OAKDALE WEST INDUSTRIAL ESTATE

Construction Noise and Vibration Management Plan
SSD 7348

Prepared for:

Goodman Property Services (Aust) Pty Ltd
Level 17
60 Castlereagh Street
Sydney NSW 2000

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Goodman Property Services (Aust) 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
610.17948-R05-v1.5	21 January 2020	Joshua Ridgway	Antony Williams	Antony Williams
610.17948-R05-v1.4	8 January 2020	Joshua Ridgway	Antony Williams	Antony Williams
610.17948-R05-v1.3	14 November 2019	Joshua Ridgway	Mark Russell	Mark Russell
610.17948-R05-v1.2	11 November 2019	Joshua Ridgway	Mark Russell	Mark Russell
610.17948-R05-v1.1	4 November 2019	Joshua Ridgway	Mark Russell	Mark Russell
610.17948-R05-v1.0	23 September 2019	Joshua Ridgway	Antony Williams	Antony Williams

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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Goodman Property Services (Aust) Pty Limited (Goodman) to prepare a Construction Noise and Vibration Management Plan (CNVMP) for construction works associated with the development of the Oakdale West Industrial Estate (Oakdale West), located in Kemps Creek.

The CNVMP addresses the potential noise and vibration impacts associated with the construction of the development and details the mitigation and management procedures for dealing with potential impacts. Construction noise and vibration impacts were previously assessed for Oakdale West as part of the *Oakdale West Estate DA Noise Impact Assessment* prepared by SLR in June 2017 (the NIA).

1.1 Development Overview

Oakdale West is a regional warehouse and distribution hub located at Kemps Creek within the Penrith local government area (LGA) and forms part of the broader Oakdale Industrial Precinct located within the Western Sydney Employment Area (WSEA) (see **Figure 1**).

Goodman Property Services (Aust) Pty Ltd (Goodman) obtained Development Consent SSD 7348 on 13 September 2019 from the Department of Planning, Industry and Environment (DPIE) for the Oakdale West 'Concept Proposal' and 'Stage 1 Development'. The Concept Proposal essentially comprises a 'Master Plan' to guide the staged development of Oakdale West and core development controls that will form the basis for design and assessment of future development applications for the site. It includes:

- Establishing primary site access, road layouts (including internal road network and connections to the external road network), developable and non-developable lands, biodiversity offsets, indicative development stages and development controls for the future development of the site;
- Stage 1 Development of the Estate including:
  - Estate Works, including site preparation, bulk earthworks and retaining walls, catchment level stormwater infrastructure, trunk services connections and utility infrastructure, roads and access infrastructure associated with Stage 1 and subdivision in Stage 1 development works;
  - Precinct Development, including construction, fit out and use of warehouse buildings within Precinct 1, detailed earthworks, on lot stormwater, services and utility infrastructure and construction of industrial/warehouse buildings;
  - Construction of a new regional road known as the Western North South Link Road (WNSLR) connecting to Lenore Drive to provide the primary access to the site; and
  - Western boundary landscaping.

This CNVMP has been prepared to cover the earthworks and civil construction across Oakdale West (see **Figure 2**) being undertaken by Burton Civil Engineering Contractors (Burton). A separate CNVMP has been prepared to cover the construction of the WNSLR which will be undertaken by Robson Civil Projects (Robson). AT&L Associates (AT&L) will act as the Project Manager and Contract Superintendent overseeing the construction of both the WNSLR and Oakdale West. Note: Where Goodman is nominated as having responsibility as the Applicant, this may be delegated to their specialist consultants.

For the purposes of this document, the development is described in *Environmental Impact Statement, Oakdale West Estate - State Significant Development Application* (EIS) prepared by Urbis (2017), including all specialist assessments and other appendices.

Figure 1 Regional Location of Oakdale West

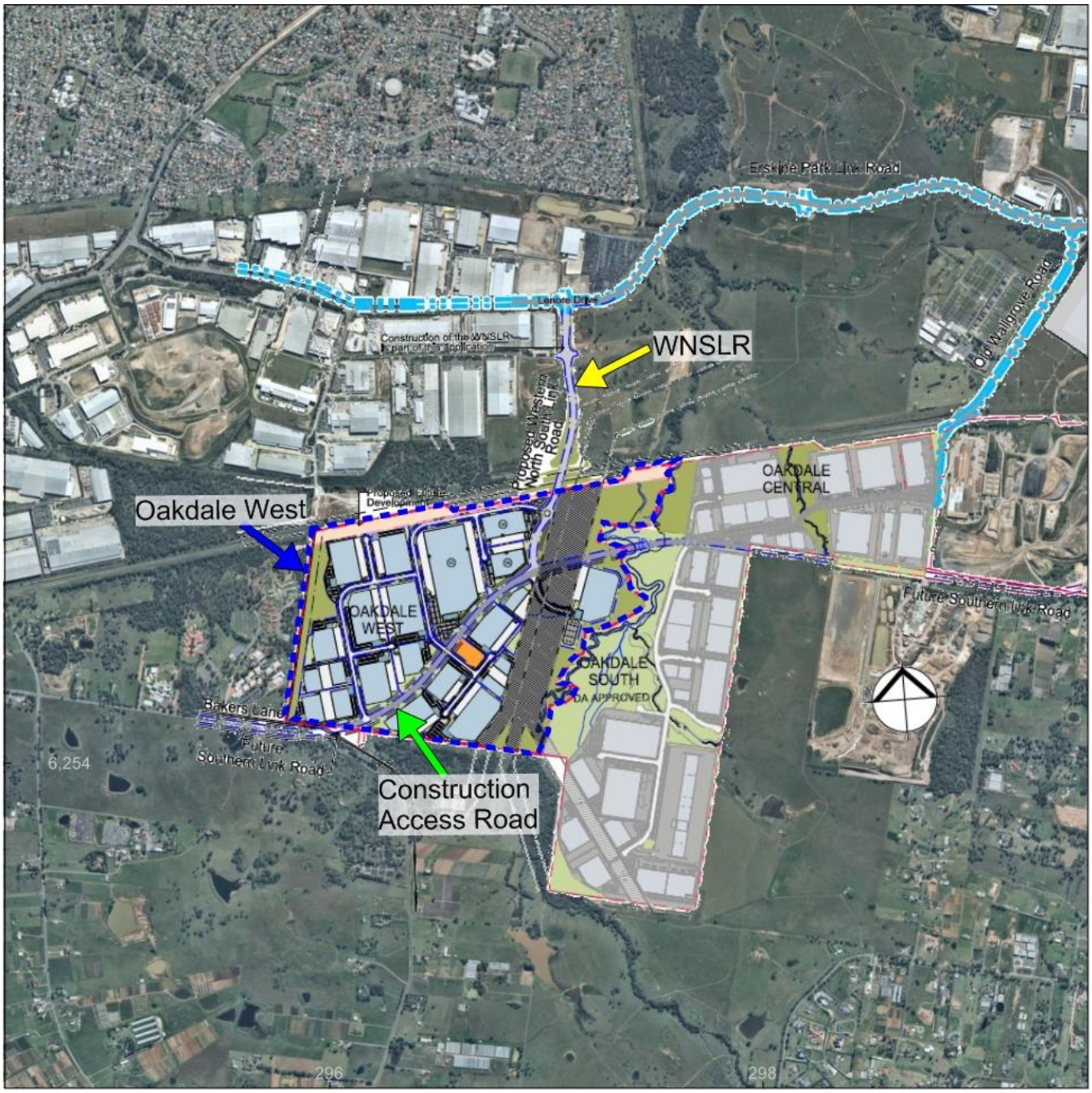


Figure 2 Oakdale West Layout

Note 1: Oakdale West shown in red. WNSLR and construction access road shown in blue.

1.2 Objectives of the CNVMP

The objectives of this CNVMP are as follows:

- Document the statutory requirements applicable to construction noise and vibration emissions;
- Detail the mitigation and management measures required achieve compliance with relevant noise and vibration criteria for surrounding sensitive receivers;
- Outline the roles and responsibilities in relation to the management of noise and vibration emissions during construction; and
- Promote environmental awareness among employees and subcontractors.

This CNVMP covers construction of the Oakdale West. Construction of the WNSLR is covered in a separate CNVMP.

1.3 Terminology

Specific acoustic terminology is used in this report. An explanation of common acoustic terms is provided in **Appendix A**.

2 Statutory Requirements

This CNVMP has been prepared to accompany the Construction Environmental Management Plan (CEMP) for Oakdale West. The conditions relevant to this CNVMP are outlined in the following sections.

