



SYD2 CNVMP Update for MOD3 SSDA

Construction Certificate Issue

A W Edwards Pty Limited
Level 12, 558 Pacific Highway
St Leonards NSW 2065

Report Reference: 220364-33 – SYD2 CNVMP Update for MOD3 – Construction Certificate Issue – R0

Date: 19 September 2025

Revision: R0

Project Number: 220364-33

DOCUMENT CONTROL

Project Name:	SYD2 CNVMP Update for MOD3
Project Number:	220364-33
Report Reference:	220364-33 – SYD2 CNVMP Update for MOD3 – Construction Certificate Issue – R0
Client:	A W Edwards Pty Limited

Revision	Description	Reference	Date	Prepared	Checked	Authorised
1	R0	220364-33 – SYD2 CNVMP Update for MOD3 – Construction Certificate Issue – R0	19/09/25	Matthew Harrison / Alex Danon	Alex Danon	Matthew Harrison

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1 INTRODUCTION

Pulse White Noise Acoustics (PWNA) have been engaged by A W Edwards Pty Limited (AWE) to prepare an update to the Construction Noise and Vibration Management Plan (CNVMP) previously prepared for the Airtrunk SYD2 Datacentre located at 1 Sirius Road, Lane Cove West.

The original CNVMP was prepared by Pulse Acoustic Consultancy (Pulse Acoustics) and is titled "*Airtrunk Data Centre – Construction Noise & Vibration Management Plan*" (Ref: 2019-11-20 Airtrunk – CNVMP Final, dated 12 December 2019). This document contains recommended criteria, noise predictions and control measures for the construction phase. The CNVMP outlines recommended noise and vibration mitigation measures to reduce the impacts on surrounding receptors during the construction works. The Pulse Acoustics CNVMP also looks at potential impacts to the nearby exhaust ventilation shaft from the Lane Cove Tunnel during excavation and piling works.

The updated CNVMP is required to address the modification to the approved Lane Cove West Data Centre at 1 Sirius Road, Lane Cove West, more formally described as Lot 1 DP 1271404. The was SSD-9741-Mod-3approved on 13/06/2024.

The proposed modification includes design amendments attributed to both the external and internal elements of the approved data centre, as a result of the detailed design process, and end user customer demand, namely involving:

- an increase to the maximum building height
- an increase to the number of data halls
- an increase to the number of chillers (from 106 to **108 Chillers located on the roof**)
- Increase in the number of generators (from 116 to **121 Transformers/Generators located on external platforms**)
- a decrease to the number of car parking spaces
- a decrease to the total site landscaping
- a slight amendment to site preparation works

Images showing the Airtrunk SYD2 Datacentre Proposed by the MOD3 modifications and the Approved Datacentre are shown in Figure 1 below.

Figure 1 Site location



This Updated CNVMP report:

- identifies the project consent conditions relevant to construction noise and vibration;
- identifies the applicable construction noise and vibration criteria;
- defines the construction methodology, equipment and indicative timing construction programme;
- presents the likely noise and vibration impacts from the construction activities; and
- and provides practicable noise and vibration management and mitigation measures suitable to the site.

A glossary of acoustic terminology used throughout this report is included in Appendix A.

1.1 Site location

The Airtrunk development is proposed to be located at 1 Sirius Road, Lane Cove West. The site is located within the Lane Cove Industrial Area, and currently lies vacant, aside from containing sporadic vegetation. Industrial receivers are located to the east, whilst the Lane Cove River and Bushwalk is located to the west.

The site location, in relation to the surrounding area is shown in Figure 2 below.

Figure 2 Site location



2 STATE SIGNIFICANT DEVELOPMENT APPLICATION

Condition B9, B10, B11, B12, B13, B14 and B15 of the Consolidated Consent, dated October 2023, for SSD-9741-MOD-3 for 1 Sirius Road, Lane Cove West (Lot 1 DP 1271404) provides Conditions that relate to both operational noise emission from the site and construction activities include the following:

NOISE

Hours of Work

B9. The Applicant must comply with the hours detailed in Table 1, unless otherwise agreed in writing by the Planning Secretary.

Table 1 Hours of Work

Activity	Day	Time
Earthworks and construction	Monday – Friday Saturday	7:00 AM to 6:00 PM 7:00 AM to 4:00 PM
Operation	Monday – Sunday	24 hours
Testing of back-up generators	Monday – Friday	7:00 AM to 6:00 PM

- B10. Works outside of the hours identified in Condition B9 may be undertaken in the following circumstances:
- (a) works that are inaudible at the nearest sensitive receivers; or
 - (b) works agreed to in writing by the Planning Secretary and in consultation with Council; or
 - (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.

Construction Noise Limits

- B11. The development must be constructed to achieve the construction noise management levels detailed in the *Interim Construction Noise Guideline* (DECC, 2009) (as may be updated or replaced from time to time). All feasible and reasonable noise mitigation measures must be implemented and any activities that could exceed the construction noise management levels must be identified and managed in accordance with the management and mitigation measures in the Appendix 2.

Construction Noise and Vibration Management Plan

- B12. The Applicant must update the Construction Noise and Vibration Management Plan (the CNVMP) included in the EIS to the satisfaction of the Planning Secretary. The CNVMP must form part of the development's Construction Environmental Management Plan (see Condition C2) and must:
- (a) describe procedures for achieving the noise management levels in EPA's *Interim Construction Noise Guideline* (DECC, 2009) (as may be updated or replaced from time to time);
 - (b) describe the measures to be implemented to manage high noise generating works, such as piling, in close proximity to sensitive receivers;
 - (c) include strategies that have been developed with the community for managing high noise generating works; and
 - (d) include a complaints management system that would be implemented for the duration of the development.

B13. The Applicant must:

- (a) not commence construction of any relevant stage until the updated CNVMP required by Condition B12 is approved by the Planning Secretary; and
- (b) implement the most recent version of the Construction Noise and Vibration Management Plan approved by the Planning Secretary for the duration of construction.

Operational Noise Limits

B14. The Applicant must ensure that noise generated by operation of the development does not exceed the noise limits in Table 2.

Table 2 Noise Limits (dB(A))

Location	Day L _{Aeq} (15 minute)	Evening L _{Aeq} (15 minute)	Night L _{Aeq} (15 minute)
R1	51	48	43
C1	63	N/A	N/A
P1	48	N/A	N/A
Any residence to the west of Pittwater Road, East Ryde	45	40	35
R2	46	42	36

Noise generated by the development is to be measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the Noise Policy for Industry (EPA, 2017) (as may be updated or replaced from time to time).

The noise criteria in Table 2 do not apply during emergency operations.

Note: The location of the sensitive receivers referred to in Table 2 are shown in Appendix 2 of this consent.

Noise Verification Report

B15. Within three months of the commencement of operation of Phase 2, Phase 3 and Phase 4 as identified in Figure 2 in Appendix 1 (or as otherwise directed by the Planning Secretary), the Applicant must prepare and submit a Noise Verification Report to the satisfaction of the Planning Secretary. Each Noise Verification Report must:

- (a) be prepared by a suitably qualified, experienced and independent acoustic consultant whose appointment has been endorsed by the Planning Secretary;
- (b) demonstrate that noise verification has been carried out in accordance with the latest version of:
 - (i) AS 1055:2018 Acoustics – Description and measurement of environmental noise (Standards Australia, 2018);
 - (ii) Approved Methods for the Measurement and Analysis of Environmental Noise in NSW (EPA, 2022); and
 - (iii) the monitoring and reporting requirements detailed in Section 7 of the Noise Policy for Industry (EPA, 2017);
- (c) include:
 - (i) an analysis of the prevailing meteorological conditions, applicable corrections for annoying noise characteristics (as per Fact Sheet C of the Noise Policy for Industry) and the development's compliance with the noise limits specified in condition B14;
 - (ii) an analysis any discrepancies between the predicted and actual noise impacts of the development (as described in the Modification Assessments); and
 - (iii) a description of additional at-source and transmission pathway mitigation measures implemented, and/or a description of contingency measures to be implemented (including a timetable for the implementation of any required actions), to address any exceedance of the noise limits specified in condition B14.

