OAKDALE SOUTH INDUSTRIAL ESTATE

Construction Noise and Vibration Management Plan
Site 1C

Prepared for:

Goodman Property Services (Aust) Pty Ltd
GPO Box 4703
SYDNEY NSW 2001

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd 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.

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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
610.15608-Oakdale South 1C CNVMP-v1.1	15 May 2020	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 Pty Ltd (Goodman) to prepare a Construction Noise and Vibration Management Plan (CNVMP) for construction works at Site 1C of the Oakdale South Industrial Estate 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 impacts. Construction noise and vibration impacts were previously assessed for the Oakdale South Industrial Estate as part of the *Oakdale South Industrial Estate DA Noise Impact Assessment* prepared by SLR in October 2015 (the NIA)

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

2 Background

The Oakdale South Industrial Estate (Oakdale South) is a regional warehouse and distribution hub, and is located at Kemps Creek within the Penrith local government area (LGA). Oakdale South forms part of the broader Oakdale Industrial Precinct which is located within the Western Sydney Employment Area (WSEA).

Goodman Property Services (Aust) Pty Ltd (Goodman) obtained Development Consent SSD 6917 on 26 October 2016 for the Oakdale South "Concept Proposal" and "Stage 1 Development". The Concept Proposal essentially comprises a "Master Plan" to guide the staged development of Oakdale South and core development controls that will form the basis for design and assessment of future development applications for the site. It includes:

- Six development precincts with a total of 14 building envelopes;
- Warehouse buildings and ancillary office floor space;
- Conceptual subdivision and lot layout, site levels, road layout, design controls, landscape designs and infrastructure arrangements; and
- An amenities lot for future small-scale local services such as commercial, retail and community facilities (including childcare facilities) that service or support the needs of local employment-generating uses in accordance with Condition C20 of the Oakdale South (SSD 6917) conditions of consent.

Additional stages of Oakdale South (i.e. Stage 2, 3, etc.) have been subject to separate development applications and approvals.

At the time of preparing this document, ten applications to modify SSD 6917 had been approved and one withdrawn. In summary, these modifications comprise:

- Mod 1 - approved on the 21 April 2017 for revisions to the approved Concept Proposal and Stage 1 Development in the northern portion of the estate;
- Mod 2 - withdrawn;
- Mod 3 - approved on the 5 October 2017 to permit out of hours importation of fill material;

- Mod 4 - approved on 18 December 2017 for revisions to the approved Concept Proposal and Stage 1 Development in the northern portion of the estate;
- Mod 5 - approved on the 23 November 2017 for administrative changes to condition E37;
- Mod 6 – approved on the 15 June 2018 to update the *Vegetation Management Plan* (VMP)/*Biodiversity Offset Strategy* (BOS) and associated changes to conditions E46 and E47;
- Mod 7 – approved 11 April 2018 for revisions of the approved concept plans to replace corner landscape, E2 zone in Lot 3A with hardstand, IN1 zone;
- Mod 8 – approved 17 December 2018 to increase the maximum height limit for a warehouse within Precinct 5 from 15 m to 16.5 m to accommodate roof plant;
- Mod 9 – approved 21 February 2019 to revise the concept masterplan to show Precinct 6 as a single rather than two warehouses;
- Mod 10 – approved 5 August 2019 to enable to storage of dangerous goods at Warehouse 1D; and
- Mod 11 – approved 29 October 2019 to update the VMP and removed the BOS.

For the purposes of this document, the approved Oakdale South Master Plan is illustrated in **Figure 1** and described in:

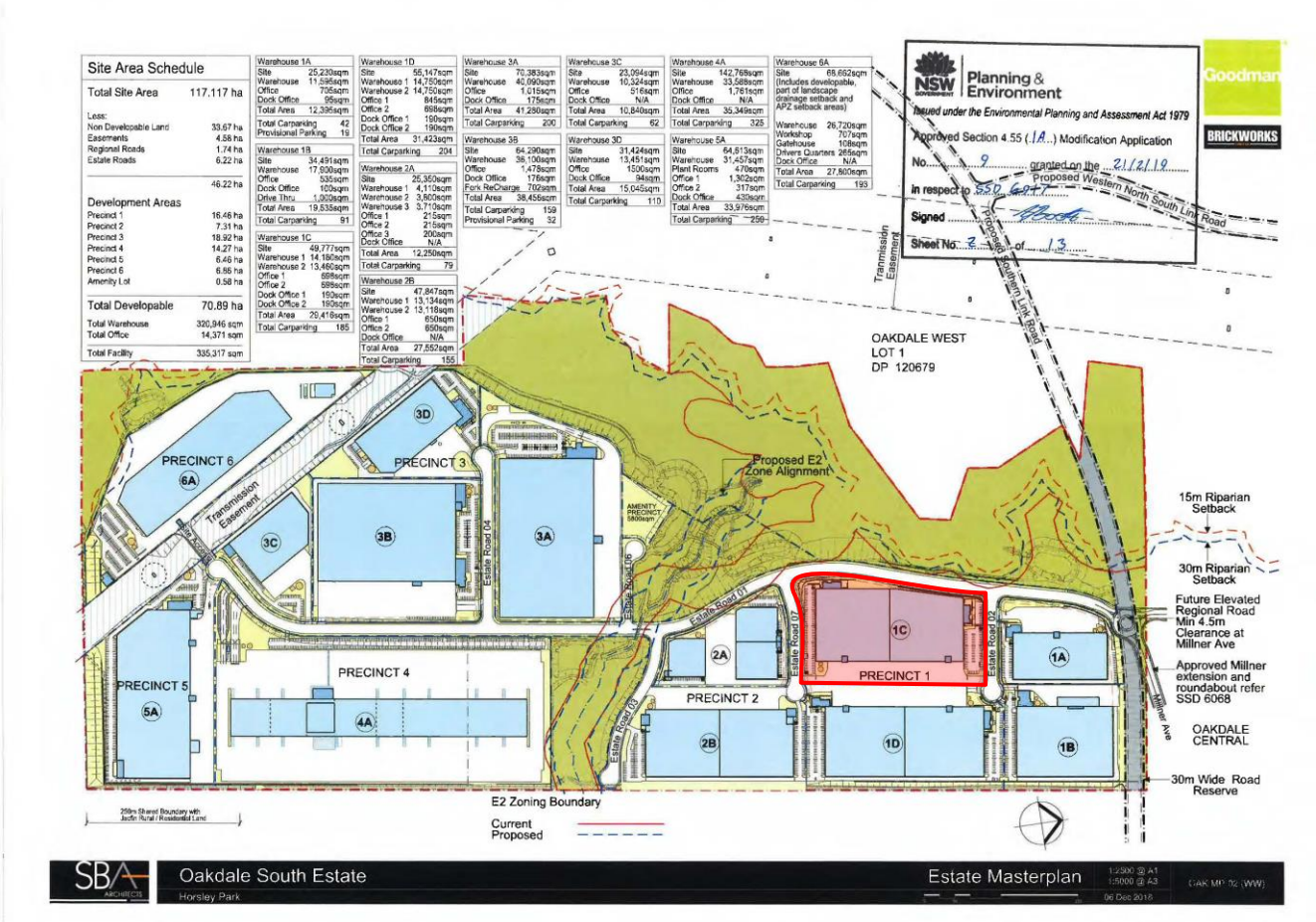
- *Environmental Impact Statement - Oakdale South Estate, State Significant Development Application Ref. 6917 (EIS) (Urban Advisory Services 2015), along with the Response to Submissions (RTS) and supplementary reports;*
- Mod 1 – *Section 96(2) Modification Proposal, Oakdale South Industrial Estate SSD (Urbis 2016), along with the RTS and supplementary reports;*
- Mod 3 – *SSD 6917: Oakdale South Industrial Estate - S.96 Application to Modify Condition E27 'Standard Construction Hours' (Goodman 2017);*
- Mod 4 – *Oakdale South Estate - SSDA 6917, Section 96(1A) Modification Application - MOD 4 (Urbis 2017), along with the RTS and supplementary reports;*
- Mod 5 – *SSD 6917: Oakdale South - S.96(1) Application to Modify Condition E37 - Noise Verification - External Mechanical Plant*;
- Mod 6 – *SSD 6917: Oakdale South Industrial Estate – Mod 6 - S.96(1a) Application to Update Vegetation Management Plan, Biodiversity Offset Strategy and Conditions E46 & E47* (Goodman 2018);
- Mod 7 – *SSD 6917: Oakdale South – S.96(1a) Application to Concept Plan to Include E2 / IN1 Zone Update on Lot 3A* (Goodman 2018);
- Mod 8 – *SSD 6917 Mod 8, Oakdale South – S.4.55(1a) Application to Modify Condition B11 Concerning External Mechanical Plant Height* (Goodman 2018);
- Mod 9 – *Oakdale South Estate, Precinct 6 - SSDA 6917 Mod 9 Section 4.55 (1a) Modification* (Urbis 2018);
- Mod 10 – *Oakdale South Estate, Precinct 6 - SSDA 6917 Mod 10 Section 4.55 (1a) Modification* (Urbis 2019); and

- Mod 11 – *SSD 6917: Oakdale South Industrial Estate, SSD 6917 Mod 11 - S.4.55(1a) Application to Update Vegetation Management Plan, Remove the Biodiversity Offset Strategy and Update Relevant Conditions of Consent* (Goodman 2019).