2.1 Development Consent

Conditions for Oakdale West and the WNSLR are specified in Department of Planning, Industry and Environment (DPIE) Development Consent SSD 7348, dated 13 September 2019. The conditions relevant to this CNVMP are reproduced in **Table 1**.

Table 1 Development Consent Conditions

<table>
<tr><th>Development Consent Conditions</th><th>Section / Comment</th></tr>
<tr><td colspan="2">Operation of Plant and Equipment</td></tr>
<tr><td>D21. All plant and equipment used on site, or to monitor the performance of Stage 1 must be:
a) maintained in a proper and efficient condition; and
b) operated in a proper and efficient manner.</td><td>Section 6 / Table 14</td></tr>
<tr><td colspan="2">Hours of Work</td></tr>
<tr><td>D70. The Applicant must comply with the hours detailed in Table 5, unless otherwise agreed in writing by the Planning Secretary.
Table 5: Hours of Works
<table>
<tr><th>Activity</th><th>Day</th><th>Time</th></tr>
<tr><td>Construction</td><td>Monday – Friday
Saturday</td><td>7 am to 6 pm
8 am to 1 pm</td></tr>
<tr><td>Operation</td><td>Monday – Sunday (including public holidays)</td><td>24 hours</td></tr>
</table></td><td>Section 3.5</td></tr>
<tr><td>D71. Works outside the hours identified in Condition D70 may be undertaken in the following circumstances:
a) works that are inaudible at the nearest sensitive receivers;
b) works agreed to in writing by the Planning Secretary;
c) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or
d) where it is required in an emergency to avoid the loss of lives, property or to prevent environmental harm.</td><td>Section 3.5</td></tr>
<tr><td colspan="2">Construction Noise Limits</td></tr>
<tr><td>D72. Stage 1 must be constructed with the aim of achieving 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 Construction Noise and Vibration Management Plan required by Condition D73.</td><td>Section 4.1, Section 5.1 and Section 6 / Table 14</td></tr>
</table>

Development Consent Conditions	Section / Comment
Construction Noise and Vibration Management Plan	
D73. The Applicant must prepare a Construction Noise and Vibration Management Plan (CNVMP) for Stage 1, to the satisfaction of the Planning Secretary. The CNVMP must form part of a CEMP in accordance with Condition D119 and must:	This document
a) be prepared by a suitably qualified and experienced noise expert;	Prepared by SLR – Author CV in **Appendix B**
b) describe procedures for achieving the noise management levels in the EPA's *Interim Construction Noise Guideline* (DECC, 2009) (as may be updated or replaced from time to time);	**Section 4.1**, **Section 5.1** and **Section 6 / Table 14**
c) describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers;	**Section 6 / Table 14**
d) include strategies to minimise impacts to sensitive receivers, including, where practicable, starting noisy equipment away from sensitive receivers and implementing respite periods;	**Section 6 / Table 14** and **Section 8**
e) include strategies that have been developed with the sensitive receivers identified in Appendix 5 for managing high noise generating works;	**Section 6 / Table 14** and **Section 8**
f) describe the community consultation undertaken to develop the strategies in Condition D73(e);	**Section 6** / **Table 14**, **Section 8** and the Community Communication Strategy (CCS)
g) include a monitoring program that: i) includes a protocol for determining exceedances of the relevant conditions in this approval; ii) evaluates and reports on the effectiveness of the noise and vibration management measures; iii) include procedures to relocate, modify, mitigate or stop work to ensure compliance with the relevant criteria; and	**Section 6 / Table 14**, **Section 8**, **Section 9** and the Compliance Monitoring and Reporting Program (CMRP)
h) include a complaints management system that would be implemented for the duration Stage 1.	**Section 7**
D74. The Applicant must: a) not commence construction of Stage 1 until the CNVMP required by Condition D73 is approved by the Planning Secretary; and; b) implement the most recent version of the CNVMP approved by the Planning Secretary for the duration of construction.	**Section 3.4** This document
Vibration Criteria	
D76. Vibration caused by construction works on the site, as measured at any residence or structure outside the site, must be limited to: a) for structural damage, the latest version of *DIN 4150-3 (1992-02) Structural vibration - Effects of vibration on structures* (German Institute for Standardisation, 1999); 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).	**Section 4.2**, **Section 5.2** and **Section 6 / Table 14**
D77. Vibratory compactors must not be used closer than 30 metres from residential buildings unless vibration monitoring confirms compliance with the vibration criteria specified in Condition D76.	**Section 4.2.3**, **Section 5.2** and **Section 6 / Table 14**

Development Consent Conditions	Section / Comment
D78. The limits in Conditions D76 and D77 apply unless otherwise outlined in a CNVMP, approved as part of the CEMP required by Condition D119 of this consent.	Noted – D76 and D77 apply
Management Plan Requirements	
D118. Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:	Noted
a) details of: i) the relevant statutory requirements (including any relevant approval, licence or lease conditions); ii) any relevant limits or performance measures and criteria; and iii) the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, Stage 1 or any management measures;	i) **Section 2** ii) **Section 4** iii) **Section 4**, **Section 6 / Table 14** and **Section 8**
b) a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	**Section 5** and **Section 6 / Table 14**
c) a program to monitor and report on the: i) impacts and environmental performance of Stage 1; and ii) effectiveness of the management measures set out pursuant to paragraph (b) above;	**Section 8**
d) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	**Section 6** and **Section 9**
e) a program to investigate and implement ways to improve the environmental performance of Stage 1 over time;	**Section 11**, and Section 6 of the CEMP
f) a protocol for managing and reporting any: i) incident and any non-compliance (specifically including any exceedance of the impact assessment criteria and performance criteria); ii) complaint; iii) failure to comply with statutory requirements; and	i) **Section 9** ii) **Section 7** iii) **Section 9**
g) a protocol for periodic review of the plan.	**Section 11**, and Section 6 of the CEMP

2.2 Relevant Guidelines

The guidelines used to assess the construction impacts from the development are listed in **Table 2**. The guidelines aim to protect the community and environment from excessive noise and vibration impacts that may result from construction of the development.

Table 2 Construction Noise and Vibration Guidelines

Guideline/Policy Name	Where Used
Environment Protection Authority (EPA) (2009) *Interim Construction Noise Guideline* (ICNG)	Assessment of noise impacts on sensitive receivers.
Roads and Maritime Services (2016) *Construction Noise and Vibration Guideline* (CNVG)	Assessment and management protocols for noise and vibration impacts.
Environment Protection Authority (EPA) (2006) *Assessing Vibration: a technical guideline*	Assessment of vibration impacts on sensitive receivers.
British Standard Institution (BSI) (1993) *BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2* (BS 7385)	Assessment of vibration impacts (structural damage) to sensitive structures.
German Institute for Standardisation (Deutsches Institut für Normung) (1999) *DIN 4150 – Structural vibration - Effects of vibration on structures* (DIN 4150)	Assessment of vibration impacts (structural damage) to sensitive structures.

3 Project Overview

3.1 Description

The Oakdale West site is bound to the north by the WaterNSW Pipeline and to the east by the Ropes Creek riparian corridor. Land along the eastern boundary of the site is also affected by a transmission easement associated with Transgrid infrastructure. To the east of the site is Goodman's Oakdale South Estate. Emmaus Catholic College and Emmaus Retirement Village are located to the west of the site. Other boundaries interface with adjoining rural lands used for a mix of rural-residential and agricultural.

3.2 Location

Located in the Penrith local government area (LGA) at the far south western extent of the WSEA, Oakdale West is made up of the land parcel legally described as Lot 11 DP 1178389, owned by Goodman.