3 EXISTING ENVIRONMENT

3.1 Nearest Sensitive Receivers

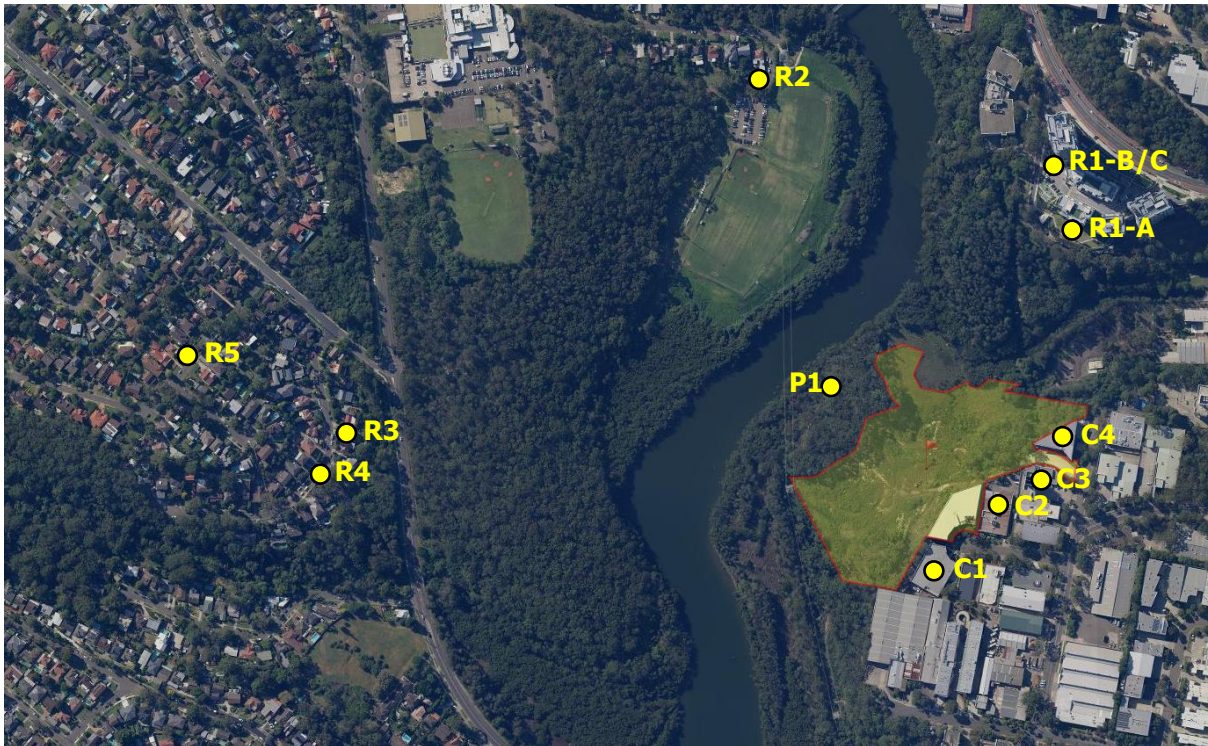
Several potentially impacted noise sensitive receivers are located in the vicinity of the datacentre development site.

The noise receivers identified in the Acoustic Assessment for SSD-9741-MOD-3, written by PWNA, dated 6 September 2023, Ref: "220364 - Acoustic Assessment Airtrunk Data Centre - 1 Sirius Road, Lane Cove West – R22" are listed in Table 1 and are shown in Figure 3 below.

Table 1 Nearest potentially affected receivers

Receiver ID	Address	Lot and DP	Type of Receiver
R1-A (5 m)	150 Epping Road, Lane Cove (Lower Floors)	Lot 1 DP 1219702	Residential
R1-B (30 m)	150 Epping Road, Lane Cove (Middle Floors)	Lot 1 DP 1219702	Residential
R1-C (60 m)	150 Epping Road, Lane Cove (Upper Floors)	Lot 1 DP 1219702	Residential
R2 (4.5 m)	65 Magdala Road, North Ryde	Lot 1 DP 416781	Residential
R3 (4.5 m)	14 Jeanette Street, East Ryde	Lot 20 DP 26556	Residential
R4 (4.5 m)	20 Jeanette Street, East Ryde	Lot 13 DP 236893	Residential
R5 (4.5 m)	12 Wolfe Road, East Ryde	Lot 9 DP 24622	Residential
C1 (1.5 m)	3 Apollo Place, Lane Cove West	Lot 8 DP 241877	Commercial
C2 (1.5 m)	1 Apollo Place, Lane Cove West	SP 80721	Commercial
C3 (1.5 m)	5 Sirius Road, Lane Cove West	Lot 5 DP 241786	Commercial
C4 (1.5 m)	1A Sirius Road, Lane Cove West	Lot 16 DP 1179953	Commercial
P1 (1.5 m)	Sirius Road, Lane Cove West	Lot 7025 DP 93903	Passive Recreation

Figure 3 Location of nearest potentially affected receivers – sourced from Six Maps



3.2 Noise descriptors and terminology

Environmental noise constantly varies in level with time. Therefore, it is necessary to measure noise in terms of quantifiable time periods with statistical descriptors. Typically, environmental noise is measured over 15-minute periods and relevant statistical descriptors of the fluctuating noise are determined to quantify the measured level.

Noise (or sound) consists of minute fluctuations in atmospheric pressure capable of detection by human hearing. Noise levels are expressed in terms of decibels, abbreviated as dB or dBA, the "A" indicating that the noise levels have been frequency weighted to approximate the characteristics of normal human hearing. Because noise is measured using a logarithmic scale, 'normal' linear arithmetic does not apply, e.g., adding two sound sources of equal values result in an increase of 3 dB (i.e., 60 dBA plus 60 dBA results in 63 dBA). A change of 1 dB or 2 dB in the sound level 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 roughly corresponds to a doubling or halving in loudness.

The most relevant environmental noise descriptors are the LAeq, LA1, LA10 and LA90 noise levels. The LAeq noise level represents the "equivalent energy average noise level". This parameter is derived by integrating the noise level measured over the measurement period. It represents the level that the fluctuating noise with the same acoustic energy would be if it were constant over the measured time period.

The LA1, LA10 and LA90 levels are the levels exceeded for 1%, 10% and 90% of the sample period. These levels can be considered as the maximum noise level, the average repeatable maximum and average repeatable minimum noise levels, respectively.

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

3.3 Environmental Noise Monitoring Results

The environmental noise monitoring results summarised in Table 6 of the PWNA Acoustic Assessment for SSD-9741-MOD-3, are given below:

Table 2 Noise Levels at Noise Sensitive Receiver Locations

Receiver ID	Time Period	Measured LA90,15min (RBL) ¹	Measured LAeq, period Noise Level (dBA)
R1 – Residential (150 Epping Road)	Day	46	53
	Evening	46	50
	Night	41	47
R2 – Residential (65 Magdala Road)	Day	42 ²	57
	Evening	42 ²	57
	Night	31 ²	49
R3 (14 Jeanette Street)	Day	42	57
	Evening	42	57
	Night	31	49
C1-C4 Commercial	When in use	N/A	N/A
P1 Passive recreation	When in use	N/A	N/A
<p>Note 1 LA90 Background Noise or Rating Background Level (RBL)</p> <p>Note 2 The noise criteria for this location is conservatively based on those adopted for R3.</p>			

B13. The Applicant must:

- (a) not commence construction of any relevant stage until the updated CNVMP required by Condition B12 is approved by the Planning Secretary; and
- (b) implement the most recent version of the Construction Noise and Vibration Management Plan approved by the Planning Secretary for the duration of construction.

Operational Noise Limits

B14. The Applicant must ensure that noise generated by operation of the development does not exceed the noise limits in Table 2.

Table 2 Noise Limits (dB(A))

Location	Day L _{Aeq} (15 minute)	Evening L _{Aeq} (15 minute)	Night L _{Aeq} (15 minute)
R1	51	48	43
C1	63	N/A	N/A
P1	48	N/A	N/A
Any residence to the west of Pittwater Road, East Ryde	45	40	35
R2	46	42	36

Noise generated by the development is to be measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the Noise Policy for Industry (EPA, 2017) (as may be updated or replaced from time to time).

The noise criteria in Table 2 do not apply during emergency operations.

Note: The location of the sensitive receivers referred to in Table 2 are shown in Appendix 2 of this consent.

4 ASSESSMENT CRITERIA

4.1 Conditions of Consent

The Consolidated Consent for SSD-9741-MOD-3, dated October 2023, as listed in Section 2 of this CNVMP, requires the following:

NOISE

Hours of Work

B9. The Applicant must comply with the hours detailed in Table 1, unless otherwise agreed in writing by the Planning Secretary.

Activity	Day	Time
Earthworks and construction	Monday – Friday Saturday	7:00 AM to 6:00 PM 7:00 AM to 4:00 PM
Operation	Monday – Sunday	24 hours
Testing of back-up generators	Monday – Friday	7:00 AM to 6:00 PM

Construction Noise Limits

B11. The development must be constructed to achieve the construction noise management levels detailed in the Interim Construction Noise Guideline (DECC, 2009) (as may be updated or replaced from time to time). All feasible and reasonable noise mitigation measures must be implemented and any activities that could exceed the construction noise management levels must be identified and managed in accordance with the management and mitigation measures in the Appendix 2.

Construction Noise and Vibration Management Plan

B12. The Applicant must update the Construction Noise and Vibration Management Plan (the CNVMP) included in the EIS to the satisfaction of the Planning Secretary. The CNVMP must form part of the development's Construction Environmental Management Plan (see Condition C2) and must:

- (a) describe procedures for achieving the noise management levels in EPA's Interim Construction Noise Guideline (DECC, 2009) (as may be updated or replaced from time to time);
- (b) describe the measures to be implemented to manage high noise generating works, such as piling, in close proximity to sensitive receivers;
- (c) include strategies that have been developed with the community for managing high noise generating works; and
- (d) include a complaints management system that would be implemented for the duration of the development.