2.1 Site Overview and Layout

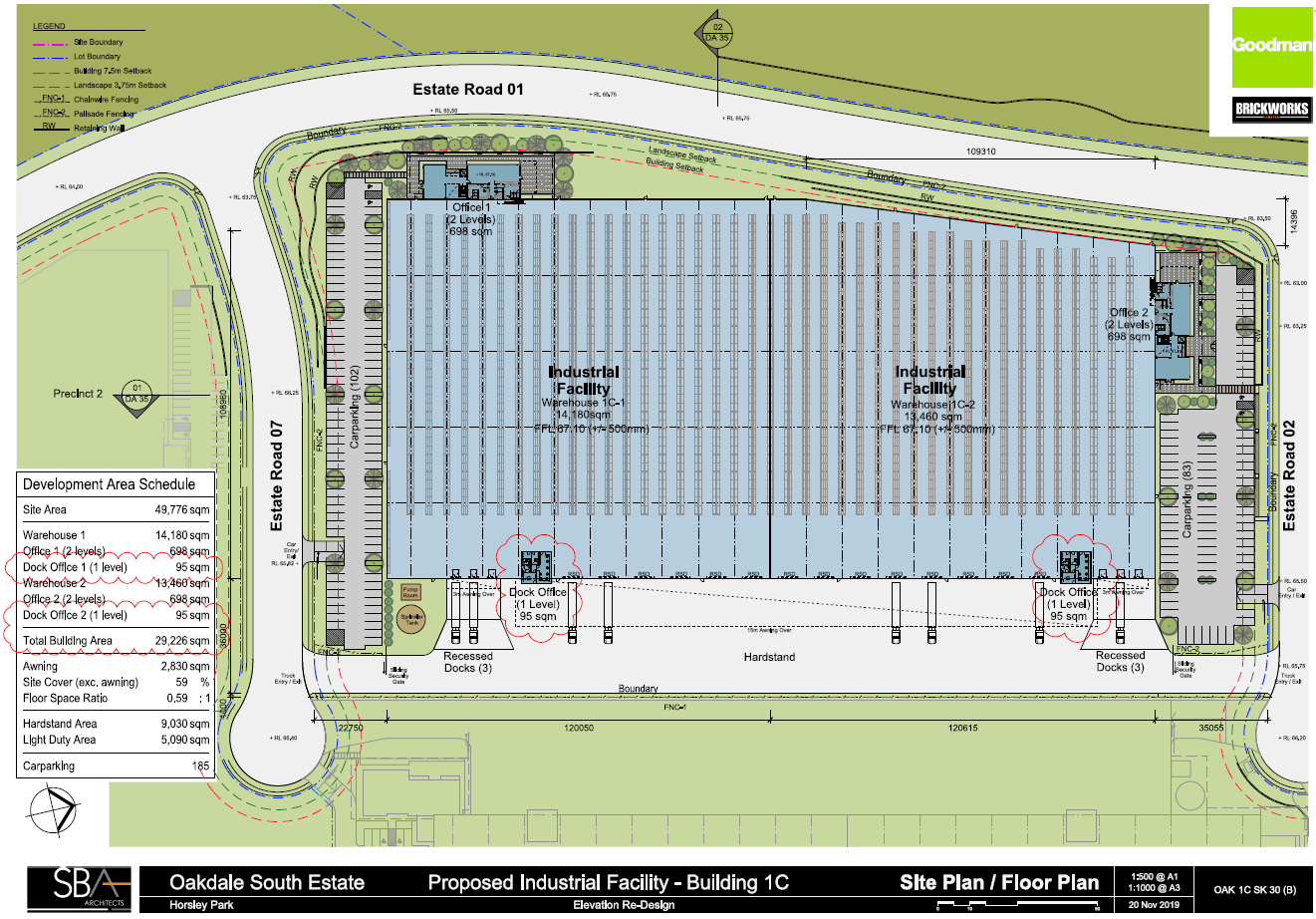
The layout of the Oakdale South Industrial Estate is shown in **Figure 1**, while **Figure 2** details the layout of Site 1C which includes site access, vehicle loading, unloading and parking, office space, and landscaping. The representative noise and vibration sensitive receivers identified in the NIA are presented in **Section 4**.

Figure 1 Oakdale South Approved Masterplan



Note 1: Site 1C indicated in red.

Figure 2 Site 1C Design Plans



3 Development Consent

3.1 Consent Conditions

This CNVMP has been prepared to accompany the Construction Environmental Management Plan (CEMP) for the site. The conditions relevant to this CNVMP are outlined below in **Table 1**.