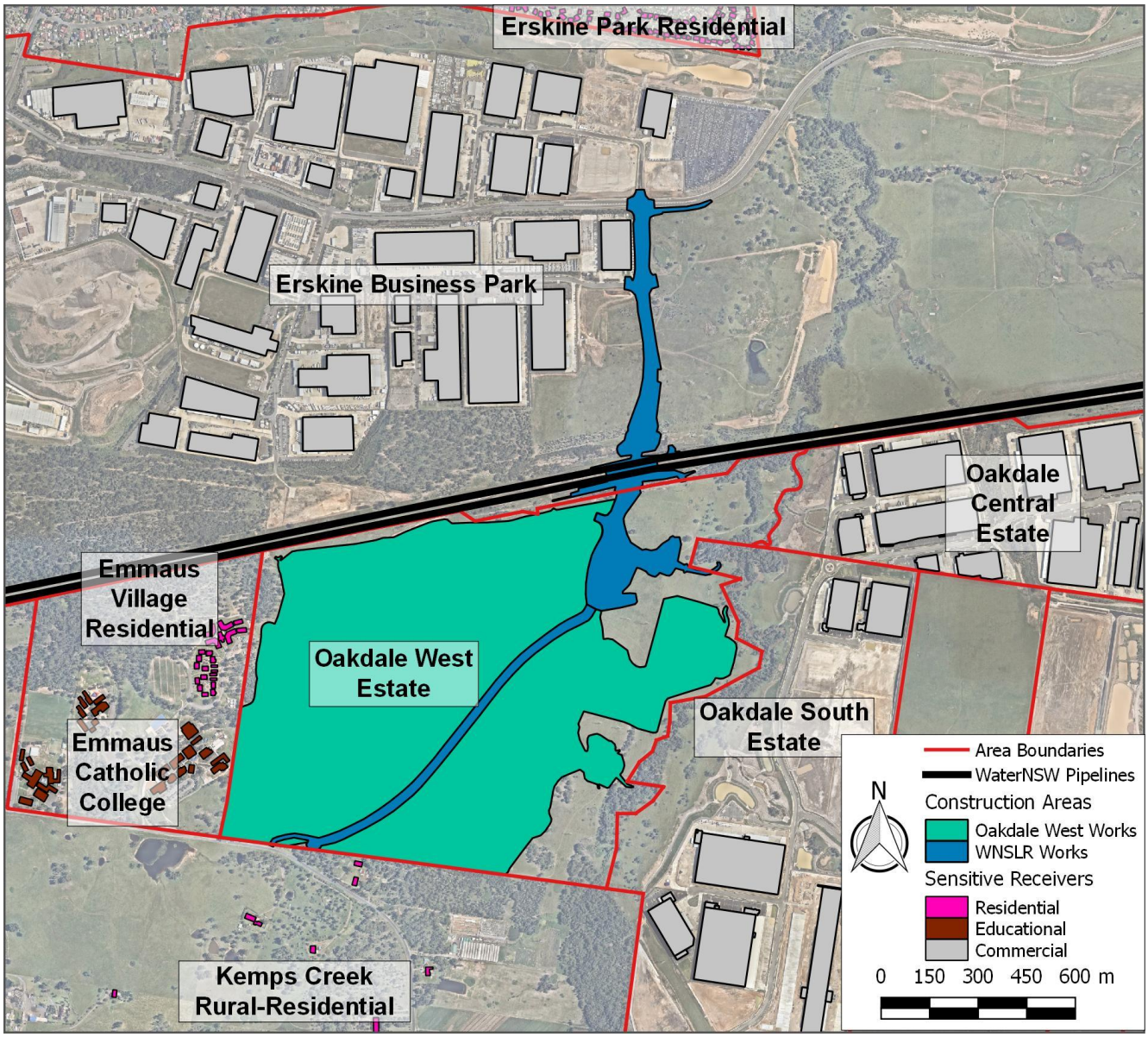
3.3 Surrounding Land Uses

The noise and vibration assessment locations representative of the nearest sensitive receiver areas surrounding Oakdale West were identified in the NIA for the project and are shown in **Figure 3**. Details of the nearest potentially affected sensitive receivers are provided in **Table 3**.

Table 3 Surrounding Sensitive Receivers

Sensitive Receivers	Receiver Type	Distance & Direction from Nearest Point of Works
Kemps Creek	Residential	20 m south
Emmaus Village	Residential	40 m west
Erskine Park	Residential	1,400 m north
Emmaus Catholic College	Educational	10 m west
Erskine Business Park	Commercial	280 m north
WaterNSW Pipeline	Structure	20 m north

Figure 3 Sensitive Receiver Areas



3.4 Construction Staging and Activities

In accordance with Condition D74 construction of Stage 1 must not commence until this CNVMP has been approved by the Planning Secretary.

Stage 1 development of the Oakdale West Concept Proposal includes the site preparation and infrastructure works required to facilitate further development of the estate in line with the Concept Proposal. This includes the construction of the WNSLR and connection to the estate road network along with the development of Precinct 1 for warehousing and distribution.

The remainder of the Oakdale West is expected to be developed over four further stages with Stage 2 being the development of Precinct 2, Stage 3 being Precinct 3, Stage 4 being Precinct 4 and Stage 5 being Precinct 5.

Construction of Stage 1 is scheduled to commence in the last quarter of 2019.

The works that will be constructed by Burtons include:

- Bulk earthworks across the entire site (with the exception to the WNSLR works area which covers the Construction Access Road and Basin 1);
- Construction of the retaining and noise walls across the site;
- Construction of the western bund;
- Construction of lead in services infrastructure, including potable water, sewer, telecommunications and electrical;
- Construction of Roads 1, 2, 6 and part of Road 7;
- Construction of Basins 2, 3, 4, and 5; and
- Landscaping across the site.

No on-lot warehouse construction will be undertaken by Burtons. Burtons work will not be staged, however the Western Bund works, which includes the installation of a new snake proof fence along the Western Boundary, will be prioritised to occur as part of the first works activities.

The earthworks require the importation of approximately 500,000 – 600,000 m^3 of material. Due the limitations to the import of general fill by Bakers Lane, the importation process cannot commence until the WNSLR is available for use.

3.5 Construction Hours

Construction hours will be in accordance with Conditions D70 and D71 of Development Consent SSD 7348, which are reproduced below:

D70. The Applicant must comply with the hours detailed in Table 5, unless otherwise agreed in writing by the Planning Secretary.

***Table 5**: Hours of Work*

Activity	Day	Time
Construction	Monday – Friday Saturday	7 am to 6 pm 8 am to 1 pm

D71. Works outside of the hours identified in Condition D70 may be undertaken in the following circumstances:

a) works that are inaudible at the nearest sensitive receivers;

b) works agreed to in writing by the Planning Secretary;

c) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or

d) where it is required in an emergency to avoid the loss of lives, property or to prevent environmental harm.

Condition D71(a) of Development Consent SSD 7348 notes that works may be undertaken outside of standard construction hours where the works are inaudible at the nearest sensitive receivers. Out of hours works can be undertaken without requiring approval from the Planning Secretary where it can be demonstrated that works will not be audible at any sensitive receivers.

The potential for audible impacts can be assessed by calculating predicted noise levels with a construction noise model, or by undertaking test measurements during a period with similar background noise levels to the proposed works period (noting that audibility is subjective and dependent on the background noise level at the time of the works). The predictions/measurements must be confirmed at the commencement of works with attended noise monitoring at the nearest sensitive receivers. These predictions and measurements will be undertaken by a suitably qualified acoustic consultant.

In accordance with Condition D71(b) of Development Consent SSD 7348, where works are required out of hours and noise is predicted to be audible at the nearest receivers, then written approval from the Planning Secretary must be received prior to commencement of works, except where the works fall under Conditions D71(c) or D71(d).

3.5.1 Extended Construction Hours for Earthworks at Lot 2B

Approval for extended construction hours for works associated with the earthworks at Lot 2B was issued by DPIE on 17 January 2020 (refer to letter *Oakdale West Estate (SSD 7348) Extended Construction Working Hours*). The modified construction hours will be:

- Monday to Sunday – 7:00 am to 10:00 pm.

Refuelling and maintenance of equipment may be completed between 6:00 am to 7:00 am and 10:00 pm to 11:00 pm Monday to Sunday. No plant movements will be allowed during the period 6:00 am to 7:00 am.

The following conditions apply to the extended construction hours:

- Extended construction working hours apply from 27 January 2020 until 31 May 2020
- Extended construction working hours apply to approved bulk earthworks to facilitate construction of Lot 2B (including movement of excavated material onto Lot 2A)
- Goodman providing evidence to the Department of noise agreements with landowners N3, N4 and N5, prior to commencement of the extended working hours
- Goodman providing evidence to the Department of any agreed mitigation measures to be implemented at landowner N1, such as the proposed noise curtains, prior to the commencement of the extended construction working hours
- The mitigation measures listed in Section 3.7 of the Noise Assessment (Wilkinson Murray report *19440-EH Version D OWE Lot 2B Extended Hours Construction Noise and Vibration Assessment*, dated January 2020) are implemented and maintained for the duration of the extended construction working hours
- Goodman providing results of any noise monitoring to the Department, on request.

Should noise monitoring or noise complaints indicate the mitigation measures are not effective at reducing noise to acceptable levels, the Department (DPIE) will require Goodman to implement additional noise controls for the duration of the extended construction working hours.

3.6 Construction Site Access

Access to Oakdale West will be separate from the construction access associated with the WNSLR works which will be constructed along the future Southern Link Road alignment. The Oakdale West construction access will be located to the west of the WNSLR access.