4.2 Construction noise criteria

4.2.1 EPA's Interim Construction Noise Guideline (ICNG)

The EPA's Interim Construction Noise Guideline (ICNG) provides guidance on appropriate construction noise management levels that should be adhered to on construction projects throughout NSW. This guideline identifies that potential impacts from construction noise is determined based on time of day of the noise, the increase in noise above background noise, the duration of the event, and any adverse characteristics of the noise

The ICNG prevents assessment procedures for the assessment of noise impacts, and management and mitigation measures procedures to address potential impacts on sensitive receivers. The main objectives of the ICNG are:

- Promote a clear understanding of ways to identify and minimise noise from construction works,
- Focus on applying all feasible and reasonable work practices to minimise construction noise impacts,
- Encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours,
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage; and
- Provide flexibility in selecting site-specific feasible and reasonable work practices to minimise noise impacts.

The ICNG identifies a quantitative assessment approach which is applicable to this project. The quantitative assessment method involves predicting noise levels at sensitive receivers and comparing them with site specific Noise Management Levels (NMLs). The NML affectation categories for receivers have been reproduced from the guideline and are listed in Table 3 and Table 4 below.

Table 3 Construction noise management levels – residential receivers

Receiver type	Time of day	Noise management level LAeq(15minute) ^{1,2}	How to apply
Residential	<u>Recommended standard hours:</u> Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. <ul style="list-style-type: none"> Where the predicted or measured LAeq(15minute) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
		Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. <ul style="list-style-type: none"> Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: <ol style="list-style-type: none"> 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	Noise affected RBL + 5 dB	<ul style="list-style-type: none"> A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.
Office, retail outlets	When in use	Highly noise affected 70 dBA	The external noise levels should be assessed at the most-affected occupied point of the premises
<p>Note 1 Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.</p> <p>Note 2 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 Industrial Noise Policy (EPA 2000).</p>			

The ICNG also provides NMLs for non-residential land uses. Unlike residential receivers, these criteria are fixed levels, independent of local background noise levels. Presented below in Table 4 are NMLs for non-residential land uses.

Table 4 Construction noise management levels – other receivers

Land use	Location applied	Noise management level, LAeq,15min
Classrooms and other educational institutions	Internal noise level	45 dB(A)
Hospital wards and operating theatres	Internal noise level	45 dB(A)
Places of worship	Internal noise level	45 dB(A)
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 dB(A)
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 dB(A)
Community centres	Refer to the recommended "maximum" internal levels in AS2107 for specific uses	
Industrial premises	External noise level	75 dB(A)
Offices, retail outlets	External noise level	70 dB(A)

4.2.2 Site specific construction noise management levels (NML)

As indicated in Section 4.1 above, the approved hours of work for construction given in the Consolidated Consent for SSD-9741-MOD-3 are:

- 7:00am to 6:00pm Monday to Friday, and
- 7:00am and 4:00pm on Saturdays

Based on the measured background noise levels summarised in Section 2, the NMLs to be used in this assessment are listed in Table 5 below.

Table 5 Site specific external construction Noise Management Levels (NML) dBA

Receiver ID	Measured LA90,15min (RBL) ¹	NML, dB LAeq(15minute)	
		Standard Construction Hours: Monday to Friday: 7am to 6pm and Saturday: 8am to 1pm	OOHW Period 1 Construction Hours: Saturday 7am to 8am and Saturday: 1pm to 4pm Noise Level (dBA)
R1 – Residential (150 Epping Road)	46 (Day)	56	51
R2 – Residential (65 Magdala Road)	42 (Day) ²	52	47
R3, R4 & R5 (14 Jeanette Street & any residence to the west of Pittwater Road)	42 (Day)	52	47
C1-C4 Commercial	When in use	70	70
P1 Passive recreation	When in use	65	65
Note 1 LA90 Background Noise or Rating Background Level (RBL) for the daytime period Note 2 The noise criteria for this location is conservatively based on those adopted for R3.			

4.3 Construction vibration criteria

Effects of ground borne vibration on buildings may be segregated into two major categories:

- Human comfort – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself
- Possible impacts to sensitive equipment – vibration that can impact on the operation of sensitive equipment such as microscopes and scientific equipment. Since this criterion will be more stringent the criteria derived to protect against human comfort and building damage, meeting the relevant criteria for the protection of the sensitive computer equipment will automatically provide adequate protection against these other undesirable vibration impacts of vibration.

4.3.1 Vibration criteria – human comfort

Vibration effects relating specifically to the human comfort aspects of the project are taken from the guideline titled “Assessing Vibration – A Technical Guideline”. (AVTG) This type of impact can be defined based on the nature of the construction works:

- Continuous vibration – from uninterrupted sources (refer to Table 6).

- Impulsive vibration – up to three instances of sudden impact e.g. dropping heavy items, per monitoring period (refer to Table 7).
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (refer to Table 8).

Table 6 Continuous vibration acceleration criteria (m/s²) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
		0.04	0.029	0.080	0.058
Workshops	Day or night-time	0.04	0.029	0.080	0.058

Table 7 Impulsive vibration acceleration criteria (m/s²) 1 Hz-80 Hz

Location	Assessment period	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

Table 8 Intermittent vibration impacts criteria (m/s^{1.75}) 1 Hz-80 Hz

Location	Daytime		Night-time	
	Preferred	Maximum	Preferred	Maximum
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



4.3.2 Vibration criteria – building contents and structure

The vibration effects on the building itself are assessed against international standards as follows:

- For transient vibration: British Standard BS 7385: Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration" (BSI 1993); and
- For continuous or repetitive vibration: German DIN 4150: Part 3 – 1999 "Effects of Vibration on Structure" (DIN 1999).

4.3.2.1 Standard BS 7385 Part 2 - 1993

For transient vibration, as discussed in standard BS 7385 Part 2-1993, the criteria are based on peak particle velocity (mm/s) which is to be measured at the base of the building.

These are summarised in Table 9 and illustrated in Figure 2.

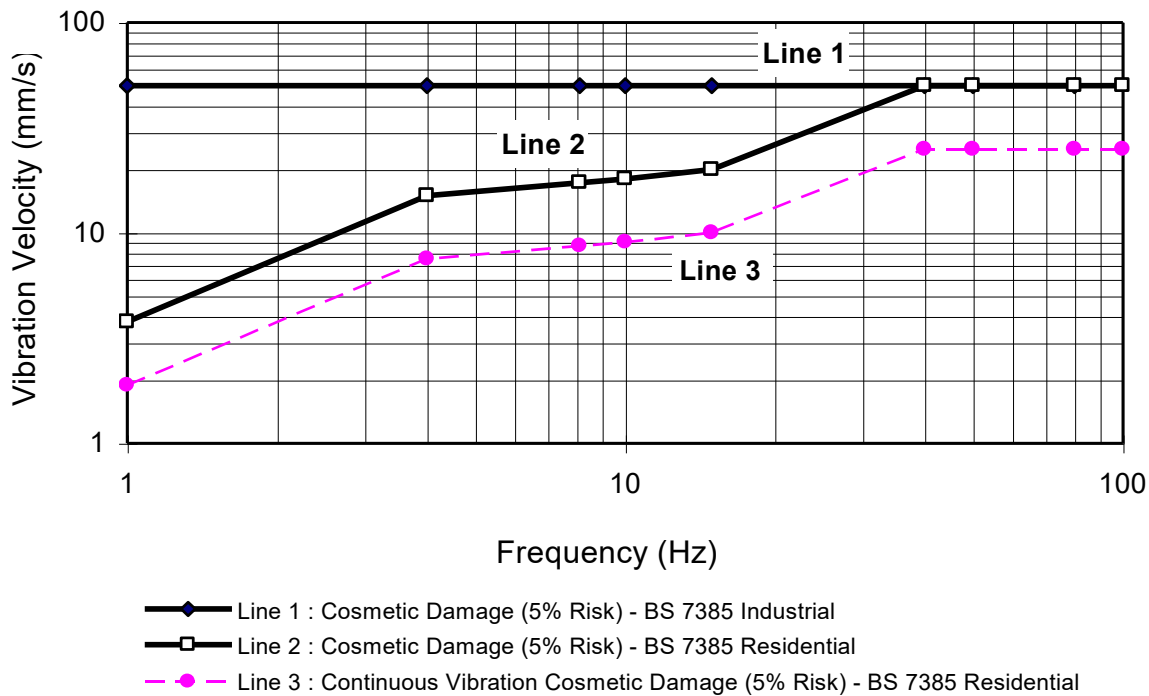
Table 9 Transient vibration criteria as per standard BS 7385 Part 2 - 1993

Line in standard	Type of Building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Standard BS 7385 Part 2 – 1993 states that the values in Table 9 relate to transient vibration which does not cause resonant responses in buildings.