Table 1 Development Consent Conditions

Development Consent Conditions	Comment
Operation of Plant and Equipment	
D27. The applicant shall ensure that all plant and equipment used for the Development is: a) Maintained in a proper and efficient condition; and b) Operated in a proper and efficient manner.	Refer to **Section 7**
Noise and Vibration	
E27. Construction activities associated with the Development shall be undertaken during the following hours: a) 7:00 am to 6:00 pm Mondays to Fridays, inclusive; and b) 8:00 am to 1:00 pm Saturdays; and c) at no time on Sundays or public holidays.	Refer to **Section 6.2**
E28. Construction works outside of the standard construction hours identified in Condition E27 may be undertaken in the following circumstances: a) construction works that generate noise that is: i. no more than 5 dB(A) above rating background level at any residence in accordance with the *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009); and ii. no more than the noise management levels specified in Table 3 of the *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009) at other sensitive receivers; or b) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or c) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or d) works approved through an EPL, or by the Secretary; or e) works as approved through the out-of-hours work protocol outlined in the CEMP as required by Condition F1.	Refer to **Section 6.2**
E29. Activities resulting in impulsive or tonal noise emissions (such as rock breaking, rock hammering, pile driving) must only be undertaken: a) between the hours of 8:00 am and 5:00 pm Monday to Friday; b) between the hours of 8:00 am and 1:00 pm Saturday; and c) in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block. For the purpose of this condition 'continuous' includes any period during which there is less than a one hour respite between ceasing and recommencing any of the work the subject of this condition.	Refer to **Section 6.2**

Development Consent Conditions	Comment
E30. The Development shall be constructed with the aim of achieving the following construction vibration goals: a) for structural damage, the vibration limits set out in the German Standard *DIN 4150-3: Structural Vibration - effects of vibration on structures*; and b) for human exposure, the acceptable vibration values set out in the *Environmental Noise Management Assessing Vibration: A Technical Guideline* (Department of Environment and Conservation, 2006).	Refer to **Section 7**
E31. Wherever practical, piling activities must be undertaken using quieter alternative methods than impact or percussion piling, such as bored piles or vibrated piles.	Refer to **Section 7**
E32. Where feasible and reasonable, noise mitigation measures must be implemented at the start of construction (or at other times during construction) to minimise construction noise impacts.	Refer to **Section 7**
Construction Noise Limits	
E33. The Development shall be constructed with the aim of achieving the construction noise management levels detailed in the *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009). All feasible and reasonable noise mitigation measures shall be implemented and any activities that could exceed the construction noise management levels shall be identified and managed in accordance with the management and mitigation measures in the RTS and SSD 6917 MOD 3.	Refer to **Section 7**
Construction Noise Management Plan	
E34. The Applicant shall prepare a Construction Noise Management Plan (CNMP) for the Development to manage high noise generating works. The CNMP shall: a) be prepared by a suitably qualified and experienced noise expert; b) be approved by the Secretary prior to the commencement of construction; c) describe procedures for achieving the noise management levels in the EPA's *Interim Construction Noise Guideline 2009*; d) describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers; e) include strategies that have been developed with the community for managing high noise generating works; f) describe the community consultation undertaken to develop the strategies in e) above; and g) include a complaints management system that would be implemented for the duration of the Development.	**This Document** a) Prepared by SLR b) Noted c) Refer to **Section 7** d) Closest receivers are over 900m away, as such no high noise generating works will be undertaken in close proximity to sensitive receivers e) as above f) as above g) Refer to **Section 8** & **9**
Noise Management	
E38. The Applicant shall: a) implement best management practice, including all reasonable and feasible measures to prevent and minimise noise and vibration during construction and operation of the Development (including low frequency noise and traffic noise); b) minimise the noise impacts of the Development during adverse meteorological conditions when noise criteria do not apply; c) maintain the effectiveness of any noise suppression equipment on plant at all times and ensure defective plant is not used operationally until fully repaired; and d) regularly assess noise monitoring data and relocate, modify and/or stop operations to ensure compliance with the relevant conditions of this consent.	Refer to **Section 7**

4 Noise and Vibration Sensitive Receivers

The noise and vibration assessment locations representative of the nearest sensitive receiver areas surrounding Oakdale South were identified in the NIA for the project and are shown in **Figure 3**. Details of the nearest potentially affected sensitive receivers are also provided in **Table 2**.

It is noted that the proposed Jacfin RU4 and Capitol Hill residential subdivisions have not yet been developed. As the construction noise and vibration criteria are applicable at existing receivers, noise and vibration emissions from the site need only to be considered in these areas once dwellings have been constructed and are occupied.