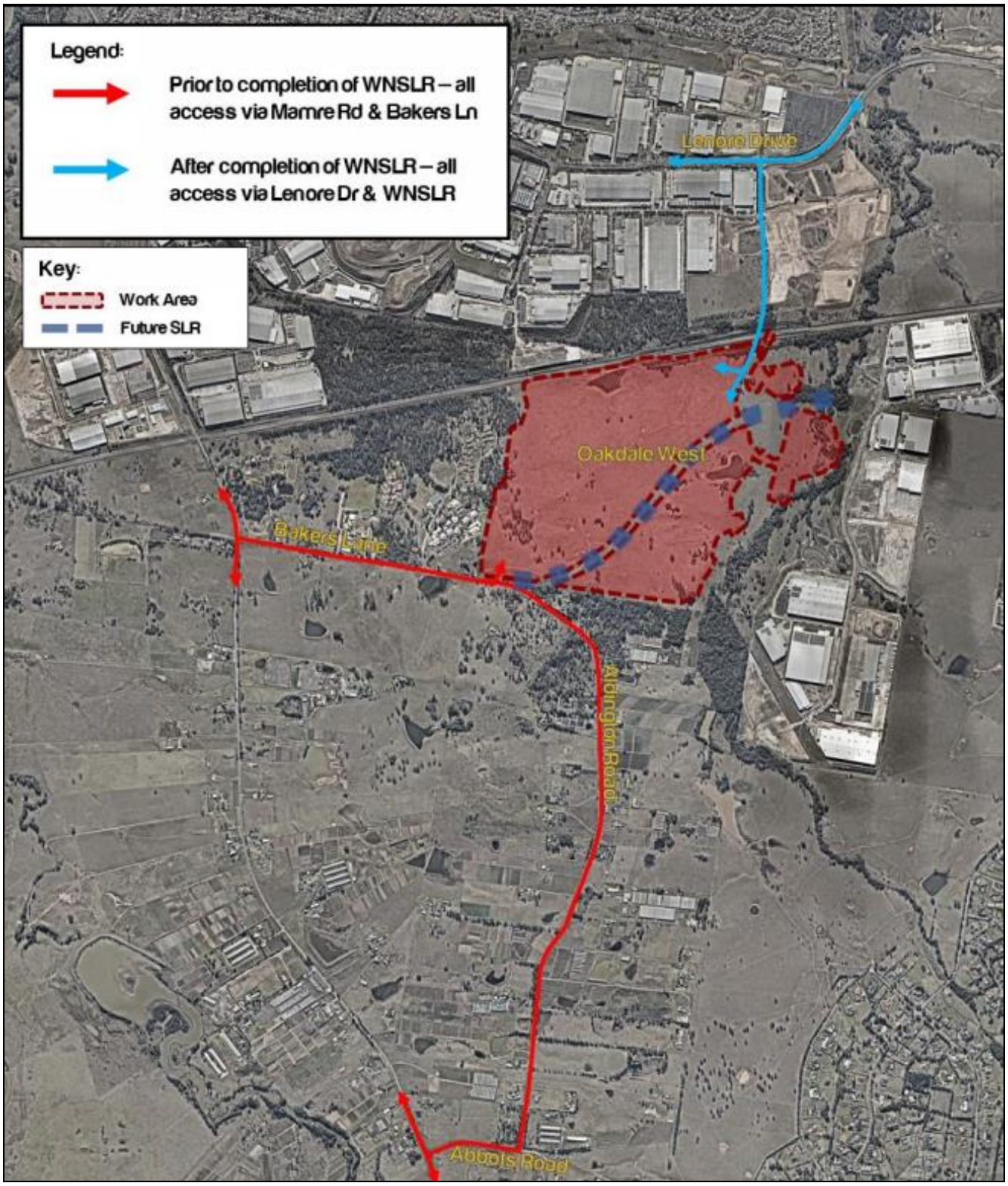
Any construction traffic crossing the Robson's (contractor constructing the WNSLR) temporary Construction Access Road will do so via designated crossing points which will be determined in consultation between Burton and Robson.

In accordance with the Construction Traffic Management Plan (CTMP) (Ason 2019), **Table 3** and **Figure 3** detail the site access arrangements for the construction of Oakdale West.

Table 4 Site Access

Work Zones	Access Arrangement
Prior to the completion of the WNSLR	All vehicles will access via Bakers Lane (Aldington Road to be used as a secondary route only).
Post completion of the WNSLR	All vehicles will access via the WNSLR.

Figure 4 Site Access



4 Construction Noise and Vibration Criteria and Guidelines

4.1 Construction Noise Criteria

In accordance with Condition D72 of the Development Consent SSD 7348, Oakdale West must be constructed with the aim of achieving the construction noise management levels (NMLs) detailed in the NSW *Interim Construction Noise Guideline* (ICNG). Explanation of what constitutes feasible and reasonable is outlined in Section 1.4 of the ICNG.

The ICNG process to determine NMLs is detailed in **Section 4.1.1**. The project specific noise criteria is summarised in **Section 4.1.2**.

4.1.1 Interim Construction Noise Guideline

The ICNG requires project specific NMLs to be established for noise affected receivers. The NMLs are not mandatory limits, however in the event construction noise levels are predicted to be above the NMLs, feasible and reasonable work practices are to be investigated to minimise noise emissions.

The ICNG provides an approach for determining NMLs at residential receivers based on Rating Background Level (RBL) for the area, as described in **Table 5**.

Table 5 Determination of NMLs for Residential Receivers

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

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

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

Note 1 The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW *Noise Policy for Industry*.

Works are recommended to be completed during Standard Construction Hours where possible. More stringent requirements are placed on works that are required to be completed outside of Standard Construction Hours (ie during the evening or night-time) which reflects the greater sensitivity of communities to noise impacts during these periods.

The ICNG also recognises other kinds of noise sensitive receivers and provides recommended NMLs for them. Those specific receivers and their recommended noise levels are presented in **Table 6**.

Table 6 Construction Noise Management Levels at Other Sensitive Land Uses

Land use	NML $L_{Aeq(15minute)}$
Classrooms at schools and other educational institutions	Internal noise level 45 dBA
Hospital wards and operating theatres	Internal noise level 45 dBA
Places of worship	Internal noise level 45 dBA
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dBA
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dBA
Community centres	Depends on the intended use of the centre

The ICNG notes that due to the broad range of sensitivities that commercial or industrial land can have to noise from construction, the process of defining management levels is separated into three categories:

- Industrial premises: external 75 dBA $L_{Aeq(15minute)}$
- Offices, retail outlets: external 70 dBA $L_{Aeq(15minute)}$
- For other businesses that may be very sensitive to noise, appropriate goals should be determined on a case by case basis with reference to Australian/New Zealand Standard *AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors* (AS2107).

4.1.2 Project Specific NML Summary

The NIA defined the airborne NMLs for the various surrounding receivers. The NMLs applicable for the receivers surrounding Oakdale West are outlined in **Table 7**.

Table 7 Project Specific Noise Management Levels

Location	Receiver Type	RBL[1]			Construction NMLs $L_{Aeq(15minute)}$ (dBA)				
		Day	Evening	Night	Standard Construction Hours[2]	Day Out of Hours[2]	Evening Out of Hours[2]	Night Out of Hours[2]	Highly Noise Affected
Erskine Park Residential[3]	Residential	37	40	39	47	42	42[5]	42[5]	75
Emmaus Village Residential	Residential	39	38	36	49	44	43	41	
Kemps Creek Residential	Residential	34	35	32	44	39	39[5]	37	
Any	Industrial	n/a			External 75 when in use				n/a
Any	Commercial	n/a			External 70 when in use				
Any	School[4]	n/a			External 55 when in use				

Note 1: RBL Periods – Day: 7:00 am to 6:00 pm Monday to Saturday, 8:00 am to 6:00 pm Sunday; Evening: 6:00 pm to 10:00 pm; Night: 10:00 pm to 7:00 am Monday to Saturday, 10:00 pm to 8:00 am Sunday.

Note 2: Standard construction hours: 7:00 am to 6:00 pm Monday to Friday, 8:00 am to 1:00 pm Saturday (refer to **Section 3.5**).
Day out of hours: 1:00 pm to 6:00 pm Saturday, 8:00 am to 7:00 pm Sunday and Public Holidays.
Evening out of hours: 6:00 pm to 10:00 pm Monday to Sunday.
Night out of hours: 10:00 pm to 7:00 am Monday to Saturday, 10:00 pm to 8:00 am Sunday and Public Holidays.

Note 3: RBL for Erskine Park Residential taken from *Western North-South Link Road DA Noise Impact Assessment* prepared by SLR in September 2016.