Where the dynamic loading caused by continuous vibration events is such as that results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in Table 9 may need to be reduced by up to 50% (refer to Line 3 in Figure 4).

Figure 4 BS 7385 Part 2 – 1993, graph of transient vibration values for cosmetic damage



In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the recommended values corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 9, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in Table 9 should not be reduced for fatigue considerations.

4.3.2.2 Standard DIN 4150 Part 3 - 1999

For continuous or repetitive vibration, standard DIN 4150 Part 3-1999 provides criteria based on values for peak particle velocity (mm/s) measured at the foundation of the building; these are summarised in Table 10. The criteria are frequency dependent and specific to particular categories of structures.

Table 10 Structural damage criteria as per standard DIN 4150 Part 3 - 1999

Type of Structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz ¹	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8
Note 1 For frequencies above 100Hz, at least the values specified in this column shall be applied.				

4.3.2.3 Ground-Borne Noise Criteria

According to the ICNG, the criterion for ground-borne noise at residences is defined as follows:

- Maximum internal noise levels of 40 dB LAeq(15mins) between 6:00pm and 10:00pm.
- Maximum internal noise levels of 35 dB LAeq(15mins) between 10:00pm and 7:00am.

As no construction works are proposed in the evening or night periods, ground-borne noise criteria is not applicable for this assessment.

4.3.2.4 Project vibration criteria

Based on the details included in the sections above the project specific vibration criteria to protect the surrounding residential receivers from structural or architectural damage includes the following:

- Project construction vibration management level at all surrounding building structures – 7.5 mm/s.

In the event that this vibration criteria is exceeded, further investigation is required, including an assessment of the nature of the vibration and frequency characteristics to determine if the vibration criteria can be relaxed for the specific nature of the works.

4.3.3 Computer Equipment Vibration Criteria

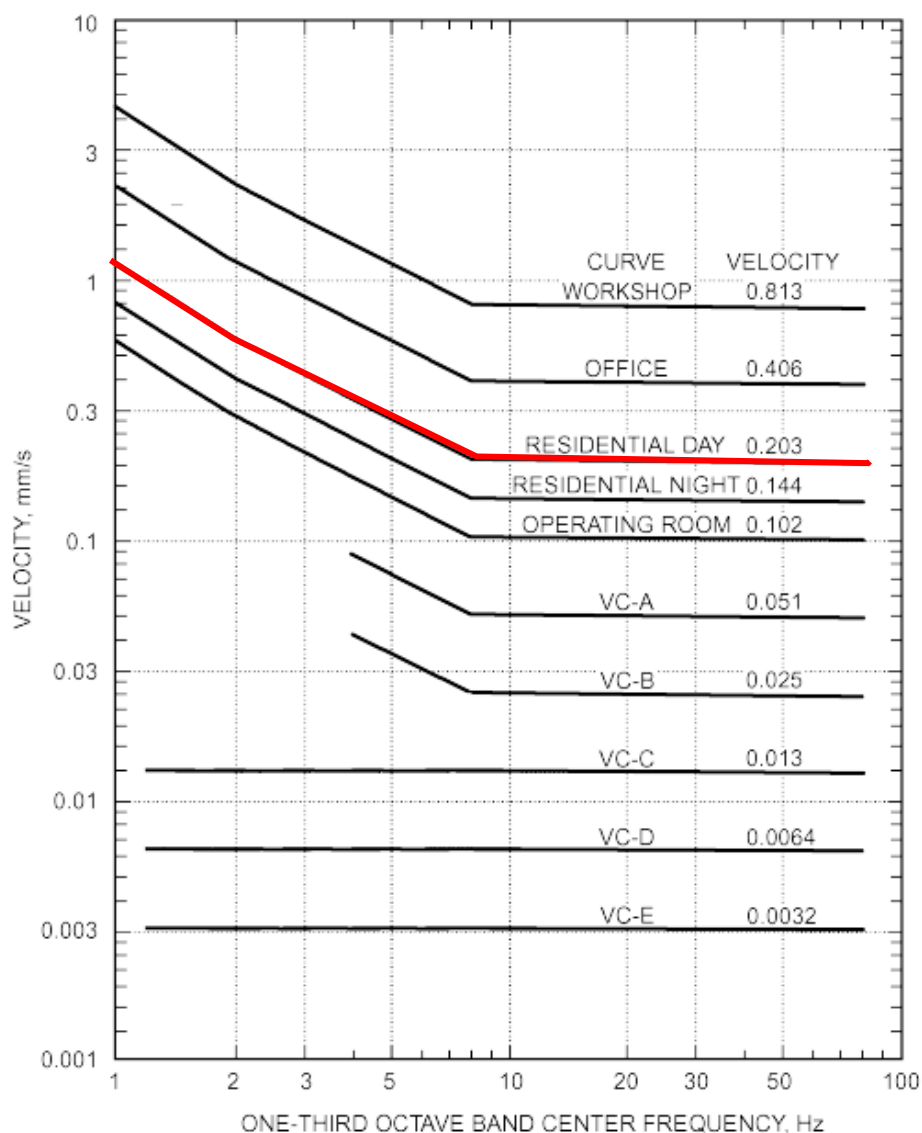
Where manufacturer's data is not available, generic vibration criterion (VC) curves may be adopted as suitable vibration goals for the assessment of sensitive IT equipment within the operational data hall.

These generic VC curves are presented below. Note that the criteria below are listed as Root Mean Square (RMS) velocity.

Table 11 Criteria for vibration sensitive equipment

Equipment	Curve (RMS velocity)
Distinctly perceptible vibration. Appropriate to workshops and nonsensitive areas.	0.813 mm/s Workshop
Perceptible vibration. Appropriate to offices and nonsensitive areas.	0.406 mm/s Office
Barely perceptible vibration. Appropriate to sleep areas in most instances. Usually adequate for computer equipment , hospital recovery rooms, semiconductor probe test equipment, and microscopes less than 40x.	0.203 mm/s Residential Day
Barely perceptible vibration. Appropriate to sleep areas for residential purposes during the night period	0.144 mm/s Residential Night
Bench microscopes up to 100× magnification; laboratory robots	0.102 mm/s Operating Room
Bench microscopes up to 400× magnification; optical and other precision balances; coordinate measuring machines; metrology laboratories; optical comparators; microelectronics manufacturing equipment; proximity and projection aligners, etc.	0.051 mm/s VC-A
Microsurgery, eye surgery, neurosurgery; bench microscopes at magnification greater than 400×; optical equipment on isolation tables; microelectronic manufacturing equipment, such as inspection and lithography equipment (including steppers) to 3 mm line widths	0.025 mm/s VC-B
Electron microscopes up to 30 000× magnification; microtomes; magnetic resonance imagers; microelectronics manufacturing equipment, such as lithography and inspection equipment to 1 mm detail size	0.013 mm/s VC-C
Electron microscopes at magnification greater than 30 000×; mass spectrometers; cell implant equipment; microelectronics manufacturing equipment, such as aligners, steppers, and other critical equipment for photolithography with line widths of 1/2 µm; includes electron beam systems	0.0054 mm/s VC-D
Non-isolated laser and optical research systems; microelectronics manufacturing equipment, such as aligners, steppers, and other critical equipment for photolithography with line widths of 1/4 µm; includes electron beam systems	0.0032 mm/s VC-E

Figure 5 Criteria for vibration sensitive equipment in RMS velocity (ASHRAE 2007, HVAC Applications, Chapter 47 "Sound and Vibration Control")





4.3.3.1 Overall Vibration Criteria for Inside Data Halls

Based on the information discussed above, the recommended operational vibration criterion for the data centre equipment is given below. The criterion is taken from the residential day criteria from the Criteria for vibration sensitive equipment (ASHRAE 2007, HVAC Applications, Chapter 47 "Sound and Vibration Control").

The criterion refers to a maximum RMS velocity of 0.203mm/s between 8 Hz and 80Hz. For the residential day criteria, this refers to "Barely perceptible vibration. Appropriate to sleep areas in most instances. Usually adequate for computer equipment, hospital recovery rooms, semiconductor probe test equipment and microscopes less than 40x".

Conversion from RMS velocity to peak velocity is as follows:

$$\text{Peak Velocity} = \text{Crest Factor} \times \text{RMS Velocity}$$

For construction equipment, including impacts from dropping of building materials, a crest factor 10 is conservatively used. **Therefore, a peak particle velocity (PPV) criterion of 2 mm/s is proposed for this assessment, for sensitive spaces within the operational data halls.**

5 CONSTRUCTION NOISE AND VIBRATION IMPACTS

Noise impacts from construction works associated with the project have been predicted in accordance with the requirements in the EPAs NPfI. Presented below is a summary of the construction activities, equipment and associated sound power levels, and a summary of the predicted noise impacts from the works. An assessment has been completed of the typical worst-case noise impacts. Noise from the project is likely to be often lower than the noise levels presented in this assessment.

5.1 Construction Program

The A W Edwards construction program for the works proposed as part of the MOD-3 approval are given in , with the works highlighted being the primary works of interest.