Table 2 Surrounding Sensitive Receivers

Sensitive Receivers	Receiver Type	Distance & Direction from Site Boundary
Erskine Park	Residential	1,800 m – North
Horsley Park	Residential	1,400 m – East
Proposed Jacfin	Residential	900 m – South
Proposed Capitol Hill	Residential	1,200 m – South
Mount Vernon	Residential	1,500 m – Southeast
Kemps Creek	Residential	1,300 m – Southwest
Emmaus Village	Residential	1,650 m – West

Figure 3 Sensitive Receivers Areas

5 Construction Noise and Vibration Criteria

5.1 Noise Guidelines

5.1.1 Interim Construction Noise Guideline

The NSW *Interim Construction Noise Guideline* (ICNG), NSW EPA, 2009, sets out ways to assess and manage the impacts of construction noise on residences and other sensitive land uses. It does this by presenting assessment approaches that are tailored to the scale of the construction works.

The ICNG requires project specific Noise Management Levels (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.

5.1.2 Residential Receivers

The ICNG provides an approach for determining NMLs at sensitive receivers based on RBL for the area, as described in **Table 3**.

Table 3 Determination of NMLs for Residential Receivers

Time of Day	NML $L_{Aeq(15minute)}$	How to Apply
Standard 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.

Outside recommended standard 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*.

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 4**.

Table 4 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

5.1.3 Commercial Premises

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 AS2017.

5.1.4 NML Summary

Background noise levels were measured at Oakdale South as part of the EIS for the Concept Proposal. Based on the measured RBLs, the airborne $L_{Aeq(15minute)}$ construction NMLs for Oakdale South were determined in accordance with the procedure outlined in the ICNG. The NMLs applicable to Site 1C (detailed in the NIA) are outlined in **Table 5**.

Table 5 Project Specific Noise Management Levels, dBA

Receiver Type	$L_{Aeq(15minute)}$ Construction NMLs	
	Standard Construction Hours[1]	Highly Noise Affected
Residential	42	75
Educational	55 external (45 internal) when in use	
Commercial	70 when in use	

Note 1: ICNG Standard Construction Hours – 7:00 am to 6:00 pm Monday to Friday; 8:00 am to 1:00 pm Saturday; no work Sunday or Public Holidays.

Note 2: If any sensitive receivers are identified in the project area of uses other than those above, see **Table 4** for applicable NMLs.

5.2 Vibration Guidelines

5.2.1 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 6**. These are maximum levels measured in any direction at the foundation or in the horizontal axes in the plane of the uppermost floor.

Table 6 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 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.

5.2.2 Assessing Vibration: A Technical Guideline

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 (ie construction works where more than three distinct vibration events occur) are presented in **Table 7**.

Table 7 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
Critical areas[2]	0.10	0.20	0.10	0.20
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
Critical areas[2]	0.10	0.20	0.10	0.20

Note 1: Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am.

Note 2: Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas.

Source: British Standard BS 6472-1992

5.2.3 Minimum Working Distances

The recommended minimum working distances for vibration intensive construction plant outlined in **Table 8** are referenced from the TfNSW *Construction Noise Strategy*.

Consistent with British Standard BS 7385 Part 2-1993 and the *Assessing Vibration: A Technical Guideline*, the recommendations are for the practical management of potential vibration to minimise the likelihood of cosmetic damage to buildings and disturbance or annoyance in humans. The human comfort minimum working distances are conservative, developed with reference to the more stringent objectives for continuous vibration for typical residential building constructions.

The minimum working distances referenced from BS 7385 have been used to determine minimum working distances for the DIN 4150 criteria for dwellings outlined in **Table 6**. It is noted that the criteria for commercial buildings is higher than that for dwellings, therefore, the minimum working distances for commercial buildings would be smaller than those outlined below. However, the below distances can still be used as a screening criteria before considering detailed assessment of vibration levels at commercial buildings.

Table 8 Recommended Minimum Working Distances for Vibration Intensive Plant

Plant Item	Rating / Description	Minimum Working Distance		
		Cosmetic Damage		Human Response[3]
		BS 7385[1] – Residential and light commercial	DIN 4150[2] – Group 2 - dwellings and similar	
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	7 m	15 m to 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	8 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	16 m	40 m
	< 300 kN (Typically 7-13 tonnes)	15 m	20 m	100 m
	> 300 kN (Typically 13-18 tonnes)	20 m	26 m	100 m
	> 300 kN (Typically > 18 tonnes)	25 m	33 m	100 m
Small Hydraulic Hammer	300 kg – 5 to 12t excavator	2 m	3 m	7 m
Medium Hydraulic Hammer	900 kg – 12 to 18t excavator	7 m	10 m	23 m
Large Hydraulic Hammer	1600 kg – 18 to 34t excavator	22 m	29 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	3 m	20 m to 100 m
Pile Boring	≤ 800 mm	2 m (nominal)	3 m	N/A
Jackhammer	Hand held	1 m (nominal)	2 m	Avoid contact with structure

Note 1: Referenced from British Standard BS 7385 Part 2-1993.