Note 4: External criteria equivalent to internal criteria plus 10 dB.

Note 5: RBL reduced to be equal to Daytime RBL in accordance with the ICNG and NPfI.

As noted in **Table 5**, where the predicted or measured $L_{Aeq(15minute)}$ construction noise levels exceed the NMLs in **Table 7**, all feasible and reasonable work practises will be applied with the aim of meeting the NMLs.

Where the predicted or measured construction noise levels are above the highly noise affected criteria (ie 75 dBA), the DPIE may require respite periods by restructuring the hours that the noisy activities can occur.

Predicted construction noise levels are discussed in **Section 5.1**.

4.2 Construction Vibration Criteria

In accordance with Condition D76 of the Development Consent SSD 7348, vibration from construction works on the site, as measured at any residence or sensitive structure, must be limited to the criteria outlined in:

- For structural damage – German Standard *DIN 4150-3 (1992-02) Structural vibration - Effects of vibration on structures* (DIN 4150); and
- For human exposure, the EPA's *Assessing Vibration: a technical guideline*.

British Standard *BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2* (BS 7385) provides further guidance with regards to reducing the potential for structural damage.

Structural damage criteria is detailed in **Section 4.2.1** and human exposure criteria is detailed in **Section 4.2.2**.

Minimum working distances based on these criteria are summarised in **Section 4.2.3**.

4.2.1 Cosmetic Damage Vibration Thresholds

British Standard BS 7385

The recommended vibration limits from BS 7385 for transient vibration for minimal risk of cosmetic damage to residential and industrial buildings are shown in **Table 8**. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk is usually taken as a 95% probability of no effect.

Table 8 Transient Vibration Guide Values for Minimal Risk of Cosmetic Damage (BS 7385)

Line	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	50 mm/s at 4 Hz and above
2	Unreinforced or light framed structures	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

German Standard DIN 4150-3

For continuous long-term vibration or repetitive vibration with the potential to cause fatigue effects, DIN 4150 provides the following Peak Particle Velocity (PPV) values as safe limits, below which even superficial cosmetic damage is not to be expected:

- 10 mm/s for commercial buildings and buildings of similar design.
- 5 mm/s for dwellings and buildings or similar design.
- 2.5 mm/s for buildings of great intrinsic value (eg heritage listed buildings).

For short-term vibration events (ie those unlikely to cause resonance or fatigue), DIN 4150 offers the criteria shown in **Table 9**. These are maximum levels measured in any direction at the foundation or in the horizontal axes in the plane of the uppermost floor.

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

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 (e.g. 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.

The "*safe limits*" given in DIN 4150 are the levels up to which no damage due to vibration effects has been observed for the particular class of building. "*Damage*" is defined by DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls.

4.2.1.1 WaterNSW Pipelines

WaterNSW pipelines are located adjacent to the northern boundary of the Oakdale West site, around 20 m from the closest point of the works. The pipelines are installed above ground and are supported on reinforced concrete saddles. The standards for vibration damage (refer to **Section 4.2.1**) do not cater for structures similar to the pipelines construction.

PSM Consult Pty Ltd have completed an assessment of the WNSLR bridge (letter report PSM1541-381L, dated April 2019, refer to **Appendix C**), which recommends a criteria of 15 mm/s PPV for the pipelines during construction of the bridge. Advice from WaterNSW has confirmed this is to be used as the vibration limit for the pipelines in the project area. While the PSM1541-381L assessment was prepared for the WNSLR works, it is considered to be suitable for Oakdale West when vibration intensive works are being undertaken in the vicinity of the WaterNSW pipelines.

4.2.2 Human Exposure Vibration Thresholds

The EPA's *Assessing Vibration: a technical guideline* provides guideline values for continuous, transient and intermittent events that are based on a Vibration Dose Value (VDV) rather than a continuous vibration level. The VDV is dependent upon the level and duration of the short-term vibration event, as well as the number of events occurring during the daytime or night-time period.

The VDVs recommended in the document for vibration of an intermittent nature (i.e. construction works where more than three distinct vibration events occur) are presented in **Table 10**.

Table 10 Acceptable Vibration Dose Values for Intermittent Vibration (m/s$^{1.75}$) (*Assessing Vibration: a technical guideline)*

Location	Daytime[1]		Night-time[1]	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Note 1: Daytime is 7:00 am to 10:00 pm and night-time is 10:00 pm to 7:00 am.

4.2.3 Minimum Working Distances

Recommended minimum working distances for vibration intensive construction plant based on the BS 7385, DIN 4150 and *Assessing Vibration: a technical guideline* are referenced from the Roads and Maritime *Construction Noise and Vibration Guideline* (CNVG). Theses minimum working distances are summarised in **Table 11**.

The minimum working distances are based on empirical data which suggests that where works are further from receivers than the quoted minimum distances then impacts are not considered likely.

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 building under typical geotechnical conditions.

Table 11 Recommended Minimum Working Distances for Vibration Intensive Equipment

Plant Item	Rating / Description	Minimum Distance		
		Cosmetic Damage		Human Response (NSW EPA Guideline)[1]
		Residential and Light Commercial (BS 7385)[1]	Heritage Items (DIN 4150 Group 3)[2]	
Vibratory Roller	< 50 kN (Typically 1-2t)	5 m	11 m	15 m to 20 m
	< 100 kN (Typically 2-4t)	6 m	13 m	20 m
	< 200 kN (Typically 4-6t)	12 m	15 m	40 m
	< 300 kN (Typically 7-13t)	15 m	31 m	100 m
	> 300 kN (Typically 13-18t)	20 m	40 m	100 m
	> 300 kN (Typically > 18t)	25 m	50 m	100 m
Small Hydraulic Hammer	300 kg – 5 to 12t excavator	2 m	5 m	7 m
Medium Hydraulic Hammer	900 kg – 12 to 18t excavator	7 m	15 m	23 m
Large Hydraulic Hammer	1600 kg – 18 to 34t excavator	22 m	44 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	5 m to 40 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	5 m	4 m
Jackhammer	Hand held	1 m (nominal)	3 m	2 m

Note 1: Criteria reference from Roads and Maritime CNVG.

Note 2: Criteria reference from DIN 4150.

In addition to the above minimum working distances, Condition D77 of the Development Consent SSD 7348 specifies that vibratory compactors must not be used closer than 30 metres from residential buildings unless vibration monitoring confirms compliance with the vibration criteria specified in Condition D76. This may include the nearest residences in Kemps Creek to the South, and potentially the nearest residences in the Emmaus Village, depending on the exact location of vibration intensive works. While this condition specifies residential buildings, it is considered that this is also applicable to vibration intensive works adjacent to the nearest buildings at Emmaus Catholic College.

5 Construction Noise and Vibration Impacts

5.1 Construction Noise Impacts

The Oakdale West NIA presented construction noise predictions from a number of construction scenarios likely to occur on site. These construction scenarios are representative of a number of activities which will be required during the construction of the site.

Table 12 details the construction scenarios assessed in the NIA together with a list of activities considered to be represented by those scenarios.

Table 12 Construction Scenarios

NIA Construction Scenario	Relevant Activities
Site Clearing and Earthworks	Site set up including environmental controls Bulk earthworks Spoil removal/import
Paving Works including concrete pours	Construction of retaining walls and noise barriers. Installation of services infrastructure (potable water, sewer, telecommunications and electrical etc)
Construction of Roadways	Laying of road surface Roadway compacting and smoothing Line marking and finishing works
Landscaping and finishing works	Landscaping

The predicted worst-case noise levels and the exceedances of the NMLs from the various construction works at Oakdale West are presented in **Table 13**.

Table 13 Predicted NML Exceedances

Receiver	LAeq(15minute) Construction Noise Levels (dBA)					
	Worst-case Predicted (any scenario)	NML (Standard Construction Hours)	NML Exceedance (Standard Construction Hours)[1]			
			Site Clearing and Earthworks	Paving Works	Roadway Construction	Landscaping
Erskine Park Residential	41	47	-	-	-	-
Emmaus Village Residential	71	49	22	10	8	8
Kemps Creek Residential	70	44	26	20	16	12
School Classrooms	70	55	15	7	-	3
Commercial Premises	58	70	-	-	-	-

Note 1: Refer to **Table 12** for which construction activities are covered by each scenario.

As detailed in the NIA and shown in **Table 13** above, the construction noise impacts for the scenarios in **Table 12** are predicted to exceed the NMLs at Emmaus Catholic College, Emmaus Village residential and Kemps Creek residential receivers for some construction works during standard construction hours. The highest exceedances of the NMLs are generally when earthworks are adjacent to the nearest receivers. Exceedances would generally reduce in magnitude as construction works move away from the nearest receivers.