Figure 6 below, with the works highlighted being the primary works of interest.

Figure 6 Airtrunk SYD2 Construction Program

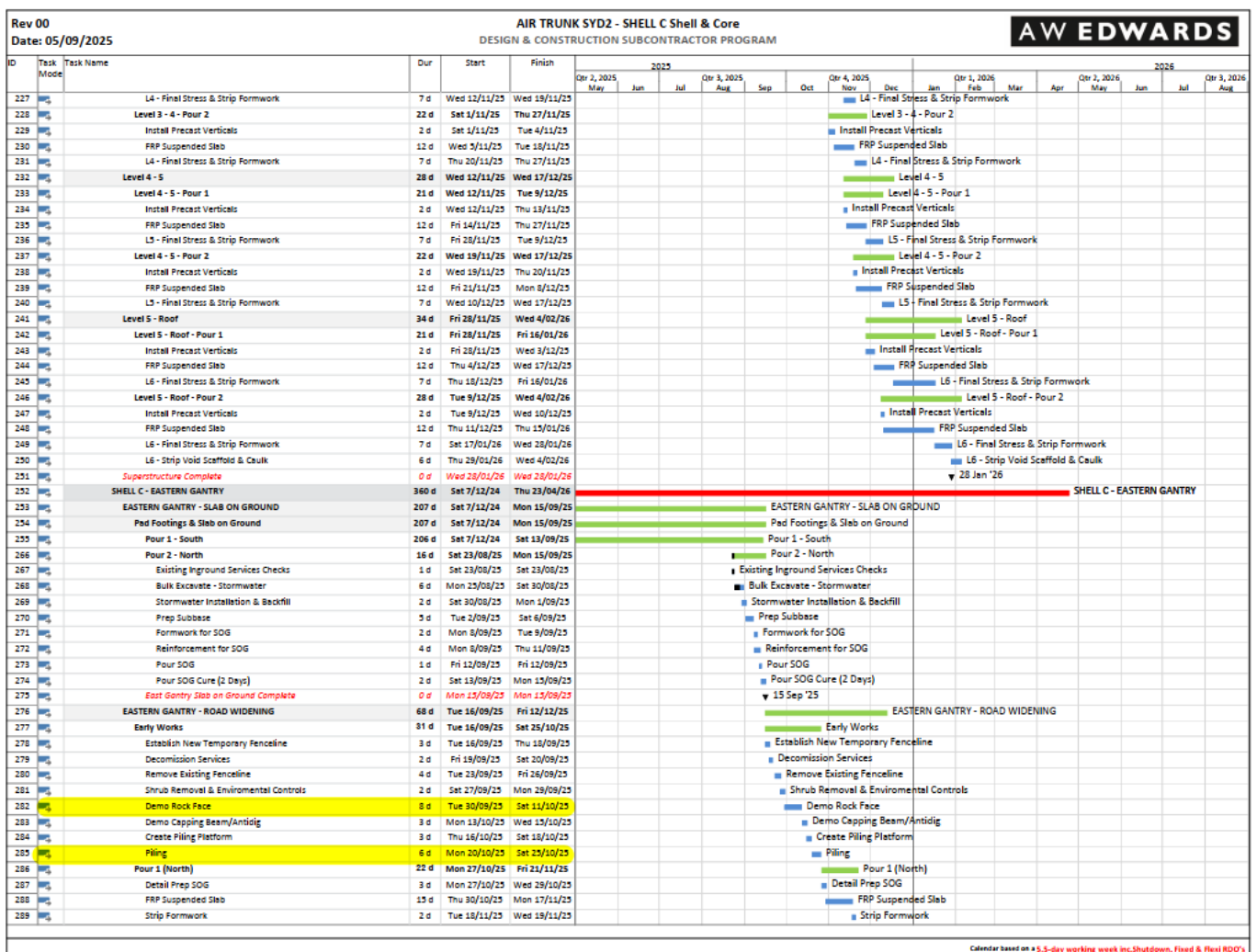


Figure 7 Indicative Location of Proposed Construction Works, Highlighted in Yellow



5.2 Construction noise scenarios

The Major Construction Activities proposed for these works involves:

- Rock excavation – proposed methodology is utilising excavator rock saw and 22t excavator hydraulic jack hammer
- Piling x 14 – proposed methodology is utilising a 60t IMT® Piling Rig A215

The sound power levels for the equipment likely to be used for each of the listed tasks are provided in Table 12 below.

Table 12 Summary of Equipment Sound Power Levels, dB(A)

Tasks	Equipment	Sound Power Levels Excluding 5dB Penalties (dBA re 1pW)	Operational Time per 15 minute period
Rock excavation	Excavator 22T with hydraulic hammer	112 ¹	10 minutes
	Excavator 22T with rock saw	108	10 minutes
	Truck	106	5 minutes
	Dozer	108	15 minutes
	Bobcat	106	5 minutes
Bored Piling	Bored piling rig	110	5 minutes
	Excavator 20T	109	10 minutes
	Concrete pump	108	15 minutes
<i>Note 1 As per section 4.5 of the Interim Construction Noise Guideline, a number of activities have been proven to be particularly annoying to nearby residents including rock hammering and sawing. Therefore 5 dB has been added to the Sound Power Levels quoted in Table 12 for this equipment.</i>			

5.3 Assessment methodology

Calculation of the noise impacts have been undertaken in accordance with the ISO9613 noise propagation algorithm at the most affected sensitive receiver locations. Receivers located further from the site would have lower noise levels from the proposed works.

The construction works would be undertaken in accordance with the approved SSDA development consent conditions. The construction hours are restricted to:

- Monday to Friday 7 am to 6 pm
- Saturday 8am to 1pm
- Sunday/Public Holiday No work or ancillary activity

Outside these hours, the following work may be undertaken:

- a. works that are inaudible at the nearest sensitive receivers; or
- b. works agreed to in writing by the Planning Secretary; or

- 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.

Construction sound pressure levels have been predicted for the construction tasks identified in the project program and tabulated below. The equipment anticipated for use in each task is based on previous project experience.

Table 13 Summary of predicted construction noise levels, LAeq, 15 min

Receiver ID	Standard Construction Hours Criteria, dBA LAeq 15 minutes	Predicted Noise Levels, dBA LAeq 15 minutes	
		Scenario 1 – Rock Excavation	Scenario 2 – Bored Piling
R1a – Residential (150 Epping Road)	56	57	55
R1b – Residential (150 Epping Road)	56	53	52
R2 – Residential (65 Magdala Road)	52	48	46
R3 – Residential (14 Jeanette Street)	52	21	19
R4 – Residential (20 Jeanette Street, East Ryde)	52	19	17
R5 – Residential (12 Wolfe Road, East Ryde)	52	26	22
C1 – Commercial (3 Apollo Place, Lane Cove West)	70	34	32
C2 – Commercial (1 Apollo Place, Lane Cove West)	70	46	46
C3 – Commercial (5 Sirius Road, Lane Cove West)	70	60	62
C4 – Commercial (1A Sirius Road, Lane Cove West)	70	54	53
P1 – Passive recreation (Sirius Road, Lane Cove West)	65	48	43

Note 1 **Green** = Receivers predicted to comply with Noise Management Levels.

Note 2 **Orange** = Noise affected receivers during the Standard Hours and Other Approved Hours of Construction.

Noise contour maps of the two construction scenarios, set to a receiver measurement height of 1.5m, are shown in the below figures. The noise model takes into account reflections and shielding by adjacent buildings, attenuation due to distance, atmospheric conditions, ground elevations within the project site as well as existing terrain elevations outside the project site.