Note 2: Referenced from German Standard DIN 4150-3.

Note 3: Referenced from *Assessing Vibration: A Technical Guideline*.

6 Construction Works

6.1 Construction Activities

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

Table 9 details the construction scenarios assessed in the NIA together with a list of activities considered to be represented by those scenarios.

Table 9 Construction Activities

Construction scenario (DA noise impact assessment)	Construction activities
Paving Works including Concrete Pours	• Detailed earthworks (bulk earthworks were undertaken as part of the Oakdale South Stage 1 works) • Construction of footings • Installation of underground services (stormwater, fire service, sewer, water service) • Reinforced concrete ground and external paving
Construction of warehouse and office structures	• Erection of precast concrete panels and structural steel • Installation of roof and wall cladding • Installation of mechanical, electrical and hydraulic services
Landscaping and finishing works	• Finishes and fixtures to the office and warehouse • Landscaping

6.2 Hours of Construction

In accordance with Condition E27, construction activities associated with the development shall be undertaken during the following hours:

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

In accordance with Condition E28, works outside of the hours identified in Condition E27 may be undertaken in the following circumstances:

a. construction works that generate noise that is:

   i: no more than 5 dB(A) above rating background level at any residence in accordance with the *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009); and

   ii: no more than the noise management levels specified in Table 3 of the *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009) at other sensitive receivers; or

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

c. where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or

d. works approved through an EPL, or by the Secretary; or

e. works as approved through the out-of-hours work protocol outlined in the CEMP as required by Condition F1.

In accordance with Condition E29 Activities resulting in impulsive or tonal noise emissions (such as rock breaking, rock hammering, pile driving) must only be undertaken:

a. between the hours of 8:00 am and 5:00 pm Monday to Friday;

b. between the hours of 8:00 am and 1:00 pm Saturday; and

c. in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block.

For the purpose of this condition 'continuous' includes any period during which there is less than a one hour respite between ceasing and recommencing any of the work the subject of this condition.

6.3 Construction Noise Predictions

The NMLs and predicted worst-case noise levels from the various construction works at Oakdale South are presented in **Table 10**.

Table 10 Predicted Noise Levels

Receiver	$L_{Aeq(15minute)}$ Construction Noise Levels (dBA)			
	NML	Worst-case Predicted		
		Paving Works including Concrete Pours	Construction of warehouse and office structures	Landscaping and finishing works
Erskine Park Residential	42	<30	<30	<30
Horsley Park Residential	42	32	<30	<30
Proposed Jacfin Residential	42	34	<30	<30
Proposed Capitol Hill Residential	42	31	<30	<30
Mount Vernon Residential	42	<30	<30	<30
Kemps Creek Residential	42	30	<30	<30
Emmaus Village Residential	42	<30	<30	<30

The above shows that the construction noise impacts for the assessed scenarios are not predicted to exceed the NMLs at any existing or proposed receivers surrounding Site 1C.

Noise levels at the nearest existing sensitive receivers of up to 34 dBA $L_{Aeq(15minute)}$ are predicted which is below the NMLs. Lower impacts are seen during other less noisy works and for sensitive receivers which are further from the site. Impacts also reduce at the nearest receivers when works are further away from these receivers.

The construction assessment includes the 5 dBA penalty for 'annoying' activities, in accordance with the ICNG.

The proposed Jacfin RU4 and Capitol Hill residential subdivisions have not yet been developed. As such, noise emissions during the construction of the site only need to be considered in these areas once dwellings have been constructed and occupied. It is also important to note that, as per the ICNG, the criteria are applicable at the most-affected point on or within the residential property boundary, or, if this is more than 30 m from the residence, at the most-affected point within 30 m of the residence.

6.4 Construction Vibration

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 paving works including concrete pours.

The nearest residential receivers to the development construction works are located over 900 m from the nearest point of Lot 1C. The separation distance between the works location and the nearest vibration sensitive receivers is considered sufficient to mitigate potential vibration generated from the site .

Where vibration intensive works are required within the minimum working distances of buildings within Oakdale South, vibration impacts shall be managed accordingly.

7 Mitigation and Management Measures

All feasible and reasonable mitigation measures will be implemented by the project. Impacts from the construction works will be minimised and managed in accordance with the procedures detailed below in **Table 11**.