No exceedance of the standard construction hours NMLs are predicted at commercial or Erskine Park residential receivers.

Best practise noise management measures will be undertaken for all construction works. Additional feasible and reasonable noise mitigation and management measures will be applied for works where an exceedance of the NMLs is identified, with the aim of achieving the applicable NMLs.

Mitigation and management measures are outlined in **Section 6**.

5.1.1 Earthworks at Lot 2B During Extended Construction Hours

Assessment of noise from earthworks at Lot 2B (including movement of excavated material onto Lot 2A) during extended construction hours was undertaken in Wilkinson Murray report *19440-EH Version D OWE Lot 2B Extended Hours Construction Noise and Vibration Assessment*, dated January 2020 (Lot 2B Extended Hours Report).

The Lot 2B Extended Hours Report assessed a number of construction activities associated with earthworks at Lot 2B and predicted that out of hours NMLs would be exceeded by up to 7 dBA at Emmaus Village residential for some earthworks activities at Lot 2B.

Earthworks at Lot 2B (including movement of excavated material onto Lot 2A) during extended construction hours will be undertaken in accordance with the mitigation and management measures outlined in **Section 6**.

Section 3.7 of the Lot 2B Extended Hours Report listed additional mitigation measures applicable these works. These mitigation measures are outlined in **Table 15**.

5.2 Construction Vibration Impacts

Vibration intensive items of plant proposed for use during the construction of the development would include plate compactors and vibratory rollers. These items of equipment are proposed to be used during various stages of works across the project.

During construction of Oakdale West, vibratory rollers and plate compactors have the potential to be operated within the recommended minimum working distances of the nearest receivers in Emmaus Catholic College, Kemps Creek, and Emmaus Village, which are located around 10 m, 20 m and 45 m respectively from the nearest point of works.

The separation distance from these buildings will be maximised and all feasible and reasonable mitigation and management measures undertaken. Mitigation and management measures are outlined in **Section 6**.

Vibration at the nearest receivers is likely to be perceptible at times during the works when vibration intensive activities are being carried out nearby.

WaterNSW pipelines are located adjacent to the northern boundary of the Oakdale West site, around 20 m from the closest point of the works. The PSM Consult assessment (PSM1541-381L) considers that excavation and compaction works in the vicinity of the pipelines have the potential to exceed the applicable vibration limits. PSM1541-381L recommends various management measures for works adjacent to the pipelines. These measures are detailed in **Section 6**.

6 Mitigation and Management Measures

In order to minimise noise impacts during works, the construction contractor will take all reasonable and feasible measures to mitigate noise effects. Impacts from the works will be minimised and managed in accordance with the procedures detailed below in **Table 14**.

Note: **Table 14** is replicated as Table 9 and Table 12 in the CEMP.

Table 14 Environmental Management Controls for Construction Noise and Vibration

Measure	Person Responsible	Timing / Frequency	Reference / Notes
Project Planning			
Less noise and vibration intensive construction techniques for rock breaking and concrete sawing will be used.	Burton	Ongoing	Best practice
Works will be completed during standard daytime construction hours outlined in **Section 3.5**, with the exception of earthworks at Lot 2B (including movement of excavated material onto Lot 2A) which have extended construction hours as outlined in **Section 3.5.1**.			
Truck routes to site will be in accordance with the approved Construction Traffic Management Plan.			
Scheduling			
Respite offers will be considered where high-noise works are predicted to exceed 75 dBA for residential receivers. For schools and retirement villages (Emmaus Village) a lower level of 65 dBA will be used to account for the sensitive daytime uses of these receivers. Respite offers will be considered for high-vibration works where the works are undertaken within the human comfort minimum working distances for all receiver types. Consultation with these receivers will be undertaken to determine appropriate respite periods, such as exam periods for schools.	Communications and Community Liaison Representative	Ongoing	SSD 7348 Condition D73
High-noise or vibration generating works will be carried out in continuous blocks no longer than three hours in length, with a minimum respite period of one hour between each block. 'Continuous' includes any period during which there is less than a one hour respite between ceasing and recommencing these works. High-noise or vibration generating works conducted outside standard construction hours (where approved) will be limited to no more than two consecutive nights except where there is a Duration Respite (see below). For night-works these periods will be separated by no less than one week, and limited to six nights per month. Where possible, high-noise and vibration generating works will be completed before 11 pm.			

Measure	Person Responsible	Timing / Frequency	Reference / Notes
Duration Respite will be considered where it may be beneficial to the sensitive receivers to increase the duration of blocks of work or number of consecutive periods in order to complete the works more quickly. The project team will engage with the community where Duration Respite is considered in accordance with the CCS.	Communications and Community Liaison Representative	Ongoing	SSD 7348 Condition D73
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 numbers will be undertaken in accordance with the CCS.			
Site Layout			
Compounds and worksites will be designed to promote one-way traffic and minimise the need for vehicle reversing.	Burton	Ongoing	Best practice
Where practicable, work compounds, parking areas, and equipment and material stockpiles will be positioned away from noise-sensitive locations and take advantage of existing screening from local topography.			
Equipment that is noisy will be started away from sensitive receivers			
Training			
Training will be provided to all personnel on noise and vibration requirements for the project. Inductions and toolbox talks to be used to inform personnel of the location and sensitivity of surrounding receivers.	Burton	Ongoing	Best practice
Plant and Equipment Source Mitigation			
All construction plant and equipment used on Site must be, in addition to other requirements: a) regularly inspected and maintained in an efficient condition; b) operated in a proper and efficient manner.	Burton	Ongoing	SSD 7348 Condition D21
Where practicable, tonal reversing alarms (beepers) will be replaced with non-tonal alarms (squawkers) on all equipment in use (subject to occupational health and safety requirements).			Best practice
Noisy equipment will be sited behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise.			

Measure	Person Responsible	Timing / Frequency	Reference / Notes
Noise generating equipment will be regularly checked and effectively maintained, including checking of hatches/enclosures regularly to ensure that seals are in good condition and doors close properly against seals.	Burton	Ongoing	Best practice
Dropping materials from a height will be avoided.			
Loading and unloading will be carried out away from noise sensitive areas, where practicable.			
Trucks will not queue outside residential properties. Truck drivers will avoid compression braking as far as practicable.			
Truck movements will be kept to a minimum, ie trucks are fully loaded on each trip.			
Screening			
Purpose-built acoustic screening or enclosures will be installed around long-term fixed plant such as generators in site compounds.	Burton	Ongoing	Best practice
Community Consultation			
Notifications will be provided to the affected community where high impacts are anticipated or where out of hours works are required. Notification will be a minimum of 24 hours. Refer to the CCS.	Communications and Community Liaison Representative	Ongoing	Best practice
Where complaints are received, work practices will be reviewed and feasible and reasonable practices implemented to minimise any further impacts. Refer to **Section 7**.			
Monitoring			
Noise and/or vibration monitoring will be conducted (as appropriate) when noise/vibration intensive works are being undertaken in close proximity to sensitive receivers.	Burton	Ongoing	Best practice
Noise and/or vibration monitoring will be conducted (as appropriate) in response to any complaints received to verify that levels are not substantially above the predicted levels.			
Refer to **Section 8** for full details of monitoring requirements.			
Vibration			
Where works are required within the minimum working distances, vibration monitoring will be undertaken to confirm that vibration is within acceptable levels.	Burton	Ongoing	Best practice
Where works are required within the cosmetic damage minimum working distances, building condition surveys will be completed before and after the works to ensure no cosmetic damage has occurred.			

Measure	Person Responsible	Timing / Frequency	Reference / Notes
Vibratory compactors will not be used closer than 30 m from residential and educational buildings unless vibration monitoring confirms compliance with the vibration criteria.	Burton	Ongoing	SSD 7348 Condition D77
A vibration limit of 15 mm/s PPV will be applied to the WaterNSW pipelines located adjacent to the northern site boundary.			PSM Vibration Assessment PSM1541-381L (and/or requested by WaterNSW)
Dilapidation surveys of the WaterNSW pipelines will be carried out prior to the commencement and after completion of any vibration intensive work within 50 m of the pipelines, at a minimum. This will include as a minimum, collecting photos of the conditions of the site and existing pipeline and foundations, and mapping/identifying any existing issues or cracks, etc, prior to, during, and after the works.			
During vibration intensive construction works within 50 m of the WaterNSW pipelines, vibration will be monitored in accordance with the procedures outlined in **Section 8.2.2**.			
WaterNSW will be immediately notified in the event of any impact to the pipeline so that they can inspect the pipes prior to confirming whether any remedial work is required.			
Where there is a risk that vibration activities may cause damage to nearby structures and buildings or if these are located within the minimum working distance from the construction activity, a building condition inspection will be undertaken at least three weeks before the construction activity commences.		Before and after any vibration activities within minimum distances	Best practice
The Building Condition Inspection Reports will contain photographs of the inspected properties and include details of the inspectors' qualification and expertise, together with a list of any identified defects, where relevant. The reports will be submitted to the owner of each property and to AT&L and Goodman before the commencement of any vibration intensive activities.			
A copy of the Building Condition Inspection Reports and CNVMP will be submitted to AT&L and Goodman at least 10 working days prior to commencement of piling, excavation by hammering or ripping, compaction, demolition operations, or any activity which may cause damage through vibration.			