Figure 8 Noise contour map – Scenario 1, Rock Excavation

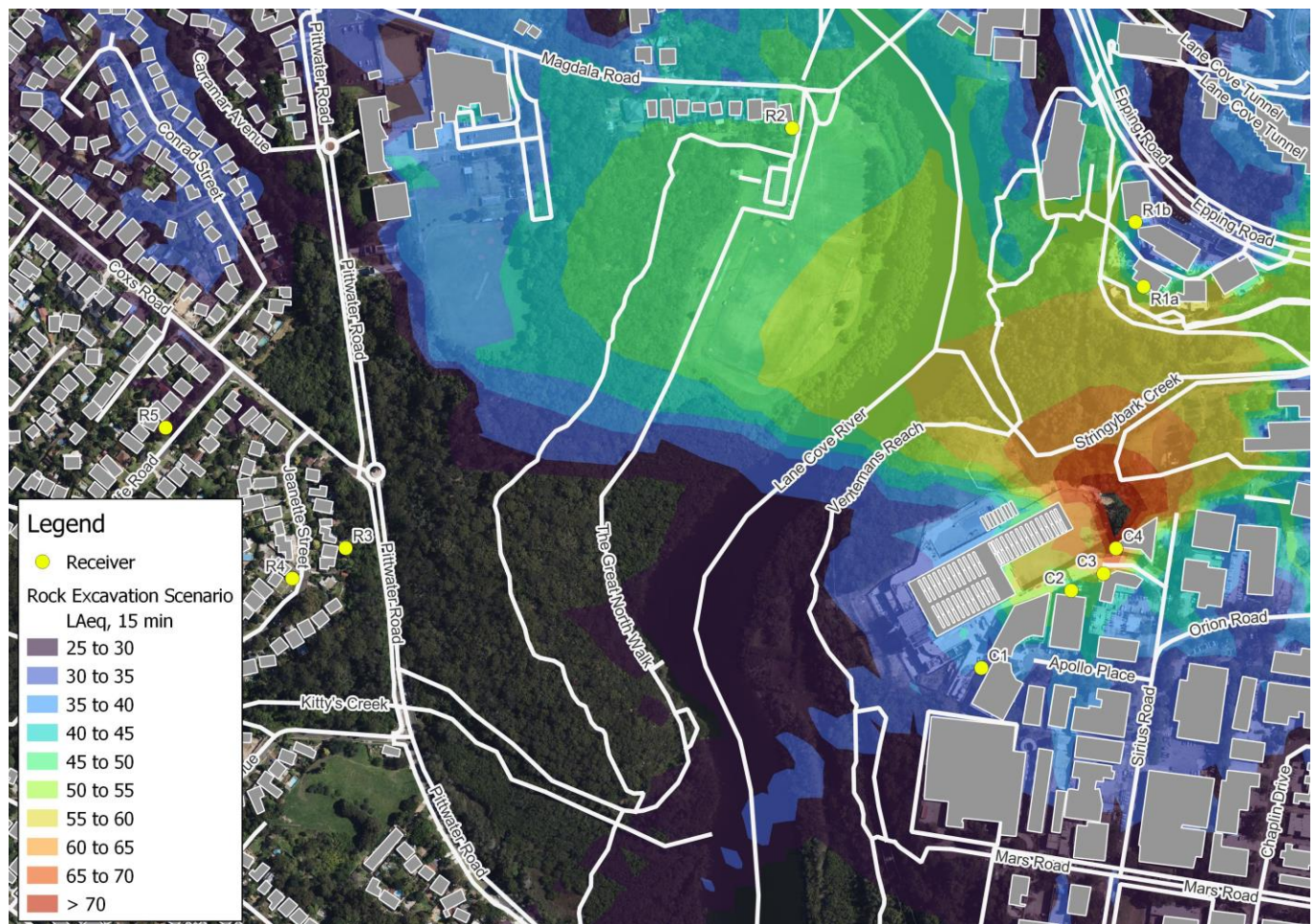
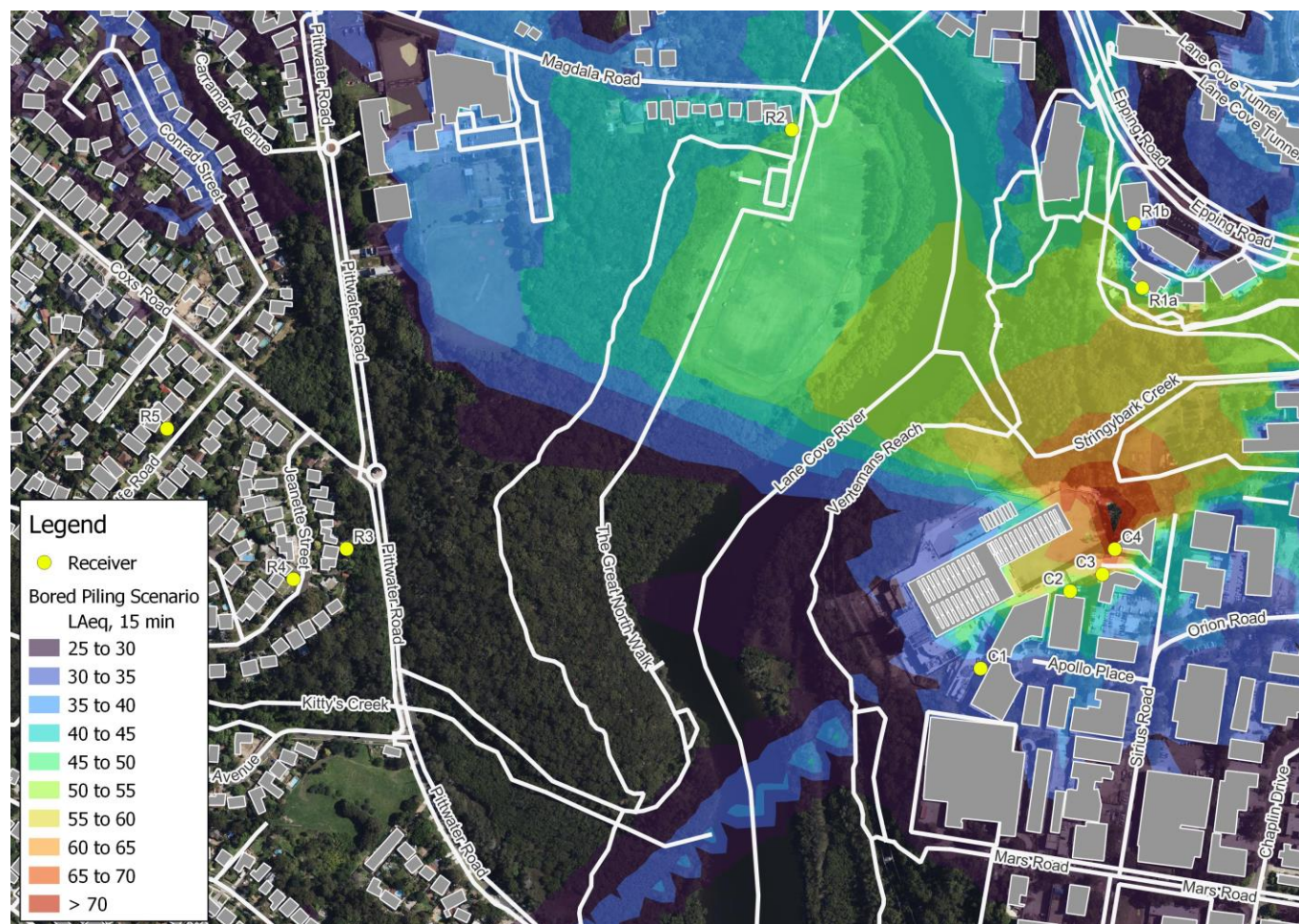


Figure 9 Noise contour map – Scenario 2, Bored Piling



Based on the above findings, the management procedures discussed in Section 6 are recommended.

5.4 Construction Vibration Assessment

To maintain compliance with the human comfort vibration criteria identified in Section 0, it is recommended that the indicative safe distances listed in Table 14 should be maintained. These indicative safe distances should be validated prior to the start of construction works by undertaking measurements of vibration levels generated by construction equipment to be used on site.

If applicable, the criteria for scientific or medical equipment (should any of these exist close to the site) can be more stringent than those required for human comfort. Vibration validating measurements should be conducted at each site to determine the vibration level and potential impact onto this sensitive equipment.

Recommended safe working distances for various items of plant are included in the following table.

Table 14 Recommended indicative safe working distances for vibration intensive plant

Plant	Rating / Description	Safe Working Distances (m)		
		Cosmetic Damage	Human Comfort (AVTG)	For IT equipment in Data Halls
Vibratory roller	< 50 kN (Typically 1 – 2 tonnes)	5	15 – 20	11
	< 100 kN (Typically 2 – 4 tonnes)	6	20	13
Small hydraulic hammer	300 kg, typically 5 – 12 tonnes excavator	2	7	4
Medium hydraulic hammer	900 kg, typically 12 – 18 tonnes excavator	7	23	16
Large hydraulic hammer	1600 kg, typically 18 – 34 tonnes excavator	22	73	49
Vibratory pile driver	Sheet piles	2 – 20	20	45
Jackhammer	Hand held	1	Avoid contact with structure and steel reinforcements	7

An assessment of the potential for vibration generated as part of the required construction activities on the project (including excavation) has been undertaken based on the expected vibration detailed in the table above.

The cosmetic damage safe working distances listed in Table 14 are for residential buildings. The receivers directly surrounding the site are industrial, which have much higher allowable vibration safe working distances. While the potential for exceedances of the human comfort criteria is possible, exceedance of the cosmetic damage criteria for industrial buildings is less likely.

6 NOISE AND VIBRATION MANAGEMENT MEASURES

Provided below in Table 15 is a summary of the recommended management procedures for airborne noise and vibration impacts. These procedures are also further discussed in the report. Hence, where applicable, links to further references are provided in Table 15.