Table 11 Environmental Management Controls for Construction Noise – Source Control

Item	Measure
Project planning	Where possible, use alternative less noise and vibration intensive construction techniques to rock breaking and concrete sawing.
	Power tools to use mains power rather than by using generators.
	Complete works during standard daytime construction hours.
	Truck routes to site will be limited to major roads.
Scheduling	Respite offers will be considered where high noise and vibration generating activities are predicted to exceed the relevant noise criteria. As a guide, work should be carried out in continuous blocks that do not exceed three hours, with a minimum respite period of one hour between each block.
	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. Notification will be a minimum of seven calendar days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required.
	Consult with the effected community to determine the need for respite periods.
	Construct noise barriers required for operational noise mitigation as early as feasible during construction to assist in mitigating construction noise impacts.

Item	Measure
Site Layout	Site entry and exit points to be located as far as possible from sensitive receivers.
	Compounds and worksites to be designed to promote one-way traffic and minimise the need for vehicle reversing.
	Position work compounds, parking areas, and equipment and material stockpiles away from noise-sensitive locations.
Training	Training to 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.
Plant and Equipment Source Mitigation	Noise emissions from plant and equipment operated on the site shall be minimised by installing and maintaining efficient silencers, low noise mufflers (residential standard) and by replacing reversing alarms with alternative silent measures, such as flashing lights (subject to occupational health and safety requirements).
	Noisy plant or processes will be replaced by less noisy alternatives. This is particularly important for piling, for example. Bored piles generate less noise than impact-driven or percussive piling methods which will be avoided.
	Operate plant and equipment in the quietest and most efficient way, including not idling vehicles or equipment unnecessarily.
	Maximise the distance between noisy equipment (ie compressors, generators, pumps, etc) and the nearest receivers. Orient plant so any vent outlets face away from receivers.
	Siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise.
	Regular and effective maintenance of noise generating equipment, including checking of hatches/enclosures regularly to ensure that seals are in good condition and doors close properly against seals.
	Avoid dropping materials from a height.
	Avoiding noisy plant working simultaneously close together.
	Carrying out loading and unloading away from noise sensitive areas.
	No queuing of trucks outside residential properties. Truck drivers will not use compression braking unless required for safety reasons.
	Ensure truck movements are kept to a minimum, ie that trucks are fully loaded on each trip.
Screening	Install purpose-built screening or enclosures around long-term fixed plant where possible.
	Site layout should take advantage of existing screening from local topography. Position site huts, maintenance sheds and/or shipping containers between noisy equipment and the affected receivers.
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 seven calendar days.
	Where complaints are received, the work practices are to be reviewed and feasible and reasonable implemented to minimise any further impacts.
Monitoring	Conduct noise and/or vibration monitoring in response to any complaints received to verify that levels are not substantially above the predicted levels.
Vibration	Where works are required within the minimum working distances, vibration monitoring will be undertaken to confirm that vibration is within acceptable levels.

Item	Measure
	Where works are required within the cosmetic damage minimum working distances, building condition surveys be completed before and after the works to ensure no cosmetic damage has occurred.
	Vibratory compactors must not be used closer than 30 m from residential buildings unless vibration monitoring confirms compliance with the vibration criteria.

7.1 Monitoring

The monitoring of noise and/or vibration is an essential part of assessing impacts, determining compliance with approval conditions and addressing community concerns. AS 2436-2010 recommends that on-site noise and vibration levels are monitored when high noise or vibration generating activities are being undertaken by a suitably qualified person appointed specifically for that purpose. If monitoring results exceed the noise goals outlined in this CNVMP then the relevant regulatory authority will be notified and appropriate mitigation measures implemented to ensure compliance with acceptable noise levels.

Should monitoring be required due to a complaint received regarding noise or vibration, monitoring will be conducted by suitably qualified specialists. The location and extent of attended monitoring will be determined in consultation with project staff 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.

All items of acoustic instrumentation utilised will be designed to comply with IEC 61672.1-2004 Electroacoustics – Sound level meters (AS IEC 61672) and carry current calibration certificates.

8 Community Consultation and Enquiries

Community consultation will be undertaken via the Contractor, including:

- Advising the community of noise/vibration intensive work to be undertaken.
- Recording and managing any complaints.

A clearly visible sign will be installed at the site access prior to commencing construction. Relevant contact details, including a phone number for community enquiries, will be included on site signage. All community enquiries will be forwarded to the Site Manager.

9 Complaints Register

Complaints will be able to be received via the contact telephone number to be included on the site signage.

A complaints register will be maintained by the Site Manager. Response to the complaint will be provided to the complainant within 24 hours.

Information recorded in the complaints register with respect to each complaint will include:

- Date and time of complaint.

- Name, address and telephone number of complainant.
- Nature of complaint.
- Response actions taken to date.

A report of complaints will be provided to the relevant regulatory authorities every three months throughout the construction of the project, or as otherwise agreed by the relevant regulatory authorities.

Preliminary investigations into the complaint will commence within 48 hours of the complaint receipt and adequate measures to identify and manage will be considered (refer to **Section 7**).