Measure	Person Responsible	Timing / Frequency	Reference / Notes
EIS Measures			
Construction hours will be limited to 7:00 am - 6:00 pm Monday to Friday and 8:00 am - 1:00 pm Saturdays (refer to **Section 3.5**), with the exception of earthworks at Lot 2B (including movement of excavated material onto Lot 2A) which have extended construction hours as outlined in **Section 3.5.1**.	Burton	Ongoing	EIS mitigation commitment
Where construction noise levels are predicted to be above the NMLs, all feasible and reasonable work practices will be investigated to minimise noise emissions, as detailed in this CNVMP.			
Construction works will be conducted during Standard Construction Hours, with out of hours work minimised as far as feasible and reasonable, and undertaken in accordance with Condition D71 (refer to **Section 3.5**).			
Locations for vibration intensive equipment will be reviewed during the planning of construction works adjacent to the most affected receivers.			

Initial consultation has been established with all potentially affected community groups and sensitive receivers (refer to the CCS). The mitigation and management measures detailed in **Table 14** are considered to be appropriate to minimise impacts on the potentially affected receivers.

These measures will be implemented and refined as informed by the results of monitoring and ongoing community consultation.

Specific consultation with the potentially affected receivers to determine suitable respite periods and management measures will be undertaken during the planning stage of high-noise generating works once specific details of the works have been identified, such as the location of the works, activities proposed to be undertaken and required equipment.

In addition to the mitigation and management measures outlined above, **Table 15** details specific measures applicable to earthworks at Lot 2B (including movement of excavated material onto Lot 2A) during extended construction hours.

Table 15 Additional Management Controls for Lot 2B Earthworks During Extended Construction Hours

Measure	Person Responsible	Timing / Frequency	Reference / Notes
During the out of hours works no fill material, equipment (apart from where required by the road authority) or other construction materials will be transported to site via public roads.	Burton	Ongoing	Lot 2B extended hours commitment
Non-tonal reversing alarms will be used on all items of plant and heavy vehicles used onsite.			

Measure	Person Responsible	Timing / Frequency	Reference / Notes
All machinery will be maintained in good working order and will be fitted with mufflers. Tail gate dampers will be used on all trucks used onsite.	Burton	Ongoing	Lot 2B extended hours commitment
The simultaneous use of multiple noise plant items will be minimised as much as practicable, particularly in the northwestern area of Lot 2B and in Lot 2A.			
Equipment used intermittently will be shut down when not in use.			
Equipment with directional noise emissions will be oriented away from sensitive receivers as much as practicable.			
The excavation of the Lot 2B area will commence at the eastern extent of the area and would progress generally in an east to west direction. Acoustic shielding provided by the western face of the excavation will be utilised as much as practicable to shield Emmaus Village from noise from earthmoving works in this area.			
Noise levels recorded by the installed Sentinex real-time noise monitoring systems located at the Oakdale West site boundaries will be proactively monitored during the works to determine the potential for exceedances of the NMLs.	Burton / Goodman		
Where the real-time noise monitoring indicates that noise levels are higher than those predicted, work methodologies and/or works locations will be amended to minimise noise emissions.			
Subject to agreement with Emmaus Village management, a temporary noise barrier (such as Echo barrier noise curtains) will be installed to a height of 4 m on the eastern side of the Emmaus Village access road/carpark (refer to the Lot 2B Extended Hours Report). This location will be confirmed in agreement with Emmaus Village management.	Burton / Goodman / Communications and Community Liaison Representative	Prior to construction	
Undertake pre-construction community consultation with the affected receivers, including Emmaus Village, in order to clearly and transparently explain the proposed works and the potential for construction noise impacts. Regular ongoing updates and consultation will be undertaken throughout the works in order to understand and address any noise related concerns of the receivers as far as practicable.	Goodman / Communications and Community Liaison Representative	Ongoing	
Goodman will finalise and execute the noise agreement with the common landowner of receivers N4 and N5 (refer to Development Consent SSD 7348) prior to undertaking works during extended hours.		Prior to construction	

7 Complaints Handling and Response Procedure

Details on complaints management are outlined in Section 3.6 of the overarching CEMP.

8 Monitoring

8.1 Construction Noise Monitoring

Attended noise measurements will be undertaken at the start of noise intensive works in the vicinity of sensitive receivers to verify the levels are as predicted and to check the effectiveness of mitigation and management measures used to minimise the impacts. This includes where works are adjacent to Emmaus Catholic College and the nearest residences in Kemps Creek and Emmaus Village.

Attended monitoring will also be undertaken in response to any complaints regarding construction noise. The location and extent of monitoring would be determined in consultation with AT&L, Goodman, and an acoustic consultant and would be dependent on the activities taking place.

The monitoring will take place during the expected noisiest construction periods and be representative / indicative of any impact across all potentially affected sensitive receivers.

Monitoring reports will be produced following each monitoring survey and provided to AT&L and Goodman for review. In the event that an exceedance of the applicable NMLs is measured (refer to **Section 4.1**), actions to be carried out are detailed in **Section 9**.

All items of acoustic instrumentation utilised will be designed to comply with applicable guidelines and carry current calibration certificates.

8.2 Construction Vibration Monitoring

8.2.1 Sensitive Receivers and Structures

Where vibration intensive works (such as vibratory rolling and plate compacting) are proposed to be undertaken within the minimum working distances of sensitive receivers or structures (refer to **Section 4.2.3**), vibration will be monitored continuously for the duration of works within the minimum working distances. This may be applicable to Emmaus Catholic College and the nearest residences in Kemps Creek (on Aldington Road) and Emmaus Village.

Attended vibration measurements will be undertaken at the commencement of vibration intensive works within the minimum working distances to confirm the levels of vibration are below the applicable vibration limits (refer to **Section 4.2**).

Geophones will be installed by an acoustic consultant at the closest points of the sensitive structure to the vibration intensive works to continuously monitor vibration for the duration of the works. Should the works location change, the geophones will be relocated to remain at the closest point of the structure to the works.

The vibration monitoring equipment will have visible and audible alarms installed where operators of equipment can see/hear them:

- A warning vibration level of 2/3 of the applicable vibration limit will set off the visual alarm if exceeded – the equipment operator must take care to limit vibration emissions when the warning level is exceeded.
- An exceedance vibration level equal to the applicable vibration limit will set off both the visual and audible alarms. Actions to be carried out if the exceedance alarm is set off are detailed in **Section 9**.

Monitoring data will be downloaded and reported monthly, at a minimum. Vibration monitoring reports will be prepared and provided to AT&L and Goodman for review at the following stages:

- Monthly during works (at a minimum)
- Within one week of an exceedance of the vibration limit alarm level (15 mm/s PPV)
- Upon completion of construction.

All items of vibration instrumentation utilised will be designed to comply with applicable guidelines and carry current calibration certificates.

8.2.2 WaterNSW Pipelines

The PSM Consult assessment (PSM1541-381L) recommends the following vibration monitoring for the WaterNSW pipelines. Advice from WaterNSW has confirmed that this program is to be adopted.

Vibrations impacts on the WaterNSW pipelines due to construction activities will be monitored continuously for the duration of earthworks and compaction works within 50 m of the WaterNSW pipeline to ensure vibration levels do not exceed the applicable limits (refer to **Section 4.2.1.1**).

Geophones will be installed by an acoustic consultant on top of each pipeline at the centre point between two saddles closest to the works. Baseline vibration measurements will be recorded for at least one week to determine background levels of vibration at the site prior to commencement of any works.

The vibration monitoring equipment will have visible and audible alarms installed where operators of equipment can see/hear them:

- A warning vibration level of 10 mm/s PPV will set off the visual alarm if exceeded.
- An exceedance vibration level of 15 mm/s PPV will set off both the visual and audible alarms.
- Actions to be carried out at each alarm level are detailed in **Section 9**.