Table 15 Summary of mitigation procedures

Procedure	Abbreviation	Description	Further Reference
General Management Measures	GMM	Introduce best-practice general mitigation measures in the workplace which are aimed at reducing the acoustic impact onto the nearest affected receivers.	Refer to Section 6.3.3 For vibration impact, also refer to Section 6.4 and Section 6.5
Project Notification	PN	Issue project updates to stakeholders, discussing overviews of current and upcoming works. Advanced warning of potential disruptions can be included. Content and length to be determined on a project-by-project basis.	Refer to Section 7
Verification Monitoring	V	Monitoring to comprise attended or unattended acoustic surveys. The purpose of the monitoring is to confirm measured levels are consistent with the predictions in the acoustic assessment, and to verify that the mitigation procedures are appropriate for the affected receivers. If the measured levels are higher than those predicted, then the measures will need to be reviewed and the management plan will need to be amended.	For noise impact, refer to Section 6.4. For vibration impact, refer to Section 6.4 and Section 6.5
Complaints Management System	CMS	Implement a management system which includes procedures for receiving and addressing complaints from affected stakeholders	Refer to Section 7.1
Specific Notification	SN	Individual letters or phone calls to notify stakeholders that noise levels are likely to exceed noise objectives. Alternatively, contractor could visit stakeholders individually in order to brief them with regards to the noise impact and the mitigation measures that will be implemented.	Refer to Section 7

The application of these procedures is in relation to the exceedances over the relevant criteria. For airborne noise, the criteria are based on NMLs. The allocation of these procedures is discussed in Section 6.1

For vibration, the criteria either correspond to human comfort, building damage or scientific and medical equipment. The application of these procedures is discussed in Section 6.2.

6.1 Allocation of noise management procedures

For residences, the management procedures have been allocated based on noise level exceedances at the affected properties, which occur over the designated NMLs (refer to Section 4.1). The allocation of these procedures is summarised in Table 16 below.

Table 16 Allocation of noise management procedures

Construction Hours	Exceedance over NML (dB)	Management procedures (see definition above)
Standard Hours	0 - 3	GMM
Mon – Fri: 7:00 am to 6:00 pm	4 - 10	GMM, PN, V 1, CMS
Sat: 8:00 am – 1:00 pm	> 10	GMM, PN, V, CMS, SN
Note 1 Verification monitoring to be undertaken upon complaints received from affected receivers		

Please note the following regarding the allocation of these procedures:

The exceedances have been estimated as part of the acoustic assessment, and these are summarised in Section 5.3.

The allocation of procedures is based on the assumptions used for noise level predictions (refer to Section 5). Consequently, these allocations can be further refined once additional details of the construction program become available.

6.2 Allocation of vibration management procedures

Table 17 below summarises the vibration management procedures to be adopted based on exceedance scenarios (i.e., whether the exceedance occurs over human comfort criteria, building damage criteria, or criteria for scientific and medical equipment). Please note these management procedures apply for any type of affected receiver.

Table 17 Allocation of vibration management procedures

Construction Hours	Exceedance Scenario	Management procedures
Standard Hours	Over human comfort criteria (refer to Section 0)	GMM, PN, V
Mon – Fri: 7:00 am to 6:00 pm	Over building damage criteria (refer to Section 0)	GMM, V
Sat: 8:00 am – 1:00 pm		

6.3 General comments

The contractor will, where reasonable and feasible, apply best practice noise mitigation measures. These measures shall include the following:

- Maximising the offset distance between plant items and nearby noise sensitive receivers.
- Preventing noisy plant working simultaneously and adjacent to sensitive receivers.
- Minimising consecutive works in the same site area.
- Orienting equipment away from noise sensitive areas.
- Carrying out loading and unloading away from noise sensitive areas.



In order to minimise noise impacts during the works, the contractor will take all reasonable and feasible measures to mitigate noise effects.

The contractor will also take reasonable steps to control noise from all plant and equipment. Examples of appropriate noise control include efficient silencers and low noise mufflers.

The contractor should apply all feasible and reasonable work practices to meet the NMLs and inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels, duration of noise generating construction works, and the contact details for the proposal.

6.3.1 Alternate equipment or process

Exceedance of the site's NMLs should result in an investigation as to whether alternate equipment could be used, or a different process could be undertaken.

In some cases, the investigation may conclude that no possible other equipment can be used, however, a different process could be undertaken.

6.3.2 Acoustic enclosures/screening

Typically, on a construction site there are three different types of plant that will be used: mobile plant (i.e., excavators, skid steers, etc.), semi mobile plant (i.e., hand tools generally) or static plant i.e. (diesel generators).

For plant items which are static it is recommended that, in the event exceedances are being measured due to operation of the plant item, an acoustic enclosure/screen is constructed to reduce impacts. These systems can be constructed from Fibre Cement (FC) sheeting or, if airflow is required, acoustic attenuators or louvres.

For semi mobile plant, relocation of plant should be investigated to either be operated in an enclosed space or at locations away from a receiver.

With mobile plant it is generally not possible to treat these sources. However, investigations into the machine itself may result in a reduction of noise (i.e., mufflers/attenuators etc).

6.3.3 General mitigation measures (Australia Standard 2436-2010)

As well as the above project specific noise mitigation controls, AS 2436-2010 "Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites" sets out numerous practical recommendations to assist in mitigating construction noise emissions. Examples of strategies that could be implemented on the subject project are listed below, including the typical noise reduction achieved, where applicable.

6.3.4 Adoption of universal work practices

- Regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration.
- Regular identification of noisy activities and adoption of improvement techniques.
- Avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby sensitive receivers.
- Where possible, avoiding the use of equipment that generates impulsive noise.
- Minimising the need for vehicle reversing for example (particularly at night), by arranging for one-way site traffic routes.
- Use of broadband audible alarms on vehicles and elevating work platforms used on site.
- Minimising the movement of materials and plant and unnecessary metal-on-metal contact.
- Minimising truck movements.



6.3.5 Plant and equipment

- The operation of plant and equipment on the site should be undertaken, including the following:
- Choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.
- Selecting plant and equipment with low vibration generation characteristics.
- Operating plant and equipment in the quietest and most efficient manner.

6.3.6 Work scheduling

- Providing respite periods which could include restricting very noisy activities to time periods that least affect the nearby noise sensitive locations, restricting the number of nights that after-hours work is conducted near residences or by determining any specific requirements.
- Scheduling work to coincide with non-sensitive periods.
- Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from the sensitive receivers.
- Optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours.
- Including contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.

6.3.7 Source noise control strategies

Some ways of controlling noise at the source are:

- Where reasonably practical, noisy plant or processes should be replaced by less noisy alternatives.
- Modify existing equipment: Engines and exhausts are typically the dominant noise sources on mobile plant such as cranes, graders, excavators, trucks, etc. In order to minimise noise emissions, residential grade mufflers should be fitted on all mobile plant utilised on site.
- Siting of equipment: locating 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.

6.3.8 Miscellaneous comments

- Deliveries should be undertaken, where possible, during standard construction hours.
- Maximise hammer penetration (and reduce blows) by using sharp hammer tips. Keep stocks of sharp profiles at site and monitor the profiles in use.
- It is advised that mobile plant and trucks operating on site for a significant portion of the project are to have reversing alarm noise emissions minimised. This is to be implemented subject to recognising the need to maintain occupational safety standards.
- No public address system should be used on site.

6.4 Vibration mitigation measures

The following general vibration mitigation measures should be implemented:



- Any vibration generating plant and equipment is to be located in areas within the site that results in lower vibration impacts on the nearest receivers, where possible.
- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
- Use lower vibration generating items of construction plant and equipment; that is, smaller capacity plant.
- Minimise conducting vibration generating works consecutively in the same area (if applicable).
- Undertake the removal of concrete within the building using saw cutting or pulverising where possible.

6.5 Construction vibration mitigation

An assessment of the potential for vibration generation as part of the required construction activities as part of the project (including ground works and construction) has been undertaken. The assessment of potential vibration impact has been undertaken such that safe working distances can be assessed such that vibration impacts can be managed for compliance with the criteria detailed in the table below.

Table 18 Recommended indicative safe working distances

Plant	Rating / Description	Safe Working Distances (m)	
		Cosmetic Damage (BS 7385: Part 2 DIN 4150: Part 3)	For IT equipment in Data Halls
Vibratory roller	< 50 kN (Typically 1 – 2 tonnes)	5 m	11
	< 100 kN (Typically 2 – 4 tonnes)	6 m	13
	> 200 kN (Typically 4 – 6 tonnes)	12 m	27
Small hydraulic hammer	300 kg, typically 5 – 12 tonnes excavator	2 m	4
Medium hydraulic hammer	900 kg, typically 12 – 18 tonnes excavator	7 m	16
Large hydraulic hammer	1600 kg, typically 18 – 34 tonnes excavator	22 m	49
Vibratory pile driver	Sheet piles	20 m	45
Jackhammer	Hand held	3 m	7
Auger or Rotary Piling	Piling including non-percussive piling equipment	2m	4
Demolition Activities	Including demolition of the existing building with excavator with hydraulic hammers and the like	5 m	11
Ground works of soft fill and material	Including excavators with buckets and the like	No limit	N/A
Movement of tracks and excavators	Movement of construction equipment without mitigation	5 m	11
Saw cutting of rock	Saw cutting using cutters installed to excavators or hand held equipment	No limit	N/A

Recommended construction methodologies which should be included as part of the proposed construction of the site include the following:

- The processing (such as pummelling of material and the like) of materials should be undertaken at a location with a maximum distance from the noise sensitive receivers, including distance of not less than 10m.
- In the event rock breaking is required within proximity to the noise sensitive receivers included in the table above a saw cut at the perimeter of the area to be removed is required to be undertaken prior to other activities commencing.