10 Contingency Plan

In the event that a non-compliance with the noise conditions is identified, the Contractor will implement the following Contingency Plan:

- the Contractor will report any non-compliance to the relevant regulatory authorities within five working days.
- the Contractor will identify an appropriate course of action with respect to the identified impact(s), in consultation with specialists and the relevant regulatory authorities, as necessary.
- the Contractor will notify affected landholders and tenants at the location of the exceedance within five working days and provide them with details of actions taken, including noise or vibration monitoring results (if applicable), until it can be shown that the site is complying with the noise and vibration criteria.
- the Contractor will, on request, submit the proposed course of action to the relevant regulatory authorities for approval.
- the Contractor will implement the approved course of action.

11 Internal Audits

Periodic internal audits will be conducted to ensure that the development consent conditions and commitments and environmental management controls outlined in this CNVMP are being properly implemented. Audit reports will be used to inform of any corrective actions.

12 Review and Improvement of Noise Management Plan

This CNVMP will be reviewed, and if necessary, updated in the following circumstances:

- Significant changes to the equipment, machinery and plant operated on the site.
- Where it is identified via monitoring that the performance of the site is not meeting the objectives of the CNVMP; and/or
- At the request of the relevant regulatory authorities or other relevant government agency.

All employees and contractors will be informed of any revisions to the CNVMP by Site Management during toolbox talks.

APPENDIX A

Acoustic Terminology

1 Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that in common usage 'noise' is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is 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 L_P are commonly used to represent Sound Pressure Level. The symbol L_A 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. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. 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

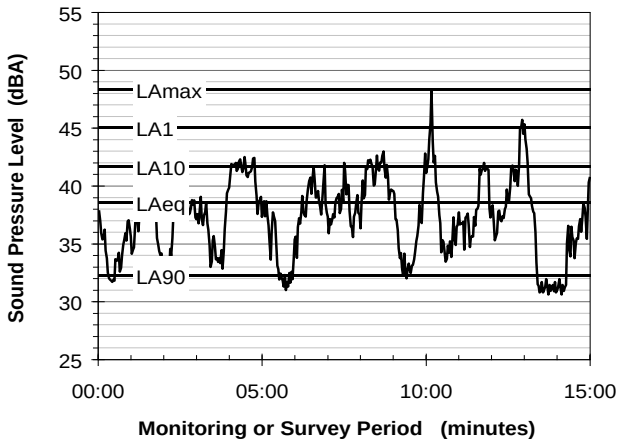
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or Lw, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure may be likened to 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 L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} 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:

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

L_{A10} The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

L_{A90} 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.

L_{Aeq} 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.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the 'repeatable minimum' L_{A90} noise level over the daytime and night-time measurement periods, as required by the EPA. In addition, the method produces mean or 'average' levels representative of the other descriptors (L_{Aeq}, L_{A10}, etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than 'broad band' noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

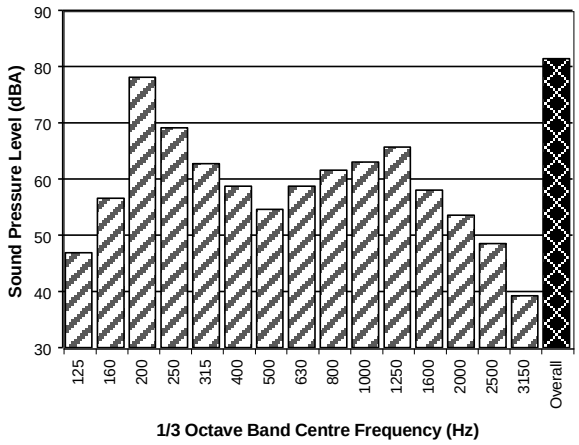
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

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 (3 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.



8 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. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) 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/V_o), where V_o is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used by some organisations.

9 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.

10 Over-Pressure

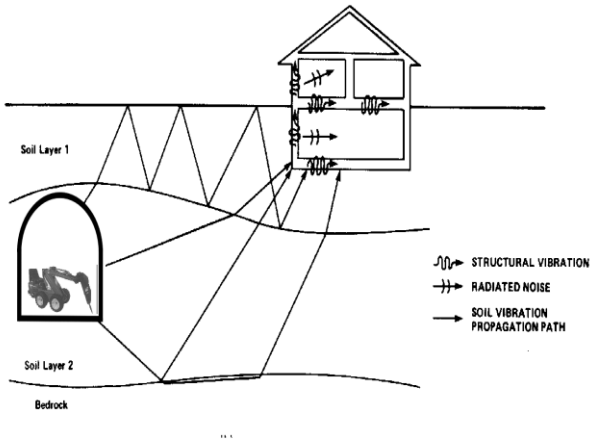
The term 'over-pressure' is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11 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

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