Monitoring data will be downloaded and reported monthly, at a minimum. Vibration monitoring reports will be prepared and provided to AT&L and Goodman to review at the following stages:

- Prior to commencement of works (baseline report)
- Monthly during works (at a minimum)
- Within one week of an exceedance of the vibration limit alarm level (15 mm/s PPV)
- Upon completion of construction.

All items of vibration instrumentation utilised will be designed to comply with applicable guidelines and carry current calibration certificates.

9 Contingency Management Plan

The following contingency management plan, shown in **Table 16**, would be used to manage any unpredicted noise and vibration impacts and their consequences.

In the event of an incident, response will be carried out in accordance with the procedures detailed in Section 3.5 of the overarching CEMP. As detailed in Section 5.4 of the overarching CEMP, all Condition Amber and Condition Red occurrences will be recorded in the Environmental Representative Monthly Report and discussed during the toolbox talks.

The following events constitute an incident in terms of noise and vibration:

- Trigger of Condition Red for noise impacts during the standard construction hours detailed in Condition D70, or the extended hours for Lot 2B earthworks (refer to **Section 3.5.1**).
- Any works occurring outside the standard construction hours detailed in Condition D70, where those works do not meet the allowable circumstances defined in Condition D71.
- Trigger of Condition Red for vibration impacts (either at sensitive receivers locations or on WaterNSW pipelines).

Table 16 Contingency Management Plan

Key Element	Trigger / Response	Condition Green	Condition Amber	Condition Red
Noise impacts at sensitive receiver locations	Trigger	Noise levels do not exceed applicable NMLs	Noise levels exceed applicable NMLs	Noise levels exceed Highly Noise Affected criteria (75 dBA)
	Response	On-going best practice management measures to minimise noise emissions	Undertake all feasible and reasonable mitigation and management measures to minimise noise impacts (aiming to achieve NMLs)	Undertake all feasible and reasonable mitigation and management measures to ensure noise levels are below Highly Noise Affected criteria. If noise levels cannot be kept below Highly Noise Affected criteria then a different construction method or equipment must be utilised.
Vibration impacts at sensitive receiver locations	Trigger	Vibration intensive works undertaken outside minimum working distance for the specific equipment in use	Vibration intensive works undertaken within minimum working distance for the specific equipment in use	Vibration levels exceed applicable vibration limits
	Response	On-going best practice management measures to minimise vibration emissions	Undertake vibration monitoring for the duration of the works to confirm vibration levels.	Stop work. Undertake all feasible and reasonable mitigation and management measures to ensure vibration levels are below applicable limits. If vibration levels cannot be kept below applicable limits then a different construction method or equipment must be utilised.

Key Element	Trigger / Response	Condition Green	Condition Amber	Condition Red
Vibration impacts on WaterNSW pipelines	Trigger	Vibration intensive works undertaken more than 50 m from the closest point of the pipeline	Vibration intensive works undertaken within 50 m of the closest point of the pipeline	Monitored vibration levels on pipeline exceed 15 mm/s PPV
	Response	On-going best practice management measures to minimise vibration emissions	Undertake vibration monitoring for the duration of the works to confirm vibration levels.	Stop work. Undertake all feasible and reasonable mitigation and management measures to ensure vibration levels are below 15 mm/s PPV. If vibration levels cannot be kept below 15 mm/s PPV then a different construction method or equipment must be utilised.

10 Roles and Responsibilities

Overall roles and responsibilities relating to the project are outlined in Section 3.2 of the overarching CEMP.

The key responsibilities specifically for noise and vibration management are as follows:

10.1 Contractor's Project Manager

- Ensuring appropriate resources are available for the implementation of this CNVMP;
- Assessing data from inspections and providing project-wide advice to ensure consistent approach and outcomes are achieved;
- Providing necessary training for project personnel to cover noise and vibration management;
- Reviewing and update of this CNVMP;
- Commissioning a suitably qualified consultant to install and maintain noise and vibration monitors and ensuring that the environmental coordinator undertakes any attended noise and vibration measurements required by this Plan;
- Assessing and (as required) mitigating risks of elevated noise and vibration levels before commencing works each day and ensuring that the appropriate controls are implemented and effective;
- Reviewing weather forecasts and current observations of meteorological conditions (as recorded at Horsley Park AWS);
- Throughout the day, visually assessing the dust levels and the effectiveness of any dust controls implemented, making adjustments accordingly;
- Ceasing works in the event of excessive noise and vibration generation due to noise enhancing weather conditions or inadequately controlled construction activities (e.g. strong winds blowing from the noise source to nearby receivers, temperature inversions, etc.); and
- In the event that a noise or vibration complaint is received, the procedure in Section 3.6 of the CEMP will be implemented (see **Section 7**).

10.2 Environmental Coordinator

- Undertaking noise monitoring program;
- Review that control measures are working in accordance with the CNVMP; and
- Identifying and reporting noise and vibration emissions incidents.

10.3 All Workers on Site

- Observing any noise and vibration emission control instructions and procedures that apply to their work;
- Taking action to prevent or minimise noise and vibration emission incidents; and
- Identifying and reporting noise and vibration emission incidents.

11 Review and Improvement of the CNVMP

Details on review and improvement are outlined in Section 6 of the overarching CEMP.

12 References

British Standard Institution (BSI) (1993) *BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2* (BS 7385)

German Institute for Standardisation (Deutsches Institut für Normung) (1999) *DIN 4150 – Structural vibration - Effects of vibration on structures* (DIN 4150)

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Environment Protection Authority (EPA) (2009) *Interim Construction Noise Guideline* (ICNG)

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APPENDIX A

Acoustic Terminology

1. Sound Level or Noise Level

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

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

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

2. 'A' Weighted Sound Pressure Level

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

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

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

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

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

3. Sound Power Level

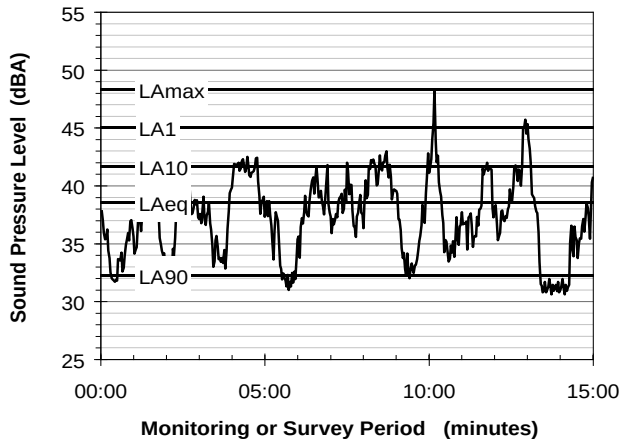
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

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

4. Statistical Noise Levels

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

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



Of particular relevance, are:

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

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

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

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

5. Frequency Analysis

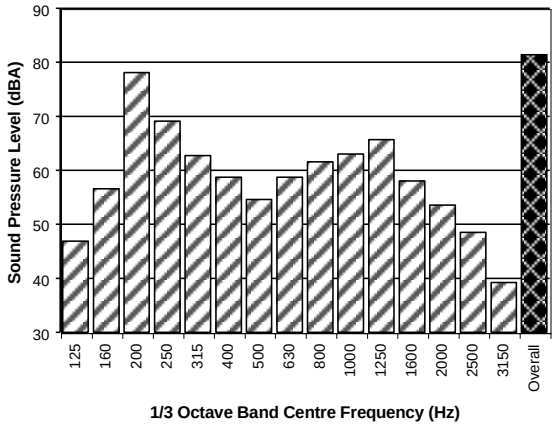
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

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

Frequency analysis can be in:

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

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



6. Annoying Noise (Special Audible Characteristics)

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

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

7. Vibration

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

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

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

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

8. Human Perception of Vibration

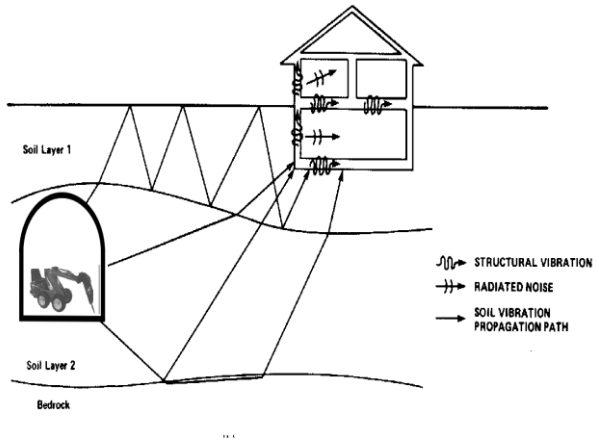
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience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

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

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

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

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



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