6.6 Noise and vibration monitoring

Noise monitoring, if required, will be performed by an acoustical consultant directly engaged by the contractor in accordance with the projects Conditions of Consent.

Noise monitoring is recommended to be undertaken by attended noise measurements at the start of any new phase of works (i.e. demolition, ground works or remediation works etc.). The statistical parameters to be measured should include the following noise descriptors: LAmin, LA90, LA10, LA1, LAmax and LAeq. Unattended noise measurements should be conducted over consecutive 15 minute periods.

The survey methodology and any equipment should comply with the requirements discussed in Standard AS 1055.1-1997.

As part of the management of noise and vibration from the proposed demolition and ground works activities to be undertaken on the site the following noise and vibration measurements are recommended to be undertaken:

4. Noise Monitoring –

- a. Attended noise level measurements of typical demolition and ground works activities should be undertaken at site. Attended construction noise surveys of the site and surrounding impacts on neighbours should be undertaken during the following as a minimum:
 - i. Start of Demolition
 - ii. Commencement of any rock breaking or sawing on the site.
 - iii. In response to any ongoing complaints received from neighbours.

5. Vibration Monitoring– To confirm vibration magnitudes are within the expected levels the following attended vibration measurements are required:

- a. Short term attended vibration measurements – Attended short term vibration measurement of activities with the potential to generate maximum vibration to be undertaken on commencement at the site, including the following:
 - i. Measurements to be undertaken at a representative location from the activity being conducted with a similar distance to the potentially affected receiver.
 - ii. Activities with the potential to generate the greatest magnitudes of vibration include:
 - iii. Hydraulic hammering of concrete slabs.
 - iv. Hydraulic hammering during ground works within rock.
- b. Long term vibration monitoring within the existing data halls is recommended, adjacent to sensitive IT equipment. This may include multiple vibration monitors at different levels and different areas of the building. Vibration monitoring should be undertaken including the following:
 - i. Vibration Monitoring to include long term continuous vibration logging.
 - ii. Monitors set to record maximum vibration levels including Peak Particle Velocity (PPV) magnitudes.
 - iii. Monitors are required to be SMS enabled such that any events recorded above 'alert' levels can be instantaneously sent to suitable builder, acoustic consultant and contractor representatives.

7 COMMUNITY ENGAGEMENT AND CONSULTATION

Active community consultation and the maintenance of positive relations with local residents and businesses would assist in alleviating concerns and thereby minimising complaint. It is common for construction projects to provide community consultation if an exceedance of noise goals has been predicted. This communication is commonly conducted in the form of a letter box drop or more active engagement with more highly impacted receivers.

This form of notification should provide specific notification of the duration and timing of the construction activities so that residents are informed about the proposed works ahead of time. The letter should also provide the community with a hotline number for a community liaison officer available to adequately respond to all project related enquiries.

Ideally the hotline number should provide concerned locals an opportunity to raise any concerns with the project proponent and provide an opportunity to determine the best method to satisfy all requirements.

Prior to the works onsite being undertaken, it is recommended that community consultation with the neighbouring affected parties be undertaken as detailed in the projects Community Consultation and Engagement Plan which will be undertaken by the building contractor.

However, should not be limited to the beginning of the onsite works but throughout, providing the community with constant updates on the progress and upcoming works. In our experience these could include:

- Site noticeboard,
- Email notifications; and
- Letterbox drops.

During the proposed construction of the project (including demolition, ground works and construction) the building contractor is required to engage in community interaction. The community interaction and notification is required to include the following:

Notification of the proposed works to be undertaken on the site and the periods when works will be conducted, including information regarding the programme of works such as demolition and ground works. This should include the expected period when activities such as hydraulic hammering, rock breaking, concrete or rock sawing is required to be undertaken.

- Details of the relevant site representative where complaints can be registered.
- Details of the methodology to respond to complaints raised from the surrounding receivers.
- A register of complaints, to be kept on site including record of time and nature of the complaint as well as the outcomes and comments regarding investigations resulting from the complaint.

7.1 Complaints management system

Should complaints arise they must be dealt with in a responsible and uniform manner, therefore, a management system to deal with complaints is detailed below:

Local residents and land owners should be informed by direct mail of a direct 24-hour telephone line where any noise complaints related to the construction will be recorded. The 24-hour telephone line number will be made available on the construction site signage.

All complaints should be investigated by the Contractor in accordance with the procedures outlined in Australia Standard 2436-2010. Consequently, a complaint response procedure should be implemented. Information to be gathered as part of this process should include:

- location of complainant
- time/s of occurrence of alleged noise or vibration impacts
- nature of impact particularly with respect to vibration
- Perceived source
- Prevailing weather conditions and similar details that could be utilised to assist in the investigation of the complaint.
- All resident complaints will be responded to in the required timeframe and action taken recorded.
- Post receiving a noise and or vibration complaint, the process outlined in the Contingency Plans below should be undertaken.

7.2 Contingency plans

Contingency plans are required to address noise or vibration problems if excessive levels are measured at surrounding sensitive receivers and/or if justified complaints occur. Such plans include:

- Stop the onsite works.
- Identify the source of the main equipment within specific areas of the site which is producing the most construction noise and vibration at the sensitive receivers; and
- Review the identified equipment and determine if an alternate piece of equipment can be used or the process can be altered.
- In the event an alternate piece of equipment or process can be used, works can re-commence.
- In the event an alternate piece of equipment or process cannot be determined implement a construction assessment to be performed by a suitably qualified acoustic consultant.

The Superintendent shall have access to view the Contractor's noise measurement records on request. The Superintendent may undertake noise monitoring if and when required.

8 CONCLUSION

Pulse White Noise Acoustics (PWNA) have been engaged by LCI (Australia) Pty Ltd to prepare a Construction Noise and Vibration Management Plan for the construction of the DCI Datacentre at 90 Peter Brock Drive, Eastern Creek. This CNVMP has been prepared to satisfy the requirements of the project SSD (SSD-21342738) development consent conditions.

Residential receivers are located to the West of the site within the Alpha Hotel Eastern Creek. Industrial receivers are located to the north and west of the project site, as well as to the north across Huntingwood Drive and to the south across the Western Motorway.

To determine the background noise levels at nearby receivers, long term unattended noise monitoring was conducted at the Alpha Hotel Eastern Creek to the west of the project site, and 179 B Reservoir Road, Blacktown to the north of the project site.

Noise and vibration criteria have been based on the conditions of consent, the EPAs ICNG, and the EPAs AVATG. The ICNG and NMLs are based on the background noise measurements and the requirements of the ICNG.

Noise and vibration impacts have been assessed for two construction scenarios and associated construction equipment. The assessment has found that at times works would exceed the applicable noise management levels. During times where the most noise intensive equipment is not operating, the noise levels are unlikely to exceed or potentially comply with the NMLs.

These impacts are typical of demolition and construction works of this nature and highlight the importance of effective management and mitigation measures. Recommended measures to reduce the impacts from the works is provided in Section 6 of this document.

Vibration impacts have been assessed against the EPAs AVATG. The assessment has identified that the proposed equipment will comply with the safe working distances and meet the requirements of the vibration criteria defined in the condition of consent. Vibration management and mitigation measures have been recommended in Section 6 to ensure that impacts are reduced as much as practicable.

Provided in Section 7 are community engagement and consultation recommendations to assist in alleviating concerns from local residents and businesses. The incorporation of these recommendations in the approach to the works should reduce adverse reactions from the local community.



APPENDIX A. ACOUSTIC TERMINOLOGY

The following is a brief description of the acoustic terminology used in this report:

Ambient Sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Character, acoustic	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. The following are examples of the decibel readings of every day sounds;
	0dB the faintest sound we can hear
	30dB a quiet library or in a quiet location in the country
	45dB typical office space. Ambience in the city at night
	60dB Martin Place at lunch time
	70dB the sound of a car passing on the street
	80dB loud music played at home
	90dB the sound of a truck passing on the street
	100dB the sound of a rock band
	115dB limit of sound permitted in industry
	120dB deafening
dBA	A-weighted decibelsThe ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dBA. Practically all noise is measured using the A filter. The sound pressure level in dBA gives a close indication of the subjective loudness of the noise.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on
Lmax	The maximum sound pressure level measured over a given period.
Lmin	The minimum sound pressure level measured over a given period.
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L90	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dBA.
Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Sound Pressure Level, LP dB	A measurement obtained directly using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the rms sound pressure to the reference sound pressure of 20 micro Pascals.
Sound Power Level, Lw dB	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power levels is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picroWatt.