNE
Level 11, 176 Wellington Parade
East Melbourne VIC 3002
Australia
T: +61 3 9249 9400
E: melbourne@slrconsulting.com

NEWCASTLE
10 Kings Road
New Lambton NSW 2305
Australia
T: +61 2 4037 3200
E: newcastleau@slrconsulting.com

PERTH
Level 1, 500 Hay Street
Subiaco WA 6008
Australia
T: +61 8 9422 5900
E: perth@slrconsulting.com

SUNSHINE COAST
Suite 2, 14-20 Aerodrome Rd
Maroochydore QLD 4558
Australia
T: +61 7 3858 4800
E: SunshineCoast@slrconsulting.com

SYDNEY
Tenancy 202 Submarine School
Sub Base Platypus
120 High Street
North Sydney NSW 2060
Australia
T: +61 2 9427 8100
E: sydney@slrconsulting.com

TOWNSVILLE
12 Cannan Street
South Townsville QLD 4810
Australia
T: +61 7 4722 8000
E: townsville@slrconsulting.com

WOLLONGONG
Level 1, The Central Building
UoW Innovation Campus
North Wollongong NSW 2500
Australia
T: +61 2 4249 1000
E: wollongong@slrconsulting.com

AUCKLAND
201 Victoria Street West
Auckland 1010
New Zealand
T: 0800 757 695
E: auckland@slrconsulting.com

NELSON
6/A Cambridge Street
Richmond, Nelson 7020
New Zealand
T: +64 274 898 628
E: nelson@slrconsulting.com

WELLINGTON
12A Waterloo Quay
Wellington 6011
New Zealand
T: +64 2181 7186
E: wellington@slrconsulting.com

SINGAPORE
39b Craig Road
Singapore 089677
T: +65 6822 2203
E: singapore@slrconsulting.com